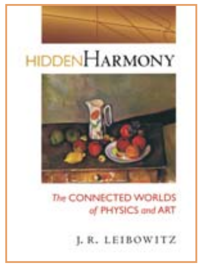
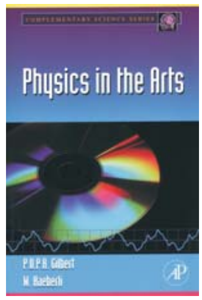
books

Beautiful physics and the physics of the beautiful





Hidden Harmony

The Connected Worlds of Physics and Art

J. R. Leibowitz
Johns Hopkins U. Press, Baltimore, MD 2008. $24.95 (148 pp.).
ISBN 978-0-8018-8866-3

Physics in the Arts

P. U. P. A. Gilbert and W. Haeberli
Academic Press/Elsevier, Burlington, MA 2008. $39.95 paper (312 pp.).
ISBN 978-0-12-374150-9

Reviewed by Eric J. Heller

Science and art have been connected for a long time. At the dawn of civilization, the two were not distinguished. In the early Renaissance, Leonardo da Vinci embodied the best of the science and art of his time. Johannes Kepler's *Harmony of the World* (1619) included pages of mystical grandiosity and suddenly, a paragraph later, his third law. A word search for "science + art" in the 1869–1900 *Nature* archives will reveal hundreds of articles, many of which have titles that could have been written yesterday. If it seems that the buzz about the connections between science and art has been increasing—and it has—then one must consider that to be a revival of interest, not a new movement.

There are many ways to think about the connections between physics and art, and the two books under review fall into quite different categories. Jack Leibowitz's *Hidden Harmony: The Connected Worlds of Physics and Art* makes high-level conceptual connections. It remains in the world of ideas and includes well-chosen examples from both art and physics. *Physics in the Arts*, by Pupa Gilbert and Willy Haeberli, takes a more practical approach, addressing the medium more than the message. It is first and foremost an elementary physics book for nonscientist undergraduates, with subjects chosen that are relevant to the arts. Thus, for example, the book extensively treats lenses, color theory, and sound, but does not mention relativity or stellar evolution. On the other hand, relativity is very much a theme in *Hidden Harmony*.

The first thing I noticed when I picked up *Hidden Harmony* was its excellent production quality and aesthetics. The paper is of fine quality, the images are beautifully reproduced, and the graphics are tastefully executed. That was an auspicious start for a book that is largely art criticism, with an eye toward relationships with physics. The next thing that attracted me to the book was Leibowitz's impeccable taste. The well-chosen reproductions are of works that haven't exactly been hidden from the public, but they are not the usual clichés. I came away thoroughly convinced that the author has an excellent knowledge of both physics and art history. Indeed, he ought to, as an emeritus professor of physics and the former chairman of the art department at the Catholic University of America. He writes extremely well, conveying his convictions in an erudite manner totally devoid of snobbery.

As is widely known, many scholars have attempted to connect art movements with revolutionary developments in physics. I'm not sympathetic to purveyors of grand theses that purport to relate major art movements, major artists, revolutionary paradigm shifts in physics, and the physicists who made them. My opinion is that artists pretty much do what they need to do on their own, without reference to science, and scientists likewise, without reference to art. My fear was that Leibowitz would come down in favor of, for example, connections between cubism and relativity. He does not. Not only does he make a cogent case against such connections; in doing so, he quotes from famous people explicitly addressing the issue—Albert Einstein, Pablo Picasso, my colleague Gerald Holton, and others of like stature.

For Leibowitz, it is form and the quest for beauty that connect art and physics. Like many of my colleagues, I came to that conviction long ago, and because the stated connections are hard to prove, I did not come away from the book with stronger convictions than I originally had. But the book was not written for me, and it is quite possible that nonspecialists will come away with new ideas about the connections between art and science. The physics in *Hidden Harmony* will be familiar to most PHYSICS TODAY readers, but the art history and interpretation will not. Even if you don't go to the bookstore and buy this highly recommended book for yourself, you might consider it as a gift for a physicist friend, or indeed any friend.

Physics in the Arts, according to its authors, is intended for the general public and liberal arts students. It is less lavishly produced than *Hidden Harmony*, though it does contain almost as many color illustrations as pages. The section on color is so good that it alone might make the book a worthwhile purchase for the general public; certainly the section is a plus for those considering the book for a class.

Some of the book's diagrams are very precise, but sloppy ray tracing in the chapters relating to optics did annoy me. Sometimes a ray is depicted as doing all its bending at the front surface of a lens, sometimes in the middle, sometimes on the back surface, and only occasionally correctly on both surfaces. It is clear from the well-written text that the authors know whereof they speak; the diagram glitches are merely "slips of the mouse."

About two-thirds of the way through, the book takes an abrupt turn

Eric Heller is a professor of physics and a professor of chemistry at Harvard University in Cambridge, Massachusetts. For five years he has taught a course on the physics of music and sound to non-scientist undergraduates. Since 2000, he has been producing visual art based on his research. Heller's exhibit of large-format images, *Approaching Chaos*, traveled the US from 2001 to 2004. To see his work, visit http://www.ericjhellergallery.com.

from optics and light to sound. The treatment begins creditably, and in places the authors quite skillfully explain wave behavior without using much space. But space is the problem: Sound, hearing, and room and musical acoustics just can't be crammed with lots of figures into 90 small pages. After doing a nice job on periodic oscillations, damping, and resonance, the authors miss some opportunities in a section called "Resonators in Musical Instruments." They mention only sympathetic resonance of a sitar, the marimba, the xylophone, the vibraphone, and the sounding board of the piano. The granddaddy of all resonators for music, the Helmholtz resonator, is not mentioned, so the playing qualities of everything from an ocarina to a violin are not discussed. Nor does the text discuss Chladni plate oscillations—another huge factor in musical instruments—except for a quick mention of piano sounding boards. When the authors consider vibrations of strings and of air in tubes, they do not mention that the vibration modes are subject to resonances, that musicians drive those resonances when they play their instruments, and that such resonances play a crucial role in the formants that make human speech possible. In a short sentence, formants are attributed to "resonances of the oral cavity." In fact they are resonances of a 17-cm-long tube very much like one treated earlier in the book; the formants are controlled by changes in the tube's cross section.

The final chapter includes a few pages devoted explicitly to the physics of musical instruments, as an application of the principles presented in the book. The rushed treatment includes the shape of violin strings during play, tone holes and mouthpieces, and such wind-instrument excitation mechanisms as feedback resonance. The topic can't be covered that quickly, and indeed it was not covered accurately or insightfully. That kind of rush job is a perennial problem for survey books meant for nonmajors.

In spite of misgivings I have concerning *Physics in the Arts*, I would recommend that someone teaching a physics and art course look the book over as a possible text. Its selection of subjects—optics, color theory, photography, harmonic oscillations, and musical acoustics—is an excellent blend for such a course. Alternatives might include separate books on sound and light, selected chapters of a more comprehensive survey book, or an extensive set of reprints and reading lists. These days, especially with the World Wide Web, one can assemble a custom set of materials and satisfy undergraduates who prefer a single reference. The question for prospective teachers will be whether *Physics in the Arts* is a suitable prepackaged version of what they would like to teach.

The Great Warming

Climate Change and the Rise and Fall of Civilizations

Brian Fagan
Bloomsbury Press, New York, 2008. $26.95 (282 pp.).
ISBN 978-1-59691-392-9

The Great Warming: Climate Change and the Rise and Fall of Civilizations is Brian Fagan's fourth book on climate change. Although the book focuses on the so-called Medieval Warm Period, it could have accurately been titled *The Great Drying*, for that is its recurrent theme.

A professor emeritus of anthropology at the University of California, Santa Barbara, Fagan is an accomplished archaeologist and prolific writer. He presents a world survey of the rise and mostly fall of civilizations from the 10th though 15th centuries during and after extended drought conditions that were possibly triggered by changes in the general circulation of the atmosphere. Not so long ago, English climatologist Hubert Horace Lamb (1913–97) established the field of climate change as a serious research subject and documented in great detail its social effects, primarily for Western and Northern Europe. The longer growing seasons of the 11th century and the Norse journeys are common knowledge, and Fagan uses those as the starting point for his worldwide excursion.

The author gives extended treatment to people and places beyond Europe: Angkor Wat in Cambodia, Chaco Canyon in New Mexico, Maya cities, the Mongol hordes, early Polynesian navigators, and other lost and exotic civilizations. Fagan does not tell their histories; instead, he imagines what the protagonists might have gone through and sketches their collective environmental experiences in broad strokes. The faces of the horsemen in Genghis Khan's horde are lashed by bitterly cold winds, sweating medieval peasants climb tall trees to lop off their branches, Viking sailors peer into the mist, and a merry band of natives gathers acorns in California. Such short vignettes are interwoven as the author