Our Star: Modern Views

Exploring the Sun. Solar Science since Galileo. KARL HUFBAUER. Johns Hopkins University Press, Baltimore, MD, 1991. xviii, 370 pp., illus. $39.95. New Series in NASA History.

The Copernican revolution elevated the Sun to a dominant position in the universe. There had always been some unease at the Aristotelian scheme, which classified the Sun as simply another planet. Now Copernicus joyfully claimed: "In the middle of all sits the Sun enthroned. He is rightly called the Lamp, the Mind, the Ruler of the Universe." But the Sun was soon dethroned from this central position. It was realized that the Copernican universe could be infinite in extent (a conclusion reached first not by Giordano Bruno, as Hufbauer implies, but by Thomas Digges). The corollary, which Bruno emphasized, was that the Sun could well be just another star. After Galileo's invention of the telescope, and subsequent discovery of new stars too faint to be seen by the human eye, this view of the Sun came to be increasingly accepted. Paradoxically, dethronement from the center of the universe increased the importance of the Sun to astronomers, for it meant that they could study it as a typical star in close-up. This possibility, along with the obvious influence of the Sun on the terrestrial environment, has formed the basic argument for investigating the Sun ever since.

As the subtitle of the book—"Solar Science since Galileo"—indicates, Galileo's work on sunspots is taken as the beginning of solar studies. So the period covered is from the 17th century to the present. The book is divided into three sections. The first gives an overview of the rise of solar studies from the 17th century to the eve of the Second World War. The second continues this for the last 50 years, with special emphasis on the events of the space age. The final section looks in detail at two areas of development during the latter period—observational and theoretical investigations of the solar wind during the years 1957 to 1970, and studies of the Sun's radiative output between 1961 and 1990.

The overview of solar studies to 1940 is a good survey of the earlier history, although occasional points of emphasis might be queried. George Ellery Hale has, deservedly, always had a good press from historians of science, but this has sometimes led to an ignoring of some of his contemporaries. In this case, to stress the importance of his spectroheliograph without mentioning Deslandres seems a little unkind. More important, it would have been worth exploring pre-war developments in areas that are subsequently examined in detail for the post-war period. For example, theoretical questions relating to the Sun's magnetism were debated in the inter-war period by such people as Sydney Chapman and Thomas Cowling, both of whom figure in this book, but not in this context. Indeed, there is a tendency even in the account of the post-war years to underplay the impact of solar magnetic studies on thinking about the Sun. A glance at successive editions of astronomy textbooks illustrates how magnetism changed from being one interesting property of the Sun among others to being the fundamental parameter that determined solar activity.

An important factor, very properly stressed for the post-war years, is the influx into solar studies of scientists trained in other fields. These were often observationalists who had realized that their instrumentation could be applied to investigating the Sun. Most of them entered via a concern with rocket or satellite-borne equipment. It was in this way that observations of solar x-rays, ultraviolet radiation, and so on were begun. Some of these entrants stayed; others—as is not, perhaps, adequately stressed in this book—moved on. They were observing the Sun less for its intrinsic fascination than because it was the only object that could be easily studied with insensitive instruments. As instrumental sensitivity increased, so many of them transferred their interests to other parts of the universe. As a consequence, post-war developments in solar physics have tended to look like a series of waves breaking successively on a beach. However spectacular the waves, their ultimate importance has been what they have contributed, after breaking, to the general tide of advance in solar studies.

The most interesting part of the book—because also the most pioneering—is the third section. Here the use of NASA archives, backed by discussions with a number of the scientists involved, have led to two detailed studies. The first concerns the discovery of the solar wind. This is a complex story, well disentangled here, though more might have been made of the magnetic problems involved, as distinct from the particle-flow problems. Particle flow from the Sun and its effects have been discussed sporadically from the 19th century onward. But particle flow by itself did not adequately explain the nature of the interaction with such objects as comets, or Earth's exosphere. Understanding what actually happens in the interplanetary medium required, and in part encouraged, the development of the new theoretical field of magnetohydrodynamics (a word that does not appear in this book).

The second case study treats an even more complex story—the measurement of the solar "constant." Here, too, the main threads are well described; the only criticism to be made concerns the question of time scales. Variations in solar radiation output relating to the solar cycle need to be distinguished from other types of alleged change, which are almost always longer-term. In addition, solar-cycle variations have been searched for via a number of different routes for many decades. Hufbauer mentions some of the earlier studies, but not all those that are relevant to this theme. For example, Douglass's studies of tree rings was an important precursor of some of the work described here.

The research for this book was supported by a grant from NASA, and it is therefore naturally concerned especially with space-related solar physics. This means that major Earth-based developments—such as the search for solar neutrinos and the study of solar oscillations—are only mentioned in passing. Similarly, a scan of the list of leading solar physicists provided here indicates that only a few have their work discussed in detail in this history. Indeed, Hufbauer reports that: "More than one solar physicist has wondered how a book about the history of solar science could devote so much attention to topics outside its mainstream." His own defense—that the topics chosen will be increasingly seen as mainstream—is probably fair enough. Certainly, although this is not a full history of solar research, it adds considerably to our knowledge of that history. NASA should feel well rewarded for their support.

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