non elucidated gastrointestinal motility by being the first to apply x-rays to the study of digestion; he demonstrated the emotional production of adrenaline, following a line of research initiated by observing the effects of stress on gastrointestinal function; and, from his work on the emergency function of the adrenal medulla, he developed the more general concept of the "fight or flight" response. The major trends in his work are of course chronicled and the key experiments are summarized. But though peaks in Cannon's research are made visible and the connections between them sketched, by and large the style and rhythms of his workaday routine—his ways as an investigator—remain more obscure. In the final analysis, the reader gets a finer-grained image of Cannon functioning in the political arenas of science and in the domestic sphere than at work in his own laboratory.

The authors have combined a deep exploration of Cannon's exceptionally rich archive with their own sensitivity to historical interpretation to produce an important and fascinating book. They exercised prudent restraint in electing to end the present study in 1917, but one can hope that their collaboration will yield a companion volume on the remainder of Cannon's life.

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Early Epidemiology

Yellow Fever in the North. The Methods of Early Epidemiology. WILLIAM COLEMAN. University of Wisconsin Press, Madison, WI, 1987. xvi, 202 pp., illus. $49.50; paper, $17.50. Wisconsin Publications in the History of Science and Medicine, no. 6.

The importance of epidemiology in the understanding of disease is well recognized, but investigation of its history has been limited. The advent of the germ theory made causal agents the primary focus of research on communicable disease, obscuring earlier approaches, and historians, especially in recent years, have been more concerned with the social and political consequences of disease outbreaks than with the ideas governing the thinking of contemporary investigators of them. William Coleman's new book makes an important contribution to knowledge of the methods of epidemiology in the period before the development of the germ theory.

Coleman has chosen yellow fever as the vehicle for his analysis. Yellow fever offers insights into epidemiological thinking because it was a center of controversy in the first half of the 19th century. Observers disagreed not only on whether the disease was contagious but also on whether it was brought from outside into a community or was the product of the development of other local "fevers." These were not just matters for theorizing but issues with consequences for action. Sanitary and quarantine measures depended on what viewpoint was predominant.

To provide illumination about epidemiological method, Coleman leaves aside the large-scale epidemics of yellow fever in the Americas and the Caribbean, where medical demands often overwhelmed investigation, and concentrates instead on two small isolated outbreaks in the port towns of Saint-Nazaire in 1861 and Swansea in 1865.

The unusual northern European setting of these epidemics in Brittany and Wales and the limited numbers of cases made it possible for epidemiological investigators to trace exhaustively the contacts and activities of those stricken and to assess fully local environmental conditions. François Mélier, a prominent French hygienist and expert on crowd diseases, reported on the Saint-Nazaire outbreak and George Buchanan, a public health inspector of the Privy Council of Britain, on the Welsh one. In the central part of his book, Coleman examines closely the model reports of these two epidemiologists, giving the most extended discussion to Mélier and Saint-Nazaire. An earlier section on the investigation by a French commission of a larger outbreak of yellow fever in Gibraltar in 1828 provides the author with a baseline for determining the significance of the findings in the later epidemics.

As Coleman shows, Mélier and Buchanan established that yellow fever had been imported into the two communities by ships. It was not a product of local environmental conditions. The disease displayed both contagious and noncontagious attributes, and its spread could be checked by sanitary measures.

Coleman closes with a chapter "What was epidemiology?" that skillfully sums up his findings. Epidemiologists had developed a clear sense of themselves and their task by mid-century. Case tracing and thorough examination of environmental factors could lead to informed decisions on sanitary and preventive measures even when the causes and agents of transmission of disease were unknown. This book should stimulate other research into the subtleties and complexities of thinking about disease.

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Marine Mycology

The Biology of Marine Fungi. S. T. Moss, Ed. Cambridge University Press, New York, 1986. xii, 382 pp., illus. $49.50. From a symposium, Portsmouth, U.K., Aug. 1985.

This collection of papers provides a reasonably up-to-date summary of the state of the art in marine mycology. And art it does seem to be. A pervading plaint, one omitted from scarcely any paper, is how much is not known about marine fungi. There has been a distinct change of direction since the extensive descriptive works of Johnson and Sparrow (1961) and the Kohlmeyers (1979) established marine mycology as a legitimate field of research. Today, the emphasis is on physiology and nontraditional phylogenetic and taxonomic approaches. However, we appear to be in the early stages of this change, so early that even the methodology to be used is under serious question, and the interpretations are even more controversial. The opening chapter, by D. H. Jennings, starts off with criticism of how fungi have been grown—a seemingly elementary matter, but one that has not been given adequate thought in the context of the marine habitat and that may affect quite considerably the derived interpretations. Given this introduction, it is not surprising to find that many papers devote considerable space to delimiting the cultural and physiological parameters of fungi. Fortunately, this puts the work into perspective and the reader gets a sense of the complexity of marine studies and of how they differ from terrestrial or freshwater investigations.

The most useful chapters may be those that deal with the evaluation of methodology: Jennings on fungal growth in the sea; Newell, Fallon, and Miller on measuring fungal biomass (an account of different methods and their limitations); Molitoris and Schaumann on determining enzyme production; and Booth and Kenkel on the distribution of marine fungi. The various chapters on physiological aspects are of interest to students of yeasts, chytrids, ascomycetes, and "protistan" fungi such as the thraustochytrids and labyrinthulids. These last two groups receive attention in three chapters—by Moss, by Bahnweg and Jäckle, and by Findlay, Fell, Coleman, and Vestal—that offer excellent accounts of the phylogeny, taxonomy, and biochemistry of these ubiquitous but poorly understood marine organisms. Moss points out that even though thraustochytrids and labyrinthulids are probably not really members of the Mycota, only mycologists have studied them, and their presence in a volume on marine fungi is therefore justified. This sug-

gests that our knowledge of marine forms is heavily biased in the direction of what individual investigators find personally interesting and that, as the book implies, we need a new paradigm for marine studies that incorporates all kinds of studies on all kinds of eukaryotic microorganisms.

Another topic of general interest is the role of marine fungi (*sensu lato*) in pathogenicity and in nonpathogenic interactions. Porter notes that even though parasitic marine fungi have been found in various associations with many animals, it is likely that we know today only a fraction of the interactions that actually exist. As economically important food organisms come under intensive monoculture, fungal epidemics surely follow. Polglase, Alderman, and Richards continue on this theme, including in their discussion organisms of little-known taxonomic affinity that cause ravaging diseases of fish. Fungal interactions with plants are discussed by Molina and by Kingman and Evans. The former is concerned with an invasive fungal (oomycete) pathogen of the red alga *Chondrus crispus*. Even though the alga has been studied and utilized commercially for many years, this is the first report of that particular interaction; one wonders how many others are out there waiting for their first report. Likewise, virtually nothing had been known about the true nature of the *Pelvetia-Mycosphaerella* interaction described by Kingham and Evans. We still know little, but their chapter clearly defines the problem and the possible solutions.

Commercial interests are well served in the chapters by Miller on secondary metabolites and their potential importance, by Hyde, Jones, and Moss on mycelial adhesion, a topic of major value in light of the concept that microbial interactions must start with adhesion, by Mouzouras on timber decay, one of the time-honored and well-recognized roles of marine fungi, and by Eaton on wood preservation.

The more traditional areas of morphology and taxonomy are well represented by seven chapters on Ascomycotina. This fungal group is not only the dominant one in marine habitats (by current estimate), it lends itself more readily to taxonomic treatment than do many of the more loosely associated organisms discussed in this book. The extensive summary by G. Hughes on biogeography and marine fungi effectively demonstrates the immense amount of work that must be put into studies of the marine fungi. Overall, this volume, though unevenly written, contains chapters of interest to many different kinds of mycologists and should be read by other biologists as well. For too long now have marine fungi been studied *in vacuo* and virtually ignored by nonmycological marine biologists. These organisms need to be incorporated as equal members in marine microbiological investigations.

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Sensory Physiology

Visual Neuroscience. J. D. PETTIGREW, K. J. SANDERSON, and W. R. LEVICK, Eds. Cambridge University Press, New York, 1986. x, 448 pp., illus. $125. From a celebration, Lord Howe Island, Australia, 1983.

The papers in this volume were written by colleagues, students, and scientific friends of Peter Bishop, formerly professor of physiology at the John Curtin School of Medical Research at the Australian National University in Canberra. The papers are renditions in print of presentations at a meeting in honor of Bishop held on Lord Howe Island, a few hundred miles off the coast of Australia, in 1983. From all accounts this was an exceptional event, and the present book is an exceptionally fine tribute to a well-known visual neurophysiologist.

Bishop's approach to science has been to emphasize precision of measurement and painstaking experimentation. His strategy for building the Department of Physiology was to assemble the best electronic and mechanical instrumentation and give younger researchers autonomy to pursue their own questions about visual neurophysiology. The camaraderie of his group was maintained by daily meetings and injections of enthusiasm and support by Bishop. This strategy resulted in significant progress on two major subjects of present concern in visual neuroscience, the neural basis of binocular depth perception and the multiple, parallel representations of the visual world in the brain.

That single visual cortical neurons can signal the distance of an object in depth, on the basis of horizontal disparity of their receptive fields in the eyes, was a major discovery by John Pettigrew in Bishop's laboratory. The evolutionary, clinical, and theoretical significance of this discovery is the subject of some of the more lively papers in the book, those by Pettigrew, D. P. Crewther and S. G. Crewther, and J. I. Nelson. Pettigrew's paper is distinguished by its enthusiasm and pugnacity toward theoreticians although his facts are not always straight.

The exploration of the multiple representations of the visual world in the arrays of X, Y, and many other types of retinal ganglion cells, and their targets in the visual cortex, constitutes a major fraction of the book. This emphasis is appropriate, because the group working under Bishop provided some of the best early evidence of the importance of parallel processing in the retina and central visual pathway. Papers on this subject by W. R. Levick, B. G. Cleland, H. Wässle, J. Bullier, G. Henry, B. Dreher, and J. Kaas are all interesting and offer new ideas as well as useful reviews of past accomplishments. An intriguing new investigation by J. Stone and D. H. Rapaport of the development of the retina, using knowledge about the multiplicity of ganglion cell types, provides a fresh perspective on an old and interesting unsolved problem. The book's most interesting paper on parallel visual pathways, in my opinion, is that by W. Burke on pressure block of Y cells in the cat optic nerve. There is some hope that Burke may finally have found a way to knock out the Y cells selectively and thereby define their role in visual behavior by measuring visual perceptual losses.

The book ends with a section on integrative aspects, an area that Bishop personally avoided but encouraged others to explore. This section includes two papers on illusory contours: a psychologist's analysis of the perceptual phenomenon of seeing a border that has no physical reality outside one's head, by R. H. Day; and an account by E. Peterhans and colleagues of recent neurophysiological experiments on single neurons in the monkey visual cortex that can "see" illusory contours like those perceived by humans. This subject is being intensely studied now in many laboratories because it seems directly related to fundamental mechanisms of the perception of form. The two papers in this book are excellent starting points for learning about the mysteries of, as well as some of the explanations for, subjective contours.

One of the special features of this book is the inclusion of the human side of science. In addition to the summaries of Bishop's career, there are brief reminiscences by many of the authors about the time they spent in his laboratories, either in Canberra or earlier in Sydney. There is also a strong implicit pride among the Australian contributors in the growth of Australian science, as exemplified by the successes of Bishop and his group. Alongside of the group's scientific accomplishments, the book gives ample evidence of Bishop's role in training a generation of Australian scientists and in building a department that attracted to Australia scientists from the United States, Britain, Japan, France, Belgium, Switzerland, Poland, and