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TEXTBOOK OF MEDICAL
MICROBIOLOGY AND
PARASITOLOGY

医学微生物学 与寄生虫学

Original Editors

- Kenneth J. Ryan C. George Ray
- Geo. F. Brooks Janet S. Butel Stephen A. Morse

Chief Editors of Adaptation Edition

Wang Shiping (汪世平)

Ye Siying (叶嗣颖)

 科学出版社
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Chengdu Medical College, Wenzhou Medical College, the editorial board members being engaged in an office, hospital or working foundation of the book, we consider you also a good candidate for the foreign edition. Based on *Journal of Microbiology and Immunology of original conditions* by the M.C. University of Science and Technology, Chengde. Because of the rapid development of microbiology concern in the world, it is necessary to publish a book by far the most comprehensive and up-to-date control and surveillance of the disease. We have used our best to make the book meet the standard for the cultivation of high-level personnel and to satisfy a satisfactory standard of teaching in English. Also, with a bold engagement and accept, we have broken through the structure of the original books and arranged fifty-four chapters which compose seven parts, namely, Fundamentals of Microbiology and Immunology, Bacteriology, Virology, My-

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Preface for Adaptation Edition

With the development of the structural reform of our higher education, the innovation of medical education has been in progress. In order to meet the need of training higher-rank medical professionals of the twenty-first century, bilingual or all-in-English teaching to the graduate, undergraduate, long-term program (seven- or eight-year program) students as well as foreign students has been carried out in our country. However, a standardized and unified bilingual or English-edition textbook is still lacking, and yet an original foreign textbook may not be suited to the actual state of our medical education. It is therefore urgent to compile an English-edition textbook that can meet the demand of our teaching syllabi and conform to the actual situation in our country.

With the support of the related department of Ministry of Education, a series of bilingual textbooks of medical sciences have been put out for the first time in our country jointly by the Science Press, PRC, and the McGraw-Hill Companies, Inc., USA. This book is one of them. The contributors of this book include sixty-odd experts and professors from more than thirty celebrated institutions of higher education nationwide, including Peking University, Peking Union Medical College, Fudan University, Central South University, Huazhong University of Science and Technology, Wuhan University, Sun Yat-sen University, Jinan University (in Guangzhou), Xi'an Jiaotong University, Shanghai Jiaotong University, Sichuan University, Shandong University, China Medical University, Capital University of Medical Sciences, Nanjing Medical University, the Second Military Medical University, the Third Military Medical University, the Fourth Military Medical University, Zhengzhou University, Nanhua University, Soochow University, Dali University, Jishou University, Dalian Medical University, Anhui Medical University, Shanxi Medical University, Chengdu Medical College, Wenzhou Medical College, Guiyang Medical College, Ningxia Medical College, etc. The majority of the editorial board members have experienced in being engaged in advanced studies abroad or working overseas. They have not only a solid foundation of professional knowledge but also a good skill in English writing. In addition, they are also well experienced in teaching in the forefront of their own professional work. Based on *Jawetz, Melnick, & Adelberg's Medical Microbiology* and *Sherris Medical Microbiology* of original edition published by the McGraw-Hill Companies, Inc., an adaptation is made in consideration of the actual conditions of medical education in our country. Because of the insufficiency of the parasitology content in these original foreign textbooks that is by far hard to meet the need of the control and treatment of parasitic diseases, contributors who are responsible for the parasitology part have expended more painstaking work to the improvement of this book. We have tried our best to make this book meet the standard for the cultivation of high-rank personnel and embody a satisfactory standard of teaching in English. Also, with a bold exploration and attempt, we have broken through the structure of the original books and arranged fifty-four chapters which compose seven parts, namely, Fundamentals of Microbiology and Parasitology, Bacteriology, Virology, My-

cology, Protozoology, Helminthology, and Arthropodology. Such arrangement can not only meet the need of the pathogen biology teaching which takes microbiology and parasitology as a whole, but also give a consideration to that the two subjects are taught separately in some universities and colleges. This textbook is designed to meet the demand of bilingual teaching to the seven- or eight-year program students, the graduate students as well as foreign students majoring in basic medicine, clinical medicine, preventive medicine, biological medicine, stomatology, forensic medicine, nursing, pharmacology, medical laboratory science, etc.

We are indebted to Prof. Wu Guanling, a doctoral student advisor of Nanjing Medical University; and Florian Rubelt, for revising the manuscript and giving valuable advice. We wish especially to acknowledge our graduate students of Department of Pathogen Biology, Central South University Xiangya School of Medicine, including associate professors Dai Gan, Yao Menghui, Li Zhengming; lecturer Li Wenkai; Drs. Xu Shaorui, Lü Zhiyue, Yu Junlong, He Zhuo, Zhu Cuiming, Li Zhongyu, Wu Xiang, Zeng Shaohua, Xiao Xiaoqin, Zhu Ping'an; masters Wu Shiyun, Peng Xianchu, Jiang Xiaoxin, Zhou Songhua, Liu Fen, Cai Shenglan, Zhang Jiayang, etc., for their painstaking work contributed to preparing meetings, editing and proofreading manuscripts. We also wish to express our appreciation to persons in charge of the Science Press and the McGraw-Hill Companies, Inc., for their support and work that make this book published. From the first compiling meeting to the publication of this book, there is only half a year for us to finish all the work. Because of the time limit, and the difficulty to coordinate and balance the manuscripts from so large a number of authors and institutions as well as the limitation of our capacity to compile a book, imperfections are hardly avoidable in this book. We therefore hope that the users of this book will give a timely feedback to wsp2355118@yahoo.com.cn so that we will be able to make an improvement in the next edition.

Wang Shipin, Ye Siying

January 10, 2006

改编版前言

随着我国高等教育体制改革的发展,我国医学教育教学改革正在不断的深入。为了满足 21 世纪高层次医药卫生专业人才培养的需要,我国高等院校对本科生和长学制(七年制、八年制)医学生以及留学生、研究生等开展了双语或英语教学。但是,国内缺乏较为规范、统一的双语或英语教材,国外原版教材又难以适应我国高等教育医学教学的实际情况。因此,迫切需要一套符合我国教学大纲要求,并适合中国国情的医学英文版教材。

在教育部主管部门的支持下,科学出版社与美国麦格劳-希尔教育出版公司联合,首次在国内推出这套医学英文原版双语教材,本教材属于该系列教材之一。来自全国 30 余所知名高校包括北京大学、中国协和医科大学、复旦大学、中南大学、华中科技大学、武汉大学、中山大学、暨南大学、西安交通大学、上海交通大学、四川大学、山东大学、中国医科大学、首都医科大学、南京医科大学、第二军医大学、第三军医大学、第四军医大学、郑州大学、南华大学、苏州大学、大理学院、吉首大学、大连医科大学、安徽医科大学、山西医科大学、成都医学院、温州医学院、贵阳医学院、宁夏医学院等 60 多位专家教授参与了本教材的编写。大多数编委都有国外进修、工作的经历,他们既有扎实的专业知识,又有较好的英文写作能力,同时还具有在一线从事本专业教学的丰富经验。本教材以美国麦格劳-希尔教育出版公司出版并授权的 *Jawetz, Melnick, & Adelberg's Medical Microbiology* 和 *Sherris Medical Microbiology* 原版教材为蓝本,结合国内医学教学的实际情况加以改编。由于原版教材中涉及医学寄生虫学部分的内容远远不能满足国内寄生虫病流行与防治的实际情况,因此,担任寄生虫学部分的编写人员为原版书的补充和完善付出了更多的辛劳。本教材的编写力求符合高层次人才培养的目标,体现英文教学的水平,大胆探索、尝试、突破原版教材的编写框架结构。全书包括总论、细菌学、病毒学、真菌学、原虫学、蠕虫学和节肢动物学七大部分,共 54 章。本书编排结构的特点是既可满足病原生物学科作为一个整体进行教学活动时合并用书的需要,同时又兼顾目

前部分院校微生物学与寄生虫学分离教学、单独用书的实际情况。本书适用于基础医学、临床医学、预防医学、生物医学、口腔医学、法医学、护理学、药学、检验等专业七、八年制学生以及留学生、研究生使用。

承蒙南京医科大学博士生导师吴观陵教授和 Dr. Florian Rubelt 审阅书稿并提出宝贵的修改意见。值得一提的是,为了本书的出版,中南大学湘雅医学院病原生物学系研究生(戴橄副教授、姚孟辉副教授、李争鸣副教授、李文凯讲师、徐绍锐博士、吕志跃博士、余俊龙博士、何卓博士、朱翠明博士、李忠玉博士、吴翔博士、曾少华博士、肖小芹博士、朱平安博士、吴仕筠硕士、彭先楚硕士、姜孝新硕士、周松华硕士、刘芬硕士、蔡胜蓝硕士、张加祥硕士等)在筹备编委会议、定稿会以及书稿的统稿、图表编排、清样校对等方面付出了辛勤的劳动。此外,科学出版社和美国麦格劳-希尔教育出版公司的负责人等为本书的出版不辞辛苦奔波、操劳,对此一并致以衷心的感谢。本书从召开编写会议到付梓出版仅半年时间,因参加编写的单位和人员较多,加上受我们的编写水平和能力以及出版时间等因素的限制,书中避免不了错误和欠妥之处,恳请广大师生在使用本教材的过程中,及时将发现的问题反馈给我们,以便今后修订再版时加以更正和完善,我们将十分感激(联系方式为: wsp2355118@yahoo.com.cn)。

汪世平 叶嗣颖

2006年1月10日

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Part I Fundamentals of Microbiology and Parasitology

Chapter 1 Introduction

Cameron (1956) stated "all infectious agents—bacteria, viruses, fungi, protozoa, helminthes and arthropods—are parasites" and the population biologists Anderson and May (1979) suggested the following subdivision of parasites: **Microparasites** are small size of parasites involving viruses, bacteria, fungal and protozoan pathogens, which multiply rapidly within the host and have a short generation time; **Macroparasites** are referred to large parasites including parasitic helminthes and arthropods, which usually do not multiply in the definitive host, and have a comparatively long generation time and are spread by direct or indirect transmission. In fact, before the mid-19th century, the division of bacteria, viruses and protozoa were not clear and the first "microbe", by which the term microbiology was defined, to be associated with a specific clinical condition was a parasitic worm—the nematode *Trichinella spiralis*, whose larval stage is just visible to the naked eye and needs to certainly be identified through microscopy. However traditionally, scientific field recognize that it is appropriate to classify bacteria, fungi and viruses as the elements of microbiology and parasitology is the scientific study of parasitic protozoa, helminthes, certain lesser groups of worms, parasitic arthropods and the vectors of parasites. That is, microbiology and parasitology have so far been internationally recognized as two disciplines in modern biomedicine and two curricula in medical education.

Since 1997, the **microbiology** and **parasitology** have been integrated into a compulsive curriculum in medical education in China based on the understanding that all parasites share the basic principles of parasitism. This integration is logically and scien-

tifically reasonable and acceptable and this textbook will cover viruses, bacteria (also included in this category are mycoplasma, chlamydiae, rickettsia, spirochaeta and actinomyces), fungi, protozoa, helminthes and arthropods but under microbiology and parasitology, which are largely an amalgamation of virology, bacteriology, mycology, protozoology, helminthology and entomology.

Medical microbiology and parasitology usually comprises part of preventive medicine and are also considered the important foundation of the clinical infectious or communicable disease and public health sciences, which studying the biological causes to human diseases. The contents include the biological features of pathogenic organisms, the relationships between pathogenic parasites and hosts and their environment, the pathogenic factors and the related pathogenesis, the laboratory diagnosis, the transmission and prevalence, and the prevention and control of the diseases infected with pathogenic organisms mentioned above.

Each pathogenic organism has its own classification system, if listed in order of their sizes and structural complexity. With the exception of virus, they can be roughly divided into 4 kingdoms: Eubacteria, Fungi, Protista and Animalia. Species is a fundamental unit in the biological classification system. Each pathogen organism is named, according to the rules of the Linnaeus binomial nomenclature, in Latin, with the genus name given first, followed by the species name. The genus name should be in its nominative form, and the species name in the possessive, e. g. *Entamoeba histolytica* Schaudinn. 1903.

SECTION 1 GENERAL PRINCIPLES

The relationships between living beings are complicated due to long term evolution. Symbiotic associations were showed between different living things with the biological evolution of parasitism. All living animals are used as habitats by other organisms; no animal, however simple, is exempt from such invasion—even protozoa have their own flora and fauna. All associations in which one species lives in or on the body of another can be grouped under a single heading—‘**symbiosis**’ (literally ‘living together’). This term has no overtones of benefit or harm, but includes a wide diversity of associations. Three broad categories, based on the relative degrees of benefit obtained by each partner from the association, can conveniently be identified: commensalism, mutualism and parasitism.

Commensalism, from the Latin for ‘eating at the same table’ denotes an association which is beneficial to one partner and at least not disadvantageous to the other. At its simplest, a commensal association is one in which one species of organism uses the body of a larger species as its physical environment, and may make use of that environment to acquire nutrient materials. The normal definition of commensalism is one of convenience only; clearly the association can grade into either mutualism or parasitism. **Mutualism** is characterized by reciprocal benefit between the two organisms involved. Frequently the relationship is obligatory for at least one member, and it may be so for both. **Parasitism** is the most medically important symbiosis. Parasitism exists from the early stage of the co-evolution of the living beings, but this relationship is not always invariable. Parasitism as a way of life may be the only possibility for a given organism, or it may be but one alternative.

SECTION 2 PARASITISM, PARASITE AND HOST

I . PARASITISM

Parasitism is such a symbiotic relationship in which one animal, the host, is to some degree injured through the activities of the other animal, the parasite, stating that the relationship is not only one-sided in its benefits to the parasite, but is also

positively harmful to the host. i. e. The classical definition of parasitism involves two factors: parasite and host. Among the symbiotic partners, the one which benefits from the other is a **parasite**, while the one which is harmed by the parasite is a **host**. It is proved that the symbiosis derived from the occasional contact between different living things, and adaptation was subsequently achieved and hence the symbiosis. The balance between parasite and host is a result of selective adaptation through long-term co-evolution.

II . PARASITE

In the relationship known as parasitism, the partner gains benefit, always smaller, is the **parasite** that to some degree injures its partner and the other to be injured at the same time is known as the *host*. Certainly parasites do benefit from the associations, being provided with their physical-chemical environment, food, respiratory and other metabolic needs and, often, the signals that regulate their developmental cycles. Equally, many parasites are certainly harmful to their hosts. It is needed to emphasize that ‘harmfulness’ is a necessary characteristic of a parasite but, in fact, many ‘parasites’ establish quite innocuous associations with their natural hosts and are not at all pathogenic under normal circumstances (i. e. in their natural host when this is in good health). However, the term ‘*parasite*’ should be scientifically defined as a weaker or smaller *invertebrate* animal that obtains food and shelter from the other, the *host*, who is injured at the same time but do not be killed immediately by the parasite.

Parasites may be classified according to different ways. Ecologically, a parasite which cannot survive in any other manner is so called an **obligate parasite**. A **facultative parasite** is an organism which may exist in a free-living state or as a commensal and which if opportunity presents itself may become parasitic. It is implicit in this term that the organism does not necessarily have to be a parasite at any stage of its existence. Some animals are obligatory parasites at one or more stages of their life cycles but free-living at others; Parasites living within the host may be distinguished as **endoparasites**, while those which are found upon the surface of the body are called **ectoparasites**; Parasites may also be called **permanent** or **intermittent** ones according to the duration of parasitism, or they may be accidental or opportunistic by chance or condition available; how-