longer. The discussions preceding the difficult theorems should be greatly expanded. At least a dozen more examples and counterexamples should be given, motivating the introduction of technical machinery. And many more diagrams could profitably be included. What a great book for students it would then be!

The book contains a few eccentricities: use of "data" as a singular noun; references to "measurements" in general relativity (for example, physical determination of a C^{r+1} atlas!) that would mystify an experimental physicist; and calling the founder of black-hole theory (in an appended translation of his original paper on the subject) by the name Peter Simon Laplace. One is reminded of those famous ghosts of Westminster Abbey: Michel Faraday and Jacques Maxwell.

The book also contains one failure to distinguish between mathematics and physics that is actually serious. This is in the proof of the main theorem of chapter 7, that given a set of Cauchy data on a smooth spacelike hypersurface there exists a unique maximal development therefrom of Einstein's empty-space equations. The proof, essentially due to Choquet-Bruhat and Geroch, makes use of the axiom of choice, in the guise of Zorn's lemma. Now mathematicians may use this axiom if they wish, but it has no place in physics. Physicists are already stretching things, from an operational standpoint, in using the axiom of infinity. It is not a question here of resurrecting an old and out-of-date mathematical controversy. The simple fact is that the axiom of choice never is really needed except when dealing with sets and relations in nonconstructible ways. Many remarkable and beautiful theorems can be proved only with its aid. But its irrelevance to physics should be evident from the fact that its denial, as Paul Cohen has shown us, is equally consistent with the other axioms of set theory. And these other axioms suffice for the construction of the real numbers, Hilbert spaces, C* algebras, and pseudo-Riemannian manifolds—that is, of all the paraphernalia of theoretical physics.

In "proving" the global Cauchy development theorem with the aid of Zorn's lemma what one is actually doing is assuming that a "choice function" exists for every set of developments extending a given Cauchy development. This, of course, is begging the question. The physicist's job is not done until he can show, by an explicit algorithm or construction, how one could in principle always select a member from every such set of developments. Failing this he has proved nothing.

Happily, every other theorem in the book is as sound as a rock, and students could not ask for better navigators through space-time than Hawking and Ellis.

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Solar Physics

The Quiet Sun. EDWARD G. GIBSON. National Aeronautics and Space Administration, Washington, D.C., 1973 (available from the Superintendent of Documents, Washington, D.C.). xviii, 330 pp., illus. $6.20. NASA SP-303.

This book resulted from the discovery by the author, while training for his role as a Skylab astronaut, that no book or compendium dealing with the physics of the whole sun had been written for over two decades. The title *The Quiet Sun* is used as a device for avoiding detailed discussions of active phenomena, not as an attempt to suggest a sharp distinction between a quiet and an active sun.

The chapter topics follow in an orthodox order. After two chapters dealing with the general characteristics of the sun, they are: "The interior," "The photosphere," "The chromosphere," and "The corona." The subject matter contained under the last three of these headings, however, departs quite strongly from that in earlier books. This difference reflects, in part, new ideas and perspectives. It also indicates a conscious decision to touch only sketchily those topics which have been discussed exhaustively elsewhere and deal critically and in detail with those for which the information has heretofore been scattered through the journals. (The comprehensive discussion of photospheric and chromospheric oscillations is an outstanding example of the latter.) This technique has greatly increased the general usefulness of the work as a starting point for the study of solar physics and makes it an excellent supplement to previous compilations on the sun. It will not replace these compilations, however. A newcomer to the field, impressed by its general excellence and apparent comprehensiveness, might, for example, conclude from it that the optical emission corona has yielded no useful information, even that it can be observed only at an eclipse. He would be unaware that optical monochromatic observations, next to sunspots, constitute the most complete synoptic record that we have of the sun; or that monochromatic photographs still give the most detailed pictures available, prior to Skylab at least, of coronal structure.

A central theme in the book is the idea that many of the phenomena of the solar atmosphere should be explained in terms of small- and larger-scale convective processes made evident by granulations and supergranulations. Another recurring idea is that the appearance of a feature in the chromosphere—whether bright or dark, for example—can be explained only through a nonlocal-thermodynamic-equilibrium computation of how the source function of the line in which the feature is observed varies with distance above the photosphere.

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Geophysics Etc.

Annual Review of Earth and Planetary Sciences. Vol. 1. FRED A. DONATH, FRANCIS G. STEHLI, and GEORGE W. WETHERILL, Eds. Annual Reviews, Palo Alto, Calif., 1973. viii, 350 pp., illus. $12.

Inaugurating a new series, this volume discusses a fascinating array of current problems and shows Annual Reviews' customary high level of editorial and authorial competence. The topics of the 14 papers are: geophysics state of the art (Jeffreys), glacioisostatic rebound (Walcott), the origin of red beds (Van Houten), rock fracture (Mogi), Jupiter's and Saturn's interiors (Hubbard), magnetospheric electrons (Coroniti and Thorne), the origin of mammals (Crompton and Jenkins), subsurface water chemistry (Barnes and Hem), the origin of mineral deposits (Skinner and Barton), earthquake strain release (Kanamori), Cenozoic plankton paleontology (Riedel), rock magnetism (Hargraves and Banerjee), lower-atmosphere electrical balance (Vonnegut), and silicate mineral order-disorder (Burnham).

The topics are really too scattered for a single volume. Do the editors seriously think that there are many people working on both mammal tax-