with an indulgent chuckle, as a detailed description of a dead end? I fully expect to know the answer to these questions before the end of my career. Moreover, I am hopeful that gravitational-wave detection will develop into a powerful tool for exploring the cosmos—a gravitational-wave astronomy.

Two techniques have been and continue to be pursued for ground-based gravitational-wave detection. The first technique, pioneered by Joseph Weber nearly 30 years ago, is called resonant-bar detection. A bar detector is a massive chunk of material, usually a cylinder of aluminum; the excitation of its fundamental acoustic mode by a gravitational wave is monitored by an electromechanical transducer and following amplifiers. The second technique, under intensive development since the mid-1970s, uses optical interferometry to monitor the distance between widely separated masses, which move freely under the influence of a gravitational wave. The goal of both techniques is to be sensitive to gravitational-wave amplitudes, or strains in space, of 10^{-21} to 10^{-22} on millisecond time scales, occurring a few times a year.

Blair has assembled contributions that cover both techniques. The articles outline the theoretical foundations for present and future detectors, and they describe nitty-gritty details of designing, building and operating gravitational-wave detectors. Most of the contributors are experimenters in the field; a few are interested theorists. The book's chief virtue lies in gathering together much of the experimental lore of gravitational-wave detection. In this virtue it is unique.

To improve the sensitivity of resonant-bar detectors, one must reduce the effect of thermal fluctuations by cooling the bar to low temperatures and by using materials with low acoustic losses, and one must also use exquisitely sensitive transducers and the quietest amplifiers. Several contributors discuss these and related topics. Just one example: It is a pleasure to read Bill Hamilton's account of his hard-won experience in designing the outlandish dewars required to cool a 2-ton aluminum bar to a few degrees or below; he adopts the welcome practice of pointing out mistakes in the design of his present detector at Louisiana State University, so they can be avoided by future experimenters.

The goal for interferometric gravitational-wave detection is to construct Michelson interferometers with baselines of several kilometers. The arms of the interferometer would contain an optical delay line or an optical cavity to make the optical path length as long as the wavelength of a gravitational wave. Walter Winkler gives a sober account of the difficulties that must be overcome to construct an interferometer with the desired sensitivity. For each difficulty, he outlines solutions that make one think that such a fantastic instrument just might work. Anyone who reads Winkler's article and the other contributions on interferometric gravitational-wave detection will come away with a sense of the magnitude of the task, but also with an appreciation of the depth of thinking and the hard work that have already taken place.

Who will buy this book? Given the price, mainly libraries. Who will read it? The emphasis on experimental nuts and bolts, virtue though it is, will limit the audience. The reader interested in a general overview of gravitational-wave detection will want to consult a more balanced presentation that gives more theoretical background and makes more of a case for gravitational-wave astronomy; I recommend Kip Thorne's article in *300 Years of Gravitation* (Cambridge U. P., New York, 1987), edited by Stephen Hawking and Werner Israel. On the other hand, if you run a gravitational-wave group, a good way to start off a new staff member or graduate student might be to hand her this book with instructions to come back in a month. A theorist wishing to gain a thorough understanding of the experimental issues in gravitational-wave detection could also profit from this volume. In addition, anyone interested in sensitive mechanical measurements or in optical interferometry would do well to consult this book, because gravitational-wave detection pushes these techniques to their limits.

This book chronicles the enormous progress in experimental technique and in theoretical understanding since the first efforts to detect gravitational waves that began nearly 30 years ago. This progress looks impressive indeed from our present perspective, yet it seemed painfully slow as it occurred. Any prediction for gravitational-wave detection must be tempered by the realization that the field has had its share of overoptimism and unfulfilled expectations.

This background clouds further the usually murky view into the crystal ball, but I'm optimistic. With the funding of the Laser Interferometer Gravitational-Wave Observatory in the US, there is for the first time an instrument planned for construction whose design sensitivity is in the ballpark of estimates for cosmic sources. Difficult scientific and technical obstacles remain, but funding uncertainties are perhaps just as significant. LIGO and comparable interferometers planned in other countries are the best reasons to believe that the oft-heard prediction of 10 years to detection might at last be a reasonable bet.

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Exploring the Sun: Solar Science Since Galileo

Karl Hufbauer
Johns Hopkins U. P., Baltimore, 1991. 370 pp. $39.95 hc ISBN 0-8018-4098-8

In 1610 the Italian natural philosopher Galileo Galilei discovered spots on the surface of the sun. Almost two centuries later, the British astronomer William Herschel, on the basis of his extensive observations with a reflecting telescope, speculated that sunspots are associated with variations in solar radiation. During the past two decades, solar physicists have used spaceborne radiometers to measure the influx of solar radiation at the outer boundary of the earth's atmosphere. As Herschel had suspected, this quantity indeed varies with sunspot activity.

Karl Hufbauer's *Exploring the Sun* tells this story, with special emphasis on recent developments. It also tells much more, describing the changing problems of solar physics, the people who solved them and the instruments they used. Both physicists and historians will find the book a clear, competent and intriguing introduction to a fascinating topic.

Three themes in Hufbauer's story merit special mention. The first is the important role that techniques and theories developed for other purposes have played in solar physics. Galileo's spyglass turned telescope, Gustave-Robert Kirchhoff and Robert Wilhelm Bunsen's spectral analysis and the spaceborne radiometers used to measure the solar constant in the 1970s and 1980s all had their origins outside the study of the Sun. Similarly, thermodynamics and later nuclear physics were central to the debate about the source of solar energy; quantum mechanics made it possible to determine the chemical composition of the Sun's atmosphere; and astrophysical theory made essential contributions to understanding the solar interior.

The book's second theme is the development of a sense of community among those studying the sun. As a historian who has examined the origins of the German chemistry community in the 18th century, Hufbauer is well qualified to explore this subject. He describes the specially equipped observatories, the sections that formed within larger astronomical organizations and the scientific rituals, such as eclipse expeditions, that have set the field apart. He notes briefly the formation of the International Solar Union at the turn of the century and the international network of observatories created between the wars to monitor sunspots. A more detailed description of the postwar community of solar physicists follows, including brief biographical sketches of important figures and an account of the early years of the journal *Solar Physics*.

Finally, Hufbauer's book suggests how patronage has shaped solar physics, especially in recent years. During World War II, observations of the corona were sponsored by the military, which provided funds for new instruments but restricted the publication of results. Early attempts to map the solar spectrum from rockets were carried out at military laboratories and fit within military schedules. In the years since Sputnik, studies of phenomena such as the solar wind and the solar constant have depended on the funds available to agencies such as NASA and the success of the spacecraft they launched. Hufbauer makes no attempt to analyze in detail the way in which such changes have affected the day-to-day work of solar physicists. Nonetheless, he not only sketches a broad outline of the history of solar physics, but suggests where more detailed drawings might be revealing. This book makes for a welcome addition to the literature of the history of science.

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Value-Free Science? Purity and Power in Modern Knowledge

Robert N. Proctor

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Throughout history, many have asserted—and others have contested—the idea that the sciences occupy a special realm beyond human values, interests and aspirations. But the value freedom of science has been conceptualized differently in different periods, and Robert Proctor's aim