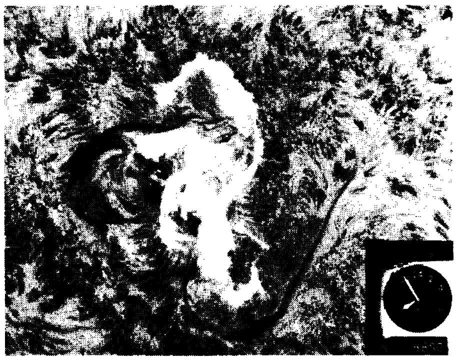

"The great 'sea horse' flare of Aug. 7 1972, taken at Hα—0.5 Å." [From *Astrophysics of the Sun*; Big Bear Solar Observatory and Zirin and Tanaka (1973)]

sunspots and their immediate vicinity. I am disappointed that there is practically no discussion of radio emission from sunspot-associated regions, especially since the microwave structure of such regions led to the development of the gyroresonance absorption interpretation of the slowly varying component.

Chapter 11, on solar flares, is quite detailed, clearly reflecting the author's expertise. The author describes step by step various facets of the flare phenomenon; spectacular pictures of flares in Hα are provided, white light flares are discussed in reasonable detail, and the normal classification of flares as well as the classification based upon HINOTORI x-ray flares is given; flares in gamma-rays (both continuum and lines) and hard x-rays (imaging and non-imaging spectrometer data) are discussed. In the radio domain, microwave spectra and associated theoretical interpretations are provided in some detail; meter-wave observations are discussed minimally, and the discussion is not up to date. Overall this is a good chapter; from it a serious student will get a good flavor of flare physics.

As a whole I find the book to be quite good. The author has covered practically all aspects of solar physics, though I do not think radio observations receive adequate treatment. There are some typographical errors, and some references cited in the text are missing from the bibliography. The book is intended as a textbook for graduate courses in solar physics, but for that purpose it will need to be supplemented by reading material, on, for instance, radio observations and coronal mass ejection events.

In the preface Zirin comments on solar physics research in general and his participation in it. As he laments, university-based solar research has dwindled, and faculty positions for solar physicists are almost nonexistent. Solar research in the United States is coming to be confined almost entirely to the national centers and federal laboratories. Every university-operated radio facility but one has disappeared for lack of funding. To a large extent, the solar physicists, who for too long have been interested only in their own subdisciplines, are to be blamed for this situation. Solar radio astronomy has specially suffered for that reason. For example, the Clark Lake Radio Observatory—a unique and powerful radio facility for observing the Sun—died because of lack of support from non-radio solar physicists, leaving a void in solar physics research that cannot readily be filled. And if solar physics is not done in the universities who will train our graduate students in solar physics? As it is now, a student gets a Ph.D. in a field such as cosmology or extragalactic astronomy and comes to solar physics, often with a contractor (a "beltway bandit"), only on failing to find a job in his or her field. This is clearly not the best way to be training solar physicists, and universities must be made to see that they have a responsibility here.

I recommend the book to all solar physicists, potential solar physicists, and the chairmen of the many astronomy departments where astronomy starts beyond the solar system: they could profitably use it in starting graduate courses in solar physics.

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High-Tech Astronomy

Observational Astrophysics. PIERRE LÉNA. Springer-Verlag, New York, 1988. xii, 328 pp., illus. $54. Astronomy and Astrophysics Library. Translated from the French edition (Paris, 1986) by A. R. King.

For much of the past century the primary tool of the astronomer was a photographic plate exposed through a large optical telescope. The observer sat in total darkness peering through an eyepiece, guiding the telescope for hours with the touch of a surgeon on the controls. Although astronomical photography still has its uses, it receives scant attention in this up-to-date description of modern *Observational Astrophysics*. Instead, we learn about solid-state detectors, bolometers cooled below 1 degree Kelvin, laser-driven heterodyne mixers, spark chambers, and superconducting grains. Some of these detect visible photons with a sensitivity increased by orders of magnitude over the venerable photographic emulsion. But the more striking technology-driven advance of the past several decades has been the opening of the entire electromagnetic spectrum to astronomical scrutiny. On the ground, vast interferometric arrays of radio telescopes probe the cores of quasars with milliarcsecond resolution. Orbiting satellites, unencumbered by the obscuring mantle of Earth's atmosphere, can record images of previously unimagined cosmic phenomena at infrared, ultraviolet, x-ray, and gamma-ray wavelengths. The neutrino burst from the nearby supernova explosion, which triggered underground particle-physics detectors in 1987, also sparked renewed enthusiasm that even this elusive messenger can be used to study astrophysical processes.

Roughly half of *Observational Astrophysics* is devoted to these new detectors and how they record the feeble rain of cosmic radiation that is our link to the rest of the universe. The descriptions, necessarily somewhat brief, are sufficiently detailed and well illustrated to inform the reader about the internal workings of each detector and what it is good for. Many useful graphs, typically with log-log scales that span several decades, compare the capabilities of alternative instrumentation. These chapters are organized by function, such as imaging or spectroscopy. Although this approach is no less contrived than a division by wavelength, it does represent the new "panchromatic" trend in astrophysics: modern observers rarely limit themselves to any single waveband now that the full spectrum is at their disposal.

Some of the other chapters are less well focused. The sections on measurement theory and signal processing are more than is required to establish notation but insufficient to educate the uninitiated. The discussion of observational methods is also quite limited. This is not a handbook for observers. It is a broader text and reference work for students, active researchers, or anyone who wants a detailed look at the tools of modern astronomy. I could wish for a more complete index to further enhance its utility.

In sharp contrast to their predecessors, observers at a modern ground-based facility sit at computer terminals well removed from the instrumentation. The gap is even more extreme in space astronomy, which will undergo a renaissance with the launch of the Hubble Space Telescope later this year. Though hardly a substitute for hands-on experience, this book can inform contemporary observers about the ingenious variety of those remote detectors that feed their terminals with images and spectra of the cosmos.

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