The standard doctrine that the only good fire was a dead fire was largely replaced — at least in the scientific community — by a perspective which sees fire as an essential ecological component of many ecosystems. This change in the scientific community paved the way for a change in federal fire policy to allow at least some fires to burn unhindered.

Reading Pyne's book gives one the sense that humans coevolved with wildfire, that we are, like the Lodgepole Pine, a fire-adapted species. Most human development and evolution took place in regions where periodic wildfires were the norm. Our dependence upon fire-adapted or fire-tolerant plant and animal communities caused humans to aid the expansion of fire's geographic influence by our propensity to set ignitions. Just as fire's natural geographic influence expands, so did the natural range of the human species. Without fire, would Ice Age hunters have ever pushed northward into Europe or cross the Bering Land Bridge? Reading Pyne, one begins to wonder if, along with the development of speech, and weapons, the partnership with fire might not also have been a major influence upon our present evolutionary course on earth.

Though such questions should be of interest to more than just those interested in fire history and ecology, this title is not likely to find its way to the best seller list. The book's completeness is also one of its major drawbacks. It takes quite a commitment of time to read and digest all the information presented. In addition, chapter organization is somewhat confusing. Each one is seemingly separate from the one before and after. As a result, there is often repetition of the same information in different chapters. However, this only becomes readily noticeable if one reads the book cover to cover in a single sitting.

Despite these minor shortcomings, Pyne's *Fire in America* is fascinating reading, not only for its completeness but the historical perspective it brings to today's land management issues. It deserves a reading by anyone interested in wildfire and its role, not only in natural history, but in human history as well.

GEORGE WUERTHNER

P.O. Box 273, Livingston, Montana 59047

Symbiosis: An Introduction to Biological Association

By Vernon Ahmadjian and Surindar Paracer. 1986. University Press of New England, Hanover, New Hampshire. 212 pp., illus. U.S. $32.50.

According to the authors, this book is primarily an introductory text designed for "students, instructors, and research workers who wish to learn more about symbiosis". I would argue that there is something here also for the naturalist. Seldom has the thesis that all living things are interconnected been so broadly and so cogently documented.

Symbiosis: An Introduction to Biological Associations has obviously been written from a conviction that the concept of symbiosis has not yet received due recognition as one of the unifying principles of biology. According to Ahmadjian and Paracer, "some of the greatest events in biological history, including the origin of the eukaryotic cell, as well as the most devastating diseases of mankind, are the results of symbiotic relationships".

The book is divided into thirteen chapters, the first of which opens with a most readable introduction. In it, the authors defend their preference for an inclusive definition of symbiosis, arguing that that is how the term was originally used by Anton de Bary, the German mycologist who coined it in 1879. To de Bary, a symbiotic association was not (as it is generally understood today) always one in which both partners benefit; rather it was simply a long-term living together of unlike organisms — without regard for the details of the relationship. As thus defined, symbiosis encompasses the entire spectrum of interspecific associations, from parasitism (one partner benefits at the expense of the other), through mutualism (both partners benefit), to commensalism (one partner benefits while the other is unaffected).

Such a broad definition allows the authors to range freely over every major branch of biology, there being no organism which does *not* enter into a symbiotic association of one kind or another. A simple listing of the major chapter heads reveals the breadth of this book: Viral Symbiotic Associations; Bacterial Associations; Symbiosis and the Origin of the Eukaryotic Cell; Fungal Associations; Protoctistan Symbiotic Associations; Helminthic Associations; Plant Symbiotic Associations; Behavioural and Social Symbioses; and, to round things out, Symbiosis and Evolution.

Each of the above topics is discussed in typical textbook fashion, with an emphasis on brevity, but usually with no corresponding loss of readability. Throughout the book, the chapters follow a standard format. After a brief introduction to the discipline in question, the authors present a

biological collage in which various symbiotic relationships are illustrated by specific examples. Closing each chapter is a summary of the main points discussed, followed by a suite of well-articulated review questions, and then followed again by a two-part bibliogrpahy — the first a list of recommended readings, and the second a listing of the more technical literature upon which the chapter was based.

Scattered throughout the book are a half dozen "box essays", in which the authors present, in popular fashion, various side themes of symbiosis. If these were intended to maintain reader interest, I can report that they work very well; perhaps space will be found in future editions to incorporate more of them.

One distracting feature of this book is the quite uneven levels of presentation. Getting through the chapter on viral symbiotic associations, for example, will probably be a real challenge for the amateur naturalist. On the other hand, the introduction to the chapter on fungal associations reads almost as a junior high school science text. Stylistic discrepancies can also be pointed out, though perhaps this is unavoidable in a team-written book of this kind.

Putting aside these small points of criticism, *Symbiosis: An Introduction to Biological Associations* is a fascinating read. Because the authors have undertaken to paint an enormous canvas, and because they paint from a perspective unfamiliar to most readers, the pictures they present are sure to amaze again and again. Did you know, for example, that:

- A heavy infestation of *Giardia* (Beaver Fever) can result in the production of more than 14 billion cysts per day?
- England's White Cliffs of Dover consist entirely of the fossil remains of foraminiferan amoebae?
- Trees infected with invading pathogens react by cordoning off the infected areas from the rest of the tree?
- Indian Pipe derives part of its nutrient requirements from trees through a sort of fungal straw?
- Three out of every four people on earth are infected with internal parasites?

Now that this book exists, I would not be without it. If only as a springboard to the vast and fascinating literature which surrounds one of the primary unifying principles of life, *Symbiosis: An Introduction to Biological Associations* is a valuable addition to any naturalist's library.

TREVOR GOWARD

Edgewood Blue, Box 131, Clearwater, British Columbia V0E 1N0

Population Ecology of Individuals

By Adam Lomnicki. 1988. Monographs of Population Biology, 26. Princeton University Press, Princeton, New Jersey. 223 p., illus. Cloth U.S. $52; paper U.S. $16.

Most classic population biology models assume no variation between individuals of a population. The population is assumed to be composed of homogeneous units. Lomnicki challenges this assumption. Then, he demonstrates how variation between individuals can lead to population stability and ultimately ecosystem stability.

Using graphs and mathematical models to illustrate his points, Lomnicki shows how population stability could result from two mechanisms: unequal resource partitioning between individuals and contest competition among individuals. Unequal resource partitioning results from phenotypic variations between individuals that cause differences in resource acquisition abilities. Differences in these abilities result in contest competition if the resource intake of the larger individuals is not affected by the resource intake of the smaller individuals. The example of contest competition given in this book was competition between trees for light. The tallest trees in a forest are able to acquire light without interference from the shortest trees; however, the light interception by the tallest trees reduces the quantity of light acquired by the shortest trees.

Obviously, the quantity of resources that an individual acquires is a function of its rank within a population. Individuals of the highest ranks often acquire resources in greater quantities than the resource levels required for reproduction and maintenance. Individuals of lower ranks may acquire resources between the resource thresholds for maintenance and reproduction or even below the threshold for maintenance. Individuals acquiring resources below the reproduction threshold will not reproduce, and individuals acquiring resources below the maintenance level will not survive long if they remain in the population. Often, the only alternative for these last two groups is to emigrate.

Lomnicki shows how emigration could cause self regulation of a population. He also shows how perception of a low probability of successful reproduction by low ranking individuals could force