In short, despite all the environmental alarums and international conferences, it appears that the scientific debate about global warming—and therefore the political debate about what, if anything, should be done—is far from over.

Paradigm Reversal

"The Revolution That Didn't Happen" by Steven Weinberg, in *The New York Review of Books* (Oct. 8, 1998), 1755 Broadway, 5th fl., New York, N.Y. 10019–3780.

In Thomas Kuhn's theory of scientific revolutions, postmodernist critics of science have found the perfect paradigm. Too bad for them that Kuhn's radical notions are "quite wrong," according to Weinberg, a Nobel Prize-winning physicist at the University of Texas at Austin.

In his 1962 book *The Structure of Scientific Revolutions*, Kuhn (1922-96) described the history of science as cyclic: periods of "normal science," in which a particular consensus view ("paradigm") prevails, alternate with revolutionary times that give birth to a new consensus. In Kuhn's famous phrase, the paradigm shifts. Thus, Newtonian physics, which had gained wide acceptance in the 18th century, was supplanted by the theory of relativity in the early 20th. So great is the gulf between successive paradigms, Kuhn maintained, that scientists adhering to the new model find it all but impossible to understand what their predecessors could have been thinking. And since there is no common standard by which to judge the respective theories, a theory can be called "true" or "false" only within the context of a given paradigm. Science progresses, Kuhn believed, in much the way that Darwinian evolution does—but not, he maintained, toward objective truth. Since all past scientific paradigms had proven false, the current one was bound to give way, too. All this, of course, is catnip to the postmodernist critics who have lately insisted that scientific theories have no more intrinsic validity than, say, astrology or shamanism.

But Kuhn was mistaken in thinking that after a paradigm shift, scientists cannot understand the science that went before, Weinberg points out: "In educating new physicists the first thing that we teach them is still good old Newtonian mechanics, and they never forget how to think in Newtonian terms, even after they learn about Einstein's theory of relativity." Kuhn was also wrong, Weinberg says, in maintaining that the revo-

A New Natural Philosophy

Lee Smolin, a physicist at Penn State University, writes in *Oxymoron* (1998) that we are in the midst of "one of the great transformations in the history of science."

We are abandoning the idea that the organization and beauty of any system, whether it be biological, ecological, economic or cosmological, is imposed from the outside, in favor of the conception that they arise internally by natural processes of self-organization. This is why Darwin's so important. Before the discovery of natural selection, there were only two ways in which the organization of the world could be explained: either a god had imposed order on chaos (as in Plato's myth of the reversing cosmos) or the order was the manifestation of mathematical laws (as in Galileo and the subsequent developments of physics). Darwin taught us that there is a third alternative: natural processes, readily accessible to our comprehension, can cause a system to evolve from a less to a more organized state. I believe that we are seeing the gradual incorporation of this insight into all the sciences that study the organization of systems, from cosmology and fundamental physics to the organization of human societies. This leads to the replacement of explanations in terms of absolute principles which are held to be eternally true with explanations that are historical and recognize the tremendous variety of possible outcomes of processes like natural selection.

lutionary shifts from one paradigm to another do not get scientists closer to the truth about nature, that all past paradigms have been rejected as utterly untrue. Newtonian mechanics, for instance, is not simply false, in the way that, say, Aristotle's theory of motion is, Weinberg points out. "Kuhn himself in his earlier book on the Copernican revolution told how parts of scientific theories survive in the more successful theories that supplant them, and seemed to have no trouble with the idea."

In *Structure*, however, Kuhn argued that Newtonian mechanics is not the same today as it was before the advent of relativity and quantum mechanics, because it was not understood then to be an approximation. This, Weinberg comments, "is like saying that the steak you eat is not the one that you bought, because now you know it is stringy and before you didn't."

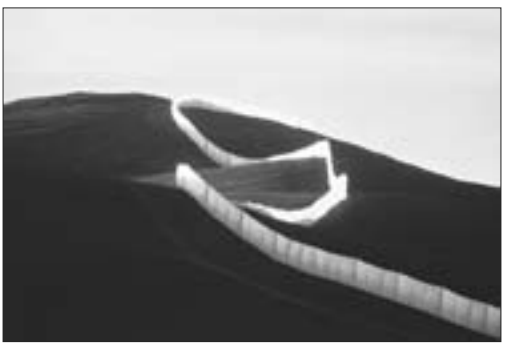
Finally, Weinberg says, Kuhn exaggerated the extent to which scientists are in thrall to the paradigm of the moment. Physicists today, for example, know that their theory of elementary particles is only an approximation to some yet unknown basic theory, and they are working hard to find new data that conflict with the current theory. Why do scientists even bother, he asks, if Kuhn's view of scientific progress is correct? "What drives us onward in the work of science," Weinberg writes, "is precisely the sense that there are truths out there to be discovered, truths that once discovered will form a permanent part of human knowledge."

ARTS & LETTERS

The New Gardens of Art

"Gardens and the Death of Art" by Stephanie Ross, in *Landscape Architecture* (July 1998), 636 Eye St. N.W., Washington, D.C. 20001–3736.

Today it is little more than a hobby—albeit an immensely popular one—but in the 18th century, gardening was a fine art. English author Horace Walpole even grouped it with poetry and painting—"Three Sisters, or the Three New Graces who dress and adorn Nature." Yet if gardening no longer is kin to poetry and painting, high art has not completely abandoned the landscape, asserts Ross, author of *What Gardens Mean* (1998). Many recent works of "environmental art," she argues, "fulfill the same functions" the gardens of Walpole's day did. "By inhabiting, addressing, and altering a site, they call into question our relations to landscape, nature, and art."



Running Fence, Sonoma and Marin Counties, California, 1972–76, *by Christo and Jeanne-Claude*

The contemporary artists whose works "most clearly recall those earlier gardens," Ross writes, include Alan Sonfist and Meg Webster. Sonfist's various *Time Landscapes* are tracts reproducing an urban area's vanished native flora. When his *Time Landscape* in New York City's La Guardia Place is finished (the first stage was dedicated in 1978), it will exhibit three stages of a forest as it would have been in the colonial era. Webster's work *Pass*, installed in Saint Louis's Laumeier Sculpture Park between 1990 and 1992, reproduces a variety of different habitats and plant varieties found throughout Missouri, including a fruit orchard, a woodland stream, a pond, sun and shade gardens, herbs, berry bushes, and various prairie grasses and flowers.

But even less obviously gardenlike works of environmental art—such as Michael Heizer's desert sculpture *Double Negative* (1969), in which 240,000 tons of earth were carved out of two facing cliffs—"force us to rethink our place in the landscape, our roles as perceivers, enjoyers, consumers, destroyers," Ross observes. "They raise profound metaphysical questions about permanence and change, about human will and agency."