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Zinsser

Microbiology

Seventeenth Edition

17th edition

ZINSSER
MICROBIOLOGY

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ZINSSER

MICROBIOLOGY

To the memory of
**Philip Hanson Hiss, Jr.,
Hans Zinsser,
and Stanhope Bayne-Jones**

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PREFACE

With each passing year the term *Microbiology* becomes a less satisfactory umbrella for the many disciplines that it attempts to cover. Bacteriology, immunology, virology, mycology, and parasitology have each long since become separate and independent disciplines. They are together in a single text simply because they deal with the agents of infectious disease in man and with the mechanisms employed by the host in his defense.

In spite of the undeniable triumphs of antibiotic chemotherapy, which has revolutionized the practice of medicine and very likely represents the greatest single triumph of biomedical science, “microbes” are by no means “conquered”; they continue to cause infections that demand a large amount of the physician’s time. In fact, new infectious agents, unsuspected properties of known agents, additional mechanisms for the genesis and persistence of infection, and advances in our understanding of the behavior of infectious agents at the molecular, cellular, and organismal levels are constantly being reported. As a result, the scope and complexity of the material to be presented to students expand rapidly, and although the literature abounds with excellent papers and reviews, the compilation of a comprehensive textbook of manageable size becomes increasingly difficult.

This new edition of Zinsser Microbiology, the 17th, is designed to fulfill several clearly definable needs. First, it is intended for use by medical students experiencing their first exposure to medical microbiology. To that end, there is presented not only a description of the pathogenic infectious agents and the diseases that they cause, but also a discussion of the basic principles of bacterial physiology and genetics, of molecular and cellular immunology, and of virology, the purpose of which is to provide a firm basis for growth with the field during the re-

mainder of the student’s future professional career. By the same token, the book will also fulfill the needs of advanced undergraduates who plan careers in medicine or biomedical research. Second, the book is intended as a comprehensive text for advanced medical students, house officers, and practicing physicians, providing in a single volume information not only on the more common infectious diseases endemic in the United States, but also on diseases such as diphtheria, poliomyelitis and smallpox, which are seen so rarely nowadays that they may not be recognized by the younger physicians. Finally, the book is designed as a reference source for instructors; to that end each chapter is supplemented with a selection of both reviews and important original papers that will permit a rapid entrée to any specialized topic that may require further study.

The 17th edition represents a very extensive revision of the 16th edition. Section 6, Medical Mycology, which had been provided by Dr. Norman Conant for eight editions that spanned three decades, is now written by Dr. Thomas C. Mitchell, who brings to it a fresh approach and new viewpoints without sacrifice of authority. Immunology, Section 2, has also been almost completely rewritten by a staff that includes several new contributors. It provides a comprehensive account of both basic and clinical immunology, organized so as to highlight topics currently deemed to be of maximum relevance to medical students. Another section, large parts of which have been rewritten completely, is Section 4, Basic Virology. Among new chapters in this section are those dealing with virus multiplication cycles, viral genetics, and the tumor viruses, areas in which our horizons are expanding at a very rapid rate.

Sections 1 and 3, Bacterial Physiology and Medical Bacteriology, have been brought up to

date. In the former, emphasis continues to be placed on properties and mechanisms unique to bacterial cells, the molecular basis of genetics and gene transfer, and on the mode of action of antimicrobial agents. In the latter, which like all other sections has been carefully edited by a single author so as to ensure a uniform format, emphasis is again placed on correlating the basic and clinical aspects of each infectious agent so that the student may acquire an appreciation of how fundamental research may be used in unraveling the complexities of the host-parasite relationship. Each chapter consists of (1) an introduction to the important biologic properties of the organism, (2) a description of the clinical infection in man, including a discussion of mechanisms of pathogenicity, (3) a section on laboratory diagnosis that provides information on modern culture and immunologic procedures, and (4) a discussion of the currently recommended treatment.

The final two sections, Clinical Virology and Parasitology, have been brought up to date by their authors. There are several entirely new chapters here also, including those on poxviruses, papovaviruses, rhabdoviruses, and slow virus infections.

With regard to the bibliography, we have once again elected not to reference specific statements in the text but to append to each chapter a list of recent reviews and key original papers. The former will quickly guide the reader to any specific aspect of microbiology and immunology that he wishes to pursue; the latter makes available the detailed considerations and circumstances that have gone into the genesis of key

discoveries. Many of the papers that are cited already are, or no doubt will soon become, "classics."

We have tried not to increase the size of the book—no easy task in view of the enormous amount of new information that has accumulated since publication of the last edition in 1976. Obviously, this has entailed the omission of a certain amount of older material; however, we are confident that there are no major gaps and that in our presentation of the newest advances we have not sacrificed careful and logical explanations of fundamental principles.

The list of individuals who have helped to produce this volume extends far beyond the circle of our colleagues who contributed textual material and to whom we are profoundly indebted. We would especially like to thank our many colleagues who permitted us to use illustrative material and who almost invariably supplied us with original photographs, and the many publishers who allowed us to reproduce previously published material. We would also like to thank Lynda Frejlach, who did a superb job in drawing the innumerable charts and diagrams, and the many secretaries who cheerfully typed and retyped the manuscript many times. Finally, we wish to express our appreciation to the staff of Appleton-Century-Crofts for their efficient cooperation in producing this new edition.

WOLFGANG K. JOKLIK
HILDA P. WILLETT
D. BERNARD AMOS

PREFACE TO THE FIRST EDITION

The volume here presented is primarily a treatise on the fundamental laws and technic of bacteriology, as illustrated by their application to the study of pathogenic bacteria.

So ubiquitous are the bacteria and so manifold their activities that bacteriology, although one of the youngest of sciences, has already been divided into special fields—medical, sanitary, agricultural, and industrial—having little in common, except problems of general bacterial physiology and certain fundamental technical procedures.

From no other point of approach, however, is such a breath of conception attainable, as through the study of bacteria in their relation to disease processes in man and animals. Through such a study one must become familiar not only with the growth characteristics and products of the bacteria apart from the animal body, thus gaining a knowledge of methods and procedures common to the study of pathogenic and non-pathogenic organisms, but also with those complicated reactions taking place between the bacteria and their products on the one hand and the cells and fluids of the animal body on the other—reactions which often manifest themselves as symptoms and lesions of disease or by visible changes in the test tube.

Through a study and comprehension of the processes underlying these reactions, our knowledge of cell physiology has been broadened, and facts of inestimable value have been discovered, which have thrown light upon some of the most obscure problems of infection and immunity and have led to hitherto unsuspected methods of treatment and diagnosis. Thus, through medical bacteriology—that highly specialized offshoot of general biology and pathology—have been given back to the parent sciences and to medicine in general methods and knowledge of the widest application.

It has been our endeavor, therefore, to present this phase of our subject in as broad and critical a manner as possible in the sections dealing with infection and immunity and with methods of biological diagnosis and treatment of disease, so that the student and practitioner of medicine, by becoming familiar with underlying laws and principles, may not only be in a position to realize the meaning and scope of some of these newer discoveries and methods, but may be in a better position to decide for themselves their proper application and limitation.

We have not hesitated, whenever necessary for a proper understanding of processes of bacterial nutrition or physiology, or for breadth of view in considering problems of the relation of bacteria to our food supply and environment, to make free use of illustrations from the more special fields of agricultural and sanitary bacteriology, and some special methods of the bacteriology of sanitation are given in the last division of the book, dealing with the bacteria in relation to our food and environment.

In conclusion it may be said that the scope and arrangement of subjects treated in this book are the direct outcome of many years of experience in the instruction of students in medical and in advanced university courses in bacteriology, and that it is our hope that this volume may not only meet the needs of such students but may prove of value to the practitioner of medicine for whom it has also been written.

It is a pleasure to acknowledge the courtesy of those who furnished us with illustrations for use in the text, and our indebtedness to Dr. Gardner Hopkins and Professor Francis Carter Wood for a number of the photomicrographs taken especially for this work.

P. H. HISS, JR.
H. ZINSSER

Color Plates

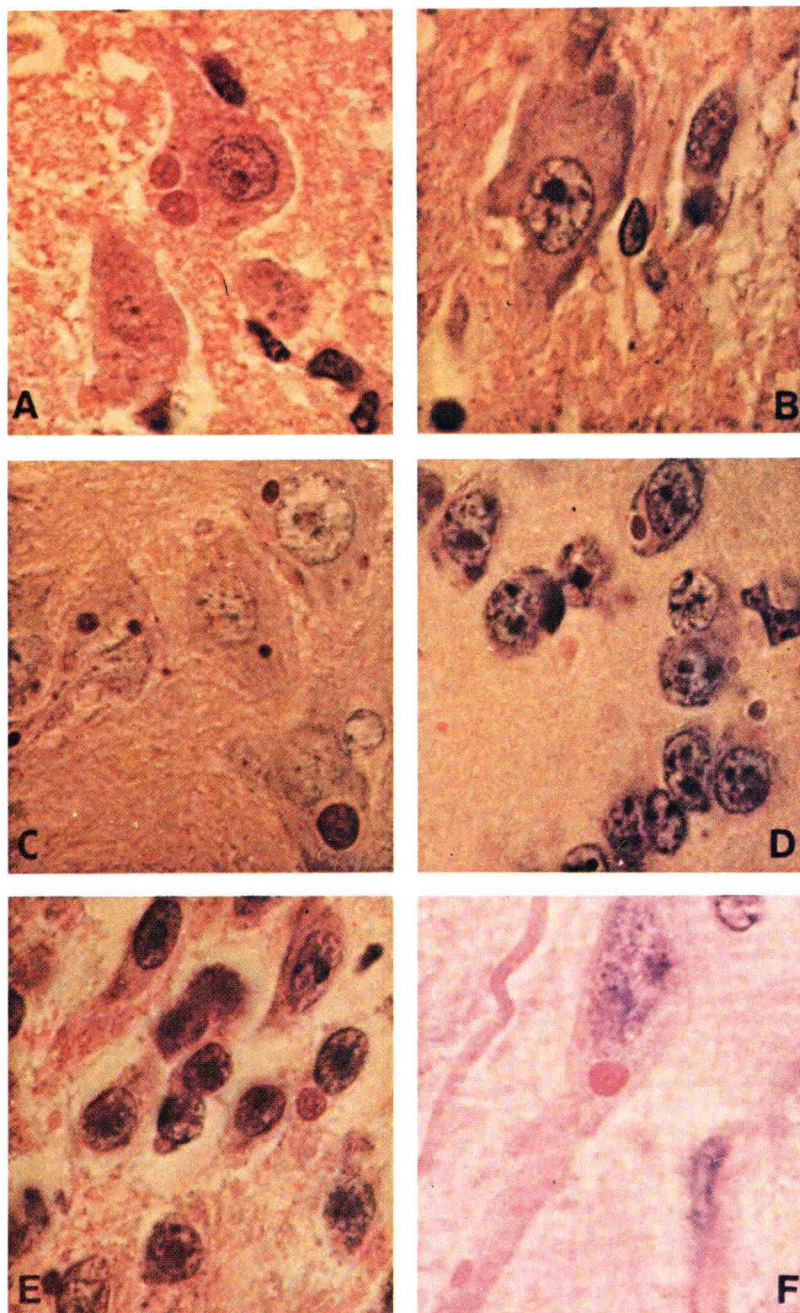


PLATE I. Negri bodies are shown here as the round eosinophilic cytoplasmic inclusions in brain cells from a variety of animals. A, Human; B, Cat; C, Dog; D, Mouse; E, Bovine; F, Fox. All sections are magnified approximately 1000–1400 \times . (From Atanasiu P, Sisman J: In Baer GM (ed): *The Natural History of Rabies*, Vol 1. Academic, New York, 1975, p 374.)

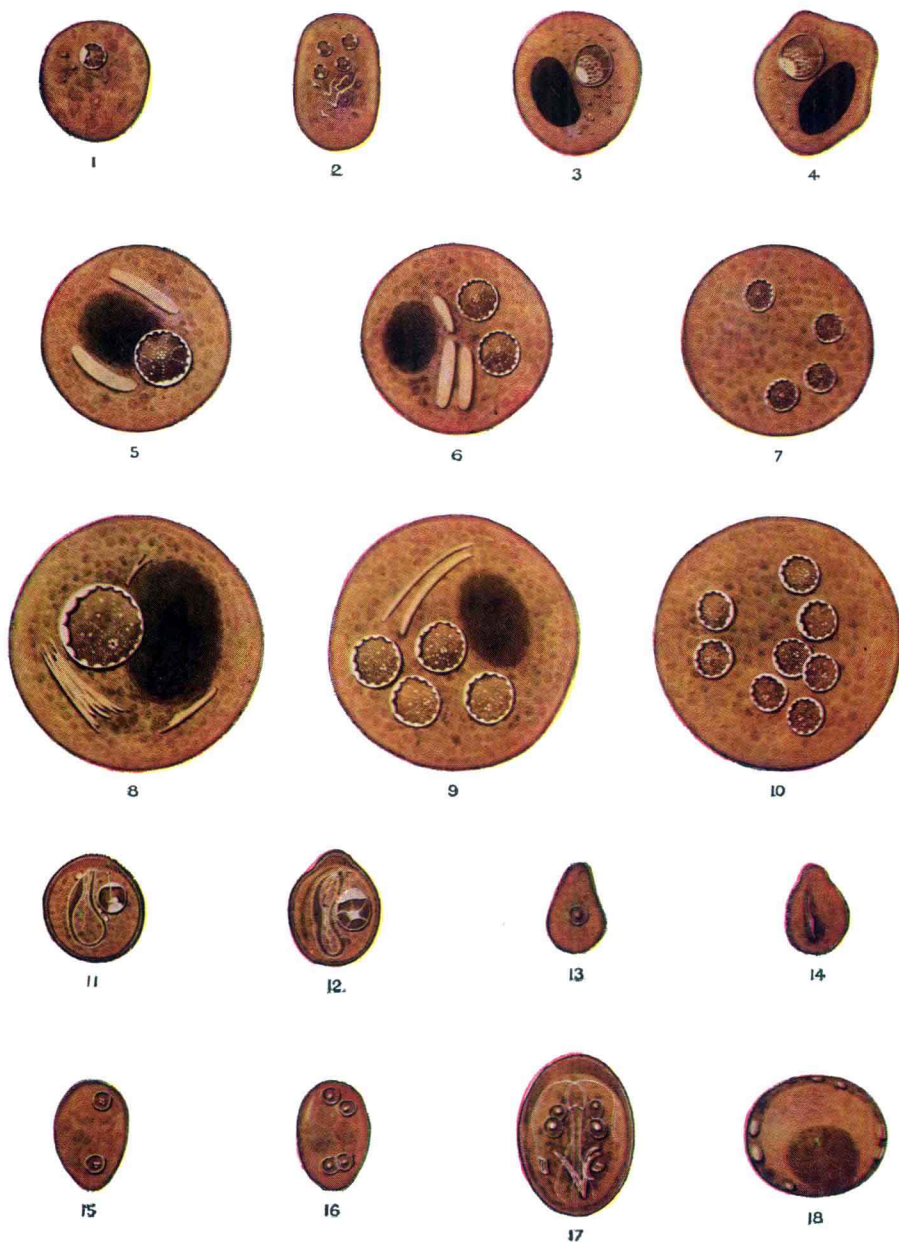


PLATE II. Cysts of intestinal protozoa treated with iodine. $\times 2000$. 1 and 2, *Endolimax nana*; 3 and 4, *Iodamoeba bütschlii*; 5, 6, and 7, *Entamoeba histolytica*; 8, 9, and 10, *Entamoeba coli*; 11 and 12, *Chilomastix mesnili*; 13 and 14, *Embadomonas intestinalis*; 15 and 16, *Enteromonas hominis*; 17, *Giardia lamblia*; 18, *Blastocystis hominis*, a yeast resembling a protozoan cyst. (From Belding: Textbook of Clinical Parasitology, 2nd ed, Appleton-Century-Crofts.)

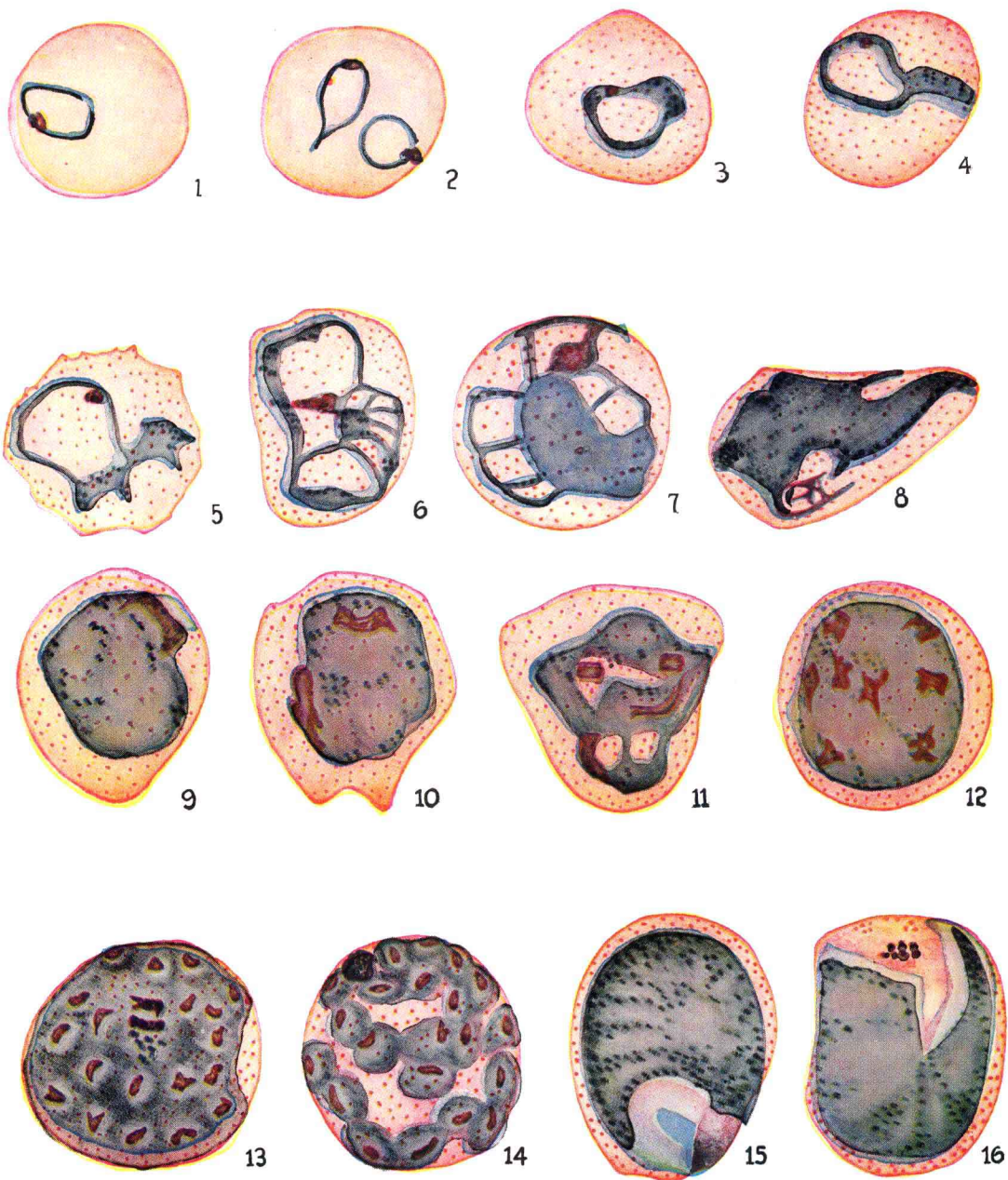
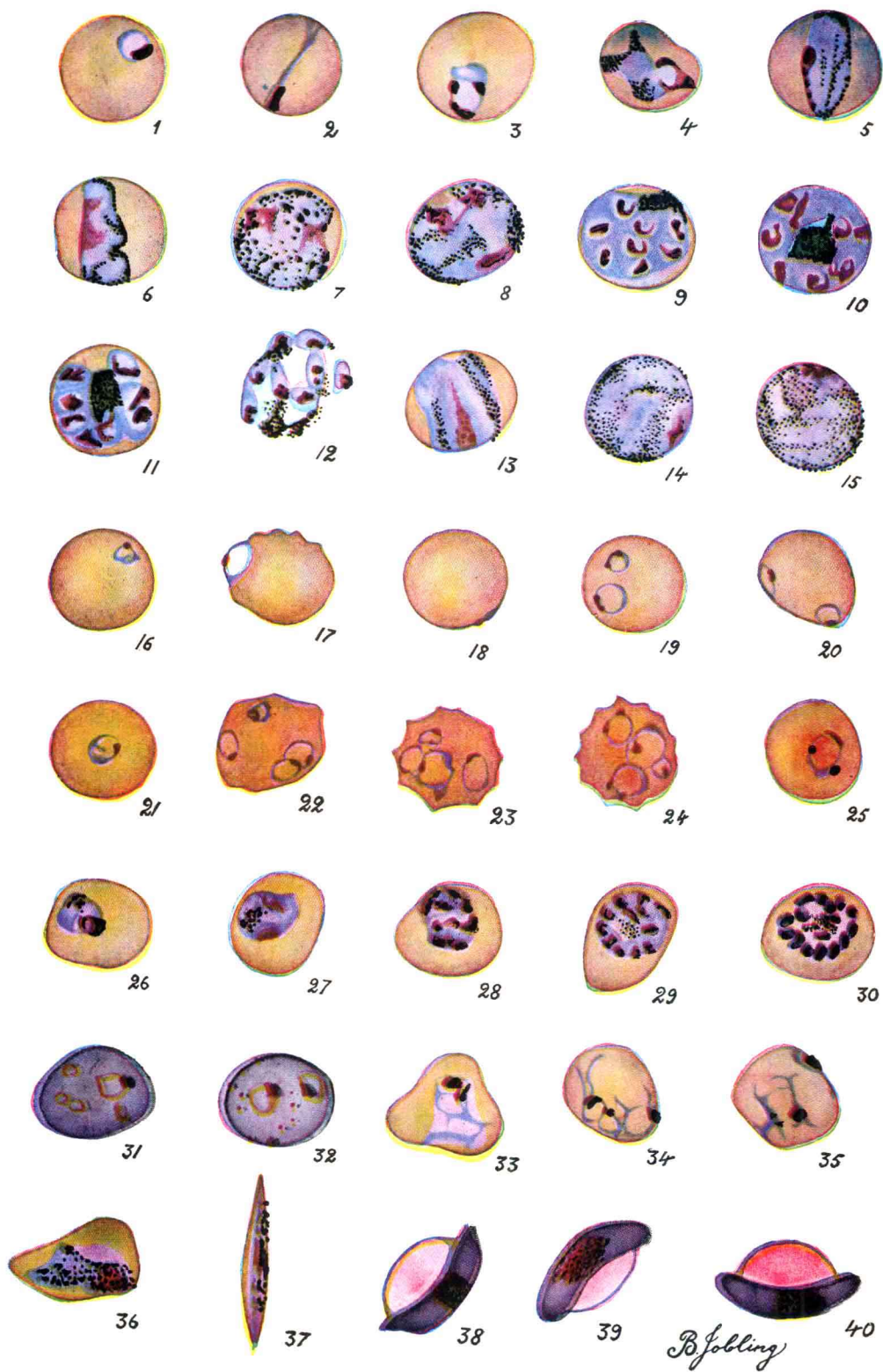


PLATE III. *Plasmodium vivax*. Sexual and asexual developmental forms of the parasite within the red cells of man from a case of benign tertian malaria, as seen in dried blood films stained with Romanovsky stain. Approx. $\times 3200$. 1 and 2, ring forms; 3-9, growth of trophozoite, enlargement and change in red cell, formation of Schüffner's dots, and deposition of pigment in cytoplasm of parasite; 10-14, growth of schizont; 15, female gametocyte (macrogametocyte); 16, male gametocyte (microgametocyte). (From Belding: Textbook of Clinical Parasitology, 2nd ed, Appleton-Century-Crofts.)



[See reverse side for explanation.]

PLATE IV. Plasmodium malariae (1-15) and *Plasmodium falciparum* (16-40) as seen in dried blood films stained with Leishman stain. $\times 2,000$. *Plasmodium malariae*: 1, young ring form; 2, young band form; 3, slightly older parasite with granule of pigment; 4-6, growth of trophozoite; 7-12, development of schizont; 13, older band form of nearly mature gametocyte; 14, female gametocyte (macrogametocyte); 15, male gametocyte (microgametocyte). *Plasmodium falciparum*: 16-24, ring forms; 25 and 26, growth of trophozoite and development of pigment; these forms usually occur in the internal organs, but are occasionally seen in the peripheral blood; 27-30, development of schizont; these forms occur rarely in the peripheral blood; 31 and 32, deeply stained cells containing ring forms and showing Stephens' and Christopher's or Maurer's dots on the surface of the cell; 33-35, irregular or ameboid young forms, showing tendency to fusion of one or more parasites ("*Plasmodium tenue*" of Stephens); 36 and 37, developing gametocytes, 38 and 40, female gametocytes (macrogametocytes) showing remains of host cell; 39, male gametocyte (microgametocyte). (From Wenyon: Protozoology, London, Baillière, Tindall and Cox, 1926. This plate was made from the original drawing now in the Museum of Medical Science, Wellcome Research Institution, obtained through the courtesy of Professor Wenyon and the Publishers. From Belding. Textbook of Clinical Parasitology, 2nd ed, Appleton-Century-Crofts.)

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