pretation of local properties, which suggests additional global nonlinearities. The message from these chapters is that cortical processing is essentially nonlinear within its normal operating range and that the field of computational vision is gearing up to meet the challenge.

Under natural conditions, the shape of an object can be sensed by using several cues. Bültoff demonstrates trade-offs between cues such as stereo, texture, and shading, using realistic images of objects generated by computer graphics. These experiments on cue integration are beginning to probe the heart of vision, which lies in building up a unified view of the world from fragmentary, noisy, and often competing sources of evidence. Mathematical models from statistics and neural networks are providing a framework for exploring these interactions. Another area of perception that has benefited from computer graphics is transparency, which Kersten explores in psychophysical experiments.

Many of the computational models in the book were developed originally for computer vision, and those readers approaching this book from a more naturalistic or ethological view may find this engineering approach limiting. Vision is, after all, in the service of behavior, and visual systems may have evolved in ways we may not have anticipated. For example, David Field at Cornell University, who was present at the meeting but does not to contribute to the book, has found that images of the natural world have a self-similar structure. Thus the world is not arbitrary, and this regularity is probably exploited by the brain in its representation of visual information. It is well established by physiological recordings that many cues, such as disparity, are represented in the visual cortex by populations of neurons that have broad, overlapping selectivities. Recent evidence also points toward a sparse population code for complex objects such as faces. In contrast, local codes for disparity are entrenched in computer vision, which has influenced Frisby's chapter on stereoscopy. We need to develop a better understanding of the types of distributed representations found in the cerebral cortex.

Parker ends the volume with a look toward the future of computational vision. One increasingly important direction is sensorimotor integration. The visual system does not passively sample the incoming stream of visual input. In fact, visual signals derived from the earliest stages of visual processing in the visual cortex are used to direct eye movements. Once the head and eyes are allowed to move under central guidance, the visual system can be used to actively seek out information about the world. Dana Ballard (*Artificial Intelligence Journal* **48**, 57–86 [1991]) has demonstrated that the coupling between sensory and action systems often simplifies the analysis of visual scenes and provides new insights into the biological problems faced by itinerant creatures such as ourselves. The future of vision is shifting from optics to robotics.

There is need for a comprehensive book on vision that presents a unified view of late as well as early vision. It may no longer be possible for a single person to encompass the subject. A 17-volume encyclopedia of vision, *Vision and Visual Dysfunction*, edited by J. R. Cronly-Dillon (Macmillan Press, London, and CRC Press, Boca Raton, Florida) has recently been completed but is difficult to digest. Landy and Movshon's book is admirable in presenting a coherent view of early vision, an achievement that is rare in a compilation. It is beautifully produced and nicely complements traditional texts for vision courses.

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Perspectives on the Sun

Solar Interior and Atmosphere. A. N. COX, W. C. LIVINGSTON, and M. S. MATTHEWS, Eds. University of Arizona Press, Tucson, 1992. xvi, 1416 pp., illus. $60.

The sun is a star; a reasonably large number of modern societies take this as a fact. The sun also just happens to be closer to us than any other star, and for this reason it is in a class by itself. The sun, then, is *our* star. We can resolve its surface and observe its small-scale changes over years, days, and seconds. This line of argument defines "solar physics" as a science that studies the physical properties and activities behind the complexity of the detailed phenomena we observe on the sun—a unique endeavor.

We can also argue, however, that the sun is a very common type of star, one among billions of similar stars that rarely do anything of significance (such as blow up in a hurry, astronomically speaking). When viewed from this perspective, "solar physics" is a science whose primary objective is to acquire information that can then be used to better understand more interesting stars.

In the "olden days" (that is, prior to the explosion of astronomical technology and, consequently, data collection), the enterprises of studying the sun as "our star" and studying it as a random example of stars in general were interwoven. My mentor, Albrecht Unsöld, was not ashamed to describe our sun in quite some detail in his standard work *Physik der Sternatmosphären* (Springer-Verlag, 1955). Now, however, in consideration of funding sources and other overriding factors, solar scientists must decide beforehand whether to stress "the sun as our star" or "the sun as a stellar example" as the focus of their research.

The editors of *Solar Interior and Atmosphere* have decided to do it all. They define the volume as a text for graduate students as well as a resource for solar and stellar physicists who study the sun, and they rightly claim that the 1400-page volume, with 101 contributors, is the most comprehensive of recent books on this subject. A. N. Cox *et al.* also include a brief history of the project and comments on their philosophy regarding commonly omitted issues such as "flavor and focusing of controversies."

J.-C. Pecker's introduction (appropriately titled "The global sun") to part 1 of the volume lays the groundwork for appreciating later discussions of how detailed, ground- and space-based observations, from the x-ray to the radio range, verify or reject the idea of the sun as a model star. Pecker places particular emphasis on what he calls coupling among physical processes, such as convection, rotation, and magnetism, for the simple reason that they provide evidence for determining properties of the solar interior and, by implication, stellar interiors. Subsequent contributions detail the observational and theoretical bases of the various processes.

The contributions in part 2 discuss in depth the various types of surface oscillations and what they reveal about the sun and its interior. These data are especially important because a multinational project (GONG, for Global Oscillations Network Group), aimed at setting up dedicated observing stations around the globe, is currently nearing completion. The relatively short part 3 singles out the use of surface observations of radiation as a method of determining a consistent picture of the solar interior. The image quality of ground-based observation is obviously one crucial item of importance, and this section provides a good summary of the early work on adaptive optics, by now one of the most promising avenues of improvements.

Part 4 deals with the bewildering array of observations of the so-called "11-year cycle" of solar activity, its most popularly known effect being the semiperiodic appearance of sunspots (lower surface temperature in the presence of localized strong magnetic fields). The reasons behind such highly localized variations in the physical parameters of solar gas, together with sudden bursts of particles and radiation, pose some of the most exciting and potentially

rewarding problems in astrophysics. Again, the more we learn about the sun, the better we will be able to interpret similar observed features on other stars. This theme is expanded in part 5, which combines discussions of solar-like phenomena observed on other stars with observations of the sun as just another star.

The 123-page bibliography lists some 4000 references (this is my guess) with full titles. The sources are almost all to be found in the refereed and commonly available literature, and they include works published up to about 1990. The book also includes a group of appendixes containing basic data on the sun's element abundances, models of its interior, and its so-called p-mode frequencies, but lacks a detailed subject index. In my opinion, this is defensible given the targeted audience and the uselessness of 100 references such as "Sunspots, magnetic fields."

Solar Interior and Atmosphere should be available to anyone involved in astrophysical or space research and teaching, and it also would be a useful addition to any solar physicist's personal library.

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A Peptide

Galanin. A New Multifunctional Peptide in the Neuro-endocrine System. TOMAS HÖKFELT, TAMAS BARTFAI, DAVID JACOBOWITZ, and DAVID OTTOSON, Eds. Macmillan, London, 1992. xviii, 433 pp., illus. £75. Wenner-Gren International Symposium Series, vol. 58. From a symposium, Stockholm, June 1990.

The biologically active peptide galanin was isolated in 1983 from porcine intestine by Tatemoto, Mutt, and collaborators, who used a biochemical protocol to identify new compounds with COOH-terminal amino acid α-amides. This type of sequence was common to many known biologically active peptides, and Tatemoto *et al.* reasoned that others could be isolated on this basis as well. The current myriad of peptides in search of function is overwhelming, but galanin stands out in that it has been clearly implicated in a number of neuromodulatory and endocrine functions. Galanin is colocalized in many cholinergic neurons of the brain, including those involved in memory acquisition and those particularly susceptible to Alzheimer's disease. Cellular and biochemical studies have shown that one of galanin's common functions is to presynaptically inhibit acetylcholine release. In the endocrine pancreas of many species, galanin acts directly on the pancreatic β cells to inhibit glucose-stimulated release of insulin. Galanin is also involved in the regulation of growth hormone release.

The potential importance of this peptide is underscored by the large international group of researchers actively investigating its actions, many of whom contributed to the symposium from which this volume is derived. The contributions are loosely organized into sections on topics ranging from the discovery, biochemistry, and molecular biology of galanin to its role in behavior and disease. The organization is somewhat arbitrary since many presentations span more than one subject; there is also considerable repetition since several groups are investigating similar aspects of galanin's function. Unfortunately, the index is poor, which means that there is no easy way to access all of the information on a particular area. These caveats aside, the volume provides an excellent overview of our current understanding of this peptide.

Chapters by Rökaeus and Waschek and Kaplan *et al.* in the first section provide especially nice reviews of the molecular biology of galanin, and excellent discussions and maps of the distribution of galanin and its binding sites are provided in the second section. The remainder of the contributions deal with functional studies on topics from receptors to behavior, with evidence at each level that the NH_2-terminal portion of the molecule is important for function. Residues 1 through 15 or 19 (of 29) generally work as well as the whole molecule. A tryptophan in the second position is crucial in many instances.

The NH_2-terminal portion of the molecule is highly conserved among all species examined, but there is considerable species diversity in the action of galanin. The chapter by McDonald *et al.* nicely addresses this issue with respect to galanin's role in inhibiting secretagogue-induced insulin release. The possibility exists that some of this diversity in the pancreas and elsewhere derives from the less conserved COOH-terminal portion of the molecule.

There is still much to be learned about galanin and its mechanisms of action. Just under the surface in many of the chapters in this volume is the idea that there may also be other galanin-like peptides yet to be discovered. Galanin has established its importance in the neuroendocrine field in less than ten years; the next ten years should be exciting.

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