

Behind the Crystal Ball: Magic, Science, and the Occult from Antiquity through the New Age

▶ Anthony Aveni
Times Books (Random House),
New York, 1996. 406 pp. \$28.00
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In historic breadth, informative punch and accessible style, Anthony Aveni's entertaining story of magical thinking and occult techniques for interacting with a coy cosmos has no modern match. To find anything comparable for the general reader, you would have to revert to Martin Gardner's classic *Fads and Fallacies in the Name of Science* (Dover, 1957) or pick up a copy of Michael Shermer's more recent *Why People Believe Weird Things* (W. H. Freeman, 1997). Neither of these, however, embraces Aveni's chronological sweep or the anthropological perspective from which he surveys the wildfires we have so often set in the landscape of reasoned analysis.

Unlike those other titles, Aveni's *Behind the Crystal Ball*, is not strictly an exposé of irrational belief and pseudoscientific claims. Although the factual and rational shortcomings in ideas as diverse as Etruscan liver divination and abduction by aliens are incorporated into his narrative, his real objective is to understand the nature and value of systems of magic. With cross-cultural verve, he distinguishes the function of science from the function of magic and sees magic as an expression of wishful thinking and as a religious response. Science, on the other hand, stalks understanding and evaluates the hunt in terms of accuracy and reliability of outcome.

Trained as an astronomer, Aveni acknowledges science's pretty good track record. It is the persistence of magical thinking and behavior, in spite of the triumph of science, that engages him. More than a quarter-century of distinguished teaching at the university level has demonstrated to him that each generation of highly educated students is intrigued by one scientifically uncorroborated claim or another—be it extraterrestrial spacecraft, Jungian archetypes or homeopathic medicine.

How can we account for the persistence of any belief at odds with the dominant system of knowledge? Aveni correctly answers the question: Mobilized by belief, individuals often respond effectively to the challenges they face. Although the thoughtful mem-

bers of the audience understand that it is really the aerodynamic properties of Dumbo's ears that permit him to fly, it's the magical feather that gets him airborne. Belief, then, is a tool for survival, and that, at the foundation, is the theme of this book.

However, highlighting the function of belief in the framework of a comparison between magic and science sidesteps the real conflict in these systems of thought. Science, after all, is just a certain way of knowing certain things with a certain kind of certainty. But it is rooted in critical thinking, and that is the door of magic's departure from science. Critical thinking has also been demonstrated to be a useful tool for survival, and it delivers valuable goods whether or not we live in anxious times. Magical thought, on the other hand, is cultivated by stress. It offers, after all, hope.

Without quarreling with the value of hope, I remain unambiguously skeptical when I see us teetering on the fence between testing knowledge and believing in miracles. Skepticism is a reasonable consumer response in today's marketplace of ideas; with too many dealers and not enough durable merchandise, marketing integrity is compromised. The current fashion of cultural relativism prompts Aveni to offer a kinder and gentler report card to magic. But by default, frauds, who trade in the romance of miracles, as well as believers, get the benefit of the doubt. This may be tolerant, but it may not be smart. In the wake of the Heaven's Gate cult suicide, we are reminded that natural selection still thins the herds that graze on absurd belief. If Aveni senses in our time a convergence of spirituality and science, that too could be wishful, magical thinking.

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Astrostatistics

▶ G. Jogesh Babu
and Eric D. Feigelson
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Astronomical observations have played an important role in the development of statistical methods. G. Jogesh Babu, professor of statistics, and Eric D. Feigelson, professor of astronomy and astrophysics, both at Pennsylvania State University, point out in their book, *Astrostatistics*, that modern data require more sophisticated analytic techniques, and they question whether today's astronomers have the neces-

sary statistical tools to analyze their large and varied data sets.

The authors note that, with modern computers, statistical analysis need no longer be limited to traditional analytic methods, methods that may not be ideally suited to some problems in astronomy and in some other fields as well. In their book, they provide an introduction to statistical applications for astronomers, and they encourage more active cooperation between astronomers and statisticians. *Astrostatistics* is aimed at professionals and graduate students in astronomy and statistics. It assumes a basic understanding of statistical concepts.

Roughly the first third of the book is devoted to overviews of astronomy and statistics, each intended as background for readers from the alternate field. The introduction includes a brief but fascinating glimpse of the development of statistical analysis of astronomical data from ancient Greece to modern times, accompanied by generous references. There is also a useful discussion of statistical software packages that are available on the Internet or commercially. The authors summarize current problems in astronomy, describe characteristics of astronomical data and provide lists of notation, catalogs and telescopes. In brief, clearly focused paragraphs, they discuss contemporary issues in astronomy and suggest introductory textbooks and intermediate-level monographs for further reading. The overview of statistics begins with very basic methods and proceeds to more advanced topics, including maximum likelihood methods, resampling methods and Fourier and wavelet analyses. The authors provide standard probability functions and equations. Applications are discussed in more detail in later chapters.

Subsequent chapters are devoted to individual topics, including analysis of spatial distributions, multivariate samples, time series data and incomplete data sets, topics that may require special treatment in astronomy because of the nature of the observational data. The discussions are mainly descriptive, with limited graphical illustrations and equations but with useful references to statistical papers and software packages. A non-astronomer would be impressed by the wide variety of data and the corresponding range of techniques for successful analysis. The authors conclude their book with a discussion of several current controversies in astronomy, with critiques of the claims and the procedures used in analyzing the data.

This small book covers a great deal of astronomy and statistical analysis in a very readable manner. However,