BOOKS: MATHEMATICS

# An Inclusive Perspective

**Helaine Selin**

**Mathematics Elsewhere**
An Exploration of Ideas Across Cultures
*by Marcia Ascher*

Princeton University Press, Princeton, NJ, 2002. 219 pp. \$24.95, £17.95. ISBN 0-691-07020-2.

I was a Peace Corps volunteer in Central Africa when I first realized that multiple forms of mathematics exist. In Malawi, I noticed that people had a different way of counting on their fingers. Whereas I would signal one using my index finger, Malawians used their thumbs. To indicate four, I would use all fingers except the thumb; Malawians used those same fingers, but arranged them so that the fingers were paired: index to middle, ring to little. When they got to five, they made a fist instead of extending all their fingers. At the time, this custom seemed like another fascinating cultural distinction, part of the whole process of learning to see myself as a product of my society and to realize that things I thought were universal human activities were in fact American ones. I was even more intrigued that Malawians indicated 100 by shaking their fists twice. This practice signaled an unusual mathematical organization, and it was my first hint that numbers and how we express them are connected to our culture and upbringing.

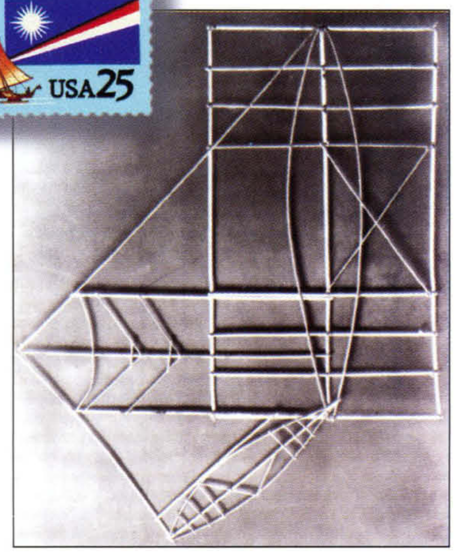
Marcia Ascher's *Mathematics Elsewhere* is part of a growing literature on the mathematical systems and ideas of people around the world, often called ethnomathematics. Eurocentric views of scholarship have changed in recent years. Newer histories of mathematics, such as George Ghevergese Joseph's *The Crest of the Peacock* (*1*) and Frank J. Swetz's *From Five Fingers to Infinity* (*2*), emphasize the debt we owe to Islamic cultures for bringing together the technique of measurement (evolved from its Egyptian roots to its final form in the hands of the Alexandrians) and our remarkable number system (which originated in India). Although these books and similar scholarly works have contributed significantly to the study of the mathematics of non-Western cultures, they focus almost entirely on cultures whose mathematical systems are precursors to our own. The nature of mathematics in other cultures is still largely overlooked. Claudia Zaslavsky published her seminal book on counting in Africa (*3*) in 1973, and only a few books have appeared since then. One of the best known of those is *Ethnomathematics* (*4*), also by Ascher, now an emeritus professor of mathematics at Ithaca College (*5*). In that book, Asher discussed mathematical ideas of people in several traditional or small-scale cultures.

Ascher's newest book takes the field further, with explorations of mathematics in additional cultures. Her discussions range from the Maya in South America and the Marshall Islanders in Oceania, through Africa and India, to Indonesia. An important intellectual leap all Westerners must make in studying these cultures is to expand their notion of mathematics to include "number, logic, spatial configuration, and...the organization of these into systems and structures." I would add measurement, form, and pattern to this list. Following Ascher's expanded definition of mathematics, she includes a great diversity of material. She considers a system of divination among the Yoruba of West Africa called Ifa, which uses patterns of seeds and nuts. She discusses complex calendars for different functions in Jewish, Mayan, and Balinese societies. She also covers maps made from palm ribs tied together with coconut fibers used for navigation and teaching in Oceania, complex kin relation systems among the Borana of East Africa, and threshold designs drawn with rice powder by Tamil Nadu women of southern India.

The author says that she is studying these cultures from her own mathematical framework, and therefore she superimposes modern math over traditional math. Sometimes this works, but sometimes it does not fit so comfortably—at least not from the point of view of a nonmathematician. In her chapter "Systems of Relationships," Ascher discusses the social organization of the Basque, Tonga, and Borana peoples. The complex mathematical interpretation she includes might get in the way of appreciating the systems in their own terms. Of course, Ascher is trying to emphasize the mathematical over the anthropological. And she points out that using modern mathematical procedures is often—as in the case of the Balinese–Javanese calendar—more complex than using their own system.

Although Ascher works hard to make the book accessible and interesting both to mathematicians and nonmathematicians, her approach sometimes makes the reading a little heavy for lay readers. She is sensitive to this, too; at one point she proclaims that she is going to spend the rest of the section on detailed mathematical steps and theorems, which some might want to simply scan before rejoining the narrative in the next section. The author is clearly an excellent teacher and a wonderful explainer. Every time I felt a bit lost, the next sentence would present the same concept in different words or with another example. She is adept at moving from the general to the specific, from narrative to figurative.

I was particularly interested in the stick charts of the Marshall Islanders, both because they expand the notion of map beyond that of locating a specific place and because they serve two different functions. One version of these charts, called a mattang, is a teaching device for a special class of navigators who learn how to pilot their outriggers by reading wave swells. The charts are formalized models that recast the ocean phenomena into "points, lines, curves, and angles." The other forms, called rebbelith and meddo, are maps of the archipelago or of smaller regions within it. Even with Ascher's detailed description, it is impossible for us to read the charts because we do not have the training and the cultural experiences of the navigators. But we can see that they are mathematical—they are part of a coherent, structured system. And we can appreciate the kind of mathematical reasoning involved in learning to use them.

**Sticks to steer by.** The lines and curves of this meddo represent the wind and sea interaction around an atoll in the southern Marshall Islands. The rebbelith shown on a 1990 U.S. postage stamp maps the entire archipelago.



For a mathematician, *Mathematics Elsewhere* will expand the universe; for a nonmathematician, the expansion will just take a little more time. The book succeeds well in presenting and explaining very different ways

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of doing math both within particular cultural contexts and in terms of modern mathematics. I find, however, that recently I have begun to take issue with the whole notion of "ethno," as it seems dismissive. Ethnomedicine isn't really medicine; ethnomathematics is their math and clearly not ours. And one more anecdote seems appropriate. When I was living in Blantyre, Malawi, 35 years ago, the main Post Office had two letter slots: one said Blantyre; the other said Elsewhere. It is important to remember that for the rest of the world, we are elsewhere.

**References and Notes**


1. G. G. Joseph, *The Crest of the Peacock: Non-European Roots of Mathematics* (I. B. Tauris, London, 1991).
2. F. J. Swetz, *From Five Fingers to Infinity: A Journey Through the History of Mathematics* (Open Court, Chicago, 1994).
3. C. Zaslavsky, *Africa Counts: Number and Pattern in African Culture* (Prindle, Weber and Schmidt, Boston, 1973).
4. M. Ascher, *Ethnomathematics: A Multicultural View of Mathematical Ideas* (Brooks/Cole, Pacific Grove, CA, 1991).
5. Other titles that may interest the reader include P. Gerdes, *Geometry from Africa: Mathematical and Educational Explorations* (Mathematical Association of America, Washington, DC, 1999); R. Eglash, *African Fractals: Modern Computing and Indigenous Design* (Rutgers Univ. Press, New Brunswick, NJ, 1999); and H. Selin, Ed., *Mathematics Across Cultures: the History of Non-Western Mathematics* (Kluwer Academic, Dordrecht, Netherlands, 2000).


**BOOKS: HISTORY OF SCIENCE**

# A Transparent Foundation?

**Michael John Gorman**

**The Glass Bathyscaphe**
**How Glass Changed the World**
***by Alan Macfarlane and Gerry Martin***

**Profile, London, 2002. 267 pp. £15. ISBN 186-197-400-0.**

**Glass**
**A World History**
**University of Chicago Press, Chicago, 2002. 267 pp. $27.50 ISBN 0-226-50028-4.**

Imagine waking up in a world without glass. There would be no windows to keep out the cold air, no airplanes, no televisions, no wristwatches, no light bulbs, and no eyeglasses to allow us to continue to read during our old age. More importantly, according to Alan Macfarlane and Gerry Martin's provocative book, there would be no modern science. In spite of the title of the U.S. edition, this book is anything but a detailed, descriptive account of the history of the manufacture of glass objects throughout the world. Instead, the authors present an original argument that is as much anthropological as it is historical. Glass is, in their view, a powerful "invisible force" in Western culture so transparent that it has frequently escaped the attention of historians. Where would science be without glass?

Whereas previous historians who had the courage to address such large questions have ascribed the causes of the emergence of modern science to factors as diverse as the invention of the printing press, the mechanical clock, the rise of the city, and the creation of the medieval universities, Macfarlane (a professor of anthropology at the University of Cambridge) and Martin (a historian of glass instruments) argue that the most important cause of what they call the "knowledge revolution"—a gradual transformation in Western science and technology occurring between 1200 and 1700—is none other than glass. Glass vessels were crucial to the alchemical experimentation that preceded modern chemistry and to the Torricellian experiment and air-pump that were fundamental for developing an understanding of atmospheric pressure. Glass lenses, originally developed for use in eyeglasses, were of critical importance in the development of the telescope, with which Galileo observed the moons of Jupiter and the rugged surface of the moon. Lenses were also required for the development of the microscope, without which most of modern biology would have been impossible.

**Aids for observation.** This detail from Jan van Eyck's *Madonna and Child with Canon van der Paele* (1436) includes the earliest depiction of concave glasses for myopia. The invention of concave lenses in Europe trailed the use of convex lenses for farsightedness by a century and a half.

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The presence of glass in a particular civilization is, from the authors' point of view, a catalyst for the extraordinary chain reaction that produces an accumulation of "reliable knowledge," leading eventually to computers and DNA, telephones and superconductors. As Samuel Johnson said of glass in 1750, "who, when he first saw the sand and ashes by a casual intenseness of heat melted into a metalline form, rugged with excrescences and clouded with impurities, would have imagined that in this shapeless lump lay concealed so many conveniences of life as would, in time, constitute a great part of the happiness of the world."

Whatever its cause, historians of science may balk at the very idea of a knowledge revolution lasting 500 years. For one thing, the term "revolution" seems inappropriate when applied to a complex and gradual process that took place over a large geographical area through half a millennium. However, the authors' position is based on claims that there was a knowledge revolution, that it occurred in Europe, and that it began roughly when glass spectacles started to be produced (in the 13th century). What the book lacks in historical complexity is compensated for by clarity of argument.

Given the fact that a good many historically significant scientific experiments made essential use of glass, Macfarlane and Martin suggest that glass was the key factor involved in the emergence of Western science. How do they develop their case? Simply by demonstrating the scientific stagnation of other sophisticated cultures in which glass was largely absent. Consider Japan, for example. The Japanese were a civilization of tea drinkers, rather than wine drinkers like the ancient Romans. Glass, which tends to crack on contact with hot liquids, was far inferior to porcelain as a material for drinking vessels. Add to this unsuitability of glass a tradition of making screens out of mulberry paper rather than glass windows, and you have a civilization that is lacking the essential factor for the development of modern science. As the authors conclude: "It does not seem too far-fetched to argue that the well-known fact that at the two ends of Eurasia very different cosmologies and ideologies developed, partly reflected the fact that at one end of the continent a glass civilization emerged, and at the other a pottery and paper one."

Macfarlane and Martin's broad claim that glass is an extremely important but largely overlooked factor in the histories of science and technology is convincing. However, many of the book's arguments are excessively speculative. Take one entertaining example: Using evidence that includes the blurred backgrounds in Chinese paintings, the authors suggest that the Chinese and Japanese civilizations may have suffered from mass myopia. They then go on to claim that this fact may have prevented the Chinese from developing an indigenous glass spectacle industry, because concave lenses (for myopic people) are more difficult to make than the convex lenses needed

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