Grassmann, Kotelnikov, and Ball. (He does not, however, incorporate the similar and often-cited works of Study [1903] and Von Mises [1924].)

All in all, volume 2 complements volume 1 nicely but does not at all "close the book" on the subject of screw theory. The work is written in a way that leaves readers with research areas to investigate, questions to ponder, and issues to resolve for themselves. (In fact, in some passages, such as 11.50 and 12.70, Phillips acknowledges some vagueness in his accounts of the subject matter.) These volumes present themselves as powerful learning tools that should bring the novice mechanism student to the forefront or send the experienced researcher back to assess his or her own foundation.

We would like to suggest that the cylindric joint noted to exist at A in figure 13.07 be done away with. This joint is not necessary because it is colinear with the revolute existing at B, and, furthermore, the two joints acting together confuse the explanation given in the figure caption. This is because the reader may be led to believe erroneously that the force acting on the line AP is the force acting in the cylindric joint. But this is a minor criticism of what is otherwise an excellent treatise.

Unfortunately, the vast majority of researchers today studying the kinematics and statics of mechanisms and robot manipulators have failed completely to recognize the power of the tools afforded to them with screw theory. The study of kinematics and statics without screw theory is analogous to the study of heat engines without the laws of thermodynamics or of electricity without Kirchoff's laws.

JOSEPH DUFFY
MICHAEL GRIFFIS
Department of Mechanical Engineering, University of Florida, Gainesville, FL 32611

The Universe Updated

The Astronomer's Universe. Stars, Galaxies, and Cosmos. HERBERT FRIEDMAN. Norton, New York, 1990. xxii, 359 pp., illus. $24.95. Commonwealth Fund Book Program.

In 1975 Herbert Friedman published a book for the National Geographic Society entitled *The Amazing Universe,* in which he described for a lay audience the wonders revealed by modern astronomy and astrophysics. His latest book, *The Astronomer's Universe: Stars, Galaxies and Cosmos,* seems in part to be another look, 15 years later. Indeed, the six chapters that make up the last two-thirds of the volume deal with the same topics as the six chapters of the 1975 book: the sun, stars, neutron stars and black holes, galaxies, cosmology, and life in the universe. But they reflect the remarkable changes that have occurred in our understanding. Friedman describes Supernova 1987A and the detection of its neutrinos; exotic close binary pairs of stars including SS433; gravitational lenses; the problem of dark matter in the universe; and inflationary universes and GUTs. For all these he points out their significance for the frontiers of our knowledge of the universe.

Friedman precedes these chapters with a section on The Tools of Astronomy, introducing devices ranging from radio telescopes and new-technology optical ones to x-ray and gamma-ray detectors and the Hubble Space Telescope. (In his section on the HST, written before its launch, he describes in considerable detail the care with which the mirror was figured and mounted; this now has an ironic ring.) This part of the book is a useful account of the many recent technological advances that have had major effects on the way astronomical research is conducted these days.

The intended audience for this book is not clear to me. Lewis Thomas's foreword, for the Commonwealth Fund, which sponsored it, indicates that the goal is to broaden public understanding of astronomy by presenting the subject in an accessible way. Part of the time Friedman does this well, using basic vocabulary, analogies, and visualization. But he is not consistent; often he uses technical terms with no definition or explanation—as in the case of a reference to piezoelectric transducers or a description of photinos as "the supersymmetric partners of photons of light." There is a glossary, but it does not help here either, since neither "transducer" nor "photino" is to be found in it. Some of these topics are discussed later on; but this gives the book a rather disorganized feel. If a lay audience is intended, I think Friedman has been less successful here than in his 1975 book; if he is writing for readers who are scientifically more sophisticated, he should say so.

Friedman is at his best describing the rocket and x-ray work with which he has himself been associated, as in his discussions of the Sun and the Crab Nebula. In other areas he is sometimes careless or misleading with his facts, as when he says that most stars evolve "along" the main sequence (they don't) or when he refers to the Sun "reaching its supergiant stage" (it will only become a red giant). His historical material is not always correct or consistent either; in some cases he states one thing in his introductory chapter and makes a contradictory statement in a later chapter, as in describing Bessel's measurements of stellar parallax. Historical dates are in error on several occasions.

Despite these shortcomings and some careless proofreading, there is a lot of fascinating material here, and the book is fairly easy to read if one has some prior acquaintance with the vocabulary of astronomy and modern physics. Readers of this journal should find it of interest; but it is not a book for the scientifically naive general reader.

KATHERINE BRACHER
Department of Astronomy, Whitman College, Walla Walla, WA 99362

Earthquakes

The Mechanics of Earthquakes and Faulting. CHRISTOPHER H. SCHOLZ. Cambridge University Press, New York, 1990. xii, 439 pp., illus., $79.50.

Earthquakes are fascinating—clues to inner workings of the earth, sources of primordial fear, and the root of complex engineering, social, and political problems for rapidly growing societies. Research into the mechanics of faulting and earthquake generation is splintered among a number of earth science disciplines—seismology, geodesy, structural and surficial geology, geomorphology, rock mechanics, and geochemistry. Christopher Scholz's goal in *The Mechanics of Earthquakes and Faulting* is to review our present understanding of earthquake and faulting processes based on work contributed by specialists from all of these disciplines. In so doing he hopes to partly remove communication barriers between the various groups of scientists. He does an admirable job on both counts.

The text proceeds in a logical fashion, from the basic physics of rock friction and crack propagation, through the nature of the fault zone, the mechanics of earthquakes, seismotectonics, and finally earthquake hazards and prediction. Scholz has done research not only in his primary field of rock mechanics but also in seismology, and he has some experience in geodesy and structural geology. This breadth is evident in his writing. The physical basis for understanding earthquakes is developed from the perspective of rock mechanics, with focus on the physics of friction and experimental results. A preferred mechanical model of faulting is proposed in which earthquake generation is confined between the upper and lower stability transition between stick-slip and stable sliding. The model is rooted in velocity-dependent friction laws, which are consistent with many experimental and earthquake phenomena. This fault model forms the

basis for discussions of numerous seismological, geological, and geodetic phenomena related to earthquakes. I found this approach rewarding. Perhaps new results will modify the model in time, but for now it gives the reader a basis upon which to explore diverse topics in earthquake science with a rich assemblage of examples.

There is discussion and analysis of earthquakes from a variety of tectonic settings, including plate margins and plate interiors. Artificially induced seismicity associated with fluid injection and reservoir loading is also discussed. The last chapter deals with earthquake hazards and prediction, the sociopolitical engine for much of current support for earthquake research. Scholz points out the successes, failures, and frustrations of this work. Great progress has been made in identifying seismic sources and their potential for causing damage to buildings and other structures. Risk assessment based on probabilistic arguments is becoming routine for engineers, planners, and politicians. An introduction and overview of these techniques are given in the book. Short-term prediction remains the Achilles heel of earthquake research. Fifteen years ago dilatancy-diffusion hypotheses held great promise as a physical basis for developing prediction techniques, but the potential did not become reality. The pitfalls and potential of prediction are discussed in the book. The ability to predict earthquakes in terms of hours, weeks, or months is perhaps not the panacea that many once thought, given the social and political havoc that such predictions create. However, for scientists, the ability to predict earthquakes would indicate that we really do understand the mechanics of faulting and earthquakes. We still don't have it right, but Scholz's book is an important reference for experienced researchers and top-gun graduate students who want to try.

Who should read this book? I think all scientists working on earthquake problems. If you don't have the time to read it through, then skip parts that bear directly on your discipline and read what everyone else has been up to. You'll be surprised, possibly excited, and will likely get some new ideas to pursue. Teachers will find the book useful for supplementary reading in advanced rock mechanics, seismology, structural geology, and neotectonics courses. The book is well suited for an interdisciplinary seminar on faulting and earthquake generation, led by faculty from different disciplines. Engineers who deal with earthquake design problems will find it useful for improving scientific insight and their ability to communicate with earth scientists. They may have some problems with jargon, but Scholz has kept that to a minimum. The book is too technical for most land-use planners or others involved in various social or political aspects of earthquake hazards, and it is definitely not written for the average lay person.

RONALD L. BRUHN
Department of Geology and Geophysics, University of Utah, Salt Lake City, UT 84112–1183

Books Received

ABC's of the Human Mind. A Family Answer Book. Alma E. Guinness *et al.*, Eds. Reader's Digest, Pleasantville, NY, 1990. 336 pp., illus. $26.95.

About Time. Inventing the Fourth Dimension. William Friedman. MIT Press, Cambridge, MA, 1990. xii, 147 pp., illus. $19.95. A Bradford Book.

Absolute Age Determination. Physical and Chemical Dating Methods and Their Application. Mebus A. Geyh and Helmut Schleicher. xii, 503 pp., illus. Paper, $69. Translated from the German by R. Clark Newcomb.

Acidification in Finland. Pekka Kauppi, Pia Anttilla, and Kaarle Kenttämies, Eds. Springer-Verlag, New York, 1990. xviii, 1237 pp., illus. $90. Finnish Acidification Research Programme HAPRO 1985–1990.

ACTH, Cushing's Syndrome, and Other Hypercortisolemic States. Dieter K. Lüdecke, George P. Chrousos, and George Tolis, Eds. Raven, New York, 1990. xviii, 318 pp., illus. $95. Progress in Endocrine Research and Therapy, vol. 5. From a symposium, Crete, Greece, April 1989.

The Big Splash. A Scientific Discovery that Revolutionizes the Way We View the Origins of Life, the Water We Drink, the Death of the Dinosaurs, the Creation of the Oceans, the Nature of the Cosmos, and the Very Future of the Earth Itself. Louis A. Frank with Patrick Huyghe. Carol, New York, 1990. viii, 255 pp., illus. $21.95. A Birch Lane Press Book.

Biochimie et Biophysique des Membranes. Aspects Structuraux et Fonctionnels. E. Schechter. Masson, Paris, 1990. xviii, 414 pp., illus. Paper, 168F.

Biology and Violence. From Birth to Adulthood. Deborah W. Denno. Cambridge University Press, New York, 1990. xiv, 218 pp., illus. $37.50.

Cellular Immunity and the Immunotherapy of Cancer. Michael T. Lotze and Olivera J. Finn, Eds. Wiley-Liss, New York, 1990, xxiv, 432 pp., illus. $125. UCLA Symposia on Molecular and Cellular Biology, vol. 135. From a colloquium, Park City, UT, Jan. 1990.

Chaos and Socio-Spatial Dynamics. Dimitrios S. Dendrinos and Michael Sonis. Springer-Verlag, New York, 1990, xviii, 184 pp., illus. $39.80. Applied Mathematical Sciences, vol. 86.

Clear Thinking. A Practical Introduction. Hy Ruchlis with Sandra Oddo, Prometheus, Buffalo, NY, 1990. x. 271 pp., illus. Paper, $15.95.

Combustion and Plasma Synthesis of High-Temperature Materials. Z. A. Munir and J. B. Holt, Eds. VCH, New York, 1990. xxii, 501 pp., illus. $95. From a symposium, San Francisco, CA, Oct. 1988.

Complexity, Entropy and the Physics of Information. Wojciech H. Zurek, Ed. Addision-Wesley, Redwood City, CA, 1990. xiv, 530 pp., illus. $48.50, paper.

David Livingstone. Letters and Documents, 1841–1872. The Zambian Collection at the Livingstone Museum Containing a Wealth of Restored, Previously Unknown or Unpublished Texts. Timothy Holmes, Ed. Published for the Livingstone Museum by Multimedia Zambia, Lusaka, and Indiana University Press, Bloomington, 1990. xx, 202 pp., illus. $37.50.

Developmental Behavior Genetics. Neural, Biometrical, and Evolutionary Approaches. Martin E. Hahn *et al.*, Eds. Oxford University Press, New York, 1990. xxii, 319 pp., illus. $59. From a symposium, Wayne, NJ.

Developmental Systems. At the Crossroads of System Theory, Computer Science, and Genetic Engineering. S. Wegrzyn, J.-C. Gille, and P. Vidal. Springer-Verlag, New York, 1990. viii, 122 pp., illus.

The Dinosauria. David B. Weishampel, Peter Dodson, and Halszka Osmólska, Eds. University of California Press, Berkeley, CA, 1990. xvi, 733 pp., illus. $85.

Functional Analysis. An Introduction for Physicists. Nino Boccara. Academic Press, San Diego, CA, 1990. xiv, 327 pp. $44.50.

Fusion. The Search for Endless Energy. Robin Herman. Cambridge University Press, New York, 1990. xii, 267 pp., illus. $19.95.

The Future of Meta-Analysis. Kenneth W. Wachter and Miron L. Straf, Eds. Russell Sage Foundation, New York, 1990. xxviii, 210 pp., illus. $29.95. A Project of the Committee on National Statistics, Commission on Behavioral and Social Sciences and Education, National Research Council.

Global Atmospheric Change and Public Health. James C. White, William Wagner, and Carole N. Beal, Eds. Elsevier, New York, 1990. xiv, 265 pp., illus. $85. From a conference, Washington, DC, Dec. 1989.

Guided-Wave Acousto-Optics. Interactions, Devices, and Applications. Chen S. Tsai, Ed. Springer-Verlag, New York, 1990. xiv, 322 pp., illus. $69.50. Springer Series in Electronics and Photonics, vol. 26.

Gunnar Myrdal and America's Conscience. Social Engineering and Racial Liberalism, 1938–1987. Walter A. Jackson. University of North Carolina Press, Chapel Hill, NC, 1990. xxiv, 447 pp., illus. $34.95. Fred W. Morrison Series in Southern Studies.

History of a Voyage to the Land of Brazil, Otherwise Called America. Jean de Léry. University of California Press, Berkeley, CA, 1990. 1xii, 276 pp., illus. $29.95. Latin American Literature and Culture, 6. Translated from the French edition (1578) by Janet Whatley.

Low Frequency Astrophysics from Space. Namir E. Kassim and Kurt Weiler, Eds. Springer-Verlag, New York, 1990. xii, 280 pp., illus. $33. Lecture Notes in Physics, 362. From a workshop, Crystal City, VA, Jan. 1990.

Mafic Dykes and Emplacement Mechanisms. A. J. Parker, P. C. Rickwood, and D. H. Tucker, Eds. Balkema, Brookfield, VT, 1990. x, 541 pp., illus. $70. International Geological Correlation Program Project 257, no. 23. From a conference, Adelaide, Australia, Sept. 1990.

Mechanics of Solid Materials. Jean Lemaitre and Jean-Louis Chaboche. Cambridge University Press, New York, 1990. xxvi, 556 pp., illus. $125. Translated from the French edition (Paris, 1985) by B. Shrivastava.

No Safe Place. Toxic Waste, Leukemia, and Community Action. Phil Brown and Edwin J. Mikkelsen. University of California Press, Berkeley, CA, 1990. xviii, 260 pp., illus. $24.95.

Novel Materials in Heterogeneous Catalysis. R. Terry K. Baker and Larry L. Murrell, Eds. American Chemical Society, Washington, DC, 1990. x, 366 pp., illus. $89.95. ACS Symposium Series, 437. From a symposium, Miami Beach, FL, Sept. 1989.

Nuclear Ambitions. The Spread of Nuclear Weapons 1989–1990. Leonard S. Spector with Jacqueline R. Smith. Westview, Boulder, CO, 1990. xii, 450 pp., illus. $54; paper, $12.95. A Carnegie Endowment Book.

Nuclear Structure From a Simple Perspective. R. F. Casten. Oxford University Press, New York, 1990. xiv, 376 pp., illus. $59. Oxford Studies in Nuclear Physics, 13.

The Ocean in Human Affairs. S. Fred Singer, Ed. International Conference on the Unity of the Sciences, New York, 1990 (distributor, Paragon, New York). x, 374 pp., illus. $34.95; paper, $17.95. An ICUS book.

Oncogenes in Cancer Diagnosis. C. R. Bartram, K. Munk and M. Schwab, Eds. Karger, New York, 1990. viii, 198 pp., illus. $58.50. Contributions to Oncology, vol. 39. From a meeting, Bonn, F.R.G., Nov. 1989.

The Passage of Arms. An Archaeological Analysis of Prehistoric Howards and Votive Deposits. Richard Bradley. Cambridge, New York, 1990. xvi, 234 pp., illus. $44.50.

A Reunion of Trees. The Discovery of Exotic Plants and Their Introduction into North American and European Landscapes. Stephen A. Spongberg. Harvard University Press, Cambridge, MA, 1990. xvi, 270 pp., illus., + plates. $35.

The Rising Seas. Martin Ince. Earthscan, East Haven, CT, 1990. vi, 152 pp., illus. Paper, $10.95.

Safe Blood. Purifying the Nation's Blood Supply in the Age of AIDS. Joseph Feldschuh with Doron Weber. Free Press (Macmillan), New York, 1990. xiv, 218 pp. $19.95.

Statistical Mechanics of Lattice Models. Vol. 1, Closed Form and Exact Theories of Cooperative Phenomena. G. M. Bell and D. A. Lavis. Horwood, Chichester, England, 1989 (U.S. distributor, Wiley, New York). 368 pp., illus. $99. Mathematics and Its Applications.