

papers or to probe a particular subject in more detail. The fields covered include electron scattering and capture, heavy-particle collisions for neutral-neutral and ion-neutral systems, and photon collisions. In the words of the author, "...the aim [is] to expose the scope of the subject rather than to discuss a few aspects in detail." Consequently, there is considerable breadth, including such topics as resonance effects in electron-atom (molecule) scattering, semi-classical scattering theory for heavy particle collisions, resonant charge transfer and photodetachment. However, Sir Harrie does not discuss some recent topics, such as the study of highly excited "Rydberg" atoms, laser fluorescence and the contributions of quantum chemists to the field. The book concludes with a chapter on problems related to atmospheric physics and interplanetary space and with appendices that focus upon various experimental techniques.

This text by Sir Harrie Massey is unique, but probably will not be selected for as many personal libraries as were his earlier books due to its rather limited scope, its intended audience and its rather high price.

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Astronomy of the Ancients

K. Brecher, M. Feirtag
215 pp. MIT, Cambridge, Mass., 1979. \$12.50

Astronomy of the Ancients is an archaeoastronomical sampler of papers from a symposium presented 10-13 January 1977 at MIT, embroidered by astrophysicist Kenneth Brecher and science editor Michael Feirtag. All but one of the eight articles (and Philip Morrison's brief but evocative introduction) originally appeared together as a special issue of *Technology Review* (December, 1977). Anthony F. Aveni's piece, "Old and New World Naked Eye Astronomy," also made its first bow in the same journal, but in a later issue (November, 1978).

Solar physicist John A. Eddy updates his fieldwork on the medicine wheels of North America's Great Plains and writes with a sensitivity worthy of the sanctity imbued in these monuments by the people who built them. NASA scientist John C. Brandt presents another aspect of American Indian sky lore: possible representations of the AD 1054 Crab supernova by eyewitnesses in the American Southwest. Although this interpretation is falling, gradually, into disfavor, Brandt presents a clear, fair statement of his argument.

A comparison, or rather a contrast,

between astronomical measuring instruments of the Old World and the New by historian of science Sharon Gibbs, renews our admiration for the sun dials and other, more remarkable devices contrived by the ancient Greeks. The Greeks were so close to the origins of modern mathematical science, they are often forgotten by those interested in prescientific astronomy. Here, then, is a welcome reminder of another side of Greek astronomy.

Anthony Aveni is a leading investigator of sites in Mesoamerica and Peru. He contrasts the ecliptic-pole scheme of Mesopotamia with the cyclic numerology of Mexico and appeals effectively for respect and further attention for the New World astronomy, so different from our own. Aveni also suggests that astronomy at temperate latitudes, unlike that at the tropics, was not focused on horizon phenomena. Though the evidence contradicts this, it does not dilute his main theme.

Co-editor Kenneth Brecher contributes his encounter with two mysteries associated with Sirius, the night's brightest star. One is a string of ancient reports of the star's red color. Sirius is white. The other is the the allegedly ancient Dogon tradition of an unseen companion of Sirius. The star exists, but the Dogon shouldn't have known about it. Brecher's account of these two enigmas is intriguing but unresolved. The mysteries await solution, and I suspect in the case of the Dogon much more may be learned by going back to the ethnographic reports.

Stonehenge is described by Owen Gingerich, well-known for his research of more recent astronomical history. Gingerich rightly separates the first stage of Stonehenge from the last, constructed 800 to 1000 years later, and regards the last as a monument to the astronomy of the first. This may, in part, be so, but Stonehenge experienced many modifications, and the astronomical dimension there is much more complex.

Two astronomical interpretations of mythology, one more convincing than the other, wrap up the book. Jerome Y. Kettvin offers an unexpected but plausible network of associations between Mediterranean cephalopods, the Gorgons of ancient Greece, and Algol, the Demon Star. His article ends with the most charming line in the book: "Most of you, of course, may prefer a rational account of things; but I was never one to put Descartes before Horus." Harald A. T. Reiche seeks Atlantis in the precession of the equinoxes. His belief in the astronomical component of myth is reasonable and well-stated, but the details of his cryptoanalysis stir uneasy memories of Pan-Babylonianism and the consequent rejection of any astronomical

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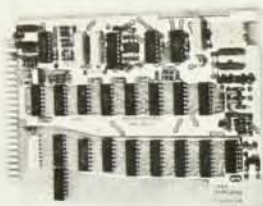
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interpretations.

Editors Brecher and Feirtag have assembled a set of readable and informative accounts of the contributors' current research or speculations. For a taste of a few of the many piquant entrees now on archaeoastronomy's menu, *Astronomy of the Ancients* provides one of those combination plates that work so well on one's first visit to a foreign restaurant. I only wish the table had been set with the fine color photographs that Technology Review originally published with these selections. Fortunately one of them, Owen Gingerich's splendid view of the winter sun at Stonehenge, made it to the book, as the jacket illustration.

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The Optics of Nonimaging Concentrators: Light and Solar Energy

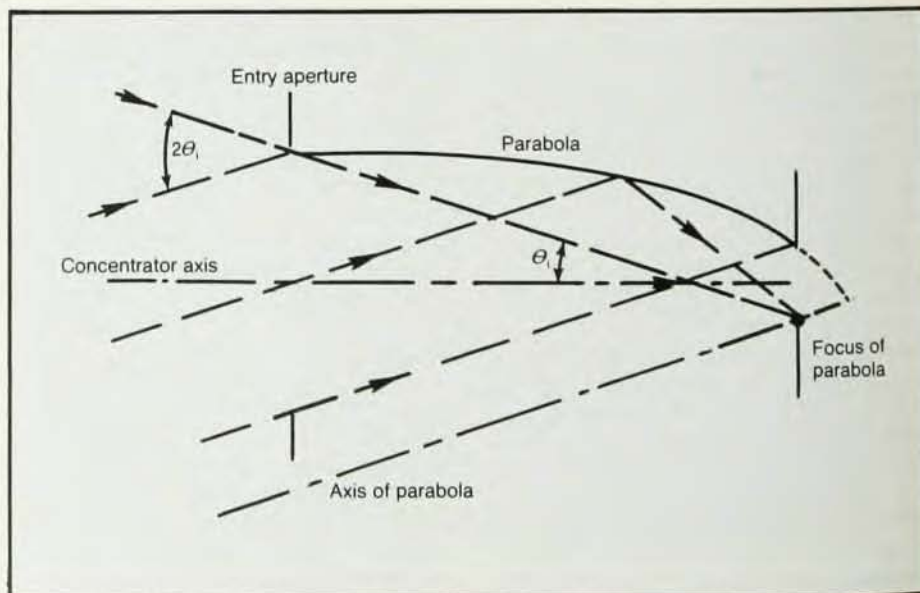
W. T. Welford, R. Winston

200 pp. Academic, New York, 1978. \$22.50

Solar-energy collectors are of many kinds, ranging from systems based on photosynthesis to those that directly convert sunlight to electricity. In direct-conversion systems, it is usually desirable to concentrate the light as much as possible before it strikes the detector to optimize the efficiency of the system. *The Optics of Nonimaging Concentrators* is a monograph that explores the consequences of the fact that the brightness of a light source cannot be increased by a passive optical system and how those consequences relate to light concentration.

An optical system can be characterized by its *étendue*, the area of the entrance aperture multiplied by the maximum projected solid angle of the entering beam that can pass through the system. One can show that in an ideal system this parameter is equal to the product of the area of the exit aperture and the projected solid angle of the exiting beam. If we want to concentrate a beam of given area into a smaller area, we can do so only by increasing the solid angle of the beam. Since the projected solid angle of the exiting beam cannot exceed $\pi/2$, there is a maximum concentration ratio for light coming from a source subtending a given solid angle. One way to compare different practical light concentrators is to see how closely they approach this theoretical maximum. W. T. Welford and Roland Winston consider several different types of both imaging and non-imaging concentrators, but the principal discussion centers on a non-imaging system called a "compound parabolic concentrator," or CPC. A CPC can be formed, in three dimensions, by rotating a section of a parabola about an axis different from the axis of the parabola. In two dimensions, a CPC consists of upper and lower parabolas that are not confocal. The authors show that the two-dimensional CPC is an ideal concentrator, in the sense of the *étendue* law, and that three-dimensional CPC, while not ideal, is nonetheless pretty good.

The theoretical development in the book is both sound and well-presented. Its level is suitable for working physicists and engineers; anyone desiring to make a research contribution to this field should be familiar with this book. The authors are to be commended for their thorough treatment, which in-



Construction of a compound parabolic concentrator profile from the edge-ray principle. The line drawing appears in *The Optics of Nonimaging Concentrators: Light and Solar Energy*.