BOOK REVIEWS

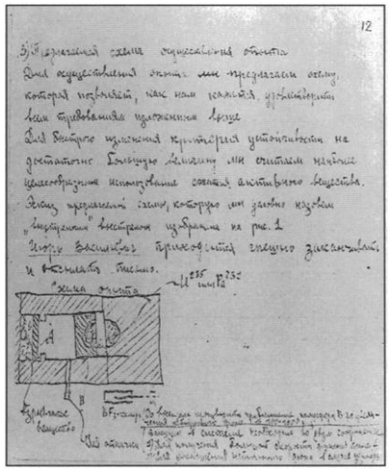
Atomic Works on a Russian Scale

Stalin and the Bomb. The Soviet Union and Atomic Energy, 1939–1956. DAVID HOLLOWAY. Yale University Press, New Haven, CT, 1994. xvi, 463 pp. + plates. $30 or £19.95.

Not surprisingly, it took longer to write the book about the Soviet atomic bomb than it took to build the first one in the 1940s. In the Soviet Union not just the atomic complex itself but even its history remained the most heavily guarded secrets. During his first trips to Moscow in the 1980s the author, a political scientist from Stanford University, could have been easily framed up as a "foreign spy." Holloway's reputation and candor, however, allowed him to weather the dangers and build relations of trust with many Soviet scientists.

The informational avalanche that has occurred since *glasnost* was a mixed blessing for Holloway's research. It opened the doors to Soviet military officials, diplomats, and atomic scientists, including the most famous of the scientists—Yulii Khariton, Georgii Flerov, and Andrei Sakharov. On the other hand, "the history of the Soviet project has become encrusted with many stories of doubtful reliability," among them the notorious atomic chapter of *Special Tasks*, the memoirs of "unwanted witness" Pavel Sudoplatov. To the author's credit, he has "tried to strip those legends away," pointing to them "only when they themselves are evidence about something else."

"Models of the first three Soviet nuclear weapons, from left to right: the 'Layer Cake' tested on August 12, 1953; the 40-kiloton weapon tested in 1951; the first Soviet atomic bomb. The photograph shows the bomb casings; it was the explosive charges only that were tested. Photograph by V. I. Luk'ianov and S. A. Nazarkin, Museum of Nuclear Weapons, Arzamas-16." [From *Stalin and the Bomb*; Iurii Smirnov]



Page of a letter from Georgii Flerov to Igor Kurchatov, December 1941. "The diagram shows Flerov's suggestion for bringing together two hemispheres of uranium-235 to cause a nuclear explosion." [From *Stalin and the Bomb*; Georgii Flerov]

"Andrei Sakharov and Igor Kurchatov, 1959." [From *Stalin and the Bomb*; Raisa Kuznetsova]

The author set a tall order for himself. He evaluates the relation between the dynamics of the nuclear project and the nature of Stalin's regime. He analyzes the relations between science and politics in the Soviet Union. And he deals with many political implications of the Soviet nuclear program, particularly its impact on Soviet foreign policy.

It turns out that Stalin, a great practitioner of power, did not learn immediately to "love the bomb." For five long years after the discovery of fission in 1939 the Soviet Union did little to explore the military potential of nuclear fission. In the summer of 1940 Vladimir Vernadskii, a great Russian scientist and philosopher, persuaded the government to create a Commission on the Uranium Problem attached to the Soviet Academy of Science. But the scientists failed to enlist state resources, and as a result the lack of uranium became later, in 1945, one of the major obstacles to the progress of the Soviet atomic effort.

Holloway also concludes that a neglect of the atomic project was one of Stalin's gravest mistakes, comparable to his miscalculation of the imminence of the German invasion of the Soviet Union that occurred in June 1941. As late as the summer of 1945 the Soviet leaders "had no conception of the impact [the bomb] was about to have on world politics." The main reason: Stalin mistrusted both his scientists and his "atomic" espionage and therefore failed to appreciate the military potential of atomic research. Another and deeper reason: Stalin's police state of command economy contained in itself "systemic obstacles" to risky, innovative projects. The physicists, in the wake of the "great terror" and continuing repression of free thought, refrained from commitments for which (as with the bomb) success was not guaranteed.

It seems logical that it was not the Soviet Union but the greatest democracy on Earth that pioneered in atomic research. But should we call it one of Stalin's "gravest" mistakes? Stalin as *ignoramus atomicus* hardly differed from Roosevelt or Churchill. Perhaps, like Hitler, he came to the conclusion that the atomic bomb would not be crucial for the outcome of the Second World War and his nation's immediate plans. There were also powerful reasons (as Holloway recognizes) why Stalin could not afford to build the bomb until the war with the Nazi Germany was over. Stalin's miscalculation may have been less in underestimation of the bomb than in two other things: he seemed not to expect that the United States would build one so soon or that the U.S.–Soviet rivalry would flare up so quickly after the war.

Whatever his reasons for inaction between 1940 and 1945, the dictator showed his strongest side after Hiroshima, when he commanded the best resources of his state for the creation of an atomic industry "on

the Russian scale." Holloway argues that, in spite of all sensational revelations, "atomic" espionage was not a decisive factor in the Soviet success in the building of the first bomb in four years: the intelligence data were significant, but an enormous amount of original work had to be done by the Soviet atomic physicists, led by Igor Kurchatov.

The book highlights factors in the Soviet success that had been underestimated in the West. First, the availability of uranium more than "any other factor" determined the time required for construction of the first bomb. In 1945 the Soviets took over rich uranium mines in East Germany (southwest Saxony) and Czechoslovakia, and this helped them accumulate much faster the amount of uranium required for experiments and the first test.

A second factor was the mobilization of a highly effective system of organization for the project. The building of the atomic bomb was "the kind of task for which the Stalinist command economy was ideally suited." Once Stalin decided to have the bomb at all costs, the Soviet government allocated enormous resources to related (and once-neglected) new areas of military technology: radar, jet propulsion, and rockets. The scale of the work performed by the half-destroyed economy of the Soviet Union in the late 1940s impresses the reader even today.

Third, the project was "a heroic undertaking," evoking enthusiasm among all participants, including the atomic designers. It was, writes Holloway, "in some psychological sense a continuation of the war with Germany." Not only did scientists willingly cooperate with the heinous Beria and his secret police henchmen who administered the project, they risked their lives to speed up crucial experiments.

Stalin and Beria needed the bomb, and therefore atomic physics became their darling. The bomb saved the Soviet physics community from the ideological witch-hunts that destroyed other scientific disciplines at the end of the 1940s, thus providing, as the Nobel Prizewinner Lev Landau sardonically joked, "the first example of successful nuclear deterrence." The atomic project even became an island of intellectual freedom and creativity in the morass of the police state (and, incidentally, demonstrates again how Stalin could sacrifice ideological dogma if it contradicted his *Realpolitik* plans).

As the secrets of the Soviet bomb project are pried open what light do they shed on the old questions of nuclear-age history? Could, for example, candor with Stalin on the part of Truman or a "peaceful" demonstration of the bomb in 1945 have prevented the nuclear arms race and improved the chances of international cooperation in atomic energy? Were there any "missed opportunities" to stop the race after Hiroshima?

Holloway's answers are firmly negative. True, Hiroshima "caught Stalin by surprise" and created an unexpected obstacle to his plans for a peace settlement. "Atomic diplomacy" by U.S. Secretary of State James Byrnes in the fall of 1945, the disadvantage to the Soviet Union of the Baruch Plan for international control of atomic weapon development, and the Bikini tests in the summer of 1946 contributed to Stalin's suspicion. Yet, as Holloway asserts, Stalin would have been after the bomb in any case, since it became a universally acknowledged symbol of immense economic, technological, and military superiority—the "scepter of state power," in the words of Russian novelist Vasilii Grossman.

The author believes that any feasible American plan for international control of atomic energy, however imaginative, "would have had little chance of acceptance" by Stalin, since by June 1946, when public discussion of the Baruch Plan started in the United Nations, the Soviet project was already proceeding at a rapid rate. "Production of uranium metal for the first Soviet reactor had already begun. Sites were being prepared for a plutonium production reactor, a gaseous diffusion separation plant, and a weapons laboratory."

The author admits that the bomb contributed to "the origins of the Cold War" but places the bulk of the responsibility on Stalin. In Holloway's words, "It is difficult to think counterfactually about this period without assuming Stalin away. His malevolent and suspicious personality pervades the history of these years."

The Stalin of Holloway's book is a cautious but not wise statesman. His suspicious and evil mind turned out to be his greatest enemy. In the short run Stalin was right in regarding the nuclear threat as not as immediate one in 1945–46. But in the longer run he was wrong as he viewed the future as a replay of the period between the two world wars and failed to foresee the advent of the U.S. hegemony in the capitalist world. He smartly undercut American "atomic diplomacy." But in doing so he overplayed his hand and precipitated the breakdown of cooperation with wartime Western allies.

Yet, in all fairness, could the nuclear race have been avoided had Stalin *been* "away"? Holloway seems to believe that Maxim Litvinov, former Soviet foreign minister, represented in 1945–46 a "line of cooperation" with the United States. Yet, as the documents of Litvinov's commission on peace treaties and postwar settlement suggest, Litvinov's stance could have been just another tactic for promoting the interests of the "greater" Soviet Union in Europe and elsewhere. As more sources come to light, it is increasingly difficult to imagine, even if Stalin had died in 1945, that the Soviet state and the United States, so similar in their ambitions and yet so polarized otherwise, could have escaped a head-on collision and atomic race. Holloway's book, for all its merits, only begins to explore the murky world of Stalin's foreign policy in the early Cold War.

The author, in conclusion, defines his book as "a study not only of horror but also of hope." But it also tells us about how the "force of things" (a concept closer to Rus-

Vignettes: Neuroscience

People nowadays tend to over-interpret their findings. Neurobiology is a fascinating field, but it has become a bit like Disneyland. There is a lot of self-advertising, which is no good for science. . . . Let's just say the field is a bit overheated right now.

—*Bert Sakmann*, as quoted in Thomas A. Bass's *Reinventing the Future: Conversations with the World's Leading Scientists* (Addison Wesley)

The lack of definitive answers on brain/mind matters is not a cause for despair . . . and is not to be seen as a sign of failure of the scientific fields now engaged in the effort. On the contrary, the spirit of the troops is high since the rate at which new findings are accruing is greater than ever. . . . If there is any cause for worry, it comes not from a lack of progress but rather from the torrent of new facts that neuroscience is delivering and the threat that they may engulf the ability to think clearly.

—*Antonio R. Damasio*, in *Descartes' Error: Emotion, Reason and the Human Brain* (Putnam)

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.

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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.

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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-