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.

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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.

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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.

The theme of *The Landforms of Japan* can be identified without even opening it. The book jacket displays an aerial photograph of Asama volcano, which in 1783 erupted and produced a spectacular pyroclastic flow. The flow consisted of large blocks propelled with such power that they eroded a trough 1 to 2 kilometers wide and up to 40 meters deep as they moved 8 kilometers from the volcano. Clearly Japan is a showcase for the long-term geomorphic action of volcanism, active faulting, and related tectonism. Moreover, the book emphasizes that landform details are shaped by mass movements and floods, many of which are generated by typhoons.

Yoshikawa, Kaizuka, and Ota explain that they originally planned that this book would be published on the occasion of the 24th International Geographical Congress, held in Tokyo in 1980. Although publication was delayed until 1981, the authors have certainly achieved their avowed purpose of explaining Japanese landforms in an Occidental language. They can even be forgiven for inventing the word "unformitarianic" to describe the repeated occurrence of "catastrophic" changes in landforms following a similar pattern over a long history of landscape development. This lesson, so obvious in Japan, was somehow resisted by the majority of Occidental geomorphologists through a century of uniformitarian tradition.

The relationship between humans and landscape is a matter of deep appreciation among Japanese geomorphologists. Modern geomorphology began in Japan following the great 1923 Kanto earthquake. The human tragedy of this disaster, 143,000 lives lost and 128,000 homes destroyed, showed the hazard of the geologic environment. However, the event also showed the importance of Holocene stratigraphy. Of the houses founded on valley bottoms underlain by thick Holocene mud and peat, 68 to 90 percent suffered collapse. But houses located on relatively thin Holocene units overlying buried abrasion platforms experienced a mere 1 percent chance of collapse. Geomorphology was found to be of immense practical, as well as academic, value.

The Landforms of Japan is highly recommended as an introduction to geomorphic research in the Japanese Islands. This refreshing Oriental perspective will reward its Occidental readers by conveying a dramatic perspective on the interplay between tectonism and denudation. Neogene sedimentation, mountain building, erosion surfaces, glacial-eustatic sea-level changes, Quaternary climatic change, marine terraces, and coral reefs complete the dramatis personae on the great stage of Japanese geomorphic history. The message of classical tragic theater was that one must suffer to be wise. Here then is a relatively painless source of geomorphic wisdom.

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The 18th Century Reconsidered

The Ferment of Knowledge. Studies in the Historiography of Eighteenth-Century Science. G. S. ROUSSEAU and ROY PORTER, Eds. Cambridge University Press, New York, 1980. xiv, 500 pp. $39.50.

This volume's subtitle summarizes its chief purposes: not to examine the history of the science during the 18th century, but rather to indicate how that history has been written, what directions might be taken by future research, and what provisional syntheses might now be made. As editors and contributors explain, there has been a remarkably persistent tendency even among historians of science to regard this period as a "trough" between the heroic ages of 17th- and 19th-century science.

On the whole, the volume fulfills its goals admirably, albeit unevenly so. Most chapters do indeed provide at least adequate guides to modern literature on their subjects. Matters needing study, however, are handled erratically, and the reader will often have to guess that what is not discussed has in fact not been studied. For example, in keeping with the state of modern scholarship, relatively little explicit attention is given to neglected non-English and non-French people, archives, and topics. Similarly, there is some tendency to stress the need for large syntheses, with erratic acknowledgement of the fact that narrower studies still are in short supply.

Despite such unevenness, most chapters open up future prospects for research, and many offer stimulating and original syntheses (tentative, to be sure). Both qualities are evident in the highest degree in the chapters by Jacques Roger ("The living world"), John L. Heilbron ("Experimental natural philosophy"), and G. S. Rousseau ("Psychology"). Roger considers whether there could be a science called "biology" before there was a concept of "life"—that is, before biomechanism and animism gave way to "a vitalism that abandoned neither the mechanical nor the chemical explanations but recognized the originality of living beings and made possible a more phenomenological approach" (p. 277). Heilbron's specialty is the history of electricity, and his use of this seemingly narrow field as a model for the exploration of other experimental sciences can only be called superb. Rousseau deals with a field that no one defined in the 18th century but whose subject matter turns up repeatedly in a great variety of writings; in suggesting ways to approach this area and places to look for relevant information, Rousseau provides an important model for those interested in the history of the social sciences—especially sociology and anthropology—which did in fact have their origins in the 18th century.

For specialists, one of the pleasures of this volume will be the opportunity to see how the experts view their fields in contexts broader than what is possible within a monograph. In addition there are the pleasures of seeing how different authors treat the same topics—Newtonianism, for example, is a pervasive theme, revealing more variations than a Bach fugue. But specialists and nonspecialists alike will get little enlightenment from two chapters: H. J. M. Bos on "Mathematics and rational mechanics," and Eric G. Forbes on "Mathematical cosmography." Anyone interested in rational mechanics will appreciate Bos's analysis of the work of Clifford Truesdell on Euler, but one would naturally like to see some discussion of the available scholarship on people like d'Alembert and Laplace. Forbes chose to present not historiography but an original piece of research on some branches of astronomy as these were investigated by the Nuremberg Cosmographical Society. The limitations of these chapters are indicated by the fact that Forbes mentions Laplace once in passing and that Bos refers to him not at all.

The editors made the laudable decision to deal with scientific fields as these were defined or ill-defined in the 18th century, and most contributors discuss the then-existing connections between fields now considered distinct. Even M. P. Crosland's "Chemistry and the chemical revolution," which seems to delineate a recognizably modern field, deals with matters that will seem strange to modern chemists, who ought also to consult passages and chapters devoted to theories of matter, experimental science, and natural philosophy. Modern physicists will have to do even more digging.