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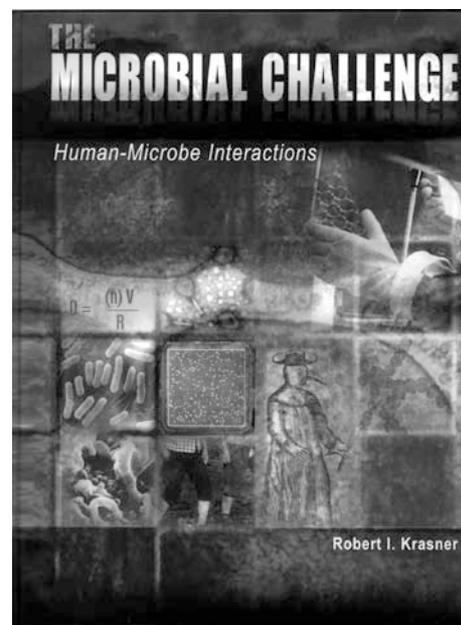
Robert I. Krasner: The microbial challenge. Human–microbe interactions

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In his article “Planet of Bacteria”, the American paleontologist Stephen Jay Gould (1941–2002) recognized the wrong that paleontology had made to the tiniest creatures living on Earth [2]. He recalled how, in his youth, he was enthralled by books devoted to the history of life. And how the fossil record used to be divided invariantly “into a series of ‘ages’ representing the progress that supposedly marked the march of evolution: the ‘Age of Invertebrates’, followed by the Age of Fishes, Reptiles, Mammals and, finally, with the parochiality of the engendered language then current, the ‘Age of Man’.” Gould, who usually wrote about organisms other than bacteria, may have wanted to compensate prokaryotes with that article, which is a celebration of bacterial life. According to him, not only do we now live in the “Age of Bacteria”, but the whole history of the planet could be regarded as the “Age of Bacteria”. He considered several elements of bacterial life that, each one individually, could lead to that conclusion: time (bacteria have lived on Earth at least since 3.5–3.6 billion years ago, and were its only inhabitants until about 1.8–1.9 billion years ago); diversity (bacteria have the highest metabolic, ecophysiological diversity among all living beings); ubiquity (bacteria can grow wherever the existence of life is possible, sometimes under conditions unsuitable for any other kind of organisms); utility for the rest of life (bacteria made the atmosphere as it is today; they close the nitrogen cycle, recovering this element from the atmosphere; they—along with fungi are the main reducers of organic matter; they—help the “superior” organisms to digest and adsorb food properly); biomass (total bacterial biomass may exceed that of all the rest of life combined).

Like Monsieur Jourdain, the character in Molière’s *Le bourgeois gentilhomme* that spoke in prose while unaware of such a capability, humans have always been in contact with microbes, harnessing them for their own



benefit, suffering diseases caused by them, or just living together in neutral associations with them, without knowing. Robert Hooke (1635–1703) was the first to explore and illustrate the microbial world in *Micrographia* (1660), a book which is a landmark in both biology and art. However, his Dutch contemporary, Antony van Leeuwenhoek (1632–1723), was the first to see and describe microorganisms—which he called “animalcules”—in any detail. These discoveries laid the foundations for the development—in the second half of the nineteenth century—of microbiology as a scientific discipline aimed mainly at the study of microorganisms as agents of disease [4]. *Bacillus anthracis*, the etiological agent of anthrax, has been the source of current concern because of its potential as a biological weapon and has greatly impacted the development of microbiology as a subdiscipline of medicine. Humans have been familiar with anthrax for more than 2,000 years; it could have been the fifth plague of Egypt described in the Bible, and

caused enormous domestic livestock losses in Europe from the seventeenth through the nineteenth century. Barthelemy demonstrated that healthy animals became infected by inoculation of blood from infected animals, and Delafond observed the anthrax bacillus microscopically. In addition, the relation between anthrax in animals and the disease known as “malignant pustule” was established. In 1877, Robert Koch proved conclusively the causal relationship between the large non-motile bacilli isolated from the blood of anthrax-infected animals and the disease they were suffering [3].

The study of microbial diseases is still a major discipline within microbiology; the challenge to defeat the relatively few microbial species that are disease producers has not yet reached an end. On the contrary, factors related to current trends in human societies, such as world population growth, ecological disturbances, jet travel and human migrations, misuse of antibiotics, and cultural and behavioral changes, have contributed to make this challenge even more difficult. New, emerging, and reemerging infections, and the threat of biological weapons are major global public concerns. *The microbial challenge* deals mostly with these aspects of microbiology.

The book is divided into three sections, which are clearly and logically structured. “The challenge” (Chaps. 1–10) is the longest section and provides the necessary background to understand the rest of the book. Chapter 1 (Identifying the challenge) discusses why microbial diseases, which 30 or 40 years ago were thought to soon become under control, are still the leading cause of death worldwide. Chapter 2 (The microbial world) introduces the basic principles needed to understand what a microorganism is, and describes the major characteristics of the five existing microbial groups (six, if you consider separately Archaea and Bacteria). Chapter 3 (The beneficial aspects of microbes: the other side of the coin) makes it clear that many microorganisms are not only beneficial to humans and to other animals, but even necessary. Chapters 4 (Bacteria) and 5 (Viruses) describe the main characteristic of these groups to introduce then, in Chaps. 6–9 (Concepts of microbial disease, The epidemiology and cycle of microbial disease, Bacterial disease, and Viral disease), the mechanisms of the diseases they cause. Chapter 10 (Protozoans and helminths and the diseases they cause) deals with eukaryotic organisms, including protozoa and helminths, as agents of disease (mycoses, however, are not discussed in the book). The second section (“Meeting the challenge”) discusses the approaches to fighting microbial disease: individually (Chap. 11, The immune response); in the population, by means of sanitation and hygiene, food and water safety, immunization, and antibiotics (Chap. 12, Control of microbial disease); and as a global endeavor in which all countries should be involved (Chap. 13, Partnerships in the control of infectious diseases). The third section (“Current challenges”) provides historical overviews to better understand the topics

discussed: biological warfare (Chap. 14, Biological weapons) and large-scale outbreaks of disease (Chap. 15, Current “plagues”). Chapter 16 (The unfinished agenda) is a reflection on the general theme of the book.

A major current issue is the emergence of biological terrorism, especially with the anthrax attacks after the events of September 11, 2001. The author describes how on September 11, 2001, after having seen the attacks on the World Trade Center, New York, on TV, he understood that Chap. 14 of this book, which he had already written, would have to be updated, as he later did. Although biological weapons are not an invention of modern societies, it was not until 1925 that the first international agreement against biological warfare—the Geneva Protocol—was signed. Since then, there have been other key regulations, laws, and international treaties restricting the production and use of biological weapons. However, *Bacillus anthracis* and other microorganisms that could be employed in biological warfare are widely available; microbiologists can obtain them from resources other than public microbial collections. In the case of *B. anthracis*, it can even be isolated from soils or infected animals (the spores are very resistant and are viable for many years) [1].

The aim of Robert I. Krasner when he wrote this book was to produce a textbook for undergraduate courses. He used several tools to engage his target audience: abundant figures and photographs (many of the photos were taken by the author himself); boxes with supplementary information; author’s notes, with short accounts of personal experience or opinion; and self-evaluation questions at the end of each chapter. All of these features make the book attractive also to lay people with an interest in medical microbiology, especially with its modern challenges. The author ends the book quoting an inscription on an outside wall at Harvard University School of Public Health: “The highest attainable standard of health is one of the fundamental rights of every human being”. He adds his own comment on the inscription: “I have walked by this inscription at least a few hundred times, but each time is like the first time; my eyes, my mind, and my emotions focus on these words; they continue to inspire me.” They have surely inspired him to write this book.

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