

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