BOOK REVIEWS

Widespread Likings

The Biophilia Hypothesis. STEPHEN R. KELLERT and EDWARD O. WILSON, Eds. Island Press, Washington, DC, 1993. viii, 484 pp., illus. $27.50 or £22.95.

Sociobiologist Edward O. Wilson and his colleagues have identified yet another human behavior that they suspect is governed by genes—nature appreciation. The rationale for "biophilia," an "inborn need for nature" (p. 448), is politically laudable, if scientifically curious. Wilson has long warned about the extinctions of thousands of species worldwide. He suggested in his 1984 book *Biophilia*, which inspired the present collection, that if people came to believe in an inherent need for nature they would then come to support environmentalism.

The Biophilia Hypothesis includes each editor's introduction to the idea that people have an "innately emotional affiliation . . . to other living organisms" (p. 31); chapters reviewing studies of how people feel about nature and nature scenes; papers on indigenous peoples' empathy for nature; and more speculative essays on evolution (including the Gaia hypothesis) and environmentalism. To the editors' credit, the book includes one paper, by Jared Diamond, that questions the entire theory of biophilia, although its arguments are not addressed by the other contributors.

It is unusual so frankly to predicate a scientific claim on its political usefulness. And the idea itself seems oddly contradictory: If biophilia existed, would people need to be mobilized? Would there even be a biodiversity crisis? Still, the authors in this volume seriously and thoughtfully explore the biophilia hypothesis. Their exploration points up problems in sociobiology generally.

Diamond's dissent aside, the contributors disagree on many issues. For example, they differ on how specific an instinct biophilia is. Some contend that it is an articulated set of emotional and behavioral responses to particular flora and fauna; others that it is a general attraction to nature of all kinds; and yet others that it is a tendency to "focus on living things" or an "affinity with life" that may or may not be innate (see for example pp. 224–25). For some, the targets of biophilia are distinct—people inherently love savannas and low-branching trees; they hate snakes and rainforests. For others, anything living—poodles or tropical fish in aquaria—is appropriate. Some discussions imply that biophilia is a universal human trait like an opposable thumb, others that it is a variable one like skin color.

The stronger formulations of the hypothesis are the most intriguing. (The weaker ones are largely hollow.) Take Roger Ulrich's argument: Humans evolved in African savannas. Selection favored individuals who were attracted to useful environmental features, such as openness, greenery, and still water, and who avoided others, such as dark, enclosed spaces. Thus, "as a remnant of evolution, modern humans might have a biologically prepared readiness to learn . . . certain positive [and negative] responses to nature but reveal no such preparedness for urban or modern elements" (p. 88). "Readiness" means that the genotypic disposition must be triggered by experience to gain expression. Pursuing this logic, another author argues that the sexual division of labor among primordial hunter-gatherers caused modern women to prefer heavily vegetated areas (p. 151).

What evidence is there for this theory, this "just-so" story, as two contributors (p. 186) put it? The strongest evidence presented, especially by Ulrich, is from studies showing that people more often prefer and feel soothed by being in or viewing pictures of nature—at least, "park- and savanna-like" scenes—than is the case with "threatening" natural views or urban settings. Ulrich also reviews evidence of "biophobias," especially fears of snakes and spiders. Other contributors raise doubts about these "proofs," however, even if only obliquely. For instance, people respond positively to theoretically inappropriate features of nature—they like to pet cats and they defend rainforests, for example. Also, some cultures do not have generalized fears of snakes. One author points out that photographs of nature scenes are themselves unnatural.

Other contributors describe how indigenous peoples—supposedly closer to our primeval ancestors than we—intimately know and revere nature. For example, elderly Yaqui Indians distinguish among many species of desert flora (although not as many as Western scientists do). Diamond's essay challenges this proof of biophilia. The native New Guineans with whom he worked were often cruel to animals and overharvested their environment. More important, the New Guineans' nature wisdom focused on those parts of nature that they exploited. In that sense, the natives' abilities to distinguish among animals are similar to a mechanic's ability to distinguish car noises—a matter of livelihood and practice, not genes.

Deeper problems plague the biophilia hypothesis. First, if selection pressures were so powerful that they could create specific, innate aversions to snakes and spiders, why did they not create a genetic aversion to more lethal stimuli, like water fouled by human wastes? One reply might be that natural selection operates, but does not operate perfectly. Yet it is an odd theory that attributes scalpel-like precision to natural selection in one sphere, such as response to tree shapes, and obtuseness to it in another, life-and-death sphere.

Second, the people who love nature most are farthest from it. The most industrialized nations try to protect endangered species; the residents of cities most often recycle; and young, educated people most support "green" positions (as Stephen Kellert's own paper shows). Contrary to many contentions in this book, it seems that those who know nature largely through media (Bambi, and the like) are the most environmentalist.

Third, there may be more behavioral evidence for "urbiphilia" than for biophilia. For millennia, people have moved from more rural to more urban places. Even in modern America it is likelier for a rural resident to move cityward than for an urbanite to move countryward.

The rejoinder to the last point is, in Wilson's phrase, that "technology has catapulted humanity" into unnatural environments (p. 32), overriding our innate biophilia. Indeed, this claim, that "technology made us do it," is the general answer to the paradox I noted at the beginning—if biophilia exists, why is there a bio-crisis? It is a weak answer.

On the one hand, Wilson has argued that human ethics are, ultimately, genes' devices for reproducing themselves (see pp. 382–83). If so, technology must also be a tool of our genes, in which case it cannot threaten the natural order. (The chapter on Gaia makes roughly this argument.) On the other hand, Wilson has also written that genes only "have culture on a leash," an image implying not genetic determinism but still strong biological constraints on culture. Still, if a mere few thousand years of civilization have overwhelmed 2 million years of natural evolution so as to bury biophilia beneath technology, then why pay so much attention to the weaker influence on human action?

The knots in the biophilia hypothesis resemble those in other genetic theories of human action. Sociobiologists notice commonalities across societies and historical eras and then leap to genetic explanations. They vastly underestimate learning. For example, probably the most habitual human activity throughout the world today after sleeping is watching television. Should we posit a TV gene? Probably not. Social learning can better explain this nearly universal behavior, as well as the widespread liking for nature scenes.

Genetic theorists have yet more problems with differences among groups or eras. Americans today differ from their great-grandparents as Sierra Club members differ from lumbermen on the environment—and on many other matters, too. These differences cannot be explained genetically, only socially.

And there is perhaps a final irony: Wilson and colleagues want to mobilize people to love and protect nature. Yet they propound a theory that says, put simply, that loving nature is in our genes. Like other theories of predestination, this notion justifies doing nothing. The real leverage for environmental activists lies in understanding the culture of nature-loving—the history of conservation, the social structure of environmentalism, nature ideologies—not its biology. Exploring these ideas might empower bio-activists to mobilize people, to make "biophilia . . . a religion-like movement" (p. 454)—in other words, a product of human culture.

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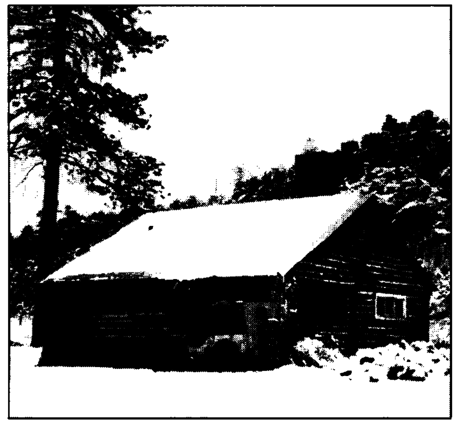
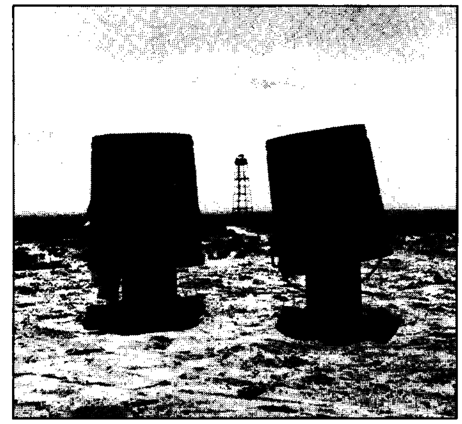
Atomic Science

Critical Assembly. A Technical History of Los Alamos During the Oppenheimer Years, 1943–1945. LILLIAN HODDESON, PAUL W. HENRIKSEN, ROGER A. MEADE, and CATHERINE WESTFALL, with contributions from Gordon Baym and five others. Cambridge University Press, New York, 1993. xvi, 509 pp., illus. $39.95 or £45.

This is the story of the work done during the Second World War at the Los Alamos laboratory, which designed and made the first nuclear weapons. Though the Los Alamos enterprise was not the largest or the most expensive part of the Manhattan Project, it had probably the largest-ever accumulation of scientific talent working under great pressure on a wartime project.





Left, Site of experiments by the spontaneous fission group of the physics research division at Los Alamos. For these experiments the group, according to George Farwell, sought a site with "peace and quiet from electrical and audible disturbances, and shielding from cosmic rays," exploring "caves at the bases of various cliffs . . . that might be easy to dig into" and eventually obtaining the use of this Forest Service cabin 14 miles from the technical area. Photo courtesy of George Farwell. *Right*, View of the Trinity test site near Los Alamos, with the tower positioned at Ground Zero for the July 1945 test of the plutonium "gadget" in the background. "The garbage cans were used to protect equipment from the elements." [From *Critical Assembly*]

Initially the task of the laboratory seemed fairly straightforward. The assembly of a supercritical mass of fissile material, uranium-235 or plutonium, from two subcritical pieces was planned to be carried out by firing one piece at the other inside a gun barrel. This had to be done fast enough to avoid predetonation—that is, a chain reaction starting before the system reached its maximum supercriticality and producing an inefficient explosion. The gun method of assembly was fast enough for this purpose, and this design proved satisfactory for the uranium weapon. Confidence in this design was, in fact, so great that it was used in the attack on Hiroshima without previous test.

This was not achieved without much intensive work. There were nuclear physics problems, including the precise determination of the critical mass for various shapes of the fissile core and for various scatterers surrounding it to reduce the escape of neutrons; an initiator, that is, a source of neutrons that would ensure that the chain reaction would start when the assembly had reached the right stage, had to be designed. The chemistry and metallurgy of uranium and plutonium had to be studied to develop methods of fabrication. The details of the gun mechanism had to be developed and estimates made of the energy released in the explosion and its effects.

So the laboratory needed nuclear accelerators and detectors, state-of-the-art metallurgical and chemical equipment, and much else, in addition of course to a staff with experience in all these fields. But there was no doubt that all the problems would be solved in good time.

When the first samples of plutonium from reactors became available, it was discovered that the rate of spontaneous fission was much higher than expected. This came as a great shock at Los Alamos, because, since a single neutron from a nucleus undergoing fission can start the chain reaction, the time taken by the assembly from the critical point to a configuration of high efficiency had to be shorter than was possible with the gun method, and one had to look for a different method of assembly for the plutonium bomb that was ultimately dropped on Nagasaki.

The principle of a faster method was available in the principle of "implosion," which Seth Neddermeyer had suggested and was beginning to develop. The idea was to surround a spherical shell of fissile material by high explosive and ignite this in many places so as to form a converging detonation wave, which would collapse the shell.

This was an ingenious idea, but making it work proved very difficult. Detonation waves tend to expand rather than converge, and the intersection of expanding waves causes great and undesirable complications. This difficulty was overcome by the use of explosive "lenses," suggested by James Tuck and analyzed by John von Neumann. Detonation waves travel in different explosives at different speeds, just as light travels at different speeds in, say, glass and air. By suitable shaping of the boundary between them one can generate converging waves, just as optical lenses make beams of light convergent. These explosive lenses were successfully developed, but they required much hard work both in calculation and in experimental studies.

It was necessary to start the detonation from several points simultaneously with great precision. This required developing new electric detonators and the electronics to control them.