ranging from river morphology to zooplankton secondary production. The chapter on fishes includes an interesting section on species adaptations to low concentrations of dissolved oxygen, a common characteristic of tropical waters. The author reminds us in the section on fisheries that a successful fish husbandry technology is less an indication of a developed nation than of one where native fisheries have already been heavily exploited. River fisheries models, for which Welcomme and his colleagues are well known, are treated only briefly in the book, which is definitely oriented toward a general audience.

The book documents in some detail humanity's greatest engineering folly—dams. Attempts at flood control have traditionally followed closely the first appearance of humans on the river floodplains. Welcomme can state that, in spite of past decades' extensive investment of time and money, the costs of damage from flooding are increasing at a greater rate in countries adopting flood-control measures than in those where the natural regime is left unmodified. Equally discouraging, fish diversity and production (as estimated by catch) are proportional to the intensity of flooding, which flood-control measures attempt to reduce. The results of flood control, therefore, include declining native fisheries as well as increasing economic costs.

If there is one major disappointment, it is the book's narrow focus. It is unfortunate that a scientist with Welcomme's expertise has not made better use of related disciplines to provide insights on a more general level. For instance, there is no reference to the extensive lessons derived from marine fisheries, such as are to be found in works by Cushing or Gulland. A lone reference to evolutionary ecology is conspicuous by its misspelling of the author's name.

As an example of how research in related areas could contribute to an understanding of the floodplains fisheries, consider that most tantalizing of topics, fish migration, a subject treated in some detail in this book. In Asia, Africa, and South America, numerous fish species undertake long and spectacular migrations. In Africa characins, mormyrids, silurid catfishes, and cyprinids such as *Labeo altivelis* leave lake habitats during the floods to ascend rivers and spawn in the upstream swamps. A similar upstream migration has been described for a tributary of the Mekong in Asia. In the La Plata and Paraná systems in South America, the characins *Salminus maxillosus* and *Prochilodus scrofa* migrate up to 1000 kilometers upstream to spawn in swamps. In the Central Amazon Basin, however, the spawning migrations are the reverse (what Welcomme describes as the "piracemas" are actually nonspawning migrations). Characins of the genera *Prochilodus*, *Semaprochilodus*, *Colossoma*, *Brycon*, and others migrate long distances down the tributaries to spawn in white waters such as the Amazon River. Having spawned, the schools immediately ascend the same tributaries. The observations of fish migrations, therefore, make up a rather complicated picture in which some species migrate upstream and others downstream to spawn and the different behaviors occur for fishes within the same or closely related families, sometimes within several hundred miles of each other.

A reasonable explanation for this otherwise confusing situation can be deduced from evolutionary considerations of fish life history patterns. As Cushing and Lasker first noted for marine systems, postlarval stages of many fish species have a "critical period" during the first several weeks of life in which mortality can reach 99 percent unless the young encounter zooplankton as food resources. My own data indicate that postlarval and juvenile fishes of the Central Amazon Basin are similarly initially dependent on zooplankton. This suggests a single explanation for the different spawning patterns; namely that adult fish enhance their larvae's chances of surviving the critical period by spawning in habitats favorable for zooplankton production such as newly flooded areas. In Asia, Africa, and southern South America these nursery grounds are located in upstream swampy regions; in central Brazil zooplankton develop in the floodplains and small lakes associated with the white-water systems. The generalization that adults feed in one habitat, young begin life in a different habitat, and the distance between the two is spanned in the spawning migration appears to be a general principle for many river fishes throughout the world, with interesting management implications.

In this book Welcomme has provided us with the first in-depth analysis of the fisheries of floodplains rivers, especially in the tropics. If the book does not answer all our questions, that is less a reflection on the author's knowledge than an indication of what is still to come.

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Life and Work of Wegener

Alfred Wegener und die Drift der Kontinente. MARTIN SCHWARZBACH. Wissenschaftlich Verlagsgesellschaft, Stuttgart, 1980. 160 pp., illus. DM 29. Grosse Naturforscher, vol. 42.

With the acceptance of plate tectonics Alfred Wegener's name has become something of a household word as belated tribute has been paid to the "father" of continental drift. Wegener was not the first to embrace the idea, but with *Die Entstehung der Kontinente und Ozeane* he succeeded beyond any of the others in focusing attention (and also ridicule and hostility) on this revolutionary concept. Yet it is doubtful that many adherents of the current conventional wisdom can cite the title of this book from memory, let alone have actually read it. Wegener's remains a one-dimensional image, not adequately reflecting the breadth and depth of his scholarly interests and contributions.

Several English-language histories of the recent geological revolution have attempted to remedy this with brief biographies. It is the merit of this concise book, written in clear and economic German by a distinguished German geologist and paleoclimatologist, that it views history from the European and Continental rather than from the Anglo-American point of view so much more familiar to us. I was surprised to find how fairly and completely modern plate tectonics can be sketched while most of the names that recur over and over again in accounts written on this side of the Atlantic Ocean are omitted.

The book succeeds well in showing how much more Wegener was than the single-minded protagonist of continental drift we usually visualize. He saw himself first and foremost as a polar explorer, but his biographer points out, somewhat mercilessly, that his achievements do not match his investment of time and, ultimately, of his life. Less well remembered but far more important was his collaboration with his father-in-law, Wladimir Köppen, on *Die Klimate der Vorzeit*, an influential work that, because of the meteorological background of the authors, proceeded far beyond the then usually very intuitive approach to this subject. On returning to this book I found it surprisingly fresh and, although dated by modern advances in paleontology, geochemistry, and paleoceanography, full of stimulating insights.

The biography is full of old acquaintances, the European heroes of geology of the first decades of this century. Many

of them deserve to be better known to their present American colleagues and are colorful and important personalities in their own right. Yet, perhaps because of the factual approach to history writing used by the author, they do not come alive and remain, as does Wegener himself, figures of ink and paper rather than flesh and blood. On the other hand, in the limited space of these pages the large and often not clearly recognized differences in the development of geology on the Continent and in North America become quite clear. Reading the book is an instructive experience that rewards the effort.

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Avian Strategies

Some Adaptations of Marsh-Nesting Blackbirds. GORDON H. ORIANS. Princeton University Press, Princeton, N.J., 1980. xii, 296 pp., illus. Cloth, $18; paper, $7.95. Monographs in Population Biology, 14.

Over the past 14 years the Princeton University Press has published major statements on topics in population biology by senior workers in the field. The latest monograph presents a synthesis of the main ideas and data from a long field study of birds. It is written in a highly personal and readable style. Like several other books in the series, it could have been given the same title as a collection of James Thurber essays: *My World—and Welcome to It.*

Gordon Orians's professional world is the world of blackbirds. There are four species breeding in North America. They show different degrees of coloniality in their breeding habits and, associated with this, different patterns of feeding. For example Brewer's blackbirds are monogamous, redwing blackbirds are polygamous. Some male redwings have one female, others have as many as six, all with different nests in the same male's territory and spaced out apparently without regard to each other. Some blackbirds travel many miles to feed, others feed locally. Such variations as these raise questions about the adaptive basis of breeding and feeding in different ways. Gordon Orians has spent nearly 20 years posing and then trying to answer these questions.

The first two chapters of his monograph describe in ample detail the North American blackbirds, their nesting habitats and food supply. The main result of an extensive sampling of their food, chiefly odonates (dragonflies), is that the emergence of the insects is generally predictable from a knowledge of the data, time of day, and weather conditions. From this it is expected that birds can integrate and use the information to anticipate prey availability and to make their decisions about where to breed and feed without having to sample the foods directly.

The following four chapters are the core of the book. In them Orians tries to discover how individual blackbirds make their decisions. He sets up models of how birds should behave according to simple premises, then tests predictions of the models with field data. In the first of these chapters the question is how males and females choose a particular place to breed. For redwing blackbirds the answer seems to be that both males and females assess variations in habitat quality in terms of food resources and protection from predators and choose the best patch available. Females, in addition, may take into account unknown (to us) qualities of the males, but they do not appear to be much influenced by whether there are four other females already on the territory or none.

Optimal foraging models are then used to predict when blackbirds should switch their feeding from one patch to another, which food items should be sought, and how many should be brought to nestlings. The predictions are tested with data on the amount and composition of food in (i) the marshes and (ii) the nestlings' throats. The predictions have mixed success. For example, according to the theory of central place foraging Orians has developed, birds should bring larger loads of food to their nestlings the further they have to go to get it, in order to compensate for the longer time the nestlings are without food. Gratifyingly, for both the theory and common sense, they do. Also as expected, birds alter their foraging among patches during the day when patch quality is changing. However, although birds should feed only on large, richly rewarding food items when their rates of capture are high, because it is uneconomical to do otherwise, in fact they feed on large and small food items when this condition is met. Nevertheless, despite several equivocal findings like this one, this and the previous chapter are the most incisive and valuable in the book.

The next chapter discusses the effect of resource variability on blackbirds and concludes that redwings and yellow-headed blackbirds respond similarly to changing resources. But yellowheads are larger than and dominant over redwings, which, apparently as a consequence of competition with yellowheads, are forced to feed in a broader range of places. This leads on to a discussion of community structure and niche overlap and to a comparison of North and South American blackbirds. The intercontinental comparison is particularly interesting for the confirmation it provides of Orians's theory that selection favors a polygynous mating system in areas where habitat quality varies greatly; in Argentina food abundance is much lower and more uniform than in North America, and none of the three blackbird species studied indulge in polygyny as their North American relatives do. The book closes with a survey of bird-supporting marsh habitats around the world and manages to establish a link with the first monograph in the series by treating marsh communities in the context of island biogeography theory.

In providing answers to questions about ecological adaptations the book is only a partial success. It often fails because the questions are complex and the techniques for answering them are inadequate. To test theories of foraging it is helpful to see the forager at work. Blackbirds are not a good choice of organism for such study because they cannot be observed when foraging in dense reeds and marsh vegetation. I suspect that part of the problem, too, is that some of the data were collected for other purposes before the development of the theories they are used to test in this book. A further problem is the sparse use of statistics, which gives rise to uncertainty as to what predictions are definitely supported and what are not. And as an illustration of the inadequacy of study methods, birds were not marked individually, so the interesting questions raised about differences between individuals in foraging cannot be addressed directly.

However, it would be wrong to judge the work solely in terms of clear answers. Its real strength lies in the discussion of adaptations and how they might be studied. In presenting reasons for considering certain questions to be important, Orians has turned a failure to answer many of them into a success by capturing some of the excitement that is felt in discussing recent research results.

Thus the book has something to say about how and why this type of ecological research is done. The use of theory is made explicit. Theory is used in two distinct but complementary ways, to design falsifiable tests and to gain further in-