would have to be probing, conceptual, analytical and well researched, using at least ten archival collections overlooked by Rhodes. Perhaps unintentionally, *Dark Sun* reveals the large gap between skillful journalistic history and serious, well-researched history.

Nazi Science: Myth, Truth and the German Atomic Bomb

Mark Walker
Plenum, New York, 1995. 325 pp. $28.95 hc ISBN 0-306-44941-2

Scientists and the Development of Nuclear Weapons: From Fission to the Limited Test Ban Treaty 1939–1963

Lawrence Badash
Humanities P., Atlantic Highlands, N. J., 1995. 129 pp. $12.50 pb ISBN 0-391-03874-5

Scientists and the Development of Nuclear Weapons and *Nazi Science*—both very readable books—examine a fundamental problem of recent times: the relationship between the scientist and the nuclear state. Although this relationship has changed with the end of the cold war, Mark Walker and Lawrence Badash each perceive the state—in the context of early nuclear weapons research—as having gained decisive control over scientists' research and professional activities. While Badash focuses on developments in the United States during World War II and the first half of the cold war, Walker explores the reactions of German scientists to the deepening dictatorship of the Third Reich, leading into the German wartime nuclear research effort. Each of these works provides, along with the author's original contributions, a remarkably succinct overview of current knowledge in its respective field. Both are intended for students, the general public and professionals alike.

Walker enters into the nightmare world of the Third Reich in arguing that the reactions of scientific institutions and non-Jewish scientists to the onset of dictatorship cannot be viewed in terms of "black and white," Nazi and anti-Nazi, but rather in "shades of gray." His cases in point are the Prussian Academy of Sciences, Nazi physicist Johannes Stark and, for the war years, Werner Heisenberg. Walker brings new research to bear on his main argument that, sadly, the problem for the prewar German physics community was perceived as not how best to resist the regime but how best to compromise with it in order to preserve an elusive modicum of independence.

Although the behavior and reactions of some German scientists might be viewed from their perspective in shades of gray, Walker leaves no doubt of his view that, when seen in retrospect, these shades add up to "black." Compromises with the regime amounted to "complicity" and "collaboration," the Prussian Academy's "surrender" made it into "a willing tool of National Socialist policy," and in his wartime travels Heisenberg became, whether he knew it or not, "an ambassador for genocide." Walker concludes that, while the Nazi regime corrupted German scientists, it did not corrupt German science, including Stark's. In the end there was no "Nazi science," an assertion that deserves more attention.

Drawing upon his own earlier works, Walker provides a good overview of German fission research and the activities of one of its leaders, Heisenberg. Walker seeks especially to debunk what he regards as "myths" and misinterpretations regarding the limited success of the German fission effort. In my view, however, he is a little too quick to dismiss the positions of others that German lack of progress was due to scientific errors, short-sightedness and professional debilitation, all resulting from persecution and destructive compromises. He attributes important German scientific shortcomings to the military authorities who, he asserts, made all of the big decisions and were ultimately responsible for such errors as the rejection of graphite as a moderator. I would especially like to see a detailed analysis of the physics Heisenberg presented at Farm Hall before accepting the assertion that the debate over Heisenberg's competence in bomb physics is "finally ended" by the recent release of the Farm Hall reports (PHYSICS TODAY, July 1994, page 62).

While Walker leaves few questions unanswered, Badash wisely leaves the most difficult and unanswerable ones to his readers. Like Walker, however, Badash perceives the relationship between scientists and the state as one that both sides willingly accepted for mutual benefit. As the relationship evolved, the scientists lost any decision-making power, and the course of research took on a life of its own, beyond the scientists' (or, for Badash, anyone's) control. In both books, this last assertion requires more support.

Badash is on surer ground when describing the Manhattan Project and cold-war weapons research. Indeed, his history of nuclear arms control and development through 1963 is the most succinct available. His discussions of the reasons for the failure of arms control, the activities of spies on both sides, and the various reactions of scientists to their research are excellent. Personally, I would like to have seen mention of the parallel effects of weapons development on the public and the environment, issues that entailed horrendous moral compromises then and that loom large today as we confront the consequences.

Together, these two works provide valuable and highly readable overviews and insights into the origins of the complex relationship between scientists and the diverse societies in which they live. What is now needed is a similar account for other nations, particularly the Soviet Union.

DAVID CASSIDY
Hofstra University
Hempstead, New York

The Same and Not the Same

Roald Hoffmann
Columbia U. P. New York, 1995. 294 pp. $34.95 hc ISBN 0-231-10138-4

Roald Hoffmann is a chemist who won the Nobel Prize for Chemistry in 1981 for finding general rules by which to predict those reactions between organic reagents that will go and those that will not go. The rules depend on the theory of molecular orbitals. He does not mention molecular orbitals in *The Same and Not the Same*; nor does he mention the work that made him famous. The book is addressed rather to a broad audience of people who know and care little about chemistry. This audience probably includes many physicists. The purpose of the book, which grew out of a series of public lectures given in 1990 at Brookhaven National Laboratory, is to describe chemistry as a part of human culture and human history. The book contains few technical details and many beautiful pictures. The price is far from exorbitant, considering the high quality of the 40 color plates. (The printing was done in Hong Kong; perhaps before long the spread of digital color reproduction technology may allow high-quality printing to return to the United States.)

The Same and Not the Same defies summarizing because it jumps con-

stantly from one theme to another. It is divided into 51 pieces, which I prefer to call snippets, since they are longer than paragraphs and shorter than chapters. Each snippet has a title and a theme. Each is composed as a separate work of art, more like a poem than a lecture, often centered around a picture. Hoffmann has published several books of poetry, and one can see the hand of the poet at work here too.

Although there is no central theme, the book is held together by a web of sinews. The sinews are the connections between chemistry and other aspects of human experience. The connections are strong to art and literature, wealth and poverty, war and weapons, health and sickness, myth and magic, fear and hope. These connections are the reasons it is important for everybody to understand a little bit of chemistry. Less important to the general public, but vital to the community of scientists, are the connections between chemistry and other sciences—biology and psychology and physics. Hoffmann strongly opposes reductionism, the philosophy that tries to reduce psychology to biology, biology to chemistry and chemistry to physics. He sees each science building its own concepts on the basis of its own tradition of observation and experiment. Chemistry builds structures out of physical components but is not reducible to physics. The essence of chemistry lies in synthesis rather than analysis. Chemistry has more in common with architecture than with logic.

Three of the snippets are on a bigger scale than the others. The big ones are "Thalidomide," "Fritz Haber" and "C_2 in All its Guises." The stories of thalidomide, crippler of children, and of Fritz Haber, promoter of poison gas warfare, are tragedies. The story of C_2 is not a tragedy, but it is an object lesson in the way science and its applications hang together. The little molecule C_2, simplest of all organic molecules, lies at the heart of polyhedral structures composed of the heavy metals nickel, gadolinium and ruthenium. And the heavy metals in turn lie at the heart of the catalytic converters that remove 90% of the noxious gases emitted by our cars.

The book is full of delightful digressions having only a tenuous relation to chemistry. One of these is the Aganippe fountain, designed by the Swedish sculptor Carl Milles and now displayed in Charleston, South Carolina. It is a work of art composed of imagination, water and bronze. Another is the centaur Chiron, a mythical beast who taught Asclepias the art of healing and freed Prometheus from unending punishment by offering up its own life in exchange. Another digression comes at the beginning of the book, in "Lives of the Twins," a snippet describing a novel by Rosamond Smith, alias Joyce Carol Oates. The chief characters in the novel are identical twin psychiatrists. The point of the digression, and of the book's title, is the existence of structures that are physically identical and yet profoundly different, both in identical twins and in chemistry.

I end this review with a little digression of my own. My twin two-and-a-half-year-old grandsons Donald and George live a mile away. I see them almost every day, but physically I cannot tell them apart. Here is a scene from the Labor Day picnic last year: A big plate of watermelon slices, a dozen wasps. One twin reaches out for a melon slice. The other seizes him by the waist and pulls him back. The melon is untouched; nobody is stung. From a distance, I know at once that the one who dared is George; the one who held him back is Donald. Though they are physically identical, their personalities are quite different. The different personalities in these two identical bodies are telling us something important about the nature and evolution of mind.

FREEMAN J. DYSON
Institute for Advanced Study
Princeton, New Jersey

The Picture Book of Quantum Mechanics

Siegmund Brandt
and Hans Dieter Dahmen
Springer-Verlag, New York, 1995.
2nd edition. 423 pp. $49.00 hc
ISBN 0-387-94380-3

What an offbeat way to approach elementary quantum mechanics! The notion is certainly attractive: to use graphic representations of basic concepts to give them intuitive meaning. In some respects, *The Picture Book of Quantum Mechanics* is very successful in doing just that. In other ways, however, it falls short of what I expect in physics texts, and it is easy to think of one lost opportunity—to which I will return—that could have made the book more interesting and useful.

The book provides illustrations of many of the simple, fundamental quantum processes. Some of those processes are easy to visualize as one reads a standard text, so the merit of this book's presentations lies in the reinforcement and perhaps refinement of a student's intuition. But some of the illustrations represent phenomena that are not easy to visualize, and here