catholicity of source materials (including at least one U.S. Geological Survey Open File Report). In addition to key original papers, the references include many syntheses by age or country; not many of the previously published compiled maps of bedrock surface geology are listed, and the scale of the atlas does not allow it to distinguish outcrop from subsurface occurrences. The compilation and the bibliography are claimed to be current to 1981, and the majority of the references cited are from the 1970's.

Those who do not read Russian will still find the atlas a very useful reference. The legends and the introductory section are in both English and Russian, and it is easy enough to find one's way around the maps. The volume is very well printed in sharply contrasting colors, and it is finely bound. For a world view of sedimentary geology there is nothing like it.

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Geomagnetism

Reversals of the Earth's Magnetic Field. J. A. JACOBS. Hilger, Bristol, 1984 (U.S. distributor, Heyden, Philadelphia). x, 230 pp., illus. $35.

In June 1967, Sir Edward Bullard delivered the Bakerian Lecture to the Royal Society on the theme "reversals of the earth's magnetic field." J. A. Jacobs, who succeeded Bullard in the chair of geophysics at Cambridge University, now brings us up to date in this new branch of geophysics, which added precision to plate tectonics by providing the magnetic chronometer used to determine rates of sea floor spreading. In this short volume, Jacobs begins by reviewing what was known at the time of Bullard's lecture; he discusses the mathematical description of the geomagnetic field, the origin of the field by electromagnetic induction in the earth's fluid core, the magnetization of rocks, with a lively description of that fascinating and initially confusing phenomenon, self reversal, the now overwhelming evidence for north-south changes (or "reversals") in the polarity of the earth's magnetic field, early attempts to model reversals using disk dynamos, and the emerging field of magnetostratigraphy. In comparing Bullard's lecture with Jacobs's book, one is struck by how clearly the main outlines of the subjects had emerged already in 1967.

The most interesting chapters deal with subjects that have opened up during the past decade or two. A comprehensive review is given of observations of the intensity and direction of the field during the polarity transitions: the intensity decreases by a factor of four and the global morphology of the field becomes largely nondipolar. Research since 1967 has firmly established that there have been changes in the frequency of reversals through geologic time. Issues under current discussion in the literature are whether changes in frequency are stepwise or smooth, whether reversals have a Poisson distribution or some other random distribution, and whether periodicities are present in reversal time series. Jacobs gives a balanced review of papers on the subject, some published as recently as 1984; he tends to favor what is probably the majority view, that reversals are a random and probably Poisson process in which periodicities are not present.

A chapter on geomagnetic excursions—wild swings of the field that do not lock into an antipodal direction—contains an extended review of the experimental data that provide the basis for the Laschamp, Lake Mungo, and Mono Lake excursions and a discussion of the all-important question of whether their ages are well enough known to permit global correlation of the excursions. Jacobs's background is that of a theoretician, not an experimentalist. Despite this (or perhaps because of it), he is remarkably shrewd in evaluating experimental data on a subject about which few observations or experiments are clear-cut. No one who has attempted to distinguish between short reversals, excursions, and bad data will want to miss Jacobs's up-to-date review and evaluation of this subject.

A chapter on models for reversals begins with the classical disk dynamo and covers recent ideas, including that of the disk dynamo as a "chaos" phenomenon. Probabilistic models for reversals and models based on cyclonic convective cells in the core are discussed extensively, but the book does not attempt a thorough review of theoretical work on the core dynamo.

A bonus is provided by a final chapter on the earth's magnetic field and climate. Changes in the paleomagnetic field accompanying changes in climate have been reported, as have faunal extinctions accompanying reversals in the geomagnetic field. After reviewing the literature on this fascinating subject, Jacobs concludes that the subject is "rather grey" and that little convincing evidence for correlations has been obtained in spite of the increasing interest in and vast literature on the subject.

Jacobs's modest book does not provide a new synthesis of modern geomagnetism but rather offers a remarkably thorough and balanced review of the recent literature. Articles about subjects as diverse as dynamo theory and rock magnetism are translated into plain English and summarized fairly and succinctly. Jacobs is one of the few geophysicists with the breadth to do this. Where the evidence concerning an issue is fairly clear-cut, Jacobs will state his own conclusions. For example, in discussing possible correlations between reversals and changing climatic conditions, he notes that "one must be wary of statistics based on very limited time series and the popular appeal of relating reversals to many other geophysical phenomena." Generally, however, the reader is given a review of what is known and left to think for herself or himself. I can't imagine a better volume to use as the basis for a graduate seminar.

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An Episode in Biotechnology

The Interferon Crusade. SANDRA PANEM. Brookings Institution, Washington, D.C., 1984. x, 109 pp., illus. $22.95; paper, $8.95.

Sandra Panem has written an excellent brief essay on the development and promotion of interferon. She recounts its scientific history, beginning in the late 1950's and continuing through the slow pursuit of its antiviral and then anticancer properties. The laborious production process required the culturing of human cells and resulted in the extraction of only minute quantities of the substance. Then, in 1979, the successful cloning of a human interferon gene by a Japanese scientist altered the time, quantity, quality, and cost dimensions of its production. As a consequence, recently formed genetic engineering and established pharmaceutical firms in the emergent biotechnology industry raced each other to exploit its market potential. That potential, everyone now realizes, has not materialized as expected: the anticancer properties of interferon have proved more elusive than expected, and various side effects have been revealed, including possible disease-inducing ones.

Panem also highlights the political

campaign to promote increased federal government research investment in interferon, which was spearheaded by Dr. Mathilde Krim of Memorial Sloan Kettering Institute, beginning in 1975. Krim, a veteran of the effort that led to the passage of the National Cancer Act of 1971, worked in alliance with Mary Lasker, Dr. Jordan Gutterman at the M. D. Anderson Hospital and Tumor Institute in Houston, and the American Cancer Society.

This essay actually contains two stories. The first focuses on the interferon crusade within the context of the National Cancer Institute (NCI) and National Institutes of Health cancer research program. The "crusade" resembles more the campaigns to promote research in cancer chemotherapy in the 1950's or in viral oncology in the 1960's, both of which took place within the NCI statutory and financial framework, than it does the 1970 and 1971 campaign, which generated a new law, created new institutions and programs, and involved a massive increase in funding. In the interferon crusade, the government behaved as a cautious banker, requiring scientific peer review of research proposals, exploring alternative production methods, and underwriting production of the substance, exchange of information, and research grants and contracts. According to Panem, interferon research was allocated between 2.0 and 3.5 percent of the research budget of the National Institute of Allergy and Infectious Diseases during the years from 1972 to 1981, and the corresponding percentages for NCI were 0.15 and 1.30 percent, hardly in the category of betting the company. Greater financial risk for research support was borne, it would seem, by the Albert and Mary Lasker Foundation, the American Cancer Society, and private industry. The government appears a model of prudence, and the spending curve seems quite reasonable given the intense political promotion of interferon research, in which enthusiasm for its promise outran the demonstrated scientific and clinical research results.

The second story of great moment is the relationship between academic and industrial research in the biological sciences as genetic engineering has reduced the time from discovery to application and blurred the distinction between university and industrial laboratory. Here the author provides less empirical detail on the relations between universities, private firms, and the government than she does for the first story. Nevertheless the interferon episode adds to our understanding of this larger problem.

A number of policy issues flow from this case. Paramount among Panem's concerns is the increasing constraint upon university research as industry increases its investment in academic research laboratories and genetic engineering. Also of interest are the problems of a limited public constituency for fundamental scientific research, prospective manpower shortages in academic biology similar to those currently affecting academic computer science and electrical engineering, and issues arising from rapid scientific change, namely obsolete reagents and regulatory and patent problems. A brief discussion of policy lessons concludes the book.

The Interferon Crusade is a good evening's read, although this reviewer wished at times for more of the details behind the reported events. The account is important, the material is well organized, the issue is thoughtfully presented, the style is direct, and—in paper—the price is right.

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Books Received

Activation of Saturated Hydrocarbons by Transition Metal Complexes. A. E. Shilov. Reidel, Boston, 1984 (distributor, Kluwer Boston, Hingham, Mass.). x, 203 pp., illus. $39. Catalysis by Metal Complexes.

The Admirable Secrets of Physick and Chyrurgery. Thomas Palmer. Thomas Rogers Forbes, Ed. Yale University Press, New Haven, Conn., 1984. x, 221 pp. $25.

Advances in Cyclic Nucleotide and Protein Phosphorylation Research. Vol. 18. Paul Greengard and G. Alan Robison, Eds. Raven, New York, 1984. x, 287 pp., illus. $49.50.

Advances in Radiation Biology. Vol. 11. John T. Lett, Ursula K. Ehmann, and Ann B. Cox, Eds. Academic Press, Orlando, Fla., 1984. xiv, 440 pp., illus. $75.

Clusters and Groups of Galaxies. F. Mardirossian, G. Giuricin, and M. Mezzetti, Eds. Reidel, Boston, 1984 (distributor, Kluwer Boston, Hingham, Mass.). xxii, 659 pp., illus. $89.50. Astrophysics and Space Science Library, vol. 111. From a meeting, Trieste, Italy, Sept. 1983.

Coastal Waders and Wildfowl in Winter. P. R. Evans, J. D. Goss-Custard, and W. G. Hale, Eds. Cambridge University Press, New York, 1984. x, 331 pp., illus. $54.50.

Coffee Rust in the Americas. Robert H. Fulton, Ed. American Phytopathological Society, St. Paul, Minn., 1984. viii, 120 pp., illus. Paper, $18. From a symposium, Salt Lake City, Aug. 1982.

Cognition, Metacognition, and Reading. Donna-Lynn Forrest-Pressley and T. Gary Waller. Springer-Verlag, New York, 1984. x, 241 pp. $32. Springer Series in Language and Communication, vol. 18.

Collections of Frozen Tissues. Value, Management, Field and Laboratory Procedures, and Directory of Existing Collections. Herbert C. Dessauer and Mark S. Hafner, Eds. Association of Systematics Collections, Lawrence, Kans., 1984. vi, 74 pp., illus. Paper, $7.50. From a workshop, Philadelphia, May 1983.

The Diel Migrations and Distributions within a Mesopelagic Community in the North East Atlantic. H. S. J. Roe *et al.* Pergamon, New York, 1984. pp. 245–511, illus. Paper, $75. *Progress in Oceanography*, vol. 13, Nos. 3/4.

Diseases of the Hair and the Scalp. L. Bartošová, V. Jorda, and Z. Štáva. Karger, Basel, 1984. x, 251 pp., illus. $49.25. Current Problems in Dermatology, vol. 12.

Drug Abuse Treatment Evaluation. Strategies, Progress, and Prospects. Frank M. Tims and Jacqueline P. Ludford, Eds. National Institute on Drug Abuse, Rockville, Md., 1984 (available from the National Clearinghouse for Drug Abuse Information, Rockville, Md.). viii, 180 pp., illus. Paper. NIDA Research Monograph 51. A RAUS Review Report. From a conference, Rockville, Md., May 1983.

Evolution by Sexual Selection Theory. Prior to 1900. Carl Jay Bajema, Ed. Van Nostrand Reinhold, New York, 1984. xvi, 379 pp., illus. $47.50. Benchmark Papers in Systematic and Evolutionary Biology Series. A Hutchinson Ross Benchmark Book.

Evolutionary Biology. Vol. 18. Max K. Hecht, Bruce Wallace, and Ghillen T. Prance, Eds. Plenum, New York, 1984. xii, 267 pp., illus. $37.50.

La Famille Subsersive. Ferdinand Mount. Mardaga, Brussels, 1984. 288 pp. Paper, 990 BF. Psychologie et Sciences Humaines. Translated from the English edition (London, 1982) by Michèle Jeunehomme, Tiziania Monacelli, and Chantal Quoirin.

Hodgkin's Disease and Non-Hodgkin's Lymphoma. New Perspectives in Immunopathology, Diagnosis, and Treatment. Richard J. Ford, Jr., Lillian M. Fuller, and Fredrick B. Hagemeister, Eds. Raven, New York, 1984. xxii, 474 pp., illus. $98. UT M. D. Anderson Clinical Conference on Cancer, vol. 27. From a conference, Houston, 1983.

How It Was. Anabolic Action of Steroids and Remembrances. Charles D. Kochakian. University of Alabama School of Medicine, Birmingham, 1984. xxii, 116 pp. $10.95.

Hybridoma Technology in Agricultural and Veterinary Research. Norman J. Stern and H. Ray Gamble, Eds. Rowman and Allanheld, Totowa, N.J., 1984. xvi, 338 pp., illus. $49.50. From a symposium, College Park, Md., Oct. 1983.

Multifacetted Modelling and Discrete Event Simulation. Bernard P. Zeigler. Academic Press, Orlando, Fla., 1984. xiv, 372 pp., illus. $42.50.

Nature's Secret World. Arco, New York, 1984. 184 pp., illus. $19.95.

Nest Building and Bird Behavior. Nicholas E. Collias and Elsie C. Collias. Princeton University Press, Princeton, N.J., 1984. xx, 337 pp., illus. $45; paper, $16.50.

Neurocommunications. An Introduction. I. C. Whitfield. Wiley-Interscience, New York, 1984. viii, 304 pp., illus. $34.95.

Neurotransmitters and the Cerebral Circulation. E. T. MacKenzie, J. Seylaz, and A. Bès, Eds. Raven, New York, 1984. xiv, 256 pp., illus. $46. L.E.R.S. Monograph Series, vol. 2. From a symposium, Paris, June 1983.

Nitrous Oxide/N_2O. Edmond I. Eger II, Ed. Elsevier, New York, 1984. xviii, 369 pp., illus. $37.50.

Proceedings of an ESA Workshop on SPLAT. Space Laser Applications and Technology. (Les Diablerets, Switzerland, March 1984.) European Space Agency, Paris, 1984. Variously paged, illus. Paper, 140 F. ESA SP-202.

Profitability of Food Processing. 1984 Onwards. The Chemical Engineers' Contribution. Pergamon, New York, 1984. 430 pp., illus. $61 EFCE Event No. 293. Institution of Chemical Engineers Symposium Series No. 84. From a meeting, Bath, England, April 1984

Progress in Behavior Modification. Vol. 16. Michel Hersen, Richard M. Eisler, and Peter M. Miller, Eds. Academic Press, Orlando, Fla., 1984. xii, 273 pp. $36.

Progress in Immunodeficiency Research and Therapy. Vol. 1. Claude Griscelli and Jaak Vossen, Eds. Excerpta Medica, Amsterdam, 1984 (U.S. distributor, Elsevier, New York). xiv, 481 pp., illus. $98. From a meeting, Chateau de Fillerval, France, March, 1984.

Studies in Russian Historical Geography. James H. Bater and R. A. French, Eds. Academic Press, Orlando, Fla., 1984. Two volumes. xlviii, 490 pp., illus. Each volume, $35.

Surface Enhanced Raman Vibrational Studies at Solid/Gas Interfaces. Iven Pockrand. Springer-Verlag, New York, 1984. x, 164 pp., illus. $28.50. Springer Tracts in Modern Physics, vol. 104.

Surfactants. Th. F. Tadros, Ed. Academic Press, Orlando, Fla., 1984. xii, 342 pp., illus. $30. From a meeting, Bristol, England, July 1983.

Symbolization and Creativity. Susan K. Deri. International Universities Press, New York, 1984. xii, 364 pp. $40.

United States Arctic Interests. The 1980s and 1990s. William E. Westermeyer and Kurt M. Shusterich, Eds. Springer-Verlag, 1984. xviii, 369 pp., illus. $35. From a workshop, Woods Hole, Mass., May 1983.

Water Law. William Goldfarb. Butterwoths, Boston, 1984. xx, 233 pp. $34.95. An Ann Arbor Science Book.

Witchcraft and the Nature of Man. Mark Graubard. University Press of America, Lanham, Md., 1984. viii, 317 pp. $25.50; paper, $14.75.