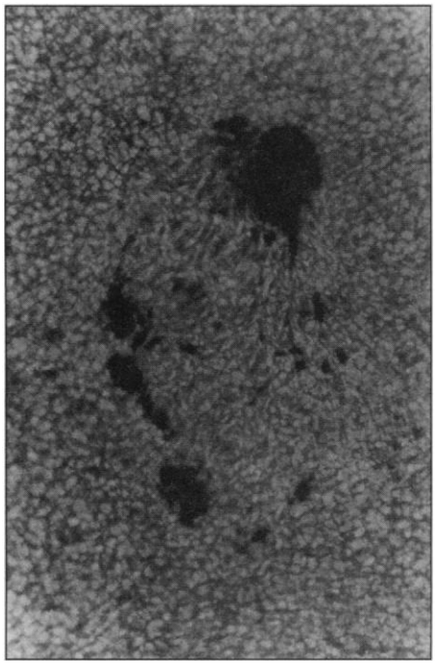
BOOK REVIEWS

Spots and Flares

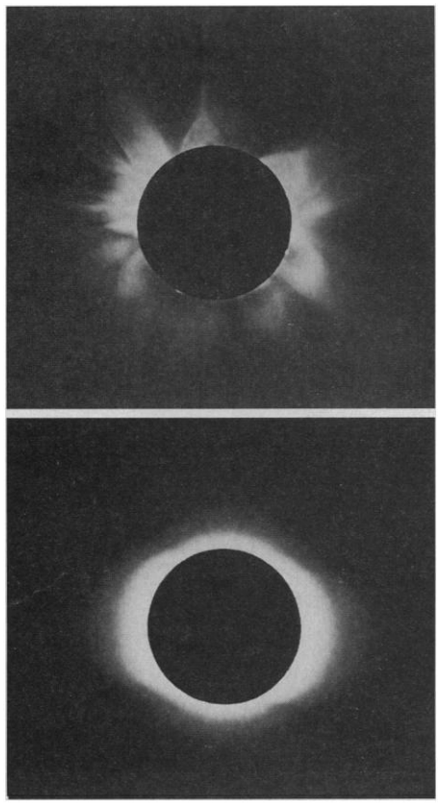
Solar and Stellar Activity Cycles. PETER R. WILSON. Cambridge University Press, New York, 1994. xviii, 274 pp., illus. $59.95 or £40. Cambridge Astrophysics Series, 24.

When Galileo made the first telescopic observations of sunspots in 1610 he ushered in the era of scientific study of the sun and its enigmatic spots. He found that these dark features moved across the solar disk as the sun rotates on its axis with a period of about 27 days and that they grew and decayed on time scales of weeks to months. But in decades following sunspots became ever harder to see, and about 1640 a prolonged dearth of sunspots (now known as the Maunder Minimum) set in and lasted until about 1715; during this period sunspots were virtually absent from the solar disk. Significantly, well-known terrestrial concomitants of sunspots, such as the Northern Lights, disappeared as well.

Today, almost four centuries later, astrophysicists know a great deal about sunspots and their activity cycle, as is described in detail by Peter Wilson in *Solar and Stellar Activity Cycles*. They know, for example, why sunspots appear dark (strong magnetic fields hamper the flow of energy from the solar interior, rendering the spots colder and fainter than their surroundings) and that spots tend to erupt on the sun in a not-very-regular magnetic cycle of about 11 years (actually 22 years, since the sunspot magnetic field polarity flips every 11 years). But the most basic question of all—what causes spots and their magnetic activity cycle in the first place—continues to elude solid understanding.



"An early stage in the emergence of a sunspot group shows the rudimentary leader and follower spots. Between these an alignment of the granules suggests the emergence of the top of a magnetic field loop." [From *Solar and Stellar Activity Cycles*; National Solar Observatory]



Coronal emissions. *Top*, "The Indian eclipse of 1980, near sunspot maximum, displays a wealth of coronal structures." *Bottom*, "In the Wisconsin eclipse of 1954, near sunspot minimum, the coronal emission is reduced, and, at high latitudes, polar plumes (short streamers) are observed extending out from the poles as part of the global magnetic field of the Sun." [From *Solar* and *Stellar Activity* Cycles]

This state of affairs is annoying not only to astronomers. It has been known for a long time that the giant magnetic explosions on the sun known as flares, often associated with sunspots, have important earthly consequences. The 1989 failure of the Hydro-Quebec power system after such a flare is one such event recounted in the book. And the sun's luminous output, found in recent years to vary slightly in step with the sunspot cycle, may have nonnegligible effects on terrestrial climate. Indeed, the unusual cold that enveloped Europe just at the time of the Maunder Minimum (sometimes called the "little ice age") may not have been coincidental. Thus it is frustrating, as well as ironic, that after so many years of study we do not have a better understanding of sunspots or the magnetic activity cycle.

The sun is an ordinary star, and it would not be surprising if other sun-like stars also showed magnetic activity cycles. Indeed they do, as the late Olin C. Wilson found from dedicated monitoring of nearly 100 stars for more than a decade. For a small fraction of his sample—significantly, those rotating comparatively slowly—he found compelling evidence for stellar activity cycles very similar to the sun's. This work opened up a new field—the "solar-stellar connection," which allows researchers to study how stellar spots and magnetic activity depend on a star's age, rotation rate, and size, effects that obviously cannot be studied by looking only at our sun. These findings from other stars can provide important clues to the physical mechanisms underlying solar activity cycles.

Peter Wilson's book ably recounts the story of our search for understanding how the sun produces its spots and its stumbling cycle of magnetic activity. Readers hoping to find the long-sought answer to the enigma will be disappointed; this is a good mystery story, but the concluding chapter fails to reveal "who done it." Rather, as the author points out, the end of the story is nowhere in sight. New technologies such as helioseismology (a method of probing the sun's interior through waves detected at its surface, much like terrestrial seismology) may help solve the mystery, and new perspectives from chaos theory could yield some insights, but one is left feeling that no breakthroughs lie around the corner.

Nevertheless, the book makes interesting reading. It describes engagingly and with authority the complex phenomena associated with solar and stellar activity cycles, and the various attempts to construct analytic or numeric "models" describing how the cycle works. A few chapters contain details and equations that will be heavy going for the nonspecialist, but any reader will get a good feel for the history, excite-

ment, and present state of the search to understand what makes the sun and similar stars behave the way they do.

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Other Books of Interest

Haldane's *Daedalus* Revisited. KRISHNA R. DRONAMRAJU, Ed. Oxford University Press, New York, 1995. xvi, 147 pp. $29.95 or £19.95.

Early in 1923 J. B. S. Haldane, age 31, recently arrived in Cambridge to take up a readership in biochemistry, read to The Heretics club a paper that was then slightly expanded and published as the first of many slim volumes in the publisher Kegan Paul's new series To-day and To-morrow. Within two years *Daedalus, or Science and the Future* had been followed by Bertrand Russell's *Icarus, or the Future of Science*, F. C. S. Schiller's *Tantalus, or the Future of Man*, Mrs. Bertrand Russell's *Hypatia, or Woman and Knowledge*, and some ten other volumes, including Haldane's own *Calinicus, a Defense of Chemical Warfare*. Haldane was a physically large man (he dwarfs his chief, Frederick Gowland Hopkins, next to whom he sits in the 1930 photograph of the Cambridge Biochemistry Department that forms the frontispiece to this volume), one who had distinguished himself also by exceptional bravery in the Great War, and he delighted in holding unconventional opinions and in expounding them loudly and publicly. But *Daedalus* was the first of the many occasions on which he would do so formally—before a formal audience and in print. This, and the distress it caused Jack's "Liberal" father, the professor of physiology at Oxford—and the evident delight it caused his mother—we learn from the editor's introduction to this reprinting of the work. A student of Haldane's in the late 1950s when Jack—now "J.B.S."—went to live in India, the editor has subsequently made continuing efforts to memorialize him. And indeed the man and the Oxbridge-Bloomsbury intellectual milieu in which he moved were remarkable. Julian Huxley was one of his closest friends, and *Daedalus*'s central prognostication—that within a century world civilization would be dramatically transformed by a eugenic program based upon a technology of in vitro fertilization and fetal development—became the premise of Aldous Huxley's *Brave New World* (1932). A republication of *Daedalus* draws its appeal from the present justice of one-half of Haldane's 1923 thesis, namely, that the era of physical technology was at its end and that of biological technology just beginning. This volume includes brief essays by M. F. Perutz, Freeman Dyson, Yaron Ezrahi, Ernst Mayr, E. A. Carlson, D. J. Weatherall, and N. A. Mitchison, focusing chiefly on the ill repute into which eugenics fell, and in which it remains. In this respect the most substantial essay is Weatherall's, which considers the present biomedical situation, while in respect of acuity, originality, and an empathetic sense for J.B.S.'s stance on technology and society. Dyson's ten pages stand out.

J. B. S. Haldane. [From the dust jacket of *Haldane's* Daedalus *Revisited*]

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Vignettes: Technological Advance

Back in the days when science fiction was unsophisticated, a standard way to make people uneasy was to introduce the subject of carnivorous plants. The idea of a vegetable preying on animals has an eerie flavor, like the conceptions of cartoonist Charles Addams. When the plant has spiked jaws that grab hold of attractive human blonds, a reader or viewer is—or was, in the old, naïve days—reliably stirred.

. . . Today the thought of plants eating people is a little less disturbing. Science fiction and special movie effects have exposed us to such shattering concepts that a maiden being eaten by anything is taken pretty much in stride by even the prepubescent public.

—*Archie Carr*, in *A Naturalist in Florida: A Celebration of Eden* (Yale University Press)

A recent spate of stories announces that guns will soon kill more people than do cars, the present number-one cause of injury-related deaths. The two graphs are projected to cross each other in the mid-1990s when, it's to be imagined, some safety-engineered car will function just long enough to participate in a drive-by shooting.

—*John Allen Paulos*, in *A Mathematician Reads the Newspaper* (BasicBooks)

The Physicists. The History of a Scientific Community in Modern America. DANIEL J. KEVLES. Harvard University Press, Cambridge, MA, 1995. xlix, 489 pp. Paper, $17.95 or £14.25. Reprint, 1978 edition.

Since its first publication in 1978 Daniel Kevles's *The Physicists* has maintained its preeminence as a historical account of physics in the United States from the 19th century to the 1970s, notable particularly, in the words of *Science*'s reviewer at the time, for its "forthright presentation of the public posture of the [physics] community" (*Science* **199**, 525 [1978]). The book was reissued in 1987 by Harvard University Press with a new preface in which the author reflected both on the position physics enjoyed as essential to the national (principally defense) interest and the growing public distrust of science following on the Vietnam war. Now the book has been reprinted a second time. The preface to the earlier reprint was written just after President Reagan had endorsed the Superconducting Supercollider; the preface to the new one is a 34-page essay on the death of that venture. In it Kevles briefly recapitulates the circumstances that led to the special prestige of high-energy physics and sets forth the scientific considerations underlying the proposal to build the huge accelerator, then provides a narrative account of its fortunes, summarizing the activities of