

nity service in businesses; and enhance job training in businesses (even few well-to-do corporations spend more than 1 or 2 percent of their budgets on training).

Each book charts the decline—today, often the absence—of earlier educational ideals, sacrificed to a newly narrowed market regime: one that, in the end, subverts the health and long-term prosperity of the nation. Society is more than its economy; it also includes beliefs, judgments, ethical decisions, acts of tolerance, acts of curiosity, and acts of charity. Education addresses all these factors.

Each book champions a return to education as a set of multiple goals. It is about time this idea received more attention. These authors argue that money and private economic gain are indeed *part* of those educational goals, but do not and should not comprise *all* of them. The relationship between education and the economy should not be one of merger but of contract. The market and the schools are two overlapping but different systems, and each will contribute more to the health of the other by recognizing those genuine differences. Together they

have a common, broader goal, one that neither alone can fully effect: a more prosperous and a more just society. ▽

James Engell, Gurney professor of English and professor of comparative literature, chairs the department of English and American literature and language at Harvard. His book (with Anthony Dangerfield) *Saving Higher Education in the Age of Money* (University of Virginia Press) will be published in April; a preliminary treatment, "The Market-Model University: Humanities in the Age of Money," appeared in this magazine's May-June 1998 issue.

Overheated Rhetoric

A new novel misrepresents global warming and distorts science.

by MICHAEL B. MCELROY and DANIEL P. SCHRAG

MICHAEL CRICHTON'S *State of Fear* is less a novel than a forum for the author to rail against what he perceives as environmental extremism. The book targets particularly those who believe that global warming poses a threat that should be taken seriously. But other issues also draw fire. The ban on chlorofluorocarbons (CFCs) implicated in reducing the effectiveness of the Earth's protective ozone layer "harmed Third World people by eliminating cheap refrigerants so that their food spoiled more often and more of them died of food poisoning." The ban on DDT was "arguably the greatest tragedy of the twentieth century.... Since the ban, two million people a year have died unnecessarily from malaria, mostly children." He also takes shots at those who would promote protection of giant sequoias: concerns about loss of global biodiversity, he posits, are ill informed. Worried about the population explosion? Relax: "The people of 2100 will be much richer than we are, consume more energy, have a smaller population, and enjoy more wilderness than we have today." You get the idea.

It would be relatively easy to respond to Crichton if his views were expressed

in a traditional science or policy forum. It is more difficult to react when his philosophy is communicated by fictional characters committed to saving the world from a surreal terrorist plot hatched by a shady environmental organization known as the National Environmental Resource Fund (NERF).

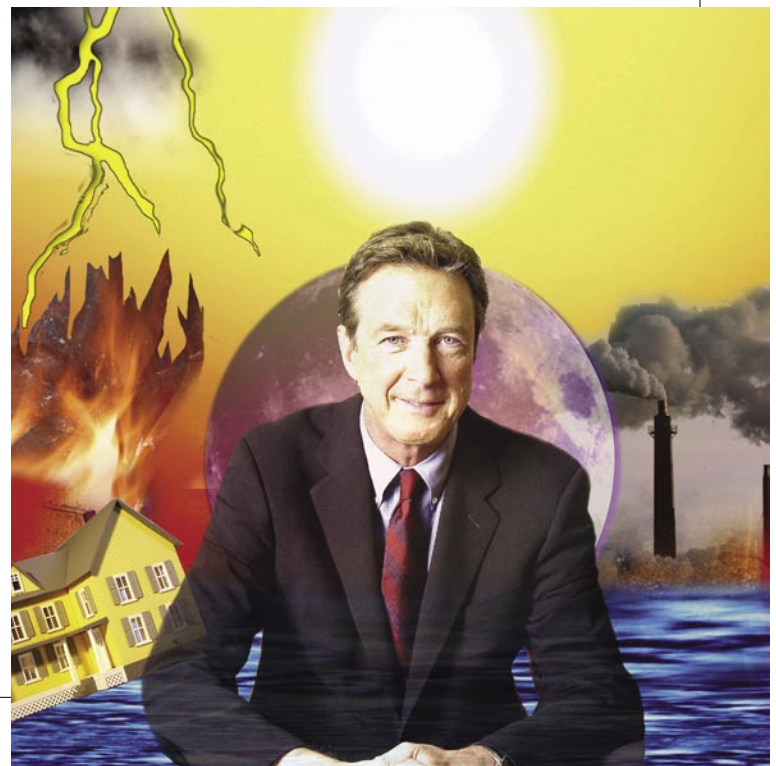
In brief, NERF has organized a conference to promote public awareness of the threat of sudden climate change. The plot involves engineering a series of climate disasters, including a tsunami induced by triggering a landslide on a deep trench in the Pacific Ocean. The tsunami would be timed to cause a wall of water up to 60 feet high to crash on the California coast just when the world's media are assembled at the conference to hear the experts expound on the dangers of sudden climate change. What better way to promote a state of fear and increase donations?

On the other hand, who in their right mind would accept that a tsunami could have anything to do with climate change? Did the recent tsunami-induced disaster in South Asia contribute in any meaningful way to the public discourse on the threat of human-induced climate change? We doubt it. But the novelist enjoys more license than the scientist or policy analyst!

Crichton's perspective is presented in Socratic fashion in the novel by a few key characters. Richard Kenner is a 39-year-old man-for-all-seasons on leave from a tenured professorship at MIT. He has earned a doctorate from Caltech at 20 and then a J.D. from Harvard Law School in two years, rather than the customary three. Along the way, he has established his expertise as a world-class skier and mountain climber and as an adviser to the

Michael Crichton
'64, M.D. '69,
State of Fear (Harper-
Collins, \$27.95).

Photomontage by Naomi Shea.
Photograph of Michael Crichton by the Associated Press



Environmental Protection Agency (EPA), Department of the Interior, Department of Defense, government of Nepal, and an unspecified number of corporations.

Jennifer Haynes, a lawyer, is a karate expert proud to have killed a would-be assailant with her bare hands when he tried to hold her up at gunpoint. She has been working on a lawsuit proposed to be filed by the Pacific island nation of “Vanutu” against the EPA. (Vanutu stands only a few feet above sea level and its 8,000 inhabitants are alleged to be in danger of having to evacuate their island home in face of the rising sea level triggered by global warming.) As Haynes works on the suit, she becomes convinced that the science of global warming is seriously flawed.

Crichton believes that there is a herd instinct in science. This could not be further from the truth.

The primary recipients for Crichton’s philosophy as expounded by Kenner and Haynes are clearly much less accomplished. Peter Evans, a young lawyer, works for George Morton, a wealthy philanthropist and the principal funder of NERF’s climate-related activities. Evans is convinced from the outset that climate change is a critical issue and that only those in the pockets of industry could doubt the reality of the scientific consensus. Through time though, under the probing questioning of Kenner and Haynes, supported by references to the original scientific literature documented in the book with a series of footnotes and summary quotations, Evans begins to realize that he has been seriously misled.

The other target for Kenner’s and Haynes’s probing questions and mini-lectures is a self-indulgent movie actor, Ted Bradley—a committed, but not very well informed, supporter of environmental issues, specifically the dangers of climate change. (He doubts that there are, or ever were, societies that practiced cannibalism; Crichton arranges to have him eaten by a tribe of cannibals in the Solomon Islands. So much for the opposition!)

As he develops the novel’s underlying theme, Crichton’s enviro-skeptics are smart, informed, and charismatic. The en-

vironmentalists, intellectually lazy and gullible, have no serious response when confronted with facts. It’s an effective strategy, especially for those predisposed to receive his book’s message. But had Evans and Bradley been a little better prepared, they could have posed a much more serious challenge to the biased, ideological presentation of the issues articulated by Kenner and Haynes.

One of Crichton’s persistent themes is that the evidence for global warming is inconclusive, perhaps even phony. Records of temperature change are presented for a variety of locations across the world for the past 150 years with appropriate references to original sources. Crichton for the most part fits the data to a single trend line for the entire time interval.

But as we know, the reality is more confusing. Annual averages and five-year running means of temperature for individual stations exhibit significant variability. It is difficult to discern a persistent long-term trend. For some stations, temperature has apparently decreased over time, for others it has increased, and for some it has stayed pretty much the same. How can we reconcile this seemingly messy picture with the consensus conclusions as summarized, for example, by the Intergovernmental Panel on Climate Change (IPCC)? This consensus indicates a modest increase in global average surface temperatures of about 0.3 degree Centigrade between 1900 and 1940, followed by a small decline, by about 0.1 degree, between 1940 and 1970. Temperatures have risen steadily since 1970, climbing by as much as 0.5 degree during this interval. The 1990s was the warmest decade on record and this warming trend persists.

Crichton, speaking through Kenner and Haynes, suggests that the scientists responsible for these analyses cooked the books by fiddling with the original data as they sought to correct, for example, for the so-called heat island effect—the fact that temperatures in cities are warmer than in the surrounding countryside, due to the reflected heat from buildings. In

fact, adjusting data appropriately to correct for biases in the primary record is necessary—and good science—if we are to get to the bottom line, to identify what actually happened to global average temperatures over time. Similar corrections are required for temperatures recorded at the same station at different times of day, or within a city at one part of the record and later at a site outside the city (the airport, for example). A large part of the earth’s surface is occupied by ocean. Temperature data are limited in this case and are derived mainly from localized ship-board measurements of surface water. These measurements, too, have been made by different methods over time. Again, to obtain a meaningful long-term trend, the analyst must be aware of the changing circumstances and must (and can) adjust accordingly.

Beyond these specifics, *State of Fear* misrepresents science broadly. Crichton has Haynes assert that the temperature data are adjusted by “the very people who have most to gain from that adjustment” and “Whenever you have one team doing all the jobs, then you are at risk for bias. If one team makes a model and also tests it and also analyzes the results, these results are at risk.” Elsewhere Haynes states that “it is never a good policy for the fox to guard the hen house.” This is transparently misleading. Several groups have analyzed the temperature data independently and reported basically similar results. Different groups of scientists have been involved in building models and comparing their outputs with actual observations. These models differ in terms of both assumptions and methodologies and results vary accordingly. Crichton, apparently, has the view that there is a herd instinct in science. This could not be further from the truth. Scientific reputations are made *not* by reaching conclusions drawn by others earlier, but rather by challenging the status quo. Competitive juices fuel progress.

Crichton’s main character, the ubiquitous Professor Kenner, singles out James E. Hansen, long-time director of the NASA Goddard Institute for Space Studies (GISS), a scientist with many years of distinguished contributions to earth and planetary science, for particular attack. In testimony to Congress in 1988, Hansen offered projections of how global temperature might increase through the end of


the twentieth century, while expressing the view that the signature of the human influence should soon be unambiguously clear in the climate record.

To project climate's future requires an assumption about future economic growth—in particular, of the pattern for future emissions of key greenhouse gases such as carbon dioxide. Following the conventional approach, Hansen considered three possible scenarios for future emissions (rapid growth, business as usual, and significant curtailment) and evaluated the consequences of each for future climate change. Crichton has Kenner focus exclusively on results from the high-growth model, concluding that Hansen's projections for future global climate change turned out to be "wrong by 300 percent." Had he opted to talk about the *intermediate* growth scenario, Crichton would have been forced to conclude that Hansen's projections were right on. But that would have spoiled the story. Why should a best-selling novelist and Hollywood personality (even with two Harvard degrees) be constrained by the usual requirements for fair play and accuracy?

Ironically, Hansen provides a classic example of how Crichton is wrong on another of his pet prejudices: that scientists follow the money and are careful to ensure that their research results are consistent with the views of their sponsors. Hansen is a civil servant, a NASA employee whose research has been supported almost exclusively by that agency for close to 40 years. When he testified in Congress on his climate projections late in Ronald Reagan's second term, Hansen's bosses at NASA sought to tone down his rhetoric. But he resisted. More recently, he announced publicly that he could not support George W. Bush's candidacy for reelection, given his antipathy to Bush's views on climate change. Hansen continues to serve as director of GISS. He has not felt constrained to adjust his science to the hopes or expectations of his sponsors. And in this he is not alone.

Crichton concludes his book with an appendix in which he discusses eugenics, the science—or pseudo-science—that deals with the improvement of the human race by selective breeding to eliminate undesirable hereditary traits. Eugenics, he points out, enjoyed popular support as a theory in the early part of the twentieth

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century: it was embraced by famous statesmen, scholars, and captains of industry. He then draws a comparison between the eugenics movement and climate change: "I am not arguing that global warming is the same as eugenics. But the similarities are not superficial." Crichton suggests that *because* there is broad consensus in the scientific community that global warming is a serious threat, and *because* many prominent people strongly support taking corrective action, the climate-change movement is, therefore, likely to be wrong, just as the eugenics movement was. Crichton is correct that skeptics play a very important role in the scientific community by making us continually challenge and test our assumptions. But to argue that a theory is wrong because there is consensus is absurd! Imagine the theories, from evolution to relativity, that we would have to discard with such logic.

Had Crichton wished to present a more balanced analysis of the climate issue, he might have informed the reader that carbon-dioxide levels are unequivocally higher now than at any time over

the past 450,000 years. This conclusion follows unambiguously from measurements of the composition of atmospheric gases trapped in the Vostok ice core. (Crichton does talk about the ice-core measurements, but only, erroneously, to argue that the world was warmer during the last two interglacials than it is today. Perhaps it was, but the Vostok ice core does *not* provide a record of global temperatures.)

In any event, does it really matter whether the world was warmer 20,000 years ago or 120,000 years ago than it is now? What we really care about is whether humankind is equipped today to deal with climate changes that might occur in the near future. Our current reliance on fossil fuels ensures that concentrations of carbon dioxide will be much higher in the near future, comparable perhaps to levels that pertained when dinosaurs roamed the earth 100 million years ago. The question, then, is whether we will be prepared to deal with the implications of the climate system that will ensue as a consequence of this unprecedented, human-induced change in the

composition of the global atmosphere, or whether we should take steps now to minimize possible adverse consequences in the future. Crichton believes that we shouldn't worry about it. A more responsible approach, we suggest, is that we take the issue seriously and get on with the necessary research and policy analysis to ensure that decisions we take now for the future will be informed by thoughtful insights rather than blind prejudice.

For a more balanced presentation of the facts, the reader should refer to the IPCC studies or, for a more nuanced analysis, to the report by the National Academy of Sciences commissioned by the Bush administration. The true state of fear is when the public gets its information on an issue as important as climate change from a novelist with an agenda, like Michael Crichton. ▽

Michael B. McElroy, Butler professor of environmental studies, recently concluded his service as faculty director of the Harvard University Center for the Environment, the post Daniel P. Schrag, professor of earth and planetary sciences, now holds.

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