the years 1968 to 1982. This does not mean that the book is ideal for teaching the subject; indeed, it is not, since the authors plunge right into the most complex of subjects. A newcomer to the field will find rather little of a tutorial approach and can benefit from the book by doing some preliminary reading in simpler textbooks. On the other hand, for the experienced worker in planetary sciences, the book is a gold mine. The thorough scholarship, combined with the high quality of the discussion, guarantees that the book will have an important influence for some considerable time.

The book deals with three principal subjects, in chapters 2, 3, and 4 (chapters 1 and 5 are brief and largely philosophical). Chapter 2 (50 pages) deals with the retention of volatiles by planets. Its basic orientation is to the chemical abundances, both of the solar nebula and of apparent condensation products of the nebula, primarily meteorites. However, there is also an extensive discussion of the probable primordial atmospheres of the planets as they accumulated within the solar nebula.

Chapter 3 (49 pages) deals with evolutionary processes. In the evolutionary sense it can be considered the successor to chapter 2. Here we learn about input and output processes and how as a result of these an atmosphere can change with time. The output processes consist of escape from an atmosphere, both thermal and nonthermal, and absorption by the body of the planet, both by dissolution and chemistry. The input processes include outgassing from the body of the planet and chemical reactions. The chemistry of interest on most planets results from the atmosphere-lithosphere interaction, but on Earth it includes biochemical processes as well.

The bulk of the book is in chapter 4 (264 pages). Major subsections deal individually with the four terrestrial planets. The remaining subsections deal collectively with the Jovian planets, with lunar-sized objects, and with asteroids. There is much discussion of photochemistry and of atmospheric structure and composition, but relatively little discussion of atmospheric dynamics. The discussion of Earth is much concerned with biochemical evolutionary effects on the atmosphere (and vice versa). Venus, Earth, and Mars receive extended treatment because there is a large body of observational data on them. The discussion of the Jovian planets is briefer and much more theoretical, as befits planets for which observational data are as yet sparse. From the observational point of view the most important lunar-sized bodies are Io and Titan, although only the latter has a substantial atmosphere, about which our knowledge is still rather rudimentary. The asteroids do not have atmospheres, and the discussion of them is mostly concerned with compositions and with inferences about their original interactions with the gas of the solar nebula.

With the high cost of the printed word today, there are very few books that I think are essential components of the bookshelves of working planetary scientists. This is one of them.

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Genetics of Fishes

Evolutionary Genetics of Fishes. BRUCE J. TURNER, Ed. Plenum, New York, 1984. xx, 636 pp., illus. $85. Monographs in Evolutionary Biology.

This is a book more on Mendelian variation (mostly allozymes) than on evolutionary genetics. Although one of its purposes is to "demonstrate the power of integrated genetic approaches to ichthyological problems," most of the 12 chapters are very narrow. The book is aimed at "classical ichthyologists and molecular biologists" as well as evolutionists, but lack of integration and jargon will make it heavy going. However, it is a useful extension to Kirpichnikov's *Genetic Bases of Fish Selection* and to volume 4 ("Vertebrates of Genetic Interest") of the *Handbook of Genetics*.

Morizot and Siciliano report that allozyme linkage relationships appear to be remarkably stable among fishes, as in mammals, and might even be stable among all vertebrates. The extensive data on poeciliid color pattern genes are ignored, but an examination of Borowsky's chapter, and of papers by Kallman and Yamamoto in the *Handbook of Genetics* volume, suggests that these linkage groups may also be conserved.

The genetics of the tetraploid families Catostomidae and Salmonidae is dealt with by Ferris and by Allendorf and Thorgaard. These authors summarize well the genetic consequences of gene duplications and speculate on how gene regulation and polyploidy coevolve. Salmonids are slow-growing, have much DNA, and develop at low temperatures. (J. P. Grime has found a similar pattern in plants.) Unlike most of the contributors, Ferris gives a good discussion of the strengths and weaknesses of methods and of interpretations. He also compares phylogenies derived from morphological and molecular data. It would have been interesting to use morphological phylogeny to deduce the sequence of changes in molecular gene duplication and regulation during salmonid evolution. Buth's chapter provides a useful commentary on the strengths and weaknesses of allozyme data in systematics and should be read by everyone doing systematic electrophoresis.

Kornfield describes allozyme and karyotypic variation in the Cichlidae, which are very diverse in morphology and ecology. Allozyme and karyotypic variation appears to be nearly independent of speciation and morphological divergence. Many cases are known of full sexual isolation among groups with identical allozymes or karyotypes; genetic markers do not always reveal sibling species. Curiously, there are significant frequency differences between sexes in one allozyme locus of *Oreochromis saka*, and there is spatial segregation of sexes following breeding. Kornfield does not detail the fascinating work on evolutionary genetics and ecology of feeding polymorphs of *Cichlasoma*, and the editor does not summarize his own parallel work on *Ilyodon*.

Borowsky discusses two *Xiphophorus* species, providing another example of the independence of morphological and allozyme variation. There is some evidence that tailspot loci are associated with differences in O_2 consumption and growth rates, which, in conjunction with stream dynamics, may explain variation at some color pattern loci. But sample sizes are small, critical tests are incomplete, and the studies ignore predation, which has major effects on color pattern genes in other peociliids. Williams and Koehn discuss eels (*Anguilla*) and argue from allozyme and morphological data that the American and European eels are a single panmictic population. If this is true, then the latitudinal clines found in three American eel allozymes result from natural selection. Proof awaits the discovery of the exact breeding sites of each population. Breeding adults have not been found; they may segregate by demes, as do many other Atlantic and North Sea fishes.

Kallman provides a discussion of the heretofore confusing subject of sex determination in Poeciliidae that will be useful for many years. Three chapters deal with asexually reproducing species and show that asexuality is not an evolu-

tionary "dead end." Monaco, Rasch, and Balsano suggest that somatic mutation may be a significant source of new variation in *Poecilia formosa* clones. Moore summarizes the population genetics of asexuality in fishes, with a comparison with lizards and salamanders. His is the only chapter in the book to provide a conceptual framework for the data and a good discussion of the evolutionary causes and consequences, as well as a balanced and critical discussion of the ideas. Of special interest is an examination of the possible advantages of asexuality. Vrijenhoek presents a good discussion (with evidence) of how genetic diversity can be maintained among clones of asexually reproducing *Poeciliopsis*. Clonal diversity may arise through repeated formation of new clones or mutation in existing clones. It can be maintained if the clones are heterotic, live in habitats intermediate between parental habitats, or specialize ecologically.

Bell summarizes the evolutionary genetics of sticklebacks, where there is circumstantial evidence for the effects of predation on many different kinds of traits. Although verbose, this is the only chapter that utilizes a broad approach, including many polymorphic and quantitative morphological traits, allozymes, and ecological factors, as well as dealing with causes of variability in a meaningful fashion.

This book has major gaps in coverage. The work of D. Powers and his associates on the biochemical genetics and associated physiology and ecology of *Fundulus* is unquestionably the best work on allozymes. My own work on predation and sexual selection on color patterns provides one of the few documentations of direct causal relationships. There are superb studies on the evolutionary genetics of life history, physiology, and behavioral traits and their causes in *Gambusia* and *Poecilia* by Stearns, Reznick, and Farr. There is no trace of any these studies in the book, and the pioneering work by Jack Schultz receives only passing mention. Except for Bell's chapter, the morphology and evolutionary genetics of quantitative traits are ignored. There is no discussion of promising methods or avenues for future research. The book is thus not a summary of the state of the art in evolutionary genetics of fishes, though it is a useful reference book on specific issues in fish genetics.

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