

# CRC Handbook Series in Zoonoses

James H. Steele, Editor-in-Chief

Section A: Bacterial, Rickettsial,  
and Mycotic Diseases

Volume II

Section Editors

Herbert Stoenner

William Kaplan

Michael Torten

# CRC Handbook Series in Zoonoses

**James H. Steele, Editor-in-Chief**

Assistant Surgeon General (Retired)  
U.S. Public Health Service  
Professor of Environmental Health  
School of Public Health  
University of Texas at Houston

## Section A: Bacterial, Rickettsial, and Mycotic Diseases

### Volume II

Section Editors

**Herbert Stoenner**

Director, Rocky Mountain Laboratory  
U.S. Public Health Service  
Hamilton, Montana

**William Kaplan**

Mycology Division  
Center for Disease Control  
Atlanta, Georgia

**Michael Torten**

Israel Institute for Biological Research  
Ness-Ziona  
Faculty of Medical Sciences  
Tel Aviv University School of Medicine  
Israel



CRC Press, Inc.  
Boca Raton, Florida

**Library of Congress Cataloging in Publication Data**

Main entry under title:

Bacterial, rickettsial, and mycotic diseases.

(CRC handbook series in zoonoses; section A,  
V, 1-2)

Includes bibliographies and indexes.

1. Bacterial diseases. 2. Rickettsial diseases.  
3. Mycoses. 4. Zoonoses. 5. Communicable diseases  
in animals. I. Steele, James H. II. Series.

RC115.B3 616.9'2 78-10696

ISBN 0-8493-2907-8

This book represents information obtained from authentic and highly regarded sources. Reprinted material is quoted with permission, and sources are indicated. A wide variety of references are listed. Every reasonable effort has been made to give reliable data and information, but the author and the publisher cannot assume responsibility for the validity of all materials or for the consequences of their use.

All rights reserved. This book, or any parts thereof, may not be reproduced in any form without written consent from the publisher.

Direct all inquiries to CRC Press, Inc. 2000 N.W. 24th Street, Boca Raton, Florida 33431.

©1980 by CRC Press, Inc.

International Standard Book Number 0-8493-2900-0 (Complete Set)

International Standard Book Number 0-8493-2905-1 (Section A)

International Standard Book Number 0-8493-2906-X (Volume I)

International Standard Book Number 0-8493-2907-8 (Volume II)

Library of Congress Card Number 78-10696

Printed in the United States

## PREFACE

### CRC HANDBOOK SERIES IN ZONOOSES

The biological adventurousness of animal diseases is exceeded only by the insatiable adventuresomeness of man. The struggle of the infectious diseases of lower forms of life to adapt themselves to more highly developed hosts is unending. As these disease agents insure their continued existence by adapting themselves to a broader host spectrum, they become a greater threat to man's well-being. Man, in his most tenuous position on this earth, has been able to protect himself from this biological onslaught by his skill in developing the preventive medical practices that are the foundation of our present public health practices.

In this century, man has made greater progress in holding back or eliminating infectious diseases than since he appeared on earth. Progress in the control of host-specific human diseases, such as smallpox, diphtheria, cholera, poliomyelitis, and syphilis, has brought to the fore animal disease problems which in many areas of the world are major challenges to human health. The eradication of smallpox is one of the major health achievements of our times. One reason this was possible was that there is no animal reservoir of smallpox. The control of diphtheria, cholera, poliomyelitis, and other childhood diseases was possible because none of these diseases have an animal reservoir.

Animal diseases threaten man's health and well-being in many ways. To examine the importance of animal health to human health, it is well for us to consider the World Health Organization (WHO) definition of health as a guide. "Health is not the mere absence of disease or injury . . . it is a state of complete physical, mental, and social well-being." The contributions that veterinary medicine can make to reach the WHO objective are succinctly presented in the definition of veterinary public health: . . . "comprises all the community efforts influencing and influenced by the veterinary medical arts and science applied to the prevention of disease, protection of life, and promotion of the well-being and efficiency of man." The present epidemic of Rift Valley Fever in the Nile Valley is an example of how serious some zoonoses can be. The 1978 epidemic has effected thousands of persons and tens of thousands of cattle, sheep, and goats. Why Rift Valley Fever became so wide spread and virulent is unknown.

The definition of health, as established by WHO, provides a very broad framework upon which to develop our theme. How veterinary medicine will participate in protecting the public health and welfare is well expressed in the broad definition of veterinary public health, and the inter-relationship of disease and health in man and animals provides a challenge that tests the imagination, ingenuity, and knowledge of man.

James H. Steele  
Editor-in-Chief

## JAMES H. STEELE, EDITOR-IN-CHIEF CRC HANDBOOK SERIES IN ZOONOSES

Dr. James H. Steele has held a broad and rewarding experience in veterinary medicine and public health. He entered the Michigan State Veterinary College in 1938 and completed his veterinary training in 1941 when he was awarded the D.V.M. degree. After an internship in veterinary medicine and the Michigan Public Health Laboratory, he was sent to Harvard School of Public Health on a U.S. Public Health Service Fellowship. On the completion of the M.P.H. degree in 1942, he was assigned to the Ohio Health Department as a sanitarian. In 1943, he was commissioned in the U.S. Public Health Service and assigned to Puerto Rico where he had his first opportunity to become acquainted with animal diseases in the tropics and received encouragement to develop a national and international program.

After world War II, he was called to the U.S. Public Health Service, Washington, D.C. to plan a program to deal with the zoonoses and veterinary public health. This was to be a part of the Communicable Disease Center in Atlanta, Georgia where it grew into a national program with an international influence. In addition to directing the CDC veterinary public health program, Dr. Steele was a consultant to U.S. government agencies and international organizations relating to the health of man and animals.

After the inauguration of the veterinary public health program in 1947, a category for veterinary officers was approved by the Surgeon General in 1948. In 1950 Dr. Steele was made Veterinary consultant to the Surgeon General and liaison to professional health organization. Later in 1967 he was to become the Assistant Surgeon General for Veterinary Affairs in the Public Health Service and Department of Health Education and Welfare. The first veterinary officer to be named to this post. He remained in this position until his retirement in 1971. During 1969 he was designated advisor to the White House office on Consumer Affairs.

Dr. Steele was a technical advisor to Surgeon General Thomas Parran when the United Nations organized the World Health Organization in 1946. Later he was appointed to the WHO Expert Committee on Zoonoses and served in varying roles. In 1966 he was elected Chairman. During 1946 the Food Agriculture Organization was having technical meetings at which he represented the United States. He has served as a consultant to the FAO on many occasions since. The Pan American Sanitary Bureau was the first to request his services in disease outbreaks in the Caribbean and Panama during and after World War II. He has been a consultant to the Pan American Health Organization since 1945 and served as chairman of their Scientific Advisory Committee in 1970. In addition to serving as a consultant to international agencies, he has been an advisor to a number of countries and universities in developing veterinary public health programs.

He has received national and international recognition from numerous governments, agencies, and societies. The U.S. Public Health Service awarded him the Medal of Merit in 1963 and the Distinguished Service plaque on his retirement in 1971. The American Public Health Service presented Dr. Steele the prestigious Bronfman Award in 1971 and the Centennial medal in 1972. In 1966 the Conference of Public Health Veterinarians honored him the recipient of the K.F. Meyer Gold Headed Cane Award. These Handbooks of the Zoonoses are dedicated to K.F. Meyer. Dr. Steele has been made an honorary member of various scientific organizations in the Americas, Europe and Asia. In 1965 he was named president of the American Veterinary Epidemiology Society. He was instrumental in the establishment of the World Veterinary Epidemiology Society in 1972 which is affiliated with the World Veterinary Association. An

award was established in his name by the WVES in 1976 which is presented to a young leader in international veterinary public health. He has been described by many of his colleagues as *Mister Veterinary Public Health*.

His publications span a period of almost 40 years and cover various subjects, especially the zoonoses of which there are more than 100 titles. He is a man of many interests.

PREFACE  
SECTION A: BACTERIAL, RICKETTSIAL, AND MYCOTIC DISEASES  
VOLUME II

Historically, zoonotic diseases have had a tremendous impact on the evolution of man, especially those cultures and societies that domesticated and bred animals for food and clothing. Early Biblical writers alluded to various associations between man and animals, particularly to those concerned with food habits and slaughtering practices. According to the Old Testament, cloven-hoofed ruminants and fish with scales were considered safe for human consumption while animals that died of natural causes and scavenger birds, presumably because they fed on animal carcasses, were disapproved of as a source of food. Likewise, blood and carcasses of animals that were not exsanguinated were unacceptable. Swine also were considered unfit for human consumption (unclean and abominable), partly because of their filthy habits and the offal and carrion they fed upon. In contrast, swine were eaten regularly by pre-Semitic inhabitants of Palestine and the Greeks often offered swine in sacrifice to their gods. Whether zoonotic diseases were even considered by early man in the development of attitudes toward various species of animals will remain conjecture. It may be assumed though that early Biblical translators and scholars focused on the religious aspects of practices and food habits and would have little reason to consider zoonotic diseases in their interpretation of scriptural writings.

The distribution of certain parasites in man and domestic and wild animals today suggests that these parasites had undergone adaptive processes to survive during the changes that man introduced in the parasite's ecosystem. For example, the speciation in the genus *Brucella* indicates that this organism made several adaptations designed to ensure its survival in independent cycles in wild and domestic animals. Although not highly host-specific, each of the major species — *abortus*, *suis*, and *melitensis* — is associated principally with one species of domestic animals. In Europe, there is a close epizootiologic relationship between leporine and porcine brucellosis, whereas in the U.S., *Brucella suis* occurs in *Lepus californicus* completely dissociated from swine. In Utah, *Br. neotomae* was found to occur only in *Neotoma lepida* despite the occurrence of many other species of wildlife hosts in its habitat. Very likely, all the species and biotypes of *Brucella* originated from a common ancestral parent from which variants become adapted to different ecological situations.

Because of the complex epizootiology of most zoonoses, responsibility for their control is often divided among health agencies, departments of agriculture, and organizations concerned with wildlife, including marine biologists. In some instances, none of the political subdivisions concerned assume responsibility, and the disease remains unchecked. Regardless of the structure of programs, control of zoonoses involves a large number of disciplines and occupational specialties in the fields of medicine, public health, regulatory veterinary medicine, and wildlife management. Hence, the primary purpose of preparing this Handbook is to provide a guide and comprehensive reference source for veterinarians, physicians, microbiologists, biologists, parasitologists, epidemiologists, health educators, and other health specialists engaged in research, control, and educational activities.

The major bacterial, rickettsial, and mycotic zoonoses are considered in Volumes I and II of this Section. Each contributor was asked to consider the following subject headings in the preparation of his chapter: the disease, etiologic agent, true and alternate hosts, distribution, disease in animals, disease in man, mode of spread, epidemiology, diagnosis, treatment, and prevention and control. Some contributors included extensive historical treatises, and some supplemented their chapters with detailed tabular information concerning various aspects of the disease. Sufficient detail is included so that the microbiologist can use the Handbook as a guide in the isolation and characterization of agents. Similarly, pertinent information presented on the clin-

ical disease in man, diagnosis, and treatment should enable the practicing physician to use the Handbook as an aid in handling human infections. Finally, health and regulatory officials should find the Handbook helpful in the development and application of control measures.

Contributors were chosen on the basis of their expertise in various zoonotic diseases. As editors, we wish to express our sincere appreciation to contributors who spent long hours preparing chapters and, in many cases, compromised fulfilling other responsibilities to meet publication deadlines.

**Herbert G. Stoenner**  
**Michael Torten**  
**William Kaplan**



## SECTION EDITORS

**William Kaplan**, is currently the Chief of the Developmental Mycology Branch, Center for Disease Control, Atlanta, Georgia. He received his B.S. and D.V.M. degrees from Cornell University in 1943 and 1946, respectively. He also received his M.P.H. degree in 1951 from the University of Minnesota. Following graduation from Cornell, Dr. Kaplan was employed as a clinical veterinarian by the United Nations Relief and Rehabilitation Administration and then was engaged in the private practice of veterinary medicine. During the period from 1948 to 1950, Dr. Kaplan was employed by the U.S. Department of Agriculture and assigned to Mexico where he was engaged in regulatory activities directed toward the eradication of foot and mouth disease in livestock. In 1951, Dr. Kaplan was employed by the Center for Disease Control, U.S. Public Health Service where he was engaged in studies on Q-fever, western equine encephalomyelitis, and chancroid disease. In 1955, he was assigned to the Mycology Division of the Center for Disease Control and has been a member of this division to the present time. His work in the area of medical mycology has been varied and has included investigations on dermatophytosis in animals and their public health importance, control of dermatophytosis in animal populations, research on the application of immunofluorescence to the diagnosis of mycotic diseases in man and animals, studies on dermatophilosis, protothecosis, and most of the subcutaneous and systemic mycoses in man and animals. He has also been involved in the presentation of courses and lectures on various aspects of medical mycology. Dr. Kaplan is an Adjunct Professor (Field), University of North Carolina, School of Public Health, Chapel Hill, North Carolina and an Adjunct Associate Professor of Microbiology, Georgia State University, Atlanta, Georgia. His society affiliations include membership on the International Society for Human and Animal Mycology, Medical Mycological Society of the Americas, American Veterinary Medical Association, American Society for Microbiology, American Public Health Association, and the Association of Military Surgeons of the United States. Dr. Kaplan is the author or co-author of close to 100 publications on various aspects of medical mycology.

**Herbert G. Stoenner**, is Director of the Rocky Mountain Laboratory, Hamilton, Montana which is one of the laboratories of the National Institute of Allergy and Infectious Diseases, National Institute of Health. Dr. Stoenner received his undergraduate training at William Jewell College, Liberty, Missouri and the University of Missouri, and he graduated in veterinary medicine from Iowa State University in 1943. Following graduation, he served for 3 years as a veterinarian in the U.S. Army and Air Force. Appointed as a commissioned officer to the Public Health Service in 1947, he was initially assigned to the Center for Disease Control, Atlanta, Georgia and attached to the Utah State Health Department where he conducted epidemiologic studies on human brucellosis and later discovered and described *Brucella neotomae*, one of the recognized species of *Brucella*. In 1949 he was assigned to the Rocky Mountain Laboratory to investigate the role of cattle in the epidemiology of Q fever. In 1953 he was attached to the Washington State Department of Agriculture to investigate bovine leptospirosis. He returned to the Rocky Mountain Laboratory in 1954 and has served as its Director since 1964. Although his career in the Public Health Service was largely administrative, he has authored more than 50 publications dealing with brucellosis, listeriosis, leptospirosis, relapsing fever, Q fever, and other rickettsial diseases. Since 1965 he has served on the Committee on Leptospirosis of the U.S. Animal Health Association.

**Michael Torten**, is Associate Professor of Medical and Veterinary Microbiology and Head of the Zoonoses Section, Faculty of Medical Sciences, Tel Aviv Univer-

sity, Tel Aviv, Israel and in the Department of Epidemiology, Israel Institute for Biological Research, Ness-Ziona, Israel. Dr. Torten graduated in 1963 from the University of California, Davis, with a D.V.M. and obtained his Ph.D. in Microbiology in 1968 from Hebrew University of Jerusalem, Israel. He is the Chief of the World Health Organization/Food and Agricultural Organization and National Leptospirosis Reference Laboratory and a member of the World Health Organization Expert Committee on Leptospirosis. Dr. Torten is a member of the Israel Veterinary Association, Israel and International Microbiological Associations, Israel and International Immunological Societies, and the Phi Zeta Honorary American Veterinary Society. Among other awards, he has received the "Zur" Award from the Ministry of Agriculture Veterinary Services for valuable contribution to veterinary medicine in Israel. He is also an Honorary Diplomat of the American Veterinary Epidemiology Society. Dr. Torten has published more than 70 scientific research papers. Since 1977, he has served as Editor-in-Chief of *Refuah Veterinarith, Israel Journal of Veterinary Medicine*.

## FOREWORD

N. Sinai

The *CRC Handbook Series in Zoonoses* is especially timely. For years, scattered reports and writings have emphasized selected problems. Now, each volume in this series will serve as a compendium of modern knowledge and practice, a manual that expresses the ideals of preventive veterinary medicine applied on a global scale.

It is significant that the International Institute of Administrative Sciences (IIAS) chose three subjects for its studies of comparative public administration. The concern of this organization lay not in the structure of the laws of selected countries but rather in the actual application of these laws. The subjects chosen were (1) workmen's compensation, (2) river pollution by industrial enterprises, and (3) cattle diseases, particularly foot-and-mouth disease. A special report on cattle diseases was published in 1964.\*

It is to the great credit of the veterinary profession that, almost since the beginning of the 18th century, prevention has played a predominant role in applied practice. This was the central purpose of the school of veterinary medicine established by royal decree in 1762 at Lyons, France. Steele\*\* has written a vivid report on the economic devastation caused by cattle plague (*rinderpest*) when it invaded Italy in 1713 and spread throughout Europe. After nearly 50 years of "petitions, bickering, enormous economic losses, and subsequent social disturbances," the school at Lyons came into being, and the philosophy of prevention became firmly established.

The world need for protein foods and food products has been stressed and documented by numerous studies. Projections of needs are often made to the year 2000 (a mere 20 years away) when, according to demographers, the world population will be approximately six billion persons. The very massiveness of the data challenges the imagination and benumbs the feeling of impending disaster.

Byerly refers to ruminant livestock as one of man's most valuable "renewable resources."\*\*\* The key word is renewable, and he emphasizes six areas in which the need for research and development is both pressing and overdue. In summary, the following areas require a massive undertaking to achieve a projected 50% increase in productivity:

1. Pasture and range improvement, particularly in tropical regions
2. Genetic resistance and vector management, especially the arthropod-borne hematoparasitic diseases and helminth parasites
3. Increased animal unit production through an improved conception rate and decreased fetal and perinatal mortality
4. Development and evaluation of systems — biological, ecological, engineering, economic, and social — for resource use, ruminant production, and product utilization
5. Development of new products such as meat protein concentrates, texturized products from trimmings and edible offals, and lactose-hydrolyzed milk for lactose-intolerant persons
6. Improvement of milk and meat production through genetic selection and feed-

\* Anon., *Prevention of Cattle Diseases*, International Institute of Administrative Sciences, Brussels, 1964, 3.

\*\* Steele, J. H., The socioeconomic responsibilities of veterinary medicine, *Public Health Rep.*, 79(7), 613, 1964.

\*\*\*Byerly, T. C., Ruminant livestock: research and development, *Science*, 195, 450, 1977.

ing programs designed to satisfy energy, protein, mineral, and other nutrient requirements of pregnant and lactating animals

It is estimated that world financial support for research and development must approximate an increase of 45% during the next 25 years. As if this were not staggering enough in concept and magnitude, both veterinarians and agriculturists face other problems of applied science — the need for training not only in the broad aspects of public health but also in the field of anthropology. The importance of the latter is demonstrated too often by the failure of programs — public health, agricultural, educational, industrial — because of ignorance or inattention to cultural obstacles. No sophisticated nutritionist would make the mistake of suggesting an immediate utilization of beef or beef products for the population of India. However, there are many obstacles other than religious ones to changes in traditional tastes and food habits.

Cassava, the staple diet for millions of persons, is an example of the adjustment of agricultural research to food tradition. This food is notable for its high carbohydrate and extremely low protein content. Accepting the premise that it takes generations of time to shift from cassava to protein-rich soya, research is centered on producing a more balanced cassava through crossing wild strains, which have a much higher percentage of protein, with the product that is commonly grown. Predictions of a successful outcome range from 3 to 5 years.

Public health workers have learned many cultural lessons the hard way. Piping water to village huts in certain areas is a classic example. It was much more than a problem of developing a source, digging trenches, and providing pipe and hydrants. The resistance of the villages, despite the lengthy walk and the burden of carrying water, resulted from the fact that the well was the main social center of the community. At least temporarily, the cost of giving up the social center outweighed the benefit of piped water.

This series of Handbooks entails a program that presents huge potential. Its underlying foundation is biological science, but biological science cannot be applied as a completely independent entity. It must be buttressed by enormous input from the humanities and social sciences.

## NATHAN SINAI

Nathan Sinai, D.V.M., M.S.P.H., Dr.P.H., professor emeritus of public health at the University of Michigan, one of the nation's most distinguished public health leaders and an internationally acclaimed medical care statesman, died November 28, 1977 at a hospital in South Laguna, California following a long illness. He was 83.

An inspired and inspiring teacher, Dr. Sinai originated and guided educational programs widely recognized and imitated. A noted health care pioneer, he became a world leader of the insurance movement. One of the founders and constant leaders in the field of medical care research, his pioneering work on group practice and on the organization and delivery of health services, dating from the early 1930s, is still followed by his students and other workers in the field.

Born November 28, 1894 in Stockton, California, Nathan Sinai attended San Francisco College where he received the Doctor of Veterinary Medicine degree in 1915. In 1924 he received the Master of Science in Public Health degree and two years later the Doctor of Public Health degree, both from the University of Michigan. He joined the University of Michigan faculty in 1924 as an instructor in public health and was appointed an assistant professor in 1927, associate professor in 1929, and full professor in 1932. Soon after his appointment to the Michigan faculty, he undertook a four-year assignment on the research staff of the Committee on the Costs of Medical Care, working with a talented group which provided leadership to American medical care research and action for the next half century.

In 1935, Dr. Sinai initiated a course in medical administration at Michigan, the first university to have such a program. He became secretary of the University of Michigan School of Public Health in 1941, the same year the school was officially designated as one of the colleges of the University, and held that position until 1952. Until 1959, Professor Sinai was director of the University's Bureau of Public Health Economics, which he established in 1943. He also worked as director of research of the Michigan State Medical Society (1932 to 1934) and was consultant to the Ann Arbor Health Department from 1941 to 1955.

Known internationally as well as nationally, Professor Sinai served as a consultant to the League of Nations and to the World Health Organization. Having taken a special interest in comparative studies of health care systems of other nations, he helped develop a health insurance plan in Windsor, Canada and was one of the earliest leading proponents of national health insurance in this country and remained so until his death. He made the most definitive study of the United States government's World War II program for Emergency Maternity and Infant Care (EMIC) and served as consultant to the U.S. Public Health Service (1936 to 1940), the Children's Bureau (1939 to 1947), the Manhattan Project, Oak Ridge, Tennessee (1944 to 1945), and many other national programs.

At the time he was named professor emeritus, in 1964 after 40 years of service to Michigan, U.M.'s regents said, "Keeping abreast of the rapid changes in the economic context of health services, Dr. Sinai became at once an expert in the field of medical insurance and a persuasive, popular exponent of the humane and sensible distribution of medical care. Within the School of Public Health, of which he was long the senior member of the faculty, he was esteemed for his superior teaching and his imaginative contributions to new instructional programs. He lent honor both to his School and to the University."

Professor Sinai remained very active throughout his retirement, maintaining his close ties to Michigan. In 1974, he returned to deliver the first annual Nathan Sinai Lecture, an honor bestowed upon him by the School of Public Health, and he returned again in 1976 to teach a course in the Department of Medical Care Organization. In

all, his continuous association with medical care teaching and research at the University of Michigan spanned 54 years.

A member of the American Public Health Association for 53 years, Dr. Sinai served with generous spirit and notable effect in posts of leadership. In 1944, Dr. Sinai was one of the members of the newly formed Subcommittee on Medical Care (of the Committee on Administrative Practice) which played a leading role in the movement for a comprehensive national health program to bring adequate health care to all Americans. The Subcommittee, under a 1946 grant by the Rockefeller Foundation, carried out an ambitious program of studies of all aspects and problems of medical care. Their activities and interests eventually led to the movement to establish a Medical Care Section within APHA. In 1946, Dr. Sinai represented his state affiliate, Michigan, on the APHA Governing Council, and from 1952 to 1954 he served the Medical Care Section in the same capacity. He was a life member and fellow of APHA, a fellow and past president (1945) of the Michigan Public Health Association, and a member of Phi Kappa Phi and Delta Omega societies.

In 1974, on the occasion of his 80th birthday, the Medical Care Section of the Southern California Public Health Association invited many of his colleagues, former students, and friends to a symposium held in his honor. Many friends gathered to pay tribute to their teacher and friend; others who could not attend sent messages of remembrance to be read.

Dr. Paul Cornely, one of Professor Sinai's earliest doctoral students in medical care administration, has said that he remembers Nate Sinai "not only for his keen, well-disciplined mind of a researcher, but much more for the grace, humor, charm, and sensitive consideration for each and all of his students, thus making him a long-remembered and most beloved teacher."

From *Am. J. Public Health*, 68(7), 701, 1978. With permission.

**ADVISORY BOARD MEMBERS**  
**SECTION A: BACTERIAL, RICKETTSIAL, AND MYCOTIC DISEASES**  
**VOLUME II**

**Robert K. Anderson**

Professor of Veterinary Public  
Health

Division of Epidemiology

School of Public Health

University of Minnesota

Minneapolis, Minnesota

**Harvey R. Fischman**

Associate Professor of Epidemiology

School of Hygiene and Public Health

Johns Hopkins University

Baltimore, Maryland

**Alexander D. Langmuir**

Professor of Epidemiology (Retired)

Medical School

Harvard University

Boston, Massachusetts

**William Mitchell**

Professor of Public Health

Ontario Veterinary College

University of Guelph

Guelph, Ontario

**Adriano Montavani**

Professor of Preventive Medicine

Veterinary Medical Faculty

University of Bologna

Bologna

Italy

**Phillip A. O'Berry**

Director

National Animal Disease Center

Ames, Iowa

**Charles H. Pilet**

Professor of Immunology,  
Microbiology, and Infectious  
Disease

Ecole Nationale D'Alfort

Alfort

France

**Julius Schacter**

Professor of Epidemiology

George Williams Hooper Foundation

Acting Director

Karl Friedrich Meyer Laboratories

University of California

San Francisco, California

**Edward A. Schilf**

Assistant to the Deputy

Administrator

Animal and Plant Health Inspection  
Service

Veterinary Services

U.S. Department of Agriculture

Washington, D.C.

**C. M. Singh**

Director

Indian Veterinary Research Institute

Izatnagar, UP

India

**CONTRIBUTORS**  
**SECTION A: BACTERIAL, RICKETTSIAL, AND MYCOTIC DISEASES**  
**VOLUME II**

**Libero Ajello**

Director, Mycology Division  
Bureau of Laboratories  
Center for Disease Control  
Atlanta, Georgia

**Benedict G. Archer**

Assistant Professor  
WOI Regional Program in  
Veterinary Medicine  
University of Idaho  
Moscow, Idaho

**J. Frederick Bell**

Medical Director PHS (retired)  
Rocky Mountain Laboratory  
National Institute of Allergy and  
Infectious Diseases  
National Institutes of Health  
Hamilton, Montana

**Willy Burgdorfer**

Head, Rickettsial Diseases Section  
Rocky Mountain Laboratory  
National Institute of Allergy and  
Infectious Diseases  
National Institutes of Health  
Hamilton, Montana

**Jay O. Cohen**

Research Microbiologist  
Biological Products Division  
Bureau of Laboratories  
Center for Disease Control  
Atlanta, Georgia

**E. Denis Erickson**

Associate Professor  
Department of Veterinary Science  
University of Nebraska  
Lincoln, Nebraska

**A. Konrad Eugster**

Head, Diagnostic Microbiology  
Texas Veterinary Medical Diagnostic  
Laboratory  
College of Veterinary Medicine  
Texas A & M University  
College Station, Texas

**B. D. Firehammer**

Professor of Veterinary  
Microbiology  
Veterinary Research Laboratory  
Agricultural Experiment Station  
Montana State University  
Bozeman, Montana

**John Francis**

Professor of Veterinary Preventive  
Medicine and Public Health  
Veterinary School  
University of Queensland  
St. Lucia, Queensland  
Australia

**Diana K. Goroff**

Microbiologist  
Department of Bacterial Diseases  
Walter Reed Army Institute of  
Research  
Washington, D.C.

**Elmer M. Himes**

Veterinarian  
National Veterinary Services  
Laboratory  
Ames, Iowa

**S. S. Kalter**

Director, Microbiology and  
Infectious Diseases  
Southwest Foundation for Research  
and Education  
San Antonio, Texas



**William Kaplan**

Assistant Director, Mycology  
Division  
Bureau of Laboratories  
Center for Disease Control  
Atlanta, Georgia

**Dennis L. Kasper**

Associate Professor of Medicine  
Channing Laboratory  
Harvard Medical School  
Peter Bent Brigham Hospital  
Boston, Massachusetts

**L. D. Konyha**

Chief Staff Veterinarian  
Veterinary Services  
Animal and Plant Health Inspection  
Service  
U.S. Department of Agriculture  
Washington, D.C.

**Robert A. MacLean**

Deputy Director of Public Health  
City of Houston Health Department  
Houston, Texas

**James A. McComb**

Director (retired)  
Biologic Laboratories  
Commonwealth of Massachusetts  
Instructor (retired)  
Harvard School of Public Health  
Boston, Massachusetts

**Lyle L. Myers**

Associate Professor of Veterinary  
Biochemistry  
Veterinary Research Laboratory  
Agricultural Experiment Station  
Montana State University  
Bozeman, Montana

**F. J. Mulhern**

Administrator  
Animal and Plant Health Inspection  
Service  
U.S. Department of Agriculture  
Washington, D.C.

**Arvind A. Padhye**

Chief, Fungus Reference Branch  
Mycology Division  
Center for Disease Control  
Atlanta, Georgia

**Robert N. Philip**

Assistant Director  
Rocky Mountain Laboratory  
National Institute of Allergy and  
Infectious Diseases  
National Institutes of Health  
Hamilton, Montana

**Allan C. Pier**

Chief, Bacteriological and  
Mycological Research Laboratory  
Science and Education  
Administration  
National Animal Disease Center  
Ames, Iowa

**Julius Schachter**

Professor of Epidemiology  
George Williams Hooper Foundation  
Acting Director  
Karl Friedrich Meyer Laboratories  
University of California  
San Francisco, California

**Emmett B. Shotts, Jr.**

Professor of Medical Microbiology  
College of Veterinary Medicine  
University of Georgia  
Athens, Georgia

**Leo G. Staley**

Major, U.S. Army  
Deputy for Veterinary Activities  
United States Military Academy  
West Point, New York

**James H. Steele**

Professor of Environmental Health  
School of Public Health  
Health Science Center  
University of Texas  
Houston, Texas