sian fatalism than to modern political science) unleashed by the triumph of science developed a Frankenstein effect: the most dangerous scientific-technical rivalry in human history and the forces of the great state directed by totalitarian will reinforced each other for several decades.

The book is also about the great temptations of the scientific mind. Ironically, it was not Stalin but Kurchatov and his physicists who made the decision to create a thermonuclear "superbomb" in 1948. The community of Soviet atomic scientists, which Holloway calls the closest thing to civil society in the Stalinist regime, continued to believe, even after facing the "horror" of the first thermonuclear tests in August 1953 and November 1955, that nuclear balance offered an ultimate hope for peace. True, after Stalin's death in 1953, they also began to convey to the political leadership the idea that the thermonuclear weapons posed a common danger for humanity.

The story that Holloway has so superbly written for us looks even more tragic with the benefit of hindsight. Today one knows that, in spite of the authority and freedom of the nuclear designers, they remained prisoners of secrecy. Kurchatov's dream of turning his nuclear complex into the basis for an unprecedented scientific-technical revolution became a reality for the advanced parts of the world, but for the Soviet Union it turned out to be a road to overextension. Numerous installations of the Soviet atomic complex, although they can be hardly compared to the forgotten pillboxes in Albania, today are more a symbol of the Cold War legacy than of a promise for Russia's greatness.

Vladislav Zubok
National Security Archives, Washington, DC 20036, USA

■

Marine Conservation

Global Marine Biological Diversity. A Strategy for Building Conservation into Decision Making. ELLIOTT A. NORSE, Ed. Island Press, Washington, DC, 1993. xxxii, 383 pp., illus. $50; paper, $27.50.

What does the variety of life have to do with rates of production or material processing by ecosystems? Ecologists and conservationists are now evaluating linkages between biodiversity and ecosystem processes and the implications of such linkages for environmental policy. Norse argues that a focus on preservation of remnant populations is risky and expensive and ignores the goods and services provided by biodiversity. Instead, we should "maintain the integrity of life," which implies that ecosystem processes as well as species should be conserved. Many of the book's specific recommendations would conserve entire marine ecosystems or communities, which often transcend geopolitical boundaries. Under this approach, conservation of genes and species follows from conservation of spatially extensive systems.

Global Marine Biological Diversity was written by more than 100 authors for the decision-makers of coastal countries. The central message is that marine biodiversity and the sea's living resources are at great risk from overexploitation, modifications of the physical environment, pollution, invasions by exotic species, and modifications of global geochemistry and climate. These stresses are attributed to root causes that include human overpopulation, overconsumption, failure to build conservation into institutional objectives, ignorance, and a tendency to undervalue nature. The book concludes with 26 pages of specific policy recommendations. A sampling of topics includes sustainable management of marine species, protection of marine habitats, pollution control, ending free rides for alien species, restoration of damaged marine ecosystems, citizen involvement in decision-making, and shifting the burden of proof to users of marine resources.

The least convincing proposal is that for strengthening the knowledge base. The main point of the book is that marine biodiversity is at risk and that we should save it through actions that sustain whole communities or ecosystems at large scales. If one accepts this goal, then it is difficult to understand how more inventories or more taxonomists will accelerate the process. The argument for research on restoration is more persuasive, as we will surely have many opportunities to learn from our mistakes as we attempt to restore marine ecosystems. Marine conservation requires "learning by doing." Conservation and restoration actions are experiments from which we can learn, provided assessment, analysis, and capacity for adaptive change are built into the management process.

In contrast, the book's call for public education and involvement is compelling. The Senegalese ecologist Baba Dioum comments, "In the end we will conserve only what we love; we will love only what we understand; and we will understand only what we are taught."

Several sections of the book offer syntheses that will engage the interests of diverse readers. The fascinating section on the spread of exotic species will dispel any notion that the sea is homogeneous. A valuable chapter evaluates the similarities and differences between terrestrial and marine conservation. In both habitats, certain productive, diverse, or risk-prone areas may be of greatest concern to specialists, while the public is most concerned about the charismatic macrofauna. However, marine habitats differ from terrestrial ones in several ways that affect conservation: sea water is a buoyant medium; marine systems are global biogeochemical sinks; food webs are different; and research and monitoring are relatively difficult.

Norse has succeeded in putting together a volume that is accessible to a wide readership. Scientists will appreciate the tables of acronyms and institutions, and nonscientists will be grateful for the glossary. The book also includes a list of endangered marine species and an index.

Stephen R. Carpenter
Center for Limnology, University of Wisconsin, Madison, WI 53706, USA

■

A Science of Fitness

Ecological Genetics. LESLIE A. REAL, Ed. Princeton University Press, Princeton, NJ, 1994. xvi, 238 pp., illus. $49.50 or £40; paper, $24.95 or £18.50.

Ecological genetics originated in the realization that genetics and ecology are equal partners in the evolutionary process and should be studied on the same time and spatial scales. The papers in the current volume embody well this outlook. The five contributors are all exciting and accomplished researchers in ecological and population genetics. Each contributes two papers, the first typically being an overview of a topic and the second a more detailed exploration of a specific problem. Montgomery Slatkin considers gene flow and population structure from a cladistic perspective. Sara Via considers the evolution of phenotypic plasticity in heterogeneous environments, taking issue with the view that plasticity is a character in its own right, one that can evolve independently of the character values. Michael Lynch reviews neutral models of phenotypic evolution, in which fluctuating selection increases genetic variability above that predicted by the neutral model. He then considers the extensive population genetics data from *Daphnia*, in which bouts of sexual reproduction expose the genetic variation hidden beneath phenotypically similar clones. Janis Antonovics emphasizes the interplay of ecological and genetic dynamics in both of his papers. The first considers theoretical models of host-pathogen systems and the second the field ecological genetics of metapopulations, specifically the *Silene-Ustilago* plant pathogen system. Joseph Travis pro-

vides a synthesis of life-history evolution with an eye toward incorporating physiology in a manner that goes beyond the simple trade-off principle that has dominated this area. Each contribution expresses a unique and powerful viewpoint on topics of considerable evolutionary interest.

Though there are many good reasons to recommend the papers contained in this collection, it is hard for me to get excited about the book as a whole, especially as a representation of the state of "ecological genetics" in the 1990s. There *is* much in the book. Current methodologies are well in evidence, especially those involving metapopulations (Slatkin, Lynch, Antonovics), quantitative genetics (Via, Lynch, Travis), cladistics (Slatkin, Lynch), and what is a must these days, molecular data (Lynch, Slatkin, Travis). But, there is also much that is missing, especially concerning behavior, mating systems, and sex, studies of all of which have undergone a revolution since the early days of ecological genetics. The emerging field of the ecological genetics of microbes is entirely absent.

More important than what is missing, however, is that the book lacks a central focus or problem. Some fields don't have a central problem, but I think ecological genetics does—or could. It is the problem of fitness. Fitness is perhaps the only concept that is uniquely biological—all else being molecular biology. What is fitness? What has fitness? What determines fitness? How do we measure fitness? These questions are the special concerns of ecological genetics. If the field is to have a real existence apart from population genetics or evolutionary genetics, it seems to me to lie in its unique approach to the problem of fitness.

What is the ecological-genetic approach to fitness? It is based on the realization that fitness is a function of both ecology and genetics. A consequence of this approach is that fitness is no longer a property of organisms, as the "propensity" interpretation of fitness popular in philosophical circles would have us believe. The ecological genetic approach to fitness is more sophisticated than the purely ecological, in which fitness equals optimality plus constraints. It is also more complex than the purely population genetic, in which fitness is an abstract constant devoid of ecological import. When I was in graduate school in 1975 I took a seminar "Ecological genetics." It was packed with ecological approaches to fitness—density-dependent, frequency-dependent, demography-dependent, and life-history-dependent fitness, fitness in heterogeneous environments, fitness in varying environments, and so on. These concerns are well in evidence in the present collection, especially in the papers by Antonovics, Via, and Travis, but fitness never emerges in the book as a central problem in its own right.

I think we are a long way from understanding fitness and its role in the evolutionary process, and I worry that the significance of this problem is not widely appreciated or, worse, that the problem is seen as passé. It appears that the advent of molecular data and their treatment with modern phylogenetic methods (like those discussed in Slatkin's chapter) will allow us to quantify history and its important role in evolution. Understanding fitness will prove to be more difficult. Case-by-case studies of selection in nature or in the lab, as were typical of the ecological genetics of the past and as are represented here in the papers of Via, Antonovics, Lynch, and Travis, will undoubtedly continue to play a role. The ongoing revolution in molecular data and phylogenetic methodologies may help frame this question. By quantifying history and its role in the evolution of a character, the role of natural selection may be more carefully de-

lineated. Nevertheless, we need more. The challenge is that there cannot be a general theory of fitness, like Newtonian physics, that applies to all organisms in all populations, because there is no overall property that is maximized by evolution. Attempts at such a theory, for example ones based on entropy, have uniformly failed in providing the needed general framework. Does this mean there can be no general theory or framework? I think not. Therein lies the task for ecological genetics, the science of fitness.

Richard E. Michod
Department of Ecology and Evolutionary Biology, University of Arizona, Tucson, AZ 85721, USA

■

Reprints of Books Previously Reviewed

Animal Minds. Donald R. Griffin. University of Chicago Press, Chicago, 1994. Paper, $12.95 or £10.25. *Reviewed* **258**, 830 (1992).

Linnaeus. The Man and His Work. Tore Frängsmyr, Ed. Science History Publications/U.S.A. (Watson), Nantucket, MA, 1994. Paper, $14.95. *Reviewed* **221**, 49 (1983).

Longevity, Senescence, and the Genome. Caleb E. Finch. University of Chicago Press, Chicago, 1994. Paper, $45 or £35.95. *Reviewed* **252**, 1864 (1991).

■

Books Received

Aerodynamics, Aeronautics, and Flight Mechanics. 2nd ed. Barnes W. McCormick. Wiley, New York, 1994. xii, 652 pp., illus. $84.95.

Breaking the Thread of Life. On Rational Suicide. Robert L. Barry. Transaction, New Brunswick, NJ, 1994. xxii, 353 pp. $34.95.

Case Studies in Biometry. Nicholas Lange *et al.*, Eds. Wiley, New York, 1994. xxii, 496 pp., illus. + diskette. $59.95; paper, $29.95. Wiley Series in Probability and Mathematical Sciences.

Diode Laser Arrays. Dan Botez and Don R. Scifres, Eds. Cambridge University Press, New York, 1994. xvi, 448 pp., illus. $100. Cambridge Series in Modern Optics, vol. 14.

Energy Needs in the Year 2000. Ethical and Environmental Perspectives. William R. Shea, Ed. Watson, Canton, MA, 1994. xviii, 222 pp., illus. Paper, $16.95. From a conference, Montreal, May 1993.

Field Days. Journal of an Itinerant Biologist. Roger B. Swain. Lyons and Burford, New York, 1994. vi, 217 pp. Paper, $12.95. Reprint, 1983 ed.

Gifted IQ. Early Developmental Aspects. Allen W. Gottfried *et al.* Plenum, New York, 1994. xii, 207 pp. $34.50. The Fullerton Longitudinal Study.

Human Facial Expression. An Evolutionary View. Alan J. Fridlund. Academic Press, San Diego, CA, 1994. xiv, 369 pp., illus. $59.

In the Belgian Château. The Spirit and Culture of a European Society in an Age of Change. Renée C. Fox. Dee, Chicago, 1994. xii, 339 pp., illus. $28.50.

Linking the Gaseous and Condensed Phases of Matter. The Behavior of Slow Electrons. Loucas G. Christophorou, Eugen Illenberger, and Werner F. Schmidt, Eds. Plenum, New York, 1994. x, 596 pp., illus. $139.50. NATO ASI Series B, vol. 326. From an institute, Patras, Greece, Sept. 1993.

Marine Light Field Statistics. Ronald E. Walker. Wiley, New York, 1994. xvi, 675 pp., illus. $89.95. Wiley Series in Pure and Applied Optics.

Nitroalkenes. Conjugated Nitro Compounds. V. V. Perekalin *et al.*, Eds. Wiley, New York, 1994. xii, 256 pp. $95.00.

Perfumery. Practice and Principles. Robert R. Calkin and J. Stephan Jellinek. Wiley, New York, 1994. xiv, 287 pp., illus. $74.95.

Permanent Magnet Materials and Their Application. Peter Campbell. Cambridge University Press, New York, 1994. x, 207 pp., illus. $49.95.

The Road to Health Care Reform. Designing a System That Works. Jeffrey C. Merrill. Plenum, New York, 1994. x, 313 pp. $29.95.

Seeds of Reflection. Word Clusters for Meditation on the Infliction and the Relief of Suffering. R. G. H. Siu. International Society for Panetics, Washington, DC, 1994. vi, 335 pp. Paper, $10. Panetics Trilogy, vol. 3.

Synchrotron Radiation in the Biosciences. B. Chance *et al.*, Eds. Oxford University Press, New York, 1994. xxxii, 784 pp., illus. $145. Based on a conference, Tsukuba, Japan.

Taking Charge. The Electric Automobile in America. Michael Brian Schiffer with Tamara C. Butts and Kimberly K. Grimm. Smithsonian Institution Press, Washington, DC, 1994. xiv, 225 pp., illus. $24.

World Atlas of Reconnaisance Satellite Images, 1: 1,000,000. Vol. 32, Portugal, Spain, Italy, Yugoslavia, Albania, Greece, Turkey, C. I. S., Iran, People's Republic of China, North Korea, Japan, U. S. A. P. Lof, Ed. Copernican Science Press, Amstelveen, The Netherlands,, 1994. iv, 145 pp. $300.