



PRACTICAL BACTERIOLOGY,
HEMATOLOGY, AND PARASITOLOGY

Contributors

The following contributors were from the Naval Medical School, the Naval Medical Research Institute, and the United States Public Health Service. Several have since left the Naval Service and at present are engaged in other fields of activity

ELMER M. BINGHAM

ROBERT J. GOODLOW

WILLIAM J. PERRY

MICHEL PIJOAN

TRENTON K. RUEBUSH

GENEVIEVE STOUT

NORMAN H. TOPPING

PAUL V. WOOLLEY



Practical Bacteriology, Hematology, and Parasitology

By

E. R. STITT, M.D., Ph.M., Sc.D., LL.D.

Rear Admiral, Medical Corps, and Surgeon General, U.S. Navy, Retired. Graduate of the London School of Tropical Medicine. Formerly: President of the National Board of Medical Examiners; Head of the Department of Tropical Medicine, U.S. Naval Medical School; Associate Professor of Medical Zoology, University of the Philippines. Consultant in Tropical Medicine to the Secretary of War, World War II

PAUL W. CLOUGH, M.D.

Physician-in-Charge of the Diagnostic Clinic, Johns Hopkins Hospital; Assistant Professor of Medicine, Johns Hopkins University; Associate Professor of Medicine, University of Maryland

SARA E. BRANHAM, M.D., Ph.D., Sc.D.

Principal Bacteriologist, National Institutes of Health; Professorial Lecturer in Preventive Medicine, The George Washington University School of Medicine

and

Contributors

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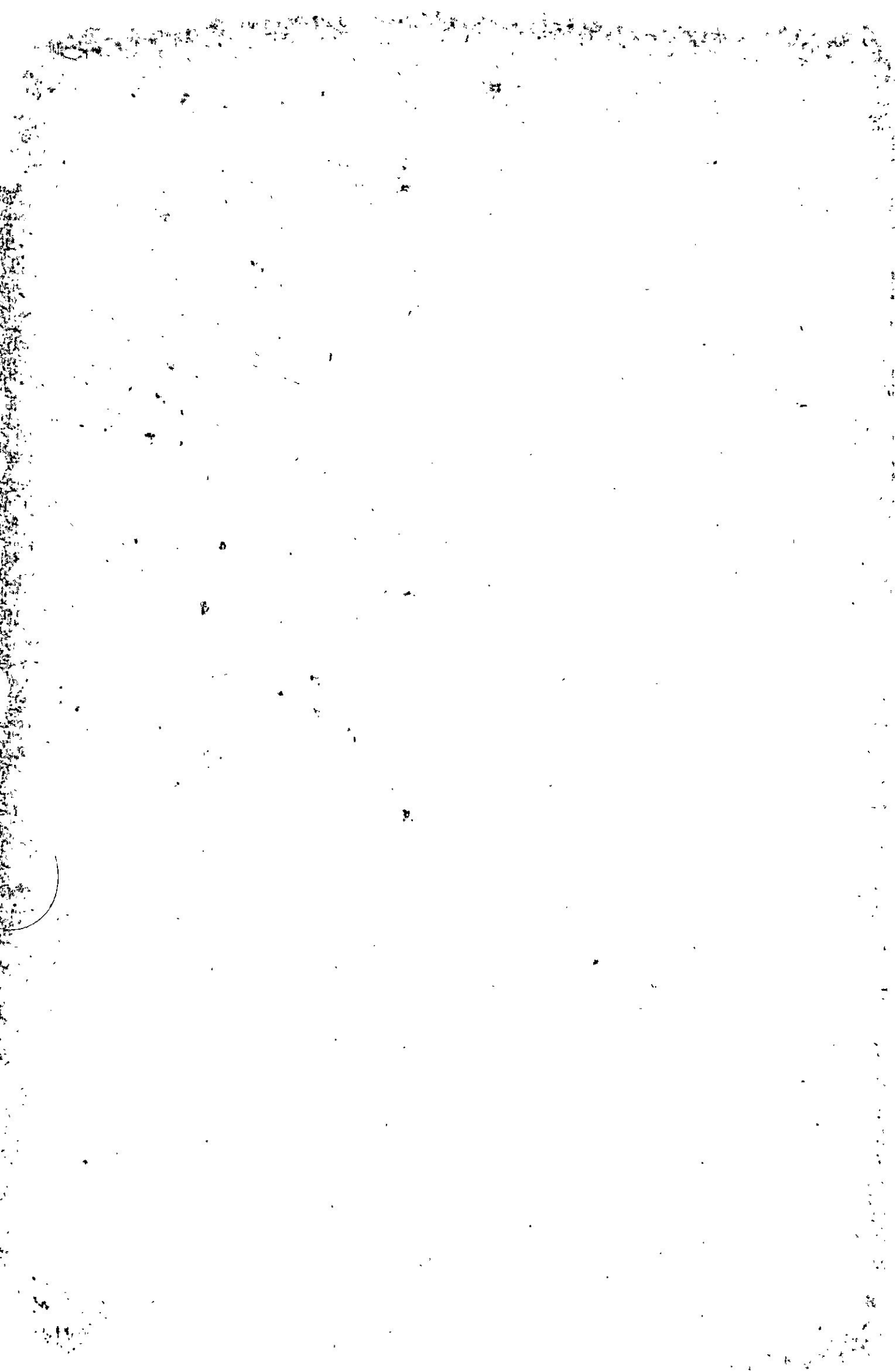
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Dedicated
to the Memory of
DR. MILDRED CLARK CLOUGH



Preface

Approximately 40 years ago the manuscript of the first edition of this manual was being written to cover the various fields of clinical microscopy in a single book. At that time it was the practice to have bacteriology, helminthology, protozoology, hematology, mycology, and urinalysis treated separately, so that there was inadequate correlation between the laboratory examinations in these fields and clinical diagnosis.

In each new revision more space has been allotted to the interpretation and diagnostic significance of the various laboratory procedures, and in this edition we have tried to correlate still further the data obtained by these examinations with the clinical picture. We believe that this is facilitated by bringing together in one book consideration of all the available types of laboratory examinations. Assistance in the selection of appropriate tests may be easily obtained by consulting *Laboratory Procedures Useful in Diagnosis, Indexed by Diseases*.

Following the Spanish-American War, interest in the study of tropical diseases was aroused, and books on the laboratory diagnosis of such diseases were being written. These, however, rarely coördinated the common diseases of temperate climates with those designated "tropical." In fact, the term "exotic diseases"—"Pathologie Exotique" of LeDantec—has seemed more appropriate than "Tropical Diseases" of Manson, for those diseases rarely or never seen in the clinics of Paris, London, or New York. Along with the first edition, successive editions followed the plan of giving equal consideration to the etiology of exotic diseases and those common to temperate climates.

Fortunate for the first edition was the assistance of Dr. Charles Wardell Stiles, later head of medical zoology in the Naval Medical School. Both here and at Johns Hopkins he covered the entire field from helminthology, his specialty, through protozoology, entomology, and herpetology, and he not only taught human parasitology but also illustrated this subject with comparative parasitology. Dr. Stiles was an international authority on zoologic nomenclature, and every zoologic name used in the first edition had his approval. Successive editions had the advice and coöperation of the officers of the Hygienic Laboratory (National Institutes of Health) as well as of those attached to the Naval Medical School. In the present tenth edition we have revisions coming from these two institutions.

In the study of the filtrable viruses the clinical manifestations of the disease in man and experimental animals play a more important part in diagnosis than is the case in other conditions. In hematology a concise presentation of the symptomatology is needed as well as details of chemical and microscopic technic. The

symptomatology of certain diseases has been stressed if the material is to be found only in the recent literature or if, from the rare or exotic nature of the disease, it is dealt with inadequately or not at all in the standard textbooks.

We have continued to bear in mind the needs of the man in tropical or remote fields, who does not have access to well-equipped libraries or laboratories.

The great impetus given to epidemiology by World War II has resulted in a recognition of the necessity of having specialists in many fields, and the authors of this edition have been fortunate in obtaining recognized specialists to revise the subjects in their fields.

Revision of the section on Bacteriology has been done by Dr. Sara E. Branham of the National Institutes of Health. This section has been almost completely rewritten. The Classification of Bacteria is based on that which will appear in the forthcoming Sixth Edition of Bergey's Manual. A number of new procedures have been described, such as determining Lancefield's groups of streptococci, newer methods of typing pneumococci and meningococci, Frobisher's chick method of determining the virulence of diphtheria bacilli, new methods of studying the enteric bacteria, and the use of the developing hen's egg for cultivation of bacteria, rickettsiae, and viruses. Sections on the Gram-negative bacteria and on the Gram-positive spore-bearing anaerobes have been extensively revised, and those dealing with the acid-fast bacteria and the lactobacilli completely rewritten.

The organisms causing actinomycosis and other related infections, formerly included under Mycology, have been discussed in Chapter 4 in connection with the acid-fast bacteria, as has also *Erysipelothrix rhusiopathiae*. The lactobacilli have been placed in Chapter 4 also, with other Gram-positive bacilli, since they are no longer considered primarily of the gastrointestinal tract. Glanders, on the other hand, has been transferred from Chapter 4 to 5 among the Gram-negative rods. The vibrio of cholera and the genus *Bacteroides* have also been placed in Chapter 5. Several new groups of bacteria have been added: *Listeria*, *Streptobacillus moniliformis* and pleuropneumonia-like organisms, and *Actinobacillus lignieresii*.

For advice concerning classification and nomenclature we are indebted to the Editorial Board in charge of the Sixth Edition of Bergey's Manual: Professor E. G. D. Murray, Lt. Colonel A. Parker Hitchens, and Professor Robert S. Breed, Chairman.

Acknowledgment is here made of the aid given by Dr. John H. Hanks in supplying material for the revision of the discussion of the acid-fast bacteria.

Obligation is here expressed to the many members of the staff of the National Institutes of Health, who were unstintingly generous with advice and information for the section on Bacteriology. Among these special thanks should be given to Dr. Francis A. Arnold, Jr., Dr. James J. Griffitts, Dr. Albert V. Hardy, Dr. Carl L. Larson, Dr. Mark P. Schultz and Dr. Elizabeth Verder for invaluable help in their respective fields. Special thanks are due Miss Laura C. McCarty of this Institute for aid in preparation of the manuscript.

In Chapter 6, Spirochetes, the treponemiasis have been discussed at considerable length. The discovery in 1938 that pinta, an important disease of the Indians of

the New World, is caused by a treponeme rather than a fungus, has broadened the field of these spirochetal diseases. There are still many unsolved problems as to the relationship of yaws and syphilis, among which is the explanation of the disappearance of yaws in our Southern States where it was introduced through thousands of cases among the African slaves.

In connection with spirochetal diseases, we have had the advice of Rear Admiral H. W. Smith (MC) USN, who was the editor of the seventh edition.

The section on rickettsial diseases, written by Dr. Norman H. Topping, of the U.S. Public Health Service, includes descriptions of Q fever and tsutsugamushi disease. He has also described the technic of cultivation of rickettsiae in eggs, the preparation of antigens from infected yolk sacs, and the soluble antigens released from certain rickettsiae by diethyl ether. For the photomicrographs of rickettsiae taken with the electron microscope we are indebted to Dr. R. W. G. Wyckoff. We also thank Dr. R. E. Dyer, Director of the National Institutes of Health, for criticism of the manuscript.

The chapter on Medical Mycology has been revised by Lt. Comdr. Robert J. Goodlow H(S) USNR, Naval Medical School, NNMC. New material added includes recent advances regarding coccidioidomycosis and histoplasmosis, and a summary of the present status of antibiotics. New original illustrations have been added. We are indebted to Dr. C. W. Emmons, of the National Institutes of Health, for advice and criticism of this section.

The section on Serologic Tests for Syphilis has been revised by Lt. Genevieve Stout H(W) USNR, Naval Medical School, NNMC. We are indebted to Dr. Reuben Kahn for a review of the section dealing with the Kahn flocculation test. The technic of the Wassermann reaction of the former edition has been replaced by the Kolmer complement-fixation test. We thank Dr. John Kolmer for a review of this section. A section has been added regarding the use of the cardiolipin antigen. For special information regarding this and for a review of this section we are indebted to Dr. Mary Pangborn, Dr. J. J. Mahoney, and Mr. A. Harris.

The chapter on Filtrable Viruses has been rewritten by Dr. Paul W. Clough. New material has been added, particularly regarding poliomyelitis, the encephalitides, lymphogranuloma inguinale, and influenza, and sections on infectious hepatitis and primary atypical pneumonia.

The short chapter on Bacteriology of Water and Milk contained in the former edition has been omitted to make room for more important material, but the essential data, particularly regarding the coliform organisms, have been included by Dr. Branham in preceding chapters.

The chapters on Preparation of Media and Reagents and Staining Methods and Special Procedures were prepared by Lt. Comdr. Paul V. Woolley (MC) USNR, Naval Medical School, NNMC, with the advice and help of Dr. Branham. These have been transferred to Part I, although for convenience some special procedures have been incorporated elsewhere. This has been radically revised, obsolete material removed, and only the most useful modern methods retained.

Revisions have been made in Part II dealing with Hematology, particularly in

pernicious anemia, sprue, and the group of hemolytic anemias. Among additional procedures discussed are: sternal marrow biopsies and punctates; new work on human blood groups and methods for their determination; the Rh factor and its relation to transfusion reactions and erythroblastosis fetalis; "cold" autohemagglutinins and their occurrence in primary atypical pneumonia; vitamin K deficiency, tests for prothrombin time, and its relation to bleeding in obstructive jaundice and hemorrhage of the newborn; preservation of blood for transfusions, and substitutes for blood.

Part III, Parasitology, has been rewritten: Medical Protozoology by Comdr. Elmer M. Bingham (MC) USNR; Medical Helminthology by Comdr. Trenton K. Ruebush H(S) USNR; and Medical Entomology by Lt. Comdr. William J. Perry H(S) USNR, all of the Naval Medical School, NNMC. Much additional material has been added, particularly important being new work on malaria, schistosomiasis, filariasis, DDT, and arthropod transmission of disease. A major addition is the large number of illustrations, practically all from new and original drawings or photographs. These include diagrammatic drawings illustrating the life cycle of the more important parasites. Colored plates illustrating malarial parasites in thin and thick blood films will, we believe, add greatly to the value of this section.

We are indebted to Lt. Comdr. Nancy H. Wheeler H(W) USNR, Naval Medical School, for reading and making many constructive criticisms of this entire section; to Dr. F. C. Bishop, Bureau of Entomology and Plant Quarantine, U.S.D.A., for reading the section on Medical Entomology; to Lt. D. E. Howell H(S) USNR, Naval Medical School, for advice in preparing the section on Medical Entomology, particularly the part dealing with the arachnids; and to Lt. (jg) J. R. Borland H(S) USNR, Naval Medical School, for preparing the photomicrographs used in the chapter on Medical Parasitology.

In Part IV, Chapter 35, Examination of the Cerebrospinal Fluid and of Fluid from the Serous Cavities, has been extensively revised and obsolete material omitted. We have substituted the new improved method of preparing colloidal gold solution now in use at the Naval Medical School laboratories, and for this we thank Lt. Comdr. Oris Western H(S) USN.

In Chapter 36 improved methods have been substituted for the determination in the blood of nonprotein nitrogen, urea nitrogen, uric acid, inorganic phosphorus, alkaline phosphatase, and serum protein. Among new procedures are the use of the photoelectric colorimeter, and methods for determining acid phosphatase, cholesterol esters, sulfonamides, and thiocyanate. We are indebted to Dr. Mary V. Buell for advice and information concerning procedures used in the Chemical Laboratories of the Medical Clinic of the Johns Hopkins Hospital. We also thank Comdr. J. J. Englefried H(S) USNR, for refinements of the Bogen method of determining alcohol in the blood.

Tests of renal function have been revised. In Chapter 42 we have added the cephalin-cholesterol flocculation test and the hippuric acid synthesis test, and have omitted several less important or less frequently used procedures.

Chapter 44, Vitamins as Specific Food Factors: Their Nutritional Significance

and Deficiency Effects, has been entirely rewritten by Lt. Comdr. M. Pijoan (MC) USNR, Naval Research Institute, NNMC. In view of the importance and current interest in this subject, a brief bibliography has been included.

In the Appendix several sections have been omitted to make room for more pertinent material. Sections B, C, and E of the former edition have been transferred to other parts of the book. Present Section G, Important Diseases and Injuries Due to Toxic Plants, has been revised and extended. For this new material we are indebted to Col. Richard P. Strong (MC) USA, who kindly made available material from the seventh edition of "Stitt's Diagnosis, Prevention and Treatment of Tropical Diseases," of which the chapter on poisonous plants had been revised by Professor Elmer D. Merrill, Director of the Arnold Arboretum. Present Section H, Laboratory Procedures Useful in Diagnosis, Indexed by Diseases, has been revised and extended.

We are indebted to Comdr. Emil Bogen (MC) V(S), USNR, for many suggestions as to revisions and additions in all sections of the book.

We wish to thank Captain H. Lamont Pugh (MC) USN, Medical Officer in Command, Naval Medical School, NNMC, for his continued interest in this book and for his kindness in making available the many illustrations and the large amount of material borrowed from the Naval Medical School.

We are especially indebted to Capt. Otis Wildman (MC) USN (Ret.), Director of Laboratories, Naval Medical School, NNMC, who has supervised the work done by the various authors from the Naval Medical School. Without his constant interest, constructive criticism and active collaboration much of this revision would have been impossible.

We are greatly indebted to the Medical Illustration Department of the Naval Medical School, under the direction of Lt. Comdr. Leon Schlossberg H(S) USNR, for the many new illustrations in the chapters Medical Parasitology and Medical Mycology. Lt. Annette Conry H(W) USNR drew two of the colored plates used in the section on Bacteriology and the thick films of malaria parasites. She also drew the plates of intestinal protozoa. The color plate of the thin film of malaria parasites was prepared under the direction of Captain James J. Sapero (MC) USN, to whom we are greatly indebted. This plate first appeared in the sixth edition of Strong: "Stitt's Diagnosis, Prevention and Treatment of Tropical Diseases," from which it is borrowed. James Garthwaite, Pharmacist's Mate, third class, made the majority of the illustrations for the chapter on Medical Entomology.

The editor also acknowledges the invaluable assistance of Comdr. Trenton K. Ruebush in editing the book, particularly Parts I and III, and in coordinating the work of the authors in the National Institutes of Health and the Naval Medical Center, who have contributed to it.

E. R. STITT
PAUL W. CLOUGH
SARA E. BRANHAM



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PART I

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Chapter 7

By Norman H. Topping, M.D.

Chapter 8

By Paul W. Clough, M.D.

Chapter 9

By Robert J. Goodlow, Ph.D., Lieutenant Commander H (S) USNR

Chapter 10

By Paul W. Clough, M.D.
and Genevieve Stout, Lieutenant H (W) NNMC

Chapters 11-12

By Paul V. Woolley, Lieutenant Commander (MC) USNR
and Sara E. Branham, M.D., Ph.D.