their responses (he is to be admired for this). The Darwin biographer James Moore, for example, believes that "Sulloway's method is profoundly unhistorical (I told him so) and next to useless for understanding Wallace." Moore argues the result will not be a composite portrait of Wallace, but of "what experts guess, suppose, or presume about him."

In other words, the "objective" method Shermer used to characterize Wallace's personality produces a measure of the culture of late-20th-century history of science rather than a portrait of Wallace. The author—the director of the California-based Skeptics Society and founder of *Skeptic Magazine*—not only gives us a fairly one-dimensional Wallace, he seems not to understand that his story, too, is embedded in a contemporary culture. If anybody plays the role of the true skeptic here, Moore does. And so do I.

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BOOKS: HISTORY OF SCIENCE

Ancient Roots Forced into Modern Pots

James E. McClellan III

Early in *Lost Discoveries*, noted science writer Dick Teresi explains that he began investigating non-Western scientific traditions to combat exaggerated claims made for them in the name of multicultural awareness. Along the road, however, he converted to the view that all of the great civilizations and many lesser societies developed sophisticated understandings of the natural world. In this he is correct, of course, but his enthusiasms have led him to craft a misleading, indeed pernicious, account of those cultures and their connections to the modern scientific enterprise.

Lost Discoveries
The Ancient Roots of Modern Science —from the Babylonians to the Maya
by Dick Teresi
Simon and Schuster, New York, 2002. 463 pp. $27, C$41. ISBN 0-684-83718-8.

Teresi combats a strawman: that the Greeks alone originated science, that Europeans revived natural philosophy in the Renaissance and created modern science in the Scientific Revolution, and that "nonwhite, non-Western" cultures "conducted no science." In place of this Eurocentric caricature, he promotes another. Teresi claims that today's science either is derivative of knowledge developed in the non-Western world or lacks originality because many of the world's peoples long ago perfected understandings of nature that modern science is only now recognizing (hence the "lost discoveries" of the book's title). To cite just three of many outlandish examples, did you know that "two hundred years before Pythagoras, philosophers in northern India had understood that gravitation held the solar system [sic] together," that Babylonian cosmology incorporated views of the big bang and Alan Guth's inflation, or that "the Higgs field showed up many centuries ago in ancient India, under the name *maya*"?

The issue is not whether human societies developed often sophisticated and always useful understandings of nature and of number. It is a commonplace that they did. The earliest civilizations in Mesopotamia and Egypt elaborated mathematical systems and astronomies that influenced the Greeks and indirectly the modern world. The 60-minute division of the hour and the 365 days of the year provide testimony enough to this fact. We know that "Arabic" numerals originated in classical India, and who today would deny original contributions by medieval Islamic scientists or their impact on later European science? (Teresi is informative on these points, if less original than he seems to think.) Similarly, at least since the appearance in 1954 of the first volume of Joseph Needham's monumental *Science and Civilization in China* (*1*), the theoretical and practical accomplishments of Chinese investigators have been universally recognized. And likewise, the field of archeo-astronomy has uncovered the achievements of Mesoamerican and South American mathematics and astronomy—although how pre-Columbian societies, cut off from the Old World, formed part of "the ancient roots of modern science" is a mystery Teresi does not reveal to us.

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The real issue is what to make of the scientific accomplishments of non-Western cultures. For the most part, Teresi simply reports interesting information in a breezy style. Tellingly, the book lacks a formal conclusion. To vet his work, Teresi recruited a distinguished "Board of Advisors." He admits that his advisors did not always agree with him, but unfortunately they did not succeed in challenging the assumptions on which he builds his account. Lacking a sustained or explicit analysis, Teresi falls back on two implicit arguments: a Whiggish one (which uses our current standards to judge the past) and a general put-down of Europe.

The Whiggish perspective is evident in the book's organization around chapters devoted to "physics," "chemistry," "astronomy," "geology," and other of our modern scientific disciplines. This approach occasions a lot of unnecessary angst over defining science and unpacking science from religion, astronomy from astrology, and chemistry from alchemy. Worse, the author's Whiggism leads him to see non-Western cultures, not in their own terms, but as "mirroring," "presaging," "hinting at," "bearing out," "paving the way for," "evidencing nascent understandings of," and "being the forerunner of" today's science. This malady is sometimes diagnosed as "precursoritis," and every graduate student knows that identifying who got what right or wrong by our lights is not the way—certainly not the best way—to tell the story of what people have thought about nature in other historical contexts or of how we came to know what we now know. Even though some parallels can be drawn between, for example, Jainist views of matter and our ideas about the "spin" of subatomic particles or between Yoruban theology and modern spectroscopy, Teresi goes further. He implies that we are dealing with identities, rather than simple (and ultimately sterile) analogies. [The failure to respect this difference was the Achilles heel of two similarly inspired books of the 1970s by Fritjof Capra (*2*) and Gary Zukav (*3*).] In the final analysis, Teresi actually denigrates the achievements of non-Western cultures by assigning value to scientific findings insofar as they are comparable to what we currently think. He would be more respectful and helpful if he explained how diverse and complex systems of knowledge arose and functioned in varied social contexts.

Moreover, it follows for Teresi that, because traditional cultures of antiquity and the Middle Ages in some fashion already knew what modern science knows, Europe is a backwater offering little originality and little of interest to historians of science. Before the 12th century, Europe was, of course, a backwater—which only begs the question (not addressed by Teresi) why Europe became a world historical power and the seat of the Scientific Revolution. But more to the point, it is not necessary or even relevant to run down European culture or the eucumenical enterprise that is today's science in order to validate knowledge systems of traditional societies. And neither is it necessary or relevant to inflate the intellectual and practical accomplishments of traditional societies in order to formulate a reasoned critique of today's scientific enterprise. Such validation and such a critique may each be worthy goals, but Teresi is not clear which he is aiming for. By vaguely trying for both, he effectively accomplishes neither.

As part of his critique, Teresi has a bone to pick with what he sees as an unreasonable privileging of theory over experiment in current science. He thinks that contemporary cosmology and the theory of the big bang are especially deplorable in these regards. For Teresi, a happy consequence ensues in that scientific cosmology cannot therefore be thought superior to any creation myth. However, he does not clarify how the wholly empirical discovery in 1965 of the 2.73 K cosmic microwave background radiation by Penzias and Wilson fits into this vision.

A final chapter concerns technology, and elsewhere along the way Teresi touches on the technological achievements of non-Western societies. The same precusoritis that colors the author's treatment of science affects his discussions of technology as well. We are told that Mesoamericans vulcanized rubber centuries before Charles Goodyear did in 1839 and that the Arabs experimented with animatronics "a thousand years ago," and we are presented with the usual (and analytically specious) laundry list of Chinese technological firsts. What is missing is any examination of the essential role of technology in every society or of the historical connections (or lack of connections) between science and technology in various historical contexts.

My dismay over this book is not about turf—the historian versus the journalist. Who in principle would spurn a popular, multicultural account of science and technology in world history? Nevertheless, Teresi could do with a better grasp of the history of science. Copernicus may have stolen the so-called "Tusi couple" from the work of Nasir al-Din al-Tusi (1201–1274). But he deployed it in the service of heliocentrism, whereas al-Tusi (despite Teresi's implications) did not. Tycho Brahe did not "push astronomy back by several centuries." Galileo did not articulate a concept of "mass," and he probably did not drop balls from the Leaning Tower of Pisa. These missteps could be forgiven anyone ranging across such a large body of material. Less easily overlooked are the anti-science, anti-West attitudes underlying this work. The pity is that *Lost Discoveries* will misinform readers and play into the hands of politically correct critics of contemporary scientific culture.

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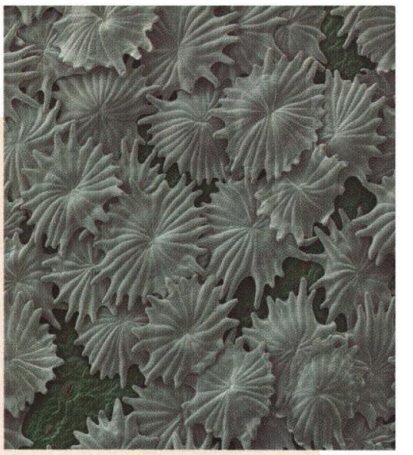
BROWSINGS



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Heaven and Earth. Unseen by the Naked Eye. *David Malin.* Phaidon, London, 2002. 384 pp. $49.95, £29.95, €49.95. ISBN 0-7148-4280-X.

This collection of striking images, compiled by astronomer Malin, demonstrates how technologies from the bubble chamber to the Hubble Space Telescope have extended the scope of human vision. For example, the surface of an olive leaf, captured in this colored scanning electron micrograph (right), is sheltered by these umbrella-like scales (diameters about 150 μm).

The Alfred Russel Wallace Reader. A Selection of Writings from the Field. *Jane Camerini, Ed.* Johns Hopkins University Press, Baltimore, MD, 2002. 243 pp. $42.50, £29.50. ISBN 0-8018-6781-9. Paper, $18.95, £13. ISBN 0-8018-6789-4.

Infinite Tropics. An Alfred Russel Wallace Anthology. *Andrew Berry, Ed.* Verso, London, 2002. 448 pp. $27, £19. ISBN 1-85984-652-1.

These two collections explore the extraordinary range of Wallace's interests, which encompassed ecology, evolution, spiritualism, and socialism. Camerini presents her selections (generally entire articles or book chapters) chronologically. Her succinct introductory essays place Wallace and his work in context. Berry offers a thematic organization, weaving extracts (usually short) together with his own commentary.