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.