MEDICAL MICROBIOLOGY

SAMUEL BARON, M.D.

Lynn M. Alperin

MICROBIOLOGY

SAMUEL BARON, M.D.

Editor
Chairman

Department of Microbiology University of Texas Medical Branch Galveston, Texas Lynn M. Alperin
Associate Editor

江苏工业学院图书馆 藏 书 章



ADDISON-WESLEY
PUBLISHING COMPANY

er and published the experience of the forest trade of the end of the published of the experience of the published of the end of the

Medical/Nursing Division Menlo Park, California Reading, Massachusetts • London • Amsterdam Don Mills, Ontario • Sydney MICROBIOLOGY

Associate Extrem

Sponsoring Editor: Richard W. Mixter

Developmental Editor: Deborah Gale

Copyeditor: Suzanne Aboulfadl

Copyright @ 1982 by Addison-Wesley Publishing Company, Inc.

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, without the prior permission of the publisher. Printed in the United States of America. Published simultaneously in Canada.

Library of Congress Cataloging in Publication Data Main entry under title:

Production Coordinator: Helene Harrington Cover and Book Design: Rodelinde Albrecht

Medical microbiology.

Includes index.

1. Medical microbiology. I. Baron, Samuel, 1928-

QR46.M467 616'.01 82-1693 ISBN 0-201-10175-0 AACR2

ABCDEFGHIJ-HA-898765432

The authors and publishers have exerted every effort to ensure that drug selection and dosage set forth in this text are in accord with current recommendations and practice at the time of publication. However, in view of ongoing research, changes in government regulations and the constant flow of information relating to drug therapy and drug reactions, the reader is urged to check the package insert for each drug for any change in indications of dosage and for added warnings and precautions. This is particularly important where the recommended agent is a new and/or infrequently employed drug.

Addison-Wesley Publishing Company
Medical/Nursing Division
2725 Sand Hill Road
Menlo Park, California 94025

MEDICAL MICROBIOLOGY

Ferdinarido Dianzani, M. Serios Edine Vitalogy
Professor and Chairman
Institute of Virology.
University of Ponte.
Rome, Italy

L. J. Olson, Ph.D.
Section Editor Paraviology
Professor
Department of Microbiology
University of Texas Medical Branch
Gubyeston, Texas

Howard Johnson; Ph.D.
Serves Editor Immunology
Professor
Duparement of Microbiology
University of Texas Mellical Branch
parement, waren

Charles P. Davis, Ph.D.
Schur Editor, Barteren age, Mycology,
and Orisor Systems
Associate Professor
Department of Microbiology
University of Texas Medical Branch
Galweston, Texas

Charles P. Davis, Ph.D.
Sector Editor, Bartero age, Mycelogy,
stud Oriest Systems
Associate Professor
Department of Microb alogy
University of Texas Medical dranch
Calvesion, Texas Medical dranch

MEDICAL

Howard Johnson, Ph.D.

Section Editor: Immunology
Professor
Department of Microbiology
University of Texas Medical Branch
Galveston, Texas

Johnny W. Peterson, Ph.D.
Section Editor: Bacteriology, Mycology,
and Organ Systems
Associate Professor
Department of Microbiology
University of Texas Medical Branch
Galveston, Texas

Charles P. Davis, Ph.D.

Section Editor: Bacteriology, Mycology, and Organ Systems

Associate Professor

Department of Microbiology

University of Texas Medical Branch

Galveston, Texas

Ferdinando Dianzani, M.D. Section Editor: Virology
Professor and Chairman
Institute of Virology
University of Rome
Rome, Italy

L. J. Olson, Ph.D.
Section Editor: Parasitology
Professor
Department of Microbiology
University of Texas Medical Branch
Galveston, Texas

Consulting Editors

Thomas B. Albrecht, Ph.D.

Associate Professor
Department of Microbiology
University of Texas Medical Branch
Galveston, Texas

Jack B. Alperin, M.D.
Associate Professor
Departments of Internal Medicine and
Human Biological Chemistry
and Genetics
University of Texas Medical Branch
Galveston, Texas

J. Edwin Blalock, Ph.D.
Associate Professor
Department of Microbiology
University of Texas Medical Branch
Galveston, Texas

Edith D. Box, Sc.D.
Associate Professor
Department of Microbiology
University of Texas Medical Branch
Galveston, Texas

Quellin T. Box, M.D.
Associate Professor
Departments of Pediatrics and Microbiology
University of Texas Medical Branch
Galveston, Texas

Teh-Sheng Chan, M.D., Ph.D. Associate Professor Department of Microbiology University of Texas Medical Branch Galveston, Texas Adam Ewert, Ph.D.
Professor
Department of Microbiology
University of Texas Medical Branch
Galveston, Texas

Douglas P. Fine, M.D.
Associate Professor
Department of Internal Medicine
University of Texas Medical Branch
Galveston, Texas

William R. Fleischmann, Ph.D. Associate Professor Department of Microbiology University of Texas Medical Branch Galveston, Texas

Armond S. Goldman, M.D.
Professor
Departments of Pediatrics and
Human Biological Chemistry and Genetics
University of Texas Medical Branch
Galveston, Texas

James Guckian, M.D.
Professor
Departments of Internal Medicine
and Microbiology
University of Texas Medical Branch
Galveston, Texas

Michael T. Kelly, M.D., Ph.D. Associate Professor Department of Pathology University of Texas Medical Branch Galveston, Texas Gary R. Klimpel, Ph.D.
Assistant Professor
Department of Microbiology
University of Texas Medical Branch
Galveston, Texas

Etta Mae Macdonald, M.D., Ph.D.
Associate Professor
Departments of Microbiology and Dermatology
University of Texas Medical Branch
Galveston, Texas

Jon T. Mader, M.D.
Assistant Professor
Department of Internal Medicine
University of Texas Medical Branch
Galveston, Texas

Edgar B. Smith, M.D.
Professor and Chairman
Department of Dermatology
University of Texas Medical Branch
Galveston, Texas

G. John Stanton, Ph.D.
Professor
Department of Microbiology
University of Texas Medical Branch
Galveston, Texas

Philip D. Thomson, Ph.D.
Assistant Professor
Departments of Internal Medicine
and Microbiology
Shriners Burns Institute
University of Texas Medical Branch
Galveston, Texas

Allan L. Truant, Ph.D.
Associate Director
Clinical Microbiology Division,
Department of Pathology
University of Texas Medicai Branch
Galveston, Texas

University of Texas Medical Demich

Contributors

G. G. Alton, D.V.M. & S. Division of Animal Health Animal Health Research Laboratory Victoria, Australia

Raza Aly, Ph.D.
Associate Professor
Departments of Dermatology and Microbiology
University of California, San Francisco
School of Medicine
San Francisco, California

M. Zouhair Atassi, Ph.D., D.Sc.
Professor
Departments of Immunology and Biochemistry
Mayo Medical School
Rochester, Minnesota

Edward Balish, Ph.D.
Professor
Departments of Surgery and
Medical Microbiology
University of Wisconsin
Madison, Wisconsin

Albert Balows, Ph.D.
Assistant Director
Laboratory Science
Center for Infectious Diseases
Centers for Disease Control
Atlanta, Georgia

Lane Barksdale, Ph.D.
Professor
Department of Microbiology
New York University
School of Medicine and Medical Center
New York, New York

Samuel Baron, M.D.
Chairman
Department of Microbiology
University of Texas Medical Branch
Galveston, Texas

Derrick Baxby, Ph.D.

Department of Medical Microbiology
University of Liverpool
New Medical School
Liverpool, England

Yechiel Becker, Ph.D.
Professor
Department of Molecular Virology
Hebrew University—Hadassah Medical School
Jerusalem, Israel

Joseph A. Bellanti, M.D.
Professor
Departments of Pediatrics and Microbiology
Georgetown University
School of Medicine
Washington, D.C.

L. Joe Berry, Ph.D.
Professor
Department of Microbiology
University of Texas at Austin
Austin, Texas

Neil R. Blacklow, M.D.
Professor
Departments of Medicine and Microbiology
University of Massachusetts
Medical School
Worcester, Massachusetts

Martin J. Blaser, M.D.

Assistant Professor
Department of Internal Medicine
University of Colorado Health Sciences Center
Denver, Colorado

Benjamin Bonavida, Ph.D.

Associate Professor

Department of Microbiology and Immunology
University of California, Los Angeles
School of Medicine
Los Angeles, California

Philip S. Brachman, M.D.

Director Epidemiology Program Office Centers for Disease Control Atlanta, Georgia

Richard A. Calderone, Ph.D.

Associate Professor

Department of Microbiology

Georgetown University

School of Medicine

Washington, D.C.

Gilbert A. Castro, Ph.D.

Professor
Department of Physiology
University of Texas Health Science Center
at Houston
Houston, Texas

Jay O. Cohen, Ph.D.

Microbiologist Biological Products Division Center for Infectious Diseases Centers for Disease Control Atlanta, Georgia

Frank M. Collins, Ph.D., D.Sc.

Member Trudeau Institute Saranac Lake, New York

Jose Costa, M.D.

Chief Pathological Anatomy Branch National Cancer Institute National Institutes of Health

Bethesda, Maryland

Robert B. Couch, M.D.

Professor

Departments of Microbiology and Immunology and Medicine

Baylor College of Medicine Houston, Texas

John P. Craig, M.D.

Professor

Department of Microbiology and Immunology

Downstate Medical Center

State University of New York

Brooklyn, New York

John H. Cross, Ph.D.

Scientific Director
U.S. Naval Medical Research Unit No. 2
APO San Francisco, California

George Cukor, Ph.D.

Associate Professor
Departments of Medicine and Microbiology
University of Massachusetts
Medical School
Worcester, Massachusetts

Clyde G. Culbertson, M.D. Carl Barrella

Lilly Laboratory for Clinical Research
Professor Emeritus
Department of Pathology
Indiana University
School of Medicine
Indianapolis, Indiana

Jim E. Cutler, Ph.D.

Associate Professor

Department of Microbiology

Montana State University

Bozeman, Montana

Summer B. Formers, Phillip.

Charles P. Davis, Ph.D. Associate Professor Department of Microbiology University of Texas Medical Branch Galveston, Texas

Ferdinando Dianzani, M.D. Professor and Chairman Institute of Virology University of Rome Rome, Italy

J. P. Dubey, M.V.Sc., Ph.D. Professor Department of Veterinary Science Veterinary Research Laboratory Montana State University Bozeman, Montana

Gisela Enders, M.D. Professor Facharzt für Mikrobiologie u. Infektions-Epidemiologie Virologisch-med. Diagnostisches Institut Stuttgart, West Germany

Dolores G. Evans, Ph.D. Associate Professor Department of Microbiology University of Texas Health Science Center at Houston Houston, Texas

Doyle J. Evans, Jr., Ph.D. Associate Professor Department of Microbiology University of Texas Health Science Center at Houston Houston, Texas

Adam Ewert, Ph.D. Professor Department of Microbiology University of Texas Medical Branch Galveston, Texas

John L. Fahey, M.D. Professor Department of Microbiology and Immunology University of California, Los Angeles School of Medicine Los Angeles, California

James C. Feeley, Ph.D. Chief Epidemiologic Investigations Laboratory Branch Bacterial Disease Division Center for Infectious Disease Centers for Disease Control Atlanta, Georgia

Frank Fenner, M.D. University Fellow Center for Resource and Environmental Studies Australian National University Canberra, Australia

Sydney M. Finegold, M.D. Chief Infectious Disease Section Veterans Administration Wadsworth Medical Center Los Angeles, California

Horst Finger, M.D. Professor and Director Stadt. Krankenanstalten Krefeld Institut F. Hygiene u. Lab.-Medizin Medizinaluntersuchungsamt Krefeld, Federal Republic of Germany

Richard A. Finkelstein, Ph.D. Professor and Chairman Department of Microbiology University of Missouri School of Medicine Columbia, Missouri

CONTRIBUTORS

Thomas J. Fitzgerald, Ph.D.

Associate Professor Department of Microbiology and Immunology University of Minnesota at Duluth Duluth, Minnesota

Samuel B. Formal, Ph.D.

Chief Immunology Division Department of Bacterial Diseases Walter Reed Army Institute of Research Washington, D.C.

J. R. L. Forsyth, M.D. Conno Detroit of anyman

Microbiological Diagnostic Unit University of Melbourne Melbourne, Australia

Mary Ann Gerencser, Ph.D.

Research Associate Department of Microbiology West Virginia University Medical Center Morgantown, West Virginia

Ralph A. Giannella, M.D. blogsort M vsubset

Professor Department of Medicine University of Cincinnati College of Medicine Cincinnati, Ohio

C. J. Gibbs, Jr., Ph.D.

Deputy Chief Laboratory of Central Nervous System Studies National Institute of Neurological and Communicative Disorders and Stroke National Institutes of Health Bethesda, Maryland

Randall M. Goldblum, M.D.

Associate Professor Departments of Pediatrics and Human Biological Chemistry and Genetics University of Texas Medical Branch Galveston, Texas

Martin Goldfield, M.D.

Columbia, South Carolina

Professor Department of Epidemiology School of Public Health University of South Carolina

Armond S. Goldman, M.D.

Professor

Departments of Pediatrics and Human Biological Chemistry and Genetics University of Texas Medical Branch Galveston, Texas

Fordinaudo Diamani, M.T.

Sherwood L. Gorbach, M.D.

Professor

Departments of Medicine and Microbiology Tufts University School of Medicine Boston, Massachusetts

J. Andrew Grant, Jr., M.D.

Associate Professor Departments of Internal Medicine and Microbiology University of Texas Medical Branch Galveston, Texas

M. Neal Guentzel, Ph.D.

Associate Professor Division of Allied Health and Life Sciences University of Texas at San Antonio San Antonio, Texas

David J. Hentges, Ph.D.

Professor and Chairman Department of Microbiology School of Medicine Texas Tech University Health Sciences Center Lubbock, Texas

Donald Heyneman, Ph.D.

Professor

Department of Epidemiology and
International Health
University of California, San Francisco
San Francisco, California

Randall K. Holmes, M.D., Ph.D.

Professor and Chairman

Department of Microbiology
Uniformed Services University of the
Health Sciences
Bethesda, Maryland

John G. Holt, Ph.D.

Professor
Department of Microbiology
Iowa State University
Ames, Iowa

Hope E. Hopps

Assistant to the Director Bureau of Biologics Food and Drug Administration Bethesda, Maryland

Alice S. Huang, Ph.D.

Professor

Department of Microbiology and Molecular Genetics Harvard Medical School Boston, Massachusetts

Walter T. Hughes, M.D.

St. Jude Children's Research Hospital Memphis, Tennessee

Tony E. Hugli, Ph.D.

Member

Department of Molecular Immunology
Scripps Clinic and Research Foundation
San Diego, California

Carolyn C. Huntley, M.D.

Professor

Department of Pediatrics
Bowman Gray School of Medicine
Winston-Salem, North Carolina

Barbara H. Iglewski, Ph.D.

Professor

Department of Microbiology and Immunology Oregon Health Sciences University Portland, Oregon

Howard Johnson, Ph.D.

Professor

Department of Microbiology
University of Texas Medical Branch
Galveston, Texas

Russell C. Johnson, Ph.D.

Professor

Department of Microbiology University of Minnesota Minneapolis, Minnesota

Peter Jurtshuk, Jr., Ph.D.

Professor and Undergraduate Chairman
Department of Biology
University of Houston
Houston, Texas

Albert Z. Kapikian, M.D.

Head

Epidemiology Section
Laboratory of Infectious Diseases
National Institute of Allergy and
Infectious Diseases
National Institutes of Health
Bethesda, Maryland

A. Latif Kazim, Ph.D.

Research Assistant Professor Department of Cell Biology University of New Mexico School of Medicine Albuquerque, New Mexico

Gerald T. Keusch, M.D.

Chief

Division of Geographic Medicine

Professor

Department of Medicine

Tufts University School of Medicine

Boston, Massachusetts

Sidney Kibrick, M.D., Ph.D.

Professor

Departments of Microbiology and Pediatrics

Boston University Medical Center

Boston, Massachusetts

Kwang-Shin Kim, Ph.D.

Associate Professor

Department of Microbiology

New York University School of Medicine

New York, New York

Thomas J. Kindt, Ph.D.

Chief

Laboratory of Immunogenetics

National Institute of Allergy and

Infectious Diseases

National Institutes of Health

Bethesda, Maryland

David W. Kingsbury, M.D.

Member

Division of Virology

St. Jude Children's Research Hospital

Memphis, Tennessee

Jan Klein, Ph.D.

Professor and Director

Abteilung Immungenetik

Max Planck Institut für Biologie

Tubingen, West Germany

George S. Kobayashi, Ph.D.

Professor

Department of Medicine

Washington University

School of Medicine

St. Louis, Missouri

Chien Liu, M.D.

Professor

Departments of Medicine and Pediatrics

University of Kansas

College of Health Sciences and Hospital

Kansas City, Kansas

Walter J. Loesche, D.M.D., Ph.D.

Professor

Departments of Dentistry and Microbiology

University of Michigan

School of Dentistry

Ann Arbor, Michigan

H. I. Maibach, M.D.

Professor

Department of Dermatology

University of California, San Francisco

School of Medicine

San Francisco, California

John R. Martin, M.D.

Senior Staff Fellow

Laboratory of Neuropathology and

Neuroanatomical Pathology

National Institute of Neurological and

Communicative Disorders and Stroke

National Institutes of Health

Bethesda, Maryland

Malcolm A. Martin, M.D.

Chief

Laboratory of Molecular Microbiology

National Institute of Allergy and

Infectious Diseases

National Institutes of Health

Bethesda, Maryland

Carl F. T. Mattern, M.D.

Senior Investigator

Laboratory of Parasitology

National Institute of Allergy and

Infectious Diseases

National Institutes of Health

Bethesda, Maryland

R. Barclay McGhee, Ph.D. Alumni Foundation Distinguished Professor Department of Zoology University of Georgia Athens, Georgia

Michael R. McGinnis, Ph.D. Associate Director Clinical Microbiology Laboratories North Carolina Memorial Hospital University of North Carolina Chapel Hill, North Carolina

Gerald Medoff, M.D. Professor Departments of Medicine and Microbiology and Immunology Washington University School of Medicine St. Louis, Missouri

Virginia A. Merchant, D.M.D.
Assistant Professor
Departments of Microbiology and Biochemistry
School of Dentistry
University of Detroit
Detroit, Michigan

Ernest A. Meyer, Sc.D.

Professor

Department of Microbiology and Immunology
Oregon Health Sciences University
Portland, Oregon

Harry M. Meyer, Jr., M.D.

Director

Bureau of Biologics

Food and Drug Administration

Bethesda, Maryland

Stephen A. Morse, Ph.D.
Associate Professor
Department of Microbiology and Immunology
Oregon Health Sciences University
Portland, Oregon

Richard Moxon, M.D. Associate Professor Department of Pediatrics Johns Hopkins University School of Medicine Baltimore, Maryland

André J. Nahmias, M.D., M.P.H.
Professor
Departments of Pediatrics and Pathology
Emory University School of Medicine
Atlanta, Georgia

Neal Nathanson, M.D.

Professor and Chairman

Department of Microbiology

University of Pennsylvania

School of Medicine

Philadelphia, Pennsylvania

Erwin Neter, M.D.
Professor Emeritus
Departments of Microbiology and Pediatrics
State University of New York
School of Medicine
Buffalo, New York

L. J. Olson, Ph.D.
Professor
Department of Microbiology
University of Texas Medical Branch
Galveston, Texas

Paul D. Parkman, M.D.
Deputy Director
Bureau of Biologics
Food and Drug Administration
Bethesda, Maryland

M. Jevitz Patterson, Ph.D.
Associate Professor
Department of Microbiology and Public Health
Michigan State University
East Lansing, Michigan

Charlotte M. Patton, M.S.
Chief
Bacterial Zoonoses Laboratory
Bacterial Diseases Division
Center for Human Diseases
Centers for Disease Control
Atlanta, Georgia

Duane L. Peavy, Ph.D.
Assistant Professor
Department of Microbiology and Immunology
Baylor College of Medicine
Houston, Texas

Lawrence L. Pelletier, Jr., M.D.
Associate Professor
Department of Medicine
University of Washington School of Medicine
Tacoma, Washington

Johnny W. Peterson, Ph.D.
Associate Professor
Department of Microbiology
University of Texas Medical Branch
Galveston, Texas

Charles J. Pfau, Ph.D.
Professor
Department of Biology
Rensselaer Polytechnic Institute
Troy, New York

Lennart Philipson, M.D., Dr.Med.Sci.
Institute of Microbiology
Biomedical Center
Uppsala University
Uppsala, Sweden

Robert M. Pike, Ph.D.

Professor

Department of Microbiology

University of Texas

Southwestern Medical School

Dallas, Texas

David D. Porter, M.D.
Professor
Department of Pathology
University of California, Los Angeles
School of Medicine
Los Angeles, California

Robin D. Powell, M.D.
Professor
Department of Medicine
Associate Dean of Academic Affairs
Northwestern University
Medical School
Chicago, Illinois

Alan S. Rabson, M.D.
Director
Division of Cancer Biology
and Diagnosis
National Cancer Institute
National Institutes of Health
Bethesda, Maryland

Shmuel Razin, Ph.D.
Professor and Chairman
Department of Membrane and
Ultrastructure Research
Hebrew University—Hadassah Medical School
Jerusalem, Israel

Sylvia E. Reed, M.B.
Consultant in Microbiology
Public Health Laboratory Service
Central Public Health Laboratory
Division of Microbiological Reagents
and Quality Control
London, England

Bernard Roizman, Sc.D.
Joseph Regenstein Professor
Departments of Microbiology and
Biophysics and Theoretical Biology
University of Chicago
Chicago, Illinois

W. Altin Waller, M.D.

Philip K. Russell, M.D. Director

Walter Reed Army Institute of Research
Washington, D.C.

Milton R. J. Salton, Sc.D.

Professor and Chairman
Department of Microbiology
New York University School of Medicine
New York, New York

Frank Schmalstieg, M.D., Ph.D.

Associate Professor
Departments of Pediatrics and
Human Biological Chemistry and Genetics
University of Texas Medical Branch
Galveston, Texas

Nathalie J. Schmidt, Ph.D.

Research Specialist Viral and Rickettsial Disease Laboratory California Department of Health Services Berkeley, California

Harold G. Scott, Ph.D.

Lecturer in Community Medicine
Tulane University
School of Medicine
New Orleans, Louisiana

John Richard Seed, Ph.D.

Chairman
Department of Parasitology
and Laboratory Practice
School of Public Health
University of North Carolina
Chapel Hill, North Carolina

James G. Shaffer, Sc.D.†
Professor of Microbiology
Rush Medical College and
Mt. Sinai Hospital Medical Center
Chicago, Ilinois

+Deceased

Robert E. Shope, M.D.

Professor

Yale Arbovirus Research Unit
Department of Epidemiology and Public Health
Yale School of Medicine

New Haven, Connecticut

Hillas Smith, M.A., M.D. Consultant Physician The Royal Free Hospital Coppetts Wood Hospital London, England

William A. Sodeman, Jr., M.D.
Professor and Chairman
Department of Comprehensive Medicine
Professor of Internal Medicine
Assistant Director of the Medical Center
University of South Florida
College of Medicine
Tampa, Florida

Norman Talal, M.D.
Professor
Departments of Medicine and Microbiology
University of Texas Health Science Center
San Antonio, Texas

Vernon J. Tipton, Ph.D.
Professor
Department of Zoology
Brigham Young University
Provo, Utah

George J. Todaro, M.D.
Chief
Laboratory of Viral Carcinogenesis
National Cancer Institute
National Institutes of Health
Frederick, Maryland

John P. Utz, M.D. Professor Department of Medicine Georgetown University School of Medicine Washington, D.C.

W. Allan Walker, M.D. Professor Department of Pediatrics Harvard Medical School Boston, Massachusetts

John W. Warren, M.D. Assistant Professor Department of Medicine University of Maryland School of Medicine Baltimore, Maryland

Kenneth S. Warren, M.D. Director Health Sciences The Rockefeller Foundation New York, New York

Norman F. Weatherly, Ph.D.
Professor
Department of Parasitology
and Laboratory Practice
School of Public Health
University of North Carolina
Chapel Hill, North Carolina

William O. Weigle, Ph.D.
Chairman
Department of Immunopathology
Scripps Clinic and Research Foundation
La Jolla, California

Carol L. Wells, Ph.D.
Assistant Professor
Department of Laboratory Medicine and Pathology
University of Minnesota
Minneapolis, Minnesota

Susan E. H. West, M.S.
Department of Anaerobic Microbiology
Virginia Polytechnic Institute and
State University
Blacksburg, Virginia

Tracy D. Wilkins, Ph.D.
Professor
Department of Microbiology
Virginia Polytechnic Institute and
State University
Blacksburg, Virginia

Robert C. Wood, Ph.D.

Associate Professor

Department of Microbiology

University of Texas Medical Branch

Galveston, Texas

Theodore E. Woodward, M.D.
Professor and Head
Department of Medicine
University of Maryland
School of Medicine
Baltimore, Maryland

Viola Mae Young, Ph.D.
Former Chief
Microbiology Section
Baltimore Cancer Research Program
Baltimore, Maryland