What Good is Science?

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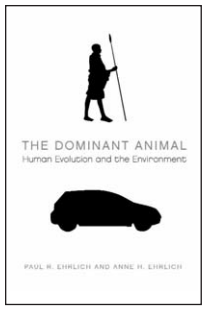
our environmental concerns or crises. The well-argued points and the comprehensive referencing should convince many of those readers that we are indeed facing myriad extremely difficult and important issues.

Since I teach my freshman course on the global environment and the evolution of human culture using many of the perspectives and materials the Ehrlichs' espouse, I am very much in agreement with most of what they write. I still prefer Robert Kaufmann and Cutler Cleveland's wonderful *Environmental Science* (McGraw-Hill, 2007) as a textbook, but certainly one could use *The Dominant Animal* effectively for a basic environmental course or seminar. The main disagreement I have with the Ehrlichs' assessment concerns their statement that we are in no danger of running out of fossil fuel (p. 293). Although technically I agree with that statement, I do believe we are in great danger of running out of the highest quality fossil fuels (oil and gas that can be exploited with a high net energy gain), and I also believe that the development of alternatives (which have a much lower net energy gain) will be enormously challenging.

Because for many the Ehrlichs appear to have lost the population-resource argument—or perhaps independent of anything academics have to say—humans continue on the same path of overpopulation and overconsumption, with governments and most economists fanning the flames. Although it is true that there are large efforts under way to conserve biodiversity and mitigate climate change, the fundamental population-resource issue has been at best on the back burner.

An important question for me has always been, Why have the Ehrlichs and others who understand the biophysical limits to growth not had more impact on national and international policies, or even on the discussion of policies in academia? Although Paul Ehrlich's earlier gloom-and-doom predictions have not come true, at least on the schedule he laid out in *The Population Bomb,* any casual perusal of major newspapers today shows that the issues he raised long ago have not gone away: the world today faces increasing hunger, disease, and unemployment fueled by shortages; increasingly unstable commodity prices; overcrowding; and burgeoning numbers of different ethnic groups trying to occupy mutual ancestral grounds that once had room enough for all. Even the much maligned limits-to-growth model is, as of this year, essentially right on track, as John W. Day Jr. and I discussed recently in "Revisiting the Limits to Growth after Peak Oil" (*American Scientist* 97: 230–237), and as shown independently by Graham Turner of Australia. As we watch the world economy tumble around us, as we learn of more and more environmental horrors, and as we understand increasingly that the basic neoclassical economic model does not transcend resource limits, it becomes ever more clear that we should have been paying far more attention to what the Ehrlichs had to say.



So is it a question of being wrong entirely or wrong just on the timing? I believe that cheap oil and petroleum-derived fertilizer allowed the world to avoid very serious population and resource issues for a few decades, but with peak oil, the price of oil is likely to continue to increase, and the chickens are coming home to the Ehrlichs' roost. Given that the issues raised in *The Dominant Animal: Human Evolution and the Environment* are among the most important ones confronting humanity, I find it interesting that most environmental science programs and papers focus on humans' impact on nature, not on humans themselves. Shouldn't more National Science Foundation programs, university departments, and other interested parties be devoted to these questions? In any event, now that we have apparently reached the global peak in oil production, many parts of the world are suffering from food shortages, and much of the world's industrial economy is crashing, it may be a good time for all of us to catch up with what the Ehrlichs are thinking. This book is certainly the place to start.

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Biology Under the Influence: Dialectical Essays on Ecology, Agriculture, and Health. Richard Lewontin and Richard Levins. Monthly Review Press, 2007. 400 pp., illus. $22.95 (ISBN 9781583671573 paper).

Biology Under the Influence is a lightly edited collection of 31 essays by Richard Lewontin and Richard Levins. Many of the essays originally appeared in essentially the same form in columns Lewontin and Levins wrote for the journal *Capitalism, Nature, Socialism* in the late 1990s, though the essays span two decades since the publication of their book *The Dialectical Biologist.* Lewontin is Alexander Agassiz Research Professor at the Museum of Comparative Zoology at Harvard University; Levins, also at Harvard, is John Rock Professor of Population Sciences, Department of Population and International Health. Together, they write these essays not only as accomplished biologists but also as social and political activists deeply committed to action, knowledge, and theory.

Especially compelling are the essays "Organism and Environment," "False Dichotomies," and "The Return of Old

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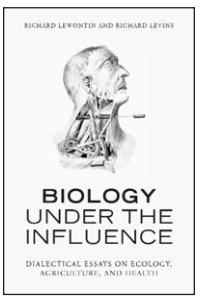
Diseases and the Appearance of New Ones," which exemplify Lewontin and Levins' commitment to a dynamic, dialectical interpretation of complex interactions within and between levels of organization in biology and nature. For instance, they underscore that "the environment" is not a static background to development and evolution, but rather organisms simultaneously develop within and substantively alter their environments; moreover, other organisms are part of "the environment," further demonstrating the necessarily dynamic nature of organism-environment relationships. These ideas will be familiar to readers of the authors' previous works, such as Lewontin's *The Triple Helix,* but the luxury *Biology Under the Influence* affords is having pithy and accessible essays at hand to introduce the ideas and reiterate them in regard to a broad range of topics. And the breadth of topics covered is indeed remarkable, including science and progress, human genetics and genomics, Cuban agriculture, the search for life on other planets, and the foibles of evolutionary psychology.

In these collected essays, as throughout their joint writings, Lewontin and Levins articulate what they see as the "dual nature" of science, guided—but not rationally so—by both nature and money. While an argument can be made in favor of intellectual curiosity as our only Sherpa through scientific *terra incognita,* such an argument is inadequate to the reality of science funding. Not all research can be funded all the time—and certainly not with public funds—so a patchwork of public and philanthropic and corporate funds, some undirected and some strategically invested, has been marshaled to support scientists' explorations. This is simply the way things have worked out; there is no reason to believe that it is the optimal arrangement for promoting important scientific discoveries. Scientifically significant questions may be displaced in favor of socially salable ones (miracle cures, for example). Socially significant questions may be displaced in favor of commercially viable ones (blockbuster drugs). The end result sates neither the hunger of intellectual curiosity nor the appetite of the interested public's interest. We are left instead with biology under the influence not only of corporate research agendas but also of partisan politics and simplistic reductionism. This perfect storm produces "a pattern of insight and blindness, of knowledge and ignorance, that is not dictated by nature, leaving us helpless in the big problems facing our species" (p. 9).



Other scientists and commentators on science have made similar diagnoses. But widely varying accounts of the etiology, treatment regimen, and prognosis for the contemporary state of science accompany each of these diagnoses. In a recent essay in *Issues in Science and Technology,* Arizona State University president Michael Crow laments the ways in which universities and funders remain committed to producing specialized new knowledge within the jealously guarded boundaries of age-old disciplines, and fail to foster innovative research collaborations focused on answering real-world problems. Crow does not demonize corporate investment in academic research, but rather challenges us all to think differently about how to frame and address the serious problems besetting our species locally and globally. For some, this is a nonstarter—the solution is to boost public funding of basic science; for others, the strategy is to facilitate the "translation" of basic science into outcomes in the clinic and elsewhere, regardless of the impact on basic science and regardless of the current status of the "source language"; for still others, the idea is to minimize curiosity-driven science and rationalize the science funding process—or to turn it over completely to the private sector.

The problem, though, is that there is no equivalent to evidence based medicine to help solve our science funding woes. There is no evidence base at all. Science policy is not a scientific endeavor, and so we don't have relevant data or even well-developed norms and values to guide science policymaking. A relatively new initiative at the National Science Foundation called "The Science of Science and Innovation Policy" might help, but only if it is not overrun by econometricians tracking a few barely relevant variables.

What good is science? I mean this as a serious question, an empirical question; it is not a rhetorical ploy. It might seem self-evident that science is inherently good, and needs no justification. But that is too facile a supposition. Science is a suite of questions and strategies and techniques for discovery, but not just any old discovery will do. Significant discoveries are what we're after in science, and the significance of a discovery or a research program must be demonstrated and not assumed. If Lewontin and Levins are right about our questions and strategies and techniques being captive, under the influence, canalized by reductionism and vested interests, then the good of contemporary science is not at all clear. Rather than assume the intrinsic value of science, let us take the justification of science seriously as a challenge.

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