

the Academy, particularly in the 19th century. The discussion of the Academy's Porto Rico Survey offers some compensation; however, the emphasis is still on political and economic developments. By the mid-20th century the Academy was sponsoring biomedical conferences, but the author fails to provide a background that adequately explains how and why those concerns had become so important. The Academy's function as an umbrella organization makes analysis of its intellectual interests difficult, but some discussion of the principal scientific questions that characterized its meetings or its publications would have enhanced the book.

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Solar Correlates

The Earth's Climate and Variability of the Sun Over Recent Millennia. Geophysical, Astronomical and Archaeological Aspects. J.-C. PECKER and S. K. RUNCORN, Eds. Royal Society, London, 1990. x, 294 pp., illus., + plates. £42.60. From a meeting, London, Feb. 1989. First published in *Philosophical Transactions of the Royal Society of London*, series A, vol. 330 (no. 1615).

Although the existence of periodicities or quasi-periodicities in solar activity has been known since the mid-19th century, it was not until the latter part of that century that Spörer and Maunder called attention to an episode of about 60 years' duration before 1700 when there were practically no sunspots and the 11-year cycle appeared to vanish or nearly vanish. This interesting phenomenon was more or less buried in the literature until it was again brought to the attention of the scientific community by Eddy in a forceful series of articles dating from 1976. Because there is an inverse relationship between solar activity, as measured by the Wolf sunspot number, and radiocarbon production, solar minima correspond to radiocarbon maxima. Fortunately, by 1976 sufficient radiocarbon data were available to enable Eddy to identify other solar minima. These radiocarbon maxima (corresponding to solar minima) appear to repeat with a periodicity of about 210 years, as was first quantitatively demonstrated in 1971 by Jan Houtermans, a student of Suess's at LaJolla. (Suess has repeatedly brought this periodicity to our attention and has persistently related the solar minima and maxima to climate change.) There are other periodicities that occur in both radiocarbon produc-

tion and solar activity, specifically 11, 52, and 88 years. Thus the utility of the radiocarbon record as a proxy record of solar activity has been firmly established.

The relationship between solar activity and climate has been much more controversial. The numerous and questionable corrections required to determine the solar "constant" and its possible variation based on data from mountain observatories and radiosonde balloons have been unconvincing. Second, as is pointed out by Runcorn, one of the editors of this volume, "Meteorologists, very conscious of the complexity of modeling the atmosphere, even assuming a constant energy input, have often been very critical of claims to have detected the solar cycle, and even hostile to the search for one" (p. 287).

Recent developments have made it imperative to reopen the question of a solar activity-climate relationship. First, the nearly continuous record of total solar irradiance monitored by the Active Cavity Radiometer Irradiance Monitor (ACRIM I) aboard the Solar Maximum Mission (SMM) have detected variations on time scales ranging from minutes to the duration of the measurements from 1980 to 1988. The variation from solar maximum to solar minimum corresponds to a peak-to-trough variation of about 0.08 percent, which, in direction if not in magnitude, is consistent with previous hypotheses concerning the relationship between solar activity and climate during the Little Ice Age (A.D. 1400 to 1750) and the Medieval Warm Epoch (A.D. 1100 to 1250); thus a direct relationship exists between solar activity and total solar irradiance. This relationship has been explained by one of the participants (Foukal) as the result of the growth and decay of excess radiation produced by bright faculae in the magnetic network outside of active regions. Second, Röthlisberger has demonstrated that climate events like the Little Ice Age are global and not merely regional in extent. This, along with the radiocarbon-climate correlation, is discussed by Wigley and Kelly. Third, Labitzke and van Loon make a convincing case for an association of the quasi-biennial oscillation with the 11-year solar cycle.

It is these new developments along with the importance of the ^{14}C record as a proxy record of solar activity that make this symposium volume both timely and interesting. ^{10}Be has also shown promise as a sensitive record of solar activity, but the ^{10}Be solar record has been deformed by the erratic fluctuations of paleo-rainfall. Fortunately, Raisbeck *et al.* in their figures 2 and 3 show a remarkably undistorted ^{10}Be record from the South Pole station that compares very

favorably with the ^{14}C record during the last millennium.

Unfortunately, historical records of solar activity, as reviewed by Stephenson and by Zhentao, are of uncertain reliability. After reading the contributions on this theme, it seems to me that paleoclimatology will be a great asset to those concerned with such records. For theoretical astrophysicists who seem to have great difficulty in reconciling solar periods such as the 210-year period with theory, the new developments, as reviewed in this volume, will present an important challenge. For anyone who wants to know about the history of atmospheric CO_2 during the last 50,000 years, recent results on astronomical determinations of solar variability, modeling the climatic response to solar variability, spectral analysis of sunspot data during the past 300 years, or any of the other topics mentioned above, this symposium volume will be worth reading. The editors' summaries also make interesting reading. My only complaints are that the recorded discussions are not sufficiently critical or illuminating and that several contributions consist of little but an abstract.

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Toxins and Cellular Signals

ADP-Ribosylating Toxins and G Proteins. Insights into Signal Transduction. JOEL MOSS and MARTHA VAUGHAN, Eds. American Society for Microbiology, Washington, DC, 1990. xviii, 567 pp., illus. \$79; to ASM members, \$69.

Diphtheria, whooping cough, and cholera are caused by bacterial toxins that share a common biochemical mechanism: Each toxin is an enzyme that cleaves NAD^+ and transfers its ADP-ribose moiety to a specific substrate protein in cells of the unfortunate host. Remarkably, almost every host protein targeted by these toxins—and by other bacterial ADP-ribosyltransferases—turns out to be a GTPase. Several of these host proteins are G proteins involved in transmembrane signaling, such as the GTP-dependent stimulator (G_s) and inhibitor (G_i) of adenylyl cyclase. Other host proteins include elongation factor (EF) 2, one or more 20- to 25-kilodalton *ras*-like GTPases, and a single ATPase, actin.

The usefulness of these exotoxins in illuminating significant problems in eukaryotic biology helps to unify this multiauthored volume. By ADP-ribosylating G_s , for instance, cholera toxin inhibits its intrinsic GTPase and enhances its ability to stimulate