the problems associated with compatibility algorithms. In terms of veracity, compatibility can be no better than the Wagner algorithm, and it is often going to be worse. As convergence and parallelism increase in the data set, compatibility will explain fewer of the data because it will ignore synapomorphies.

The sixth chapter, on the phylogenetic approach to classification, is excellent. Wiley updates his recently published conventions and rules for an annotated Linnaean system of classification. Unfortunately, his description and example of how to include anagenetic data are difficult to understand because of an incompletely and incorrectly labeled table 6.1 and figure 6.13. I might add that typographical errors are common throughout the book, and careful editing must accompany a second printing.

Wiley treats the alternatives to the phylogenetic system of classification in the next chapter. I agree with him that the fundamental difference remaining between evolutionary systematists and cladists reduces to whether or not paraphyletic groups are recognized. No one has yet identified the discordance between genealogy and genetic similarity that might justify the recognition of paraphyletic groups, and the continued adherence to such unnatural assemblages seems to stem from evolutionary systematists' treatment of higher taxa as artificial entities, their assumption that higher taxa originate from supraspecific taxa of equal or lower rank, and their assumption that lower taxa develop into higher taxa sometime after the origin of the stem species of those higher taxa. Wiley refutes on logical and empirical grounds the pheneticists' assertion that their classifications based on overall similarity are the most stable and natural.

Wiley reviews the relationship between phylogenetic systematics and biogeography in chapter 8. He suggests that primary causal agents for present disjunct distributions must be sought in vicariance events, rather than dispersal. The simplest argument for doing so is that all organisms seem capable of some dispersal, and, in being able to explain any conceivable distribution, dispersal can really explain nothing. Unfortunately, vicariance biogeography is of limited application at this time because there are too few well-corroborated cladograms for a variety of organisms living in a given general region.

The concluding chapters, on specimens and curation, characters and quantitative character analysis, and publication and rules of nomenclature, may seem out of place to more advanced students of systematics. However, I would like to point out that the new systematist, for whom this book is intended, should be apprised of all matters relevant to the discipline. What could be more important than the characters that provide the basic evidence for historical relationships, the care of the specimens that provide those data, and the publication effort itself? Except for some disjointedness in the text of these chapters, Wiley is to be commended for attempting a complete book on phylogenetic systematics.

ARNOLD G. KLUGE
Museum of Zoology, University of Michigan, Ann Arbor 48109

Transposons

Movable Genetic Elements. Papers from a symposium, Cold Spring Harbor, N.Y., 1980. Cold Spring Harbor Laboratory, Cold Spring Harbor, N.Y., 1981. In two volumes. xxxvi, 1026 pp., illus. $130. Cold Spring Harbor Symposia on Quantitative Biology, vol. 45.

Although chromosomes usually contain stable linear arrays of genes, exceptions to the rules of stability have been known for a long time. Barbara McClintock's genetic crosses in maize provided the first well-studied example of "movable genetic elements." In the late 1960's Shapiro and Starlinger found elements in *Escherichia coli* that caused pleiotropic mutations when inserted within genes.

During the past decade, the development of new technologies to study DNA structure has led to the discovery of movable elements in prokaryotes, eukaryotes, and their viruses. These two volumes present the most up-to-date and comprehensive collection of papers available on the subject. A comparison of this book with a previous compilation of papers (*DNA Insertion Elements, Plasmids, and Episomes*, Bukhari, Shapiro, and Adhya, Eds., Cold Spring Harbor Laboratory, 1977) reveals the rapidity with which this field has expanded during the past few years.

Summarizing the contents of these two volumes in a review is impossible owing to the number (115) of papers included. Two papers are worthy of special mention. The introduction by Allan Campbell puts in perspective our understanding of "movable genetic elements" and DNA rearrangements and its implications for our understanding of the evolution and regulation of gene expression and development. Michael Yarmolinsky's superb summary complements the introduction and serves as a guide to the reading of some of the papers in the book.

The first volume of the book presents detailed genetic and physical analyses of the structure and function of movable genetic elements (transposons) in bacteria. Several papers delineate both host and transposon-coded factors required for the transposition process. The mechanism of transposition is analyzed in depth in two systems: bacteriophage mu and Tn3.

The second volume provides a picture of how widespread these elements are. Papers dealing with their presence in yeast, plants, and *Drosophila* are included. Especially exciting is a group of papers on the structure of integrated retroviruses and the discovery of the structural similarities of such retroviruses and bacterial transposable elements. One section in this volume, although not dealing with movable elements, includes papers on the organization and structure of some eukaryotic genes: globins, collagen, yeast invertases, and histones. This is followed by a comprehensive group of papers on the involvement of controlled DNA rearrangements in the expression of immunoglobulins, antigenic variation in trypanosomes, and mating-type switching in yeast.

The significance of movable genetic elements and DNA rearrangements is just now emerging. By themselves, the elements are able to regulate gene expression in a wide variety of ways. By flanking specific genes, they are able to disseminate antibiotic resistance in bacteria and to determine host specificity and phase variation. Moreover, in the developmental systems that have been examined at the molecular level, for example, immunoglobulins and *Drosophila* homeotic mutants, developmental changes are associated with DNA rearrangements.

Several papers in the book point to the importance of the ends of transposons in the transposition process. It is now clear that there are similarities in structure at the ends of both prokaryotic and eukaryotic transposons that suggest a generality in the mechanism of transposition. In some systems that involve just inversions of the movable sequences, such as the invertons controlling flagellar antigen variation in *Salmonella* and host range specificity in bacteriophages mu and P1, the specific recombination systems are even interchangeable. In spite of these similarities, a single molecular model of transposition cannot explain the wide variety of DNA rearrangements described.

The wealth of information in the book points out that we now have detailed descriptions of events and structures that are required for transposition. On the other hand, little is known about the complex biochemical processes involved. Three systems emerge as good candidates for immediate biochemical studies: mini mu, Tn3, and mating-type switching in yeast.

In summary, these volumes provide not only a superb comprehensive reference work but also directions for future developments in a subject of central importance in contemporary genetics research.

LUCIA ROTHMAN-DENES
Department of Biophysics and Theoretical Biology, University of Chicago, Chicago, Illinois 60637

Cosmology and Relativity

Essays in General Relativity. A Festschrift for Abraham Taub. FRANK J. TIPLER, Ed. Academic Press, New York, 1980. xviii, 236 pp. $30.

This volume is dedicated to Abraham Taub, who recently retired from the mathematics faculty of the University of California at Berkeley. Taub's most important contributions to general relativity include the discovery of a homogeneous vacuum solution of Einstein's equations (the Taub universe) as well as other investigations involving homogeneous cosmological models, studies of general relativistic hydrodynamics, and investigations of mathematical issues concerning Einstein's equation, particularly studies of the validity of approximation schemes. It is appropriate, therefore, that many of the 16 contributions to this volume deal with these topics.

For the most part, the contributions would be more aptly described as "technical papers" than as "essays." An important exception is a contribution by Wheeler, which deals with the "anthropic viewpoint" in cosmology. In this viewpoint, one seeks to explain why the universe is the way we observe it to be on the basis of its being the "simplest" and "most economical" universe consistent with general relativity for which life could develop. Our universe is spatially much larger than necessary for life, but in the standard closed Friedmann cosmology this large spatial extent is needed for there to be enough time for life to develop. However, Wheeler points out that in the Taub universe there can be a long lifetime with a small spatial size. (As Shepley shows in the following paper, although tidal forces due to anisotropic expansion are relatively large in this Taub universe, they should not be large enough to interfere with star formation or other processes necessary for life.) Thus, Wheeler suggests that this is a serious difficulty for the anthropic viewpoint, since the "anthropic principle" should favor the Taub universe over the universe we observe.

Contributions by Liang, Tipler, and Zimmermann and Thorne can also be read with profit by most nonexperts in general relativity. Liang briefly reviews the issue of the origin of the inhomogeneities we observe in our universe from the scale of galaxies to that of superclusters of galaxies. He presents some evidence against the hypothesis of selective survival by nonlinear hydrodynamical processes of originally chaotic fluctuations and speculates that some sort of gravithermal collective process occurring at decoupling may be involved in the correct explanation. Tipler points out that the singularity theorems and related arguments of general relativity prevent a closed universe from returning arbitrarily close to its initial configuration. (Such "Poincaré recurrence" occurs for ordinary classical mechanical systems.) Using very conservative theoretical postulates ("cherished beliefs"), Zimmermann and Thorne derive upper limits on the gravitational wave flux at earth. In order for present-day detectors to observe gravitational radiation, the actual flux at earth would need to be very near these upper limits.

Most of the remaining contributions will be of interest primarily to researchers in general relativity. York reviews definitions of total mass, momentum, and angular momentum of isolated systems in general relativity and the results establishing positivity of total mass. (However, some of the very recent results of Shoen and Yau and Witten were obtained after York's review was written.) Fischer, Marsden, and Moncrief discuss issues related to the manifold structure of solutions of Einstein's equation. Jantzen constructs a gauge-invariant perturbation theory of certain homogeneous cosmological models. MacCallum analyzes homogeneous cosmological models with a four-parameter group of symmetries acting on the homogeneous surfaces. Penrose shows that no conformally flat metric can be found whose light cones contain the light cones of the conformally completed Schwarzschild metric. (This poses difficulties for attempts to describe the Schwarzschild solution in a "Lorentz covariant" framework.) Piran and Smarr, Taubes, and Wilson discuss coordinate choices in general relativistic hydrodynamics. Lichnerowicz discusses the algebras that can be obtained by deformation of Poisson algebra of ordinary classical mechanics. Misner briefly discusses some properties and applications of harmonic maps. Brief contributions by Lindblom and Brill (on the topology of space-times describing nonsingular stellar models) and Papapetrou (on the relation between stationary, axisymmetric vacuum solutions and static, axisymmetric electrovac solutions) complete the volume.

On the whole the contributions in this volume are not of the outstanding caliber found in some other recent volumes (such as *General Relativity*, the Einstein centenary volume edited by Hawking and Israel), but the book certainly should be of interest to researchers in general relativity.

ROBERT WALD
Enrico Fermi Institute, University of Chicago, Chicago, Illinois 60637

Geomorphology in Japan

The Landforms of Japan. TORAO YOSHIKAWA, SOHEI KAIZUKA, and YOKO OTA. University of Tokyo Press, Tokyo, 1981 (U.S. distributor, Columbia University Press, New York). vii, 222 pp., illus., + map. $39.50.

Although small in area, the Japanese Islands display a large variety of landforms. Even more extraordinary are the dramatic changes in Japanese landscapes produced by catastrophic surficial processes. Japan has 200 Quaternary volcanoes, of which 60 have records of eruption in historical times. Quaternary folds, active faults, subsiding basins, emerging shorelines, and complex fluvial terraces provide detailed evidence of neotectonic activity. More than 600 destructive earthquakes have occurred in the Japanese Islands in historical times, and 122 of these were accompanied by tsunamis of varying magnitude. Greatest of the latter was the 1771 catastrophe in the southern Ryukyu Islands (the island arc extending from Japan to Taiwan). Whole villages were destroyed by waves that reached up to 80 meters above sea level. Blocks of coral limestone weighing 700 tons were thrown high onto raised coral reefs. The famine and widespread illness that followed this disaster prevented the island population from regaining its pre-earthquake level for about 150 years.