counter. Thus those scientists may infer that the book is not relevant to them. They should not. Results in the physical sciences can have enormous human and societal impacts and can raise knotty moral problems, as history has shown. *Science for Sale* is a cautionary tale that should provoke thoughtful discussions among researchers and academic administrators.

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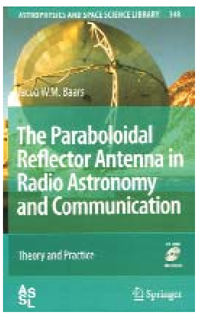
The Paraboloidal Reflector Antenna in Radio Astronomy and Communication

Theory and Practice

Jacob W. M. Baars
Springer, New York, 2007. $169.00 (253 pp.). ISBN 978-0-387-69733-8, CD-ROM

Paraboloidal reflector antennas are ubiquitous in modern society. They appear in large numbers on or near urban residences, in rural areas, on communication towers, and on the premises of cable-television providers. Those small dishes serve communication functions, largely domestic television reception, for which they are deployed in the tens of millions. That particular application, however, is not what Jacob W. M. Baars aims to cover in his elegant *The Paraboloidal Reflector Antenna in Radio Astronomy and Communication: Theory and Practice*. He instead discusses the much larger, enormously more expensive, more sophisticated, and highly photogenic modern radio telescope used for cutting-edge research in radio astronomy. Baars has been centrally involved in the design and construction of several of the world's major radio telescopes of the past three decades and thus is well qualified to treat his subject.



The book is physically attractive. Many of the radio telescopes under discussion are pictured in full color, and the mathematical notation is familiar and elegant, as is the text format. I was especially intrigued to learn that the entire book had been composed in Mathematica. The mathematical analyses are coupled with textual listings of the Mathematica routines used to compute the examples, and a CD-ROM with the routines, but not the Mathematica program, accompanies the book.

Despite the importance of the parabolic reflector antenna and its variants in modern communication technology and in scientific research, not many books have been written on the topic. Part of the reason for that may be because performance of small antennas for the consumer market is not critical, which makes the antennas easy to design. Another reason is that large radio telescopes and deep-space communication antennas have a large size-to-wavelength ratio, and thus classical geometrical optics and diffraction theory suffice for antenna performance analysis. Yet in both space-communication and astronomical applications, stringent requirements for high efficiency, low noise, and precise shaping of the received or radiated field have generated many sophisticated modifications of the basic paraboloid of revolution with a small receiving antenna at the focus. Consequently, a plethora of papers have been published, and Baars selects a number of the topics they cover—for example, the effects on antenna performance of axial and lateral defocusing, random errors in reflector surface accuracy, and intentional beam steering by lateral deviation of the receiving antenna—some for theoretical analysis and some for qualitative description.

Underlying those special topics is Baars's attempt to offer a coherent analysis of the basic reflector antenna. For three decades I have taught the subject and find myself somewhat uncomfortable with his mathematical treatment, which is rather discontinuous and sometimes obscure. For example, he often skips large intermediate steps in a derivation. For a basic, first-principles pedagogical treatment, one might be better off consulting the classic *Microwave Antenna Theory and Design* (McGraw-Hill, 1949), edited by Samuel Silver; Willard Van Tuyl Rusch and Philip Potter's *Analysis of Reflector Antennas* (Academic Press, 1970); Peter Wood's *Reflector Antenna Analysis and Design* (Peter Peregrinus, 1980); or Brian Westcott's *Shaped Reflector Antenna Design* (Research Studies Press, 1983).

Another matter of concern is a major flaw in the treatment of what is probably the most important relationship in the whole subject of aperture antennas, including paraboloids—the Fourier transform relation between the field in the aperture and the radiated field in the Fraunhofer region. In chapter 3, figure 3.9 and its caption are incompatible, and the accompanying text only adds to the confusion. Given this indication of perfunctory editing and proofreading, one hopes that no other, less obvious anomalies exist.

Overall, Baars's text is a valuable addition to the literature on large reflector antennas. As an encyclopedia of modern, very large paraboloidal antennas, it has no equal, and the existing state of the art is well documented therein. Despite the book's flaws, I believe it will become a standard reference.

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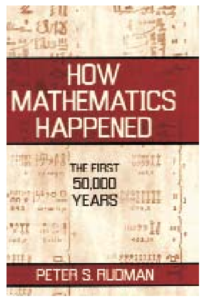
How Mathematics Happened

The First 50,000 Years

Peter S. Rudman
Prometheus Books, Amherst, NY, 2007. $26.00 (314 pp.). ISBN 978-1-59102-477-4



Given the title of Peter S. Rudman's *How Mathematics Happened: The First 50,000 Years*, one would expect an explanation of, well, how mathematics happened. But in the introduction, Rudman explains what he's really writing about: "There is an essential role for judicious guessing in mathematics, and sometimes that is the best we can do. . . . I, or anyone else who tries to interpret the archeological record in terms of not just *what* was done, but also in terms of *why* it was so done, must rely on conjecture" (page 27). Thus his book is intentionally full of conjectures—mostly plausible ones.

Some of Rudman's conjectures show his romantic side. One example is his explanation behind the purpose of the Old Babylonian tablet known as Plimpton 322, which is more than 3500 years old and on display at Columbia University. It is a table of a few lines of numbers that, with some interpretation by researchers, suggests the Babylonians knew what we now call Pythagorean triples, three positive integers a, b, and c, such that $a^2 + b^2 = c^2$. Rudman's contribution is to explain how Plimpton 322 was used in the construction of Babylonian ziggurats, buildings that had the shape of frustums of square pyramids. He justifies his argument, in part, with conjectured contacts between Babylonia and ancient India, areas where altar construction relied on the Pythagorean theorem. His ziggurat conjecture makes for interesting reading, but its historical likelihood is nil.

Rudman, a retired professor of physics at the Technion–Israel Institute of Technology, also has a skeptical side that is not restricted to mathematics. In his section on "pyramidiots," he lambastes "wacky Egyptology," in which many amateurs have made numerological claims about the pyramids. Despite his disdain for such claims, he is not above making some of his own. He also validly criticizes Thor Heyerdahl's diffusion theory that Egyptian pyramid-building technology influenced Mayan pyramids and Erich von Däniken's "fabricated nonsense" of extraterrestrial contact with ancient Egyptians. Again, this makes for interesting reading, but it's not clear what business it has in what's billed as a book on the history of mathematics.

The subtitle of the book also needs an explanation, and Rudman supplies one: "I shall somewhat arbitrarily choose the era with unambiguous physical evidence of contemplative thinking, roughly 50,000 BCE, to define the beginning of real counting and the birth date of arithmetic" (page 53). But he qualifies his statement by saying the birth date might have been as early as a million years ago or as late as 30 000 BCE. In any case, the scope of history under his consideration begins with counting and how it started independently in several regions around the world, and moves to the mathematics of ancient Egypt and Babylonia, primarily in the second and third millennia BCE. He also provides a few pages about early Greek mathematics in the first millennium BCE; more recent mathematics is not mentioned except for comparative purposes.

The book is clearly not a research text on the subject but a popularization. Throughout the text Rudman offers "fun questions" that in other books might be called exercises. It's hard to see how a problem like "Convert 456 and 567 into hieroglyphic symbols and add them" is considered fun. Yet some of the questions are a bit fun, like the one that begins with "Zorbi, an alien from the planet Geek of the star Gamma Centuri in the Andromeda galaxy, landed in my backyard, of all places," and ends with "Use the greedy algorithm" (page 47). Plenty of room exists to criticize the book: For instance, Rudman writes, "Women's intuition is more hindsight than foresight, as expressed by a husband's whimsical wish, 'If I only knew yesterday what my wife knows today'" (pages 25 and 26). What *can* one say to that?

Rudman is an accomplished physicist who has used *How Mathematics Happened* to share his views, both romantic and skeptical, on why the ancients did mathematics in the particular and the peculiar ways they did. From my knowledge, no otherwise similar book on the history of mathematics covers the same period; several others do include most of the material Rudman treats, though they tend to cover more recent times. The value of Rudman's book comes from his personality, which shines through every page, and from his enjoyable exposition of the subject.

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astronomy and astrophysics

Cosmic Frontiers. N. Metcalfe, T. Shanks, eds. *Astronomical Society of the Pacific Conference Series 379*. Proc. conf., Durham, UK, July–Aug. 2006. Astronomical Society of the Pacific, San Francisco, 2007. $77.00 (364 pp.). ISBN 978-1-58381-320-1

First Light in the Universe. A. Loeb, A. Ferrara, R. S. Ellis. *Saas-Fee Advanced*