acceleration of the solar atmosphere.

The Sun's magnetic field, which is thought to be generated by some dynamo mechanism in the Sun's convective envelope, can also serve as a probe of the solar interior. Recent observations, as well as reexamination of old data, have revealed some remarkable facts about that magnetic field. At the visible surface the field is clumped into small (about 400 km in diameter), intense (about 2000 gauss) flux tubes, which are spatially organized by the supergranular convective cells. On larger scales the field is organized by sunspots and their surrounding "active regions," which migrate in latitude and change polarity in the course of the 22-year solar cycle. This cycle is itself irregular, and there is compelling evidence that it can turn off entirely, as it did during the "Maunder minimum" (1645–1715). On still larger scales one finds that the magnetic field exhibits persistent "active longitudes" and large areas of dominant polarity that are associated with "coronal holes"—regions of open field and enhanced solar wind flows. Much has been discovered in recent years about the flows required to produce the fields, but still not enough is known to construct a convincing dynamo model, as Peter Gilman discusses in a meticulously researched chapter.

Volume II is concerned with the solar atmosphere, for which spacecraft have provided the newest data. Wherever one looks, the Sun is highly inhomogeneous: X-ray bright points, active region loops, jets, fibrils, spicules, coronal transients and magnetic canopies are but a few of the phenomena seen. These structures are invariably dynamic, they are highly energetic and they appear to be governed by the magnetic field. The eight chapters of volume II cover the data, the physical processes involved in the production of the observed photon and particle emissions, and current theories about the physical nature of the observed phenomena. The authors emphasize deficiencies of these theories and comment on the inadequacies of the available observations. Better data, from the Solar Optical Telescope, will unfortunately have to await NASA's resolution of its current troubles. However, the essential role of the magnetic field still presents a stumbling block, since high-resolution measurements of vector magnetic fields above the visible surface do not at present appear to be feasible.

Volume III puts what we know about the Sun in the larger context of astrophysics and solar–terrestrial relations. Much of the volume is devoted to problems posed by many stars: There are star spots and stellar activity cycles; the dynamo problem is ubiquitous; stellar atmospheres are heated and many stars show strong outflowing winds. Three final chapters discuss the Sun's role in a variety of terrestrial phenomena: Its emission of high-energy photons and charged particles affects the Earth's ionosphere and upper atmosphere in numerous ways, and the solar wind is known to be responsible for phenomena such as the aurora and geomagnetic substorms. The recent discovery that sunspots reduce the Sun's net luminosity may have profound implications for climatology.

In spite of my general enthusiasm for these volumes, there are some disappointments. The most significant appears to be a long delay in publication. Fortunately, most of the chapters are largely tutorial, and they are of enduring value. But some chapters are primarily reviews of the literature, and they are already somewhat out of date: There are virtually no references later than 1982. The chapter on dynamos is particularly disappointing in this regard; a tutorial exposition of the mathematical development of dynamo theories would have been very useful.

I am also disappointed that the solar wind is discussed only as parts of several chapters. The wind is the only region of the Sun's atmosphere that can be directly sampled. It is highly likely that phenomena we see in the solar wind are occurring elsewhere in the solar atmosphere. The importance of the solar wind for solar physics has been lost in these volumes. Indeed, magnetohydrodynamic turbulence, which is observed in the wind, is not discussed at all.

Magnetic reconnection is another fundamentally important physical process that is not adequately covered. Nancy Crooker and George Siscoe provide a discussion of observations of reconnection in the Earth's magnetosphere, but do not emphasize the importance of these observations for solar physics. Eugene Parker's coronal heating theory, which involves reconnection, is barely mentioned, and modern numerical models of reconnection in solar flares are omitted.

These volumes thus reveal a tendency on the part of many solar physicists to overlook the value of *in situ* observations of space plasmas. A happy exception is the chapter on solar radio emissions, by Martin Goldman and Dean Smith. These authors use *in situ* solar wind data to guide the interpretation and theory of solar radio bursts. This chapter shows how much can be done with this approach.

Finally, I would like to make note of several other works that can be used as companions to the present volumes. For general discussions of the physics of magnetic fields and their roles in the solar atmosphere, *Cosmical Magnetic Fields* by Eugene Parker (Clarendon Press, Oxford, 1979) and *Solar Magnetohydrodynamics* by Eric Priest (Reidel, Boston, 1982) are unsurpassed. Another good reference is the NASA publication *The Sun as a Star*, edited by Stuart Jordan (1981). And to celebrate its centennial volume, the journal *Solar Physics* has recently published a series of review articles on virtually all aspects of solar physics.

Thermoluminescence of Solids

S. W. S. McKeever

376 pp. Cambridge U. P., New York, 1985. $72.50

Stephen McKeever of the department of physics at Oklahoma State University has been active over the last decade in the application of the techniques here called "thermoluminescence" to fields such as dosimetry, dating and geology. It is the purpose of this volume in the *Cambridge Solid State Science Series* to describe how thermoluminescence originates in the solid-state properties of insulators and semiconductors and to indicate how the phenomenon can be used as a research tool.

Thermoluminescence arises when carriers that have been excited into metastable trapping states by radiation are thermally excited from the traps and return to their ground states with the emission of a photon. The field received a major stimulus in the 1940s and 1950s with the analyses by J. T. Randall and M. H. F. Wilkins and by G. F. J. Garlick and A. F. Gibson in England, and with the applications to dating pioneered by Farrington Daniels in the US. (The naming of the phenomenon represents one of those cases of inappropriate nomenclature's taking hold and sticking. When electrons are thermally freed from traps, they may also increase the conductivity; this phenomenon is universally known as "thermally stimulated conductivity," and no one would ever think of calling it "thermoconductivity." The related luminescence phenomenon should be known as "thermally stimulated luminescence," and this title has indeed been used. In his pioneering work of 1950, *Luminescence of Solids*, H. W. Leverenz pointed out the incongruities of using the term "thermoluminescence," which implies the excitation of luminescence by heat, but to no avail; the term is still with us.) In today's analysis of the properties of defects in semiconductors, this luminescence technique has been augmented by a variety of thermally stimulated conductivity experiments and by the whole range of capacitance measurements known under the collective heading of "deep-level transient spectroscopy."

The first half of this book is devoted to a detailed summary of the various models and methods of analysis that have been applied. Examples of the investigation of defects in materials are provided for alkali halides, quartz and silica. The remainder of the book is concerned with uses of the technique (including a discussion of the major materials used) in dosimetry in general and medicine in particular, in dating, in geological problems involving meteorites and lunar materials and in terrestrial applications such as shock detection, geo- and paleothermometry and prospecting.

The book concludes with a discussion of the instrumentation needed for carrying out research in thermally stimulated luminescence, appendices on minerals and available systems, a list of over 1000 references and an index.

McKeever has performed a genuine service in collecting in this book the major theoretical and practical information concerning thermally stimulated luminescence. It will be particularly useful to those who desire to use the technique in one of the fields described.

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Supercomputers in Theoretical and Experimental Science

Jozef T. Devreese and Piet Van Camp
225 pp. Plenum, New York, 1985. $59.50

The use of supercomputers in all disciplines of science has increased tremendously in the last few years. Academic scientists in the United States have access to supercomputers in large part because of the initiatives of the US Department of Energy and the National Science Foundation. These agencies have directly funded first-rate supercomputer centers in universities and have provided reasonably adequate access to the centers for nearly all scientists who need supercomputer power in their research. This new and exciting method of research is often dignified with the title "computational science" and frequently is even promoted as a third way of doing science, alongside the more traditional theoretical and experimental methods.

Whether or not one subscribes to the view that computational science is providing a revolutionary new method of doing basic research, literally thou-