first-rate, as is her examination of how scientists have become advocates for their profession and public relations specialists. Nelkin sees the character of science journalism changing from that of a booster "selling science" to that of a mature critical observer that often challenges the assertions of the scientist. Her text is well written, easy to read, and filled with delightful anecdotes. Yet the book is uneven and often disquieting.

The book suffers from one problem attributed to science journalism—the need to condense and simplify. Nelkin, aware that all branches of the media would be too ambitious a subject, has rightly chosen to focus on the relationship between the print media and the scientific community. But both communities are drawn too homogeneously.

Another grounds for concern is the apparent vacillation about which of several apparently conflicting roles is most appropriate for science journalism. One role for the journalist is as a decipherer, accurately translating technical images into the language of the lay reader. The other is as an arbiter of scientific controversy, providing for the reader not only the different scientific arguments but an assessment of which point of view the reader should credit. In the end, Nelkin seems to favor the latter and even more, calling for journalists to "try to convey understanding as well as information. It is not enough to merely react to scientific events, translating and elucidating them for popular consumption. To understand science and technology, readers need to know their context: the social, political, and economic implications of scientific activities, the nature of evidence underlying decisions, and the limits as well as the power of science as applied to human affairs."

Finally, I am bothered by the lack of sufficient discussion of one feature that distinguishes science and journalism. Science is often self-correcting; that is, the imperative for independent verification of facts forces accountability on scientific reports. In journalism, there is no comparable pressure for accountability. Despite some of Nelkin's suggestions, I doubt that any standards can be imposed by outside groups. Standards for science journalism must come from within the journalism profession.

This is a book that should and will be read. As with much good analysis, more questions are raised than answered, and the discussion this book can provoke may well reveal how to improve science communications.

SANDRA PANEM
Alfred P. Sloan Foundation, New York, NY 10111

The Manhattan Story Retold

The Making of the Atomic Bomb. RICHARD RHODES. Simon and Schuster, New York, 1987. 886 pp. + plates. $22.95.

At first glance, this does not seem to be a book to command the serious attention of *Science* readers. Its author, a journalist, novelist, and nonfiction writer, tells a story whose outlines, at least, are well known to the scientific community; it is based for the most part on well-mined sources; it is novelistic in its treatment of people and events; and it is very long. But to turn away from the book would be a mistake. Because of its comprehensiveness and the framework within which its main story unfolds, it broadens and deepens our understanding of the familiar subject; and it is a very good read.

Chronologically, *The Making of the Atomic Bomb* takes us from the birth of modern physics in the late 19th century to the first tests of hydrogen bombs, by the United States in 1954 and the Soviet Union in 1955. Geographically, though its central locale is America, it ranges across the great European laboratories where modern physics was born, the theaters of operation in both world wars, and the sites of the nascent nuclear bomb projects in Germany, Russia, and Japan. Its cast of characters is as large as its subject; it includes the scientific, political, and military figures who had a hand in making the 20th century the most violent time in human history. Its mode is narrative; yet within that structure the author provides detailed explanations of the physics and engineering that are behind the birth of the atomic age.

Apart from the Leo Szilard papers, which only recently have become available for use, Rhodes's archival sources are standard for the subject, including chiefly the Bush-Conant File in the Office of Scientific Research and Development papers, the Manhattan Engineer District records, the papers of J. Robert Oppenheimer, and interview transcripts at the American Institute of Physics. Rhodes himself interviewed a number of surviving participants in the events he describes and visited many of the institutions in the United States, Europe, and Japan where those events took place. Although one can wonder about some omissions, the bibliography of printed sources, both primary and secondary, is impressively thorough and wide-ranging and gives him a solid foundation for his ambitious book.

The narrative thrust of this book is toward the dawn of the "new age" that was born with the testing and use of atomic bombs, which would render obsolete traditional ideas about warfare and security and the customary conduct of international affairs. But within this theme of novelty Rhodes develops a subtheme of equal importance: from the gassing to death of soldiers in World War I, to the incineration of civilians in massive incendiary raids in World War II, to the blasting and radiating to death of appalling numbers of people with two atomic bombs in Hiroshima and Nagasaki, 20th-century warfare is on a single continuum. The marriage of science and technology has made it possible for the nation-state to deal death to an enemy on an awesome scale. The temptation to realize that possibility proved to be irresistible and was "justified" as a means of saving life by winning (ending) the war, even though all moral inhibitions and legal restraints on the conduct of war were thereby nullified. This observation, of course, has been made before. But by directing our attention to the continuum at the same time as he describes a revolution, Rhodes gives emphasis to what we already know about technology, total death-making, and the inner imperative that drives the technology of total death-making toward an always unattainable perfection. Furthermore, Rhodes describes the experience of human beings who were subject to technological death-making in unforgettable prose.

Rhodes reminds us of the different perspectives of scientists, who were motivated to work on the Manhattan Project out of fear of a thousand-year Reich made invulnerable with atomic bombs, and policymakers, like Franklin Roosevelt, Vannevar Bush, and General Leslie R. Groves, who never were primarily concerned about the possibility of a German atomic bomb. For them the chief considerations were the offensive advantage that such a bomb would confer and the long-range consequences of a new class of destructive weapons. The reminder that in policy-making quarters atomic bombs always had been viewed as another instrument of war helps us to understand the almost perfunctory consideration of alternatives to dropping them on Japanese cities.

Two scientists who from the first recognized that nuclear weapons had revolutionary military and political implications and

tried to influence political leaders about their use serve as polestars for Rhodes's narrative. Rhodes uses Leo Szilard, whose epiphany on a London street corner in 1933 constituted the first realization of the possibility of a nuclear chain reaction, who played a key role in getting the Manhattan Project under way, and who became an increasingly determined critic of plans to use atomic bombs to end the war, as a running commentator throughout the book. This device works well, because Szilard had both the insider's experience and the perspective of a perpetual outsider, and evidence exists concerning his views from the beginning of the Manhattan Project to its end. Unfortunately, Rhodes drops the thread of Szilard's commentary in a place where it would have served him well, his discussion of area bombing. In a postwar symposium on the decision to drop atomic bombs Szilard said that for him the moral divide had been crossed earlier, when the American government rained incendiary bombs on Japanese cities. What better support could have been provided for Rhodes's insistence that we see technological war as a piece?

And yet nuclear bombs did usher in a "new age," and no one knew that better than Niels Bohr. Like Szilard Bohr struggled to alert policy-makers to the implications of nuclear energy for world peace and world order, and like Szilard Bohr is used prominently by Rhodes to put the making of the atomic bomb into a world political perspective. Because Rhodes has earlier explained Bohr's principle of "complementarity," by which he reconciled conflicts between classical and quantum physics, the reader is prepared to understand how Bohr viewed the peril and the hope posed by nuclear energy as being complementary and how he believed that the complementarity might be used as the basis of a charter for a postnuclear world. Both Szilard's and Bohr's efforts to gain a sympathetic hearing of their views from political figures (in Bohr's case from Prime Minister Winston Churchill and President Franklin Roosevelt, in Szilard's from Secretary of State designate James Byrnes) failed dismally. Szilard and Bohr succeeded in predicting a postwar arms race, which we have yet to find a way to bring to an end.

Inevitably, in a book of this scope by an author who is neither a scientist nor a professional scholar, there are some gaps in historiography, some instances of mistaken judgment, and some errors of fact. But these do not undermine the book's overall value. Rhodes has succeeded in treating a subject with vast moral implications without being moralistic. He does not fail to understand the origins and implications of the conflict, in World War II, and he neither ignores nor underplays German and Japanese atrocities. He has appropriate respect for the technological achievement of the Manhattan Project and, more important, for the scientists and political figures who had the unenviable task of simultaneously straining to develop a new device and deciding what to do with it, in a time of unprecedented stress and peril. He is not interested in asserting blame or casting stones. (Only once does he seem to pass judgment. His language suggests contempt for Curtis LeMay's justification of the fire-bombing of Japanese civilians on the grounds that drill presses sticking up in the ruins revealed that every paper house was a weapons factory.) He has a larger purpose: to expose the modern possibility of delivering "total death" as a product of "the nation-state parasitizing applied science and industrial technology to protect itself and to further its ambitions" (p. 781) and to warn that total death is certain unless the inherent lawlessness of the sovereign state can be curbed.

Rhodes proposes a version of Michael Polanyi's model of the "republic of science," open in its spirit, international in its scope, and transnational in its culture, as a model for world order. Science, he says, "fights the exclusivity of the nation-state . . . by sharing its discoveries freely" and by demonstrating "how an open world could function without chartered violence" (p. 784). This is a compelling idea; it has been experimented with on a small scale by the Pugwash movement. But it also is a problematic vision. As Niels Bohr, Leo Szilard, and their descendants are citizens of the republic of science, so too are Edward Teller and his young Star Warrior disciples. And modern science has not developed as separately from the modern state as Rhodes would have us think it has. Science is as much a product of the environment in which it grows as it is of individual genius, and modern science could not have reached its present state of development without the modern state's resources. It is idealistic to present the two as antithetical. These caveats aside, Rhodes's book is a remarkable achievement.

CAROL S. GRUBER
Department of History, William Paterson College, Wayne, NJ 07470

Arms Control: A View from Inside

Stemming the Tide. Arms Control in the Johnson Years. GLENN T. SEABORG with BENJAMIN L. LOEB. Lexington (Heath), Lexington, MA, 1987. xxii, 497 pp. + plates. $24.95.

This is the first attempt to lay out the story of arms control during Lyndon B. Johnson's presidency, and Glenn Seaborg has succeeded well. Drawing on his diary and on papers from his tenure as chairman of the Atomic Energy Commission (1961–1971) and supplementing them with declassified documents and interviews, Seaborg has marshaled a great deal of material not heretofore in the public domain and told the story lucidly and in detail.

The book contains the first written account of an important presidential study commission on nuclear nonproliferation in late 1964 and early 1965, the Gilpatric Committee (named for its chairman, former deputy secretary of defense Roswell L. Gilpatric). Seaborg reviews the work of the committee (which included such luminaries as Dean Acheson, Robert Lovett, John Jay McCloy, Allen Dulles, George Kistiakowsky, Alfred Gruenther, and Herbert York) and the reasons for the limited impact of the study and the cool reception it received. As one involved both in the work of the committee and in Secretary Dean Rusk's negative reaction to it, I disagree to some extent with Seaborg's assumption that the State Department's main objection to the committee's recommendations was the priority assigned to nonproliferation over the North Atlantic Treaty Organization's multilateral nuclear force (MLF). Although the report gave a much-needed impetus to nonproliferation, it was in Rusk's (and my) opinion too hard in the punitive political measures it proposed not only against governments that undertook further nuclear proliferation but even against our then nuclear allies, Britain and especially France, in an effort to roll proliferation back.

Seaborg also discloses for the first time in public reference the fact that in 1964 the United States government considered unilateral action or joint action with the Soviet Union against China if it did not give up its nuclear weapons ambitions, including "even a possible agreement to cooperate in preventive military action" (pp. 111–112). Incidentally, in noting President Johnson's calming announcement after the Chinese made public their first test in October 1964, he does not recall that Secretary Rusk had previously made an anticipatory statement, based on our advance intelligence on the impending Chinese test, which was also intended to deflate the impact of the event.

The main content and value of the book are not in such occasional revelations, however, but in the thorough and well-reviewed account of the major arms control efforts of the Johnson administration, above all with respect to nuclear nonproliferation, nuclear