Infectious Disease Dynamics

Infectious Diseases of Humans: Dynamics and Control, by Roy M. Anderson and Robert M. May, 757 pp, with illus, $95, ISBN 0-19-854599-1, New York, NY, Oxford University Press, 1991.

This long and important book summarizes the results of nearly a decade and a half of collaboration between two of the world's best analysts of infectious diseases and alludes to related work by many others. The authors are Roy M. Anderson, FRS, of Imperial College, University of London, and Robert M. May, FRS and Foreign Member of the US National Academy of Sciences, of the University of Oxford.

The authors write, "The primary aim of this book is to show how simple mathematical models of the transmission of infectious agents within human communities can help to interpret observed epidemiological trends, to guide the collection of data towards further understanding, and to design programmes for the control of infection and disease. Our major goal is further understanding of the interplay between the variables that determine the course of infection within an individual, and the variables that control the pattern of infection within communities of people."

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Infectious agents are divided into two major types, microparasites and macroparasites. These types are defined operationally in terms of simple mathematical models. A microparasite is "an organism whose population biology can to a sensible first approximation be described by [a] compartmental model" that divides the host population into a few classes of individuals, such as susceptible, latent, infectious, and immune. According to Anderson and May, such models are most appropriate for "those parasites which have direct reproduction—usually at very high rates—within the host. They tend to be characterized by small size and a short generation time." Typical microparasites are most viruses and bacteria and some protozoa.

By contrast, "our definition of a macroparasite is one whose population biology requires . . . a full description of the distribution of parasites among hosts." Models of macroparasites keep track of the number of hosts that harbor zero parasites, the number of hosts that harbor one parasite, the number of hosts that harbor two parasites, and so on. Such models are viewed as most appropriate for parasites that have no direct reproduction within the definitive host. "This category embraces most parasitic helminths and arthropods. Macroparasites are typically larger and have much longer generation times than microparasites. . . . Macroparasitic infections are typically of a persistent nature, with hosts being continually reinfected" (p 15).

Anderson and May emphasize that this dichotomy between microparasites and macroparasites is an idealization, and show how it can be adapted to important cases, such as malaria, that do not neatly conform to it. They develop numerous specific models and compare the predictions of some models with quantitative data. They attain insights into the statics and dynamics of endemic and epidemic infectious diseases that are attainable only by using simple mathematical models and quantitative data. For example, they interpret why smallpox yielded to, and malaria resisted, a strategy of global eradication. This book displays the courage to think simply and to compare the consequences of precise thought with reality. This brave spirit is a major contribution to the study of infectious diseases.

Infectious Diseases of Humans focuses on the internal workings of infectious diseases in populations. The external relations of infectious diseases to economic development and agriculture, for example, receive hardly any attention. The authors claim that "Mathematical details are kept to a minimum, and the book is directed towards epidemiologists, public health workers, parasitologists, and ecologists." Nonetheless, the reader should be prepared to cope with thickets of mathematical equations (nothing beyond partial differential equations, however). The book does not aspire to be an encyclopedia of infectious diseases. Chagas' disease and tuberculosis, for example, are nowhere mentioned. Instead, general approaches are developed that may be applicable to these and other diseases. Applying the proposed models and methods to diseases not covered here remains a task for the future.

As for the future, Sir Macfarlane Burnet, Nobel Laureate, and David O. White end the fourth (1972) edition of their classic *Natural History of Infectious Disease* with the following prognosis:

> On the basis of what has happened in the last thirty years, can we forecast any likely developments for the '70s? If for the present we retain a basic optimism and assume no major catastrophes occur and that any wars are kept at the "brush fire" level, the most likely forecast about the future of infectious disease is that it will be very dull. There may be some wholly unexpected emergence of a new and dangerous infectious disease, but nothing of the sort has marked the last fifty years. There have been isolated outbreaks of fatal infections derived from exotic animals as in the instance of the laboratory workers struck down with the Marburg virus from African monkeys and the cases of severe haemorrhagic fever due to Lassa virus infection in Nigeria. Similar episodes will doubtless occur in the future but they will presumably be safely contained.

In an intriguing section on parasites and the population biology of humans, Anderson and May note that "the problem of 'where the AIDS virus came from' is not a new one; most of the microparasitic infections of childhood have appeared in human populations only in the last 10 000 years or so, which is a blink of an eye in evolutionary time."

A recurrent theme of the book is that large host population size permits the establishment of infectious agents that could not become established in smaller host populations. As the human population surges toward 10 billion, the most likely forecast about the practical and intellectual future of infectious disease is that it will be the opposite of very dull.

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Neural Science

Principles of Neural Science, edited by Eric R. Kandel, James H. Schwartz, and Thomas M. Jessell, 3rd ed, 1135 pp, with illus, $65, ISBN 0-444-01562-0, New York, NY, Elsevier, 1991.

This book has expanded in size through three editions but has maintained its preeminence as a leading text of neurobiology. I use the word "neurobiology" deliberately as it is often referred to as a neurophysiology text. It is not—it is much more. It is a textbook that tries to integrate biochemistry, physiology, and structure with function.

The preface gives the philosophical background of the book, namely, "to write a coherent introduction to the nervous system for a broad range of students of behavior, biology and medicine." I might add that it is also an excellent review of neurobiology for the practitioner who wants to keep up to date with the latest in basic science. The chapters are clearly written (despite multiple authors) and cross-referenced. The cartoons and diagrams are clearly labeled with comprehensive explanations nicely integrated with the text. The reader who has not been in a laboratory for 20 years will not be intimidated by