The Three Hiroshima Panoramas, Photography of October, 1945; each approx. 8 ft in length. Marginal notes in English and Japanese. NEAR SHIMA HOSPITAL, 20 Linda Lane, Normal, IL 61761. Price: $25.00 ppd. No ISBN. (Reviewed by William L. Trousdale.)

As the confrontation and antagonism between the superpowers winds down, there is a sense of relief that the world now has a good chance of avoiding a nuclear holocaust. However, in these more optimistic times it is important to remember that there exist tens of thousands of nuclear warheads. The missiles and airplanes that can reliably deliver these weapons are in place. The nuclear-armed nations of the world continue to hold one another in jeopardy and to threaten the biological viability of the world. Even if that time were to arrive when all nuclear warheads would have been peacefully destroyed, the knowledge of how to build them would remain. The century that is coming to a close should have taught us that the enormous productive capacity of the industrial age has made war an irrational choice. The invention of nuclear weapons during World War II converted the choice of going to war from an irrationality to an insanity.

It is from this view that the Hiroshima photographs are useful. These three panoramas are best seen displayed fully, as a mural. The combination of distant and close-up views conveys some idea of the physical effects of a nuclear explosion. What had been a city became a wasteland. Buildings were converted to rubble, ashes, or shells. It remains difficult to believe that all this destruction resulted from a single explosion. Fully displayed, these photographs make vivid the enormity of nuclear explosions.

But these photographs do not completely convey the effect of nuclear war. The Hiroshima bomb was one small bomb on one small city. Its energy release was one part in a million of present arsenals. There is also no direct evidence of the human suffering caused by the explosion. It requires an act of imagination to realize that when the bomb went off, these streets and buildings were filled with real, living people. The photographs, taken two months after the explosion, show a few people on the streets. Where did they come from? Are they some of the survivors? The rescuers? Are they the walking dead? In this sense the photographs provide a sanitized view of the Hiroshima bombing and of the consequences of nuclear war. But it is precisely that sanitized view, an artistic transformation, that makes the photographs effective. They force us to the next level of comprehension.

William Trousdale is Associate Professor of Physics, Emeritus at Wesleyan University, Middletown, CT. He taught a course on Nuclear War from 1979 to 1988.

An Institute for an Empire: The Physikalisch–Technische Reichsanstalt, 1871–1918. David Cahan. 315 pp. Cambridge U.P., New York, 1989. Price not given. ISBN 0-521-33057-2. (Reviewed by Zuoyue Wang.)

Germany's Physikalisch–Technische Reichsanstalt (Imperial Institute of Physics and Technology) was unique in several respects. Perhaps the largest and best equipped physics institution in the world at the turn of the century, it led the way into the era of Big Science. It employed (literally and unprecedentedly) dozens of physicists and conducted much scientific research, all at the expense of the Reich government. As the official agency responsible for standardizing and testing new technological products, it also embodied the increasing interactions among science, industry, and government in a rapidly industrializing and expanding society. These are themes of David Cahan's fine history of the Reichsanstalt in its early years. Putting it in the multidimensional social context of the young German Empire, he does a good job in explaining the Reichsanstalt's origin, growth, achievements, and failures.

The idea of a government-sponsored institute of precision technology at Berlin, to aid both science and industry, was first proposed by a group of Prussian scientists to their state in 1872, shortly after the Franco–Prussian War. At that time, German physics was undergoing a sweeping institutional revolution, many physics institutes being constructed by the individual German states. Yet for fear of generating competition with the academic institutions and other reasons, the Prussian government delayed in approving the proposed Prussian Physical–Mechanical Institute for more than a decade.

The lack of progress deeply worried Werner von Siemens, who was involved in the project from the beginning. A powerful, millionaire industrial scientist, Siemens decided in 1883 to take the matter "into his own hands." Recognizing the "national meaning" of the future institute, he changed its sponsorship. In 1884 he asked the Reich to create the Reichsanstalt, with a patriotic offer of his own: land and significant funds for the institute. Bismarck agreed immediately, despite the tradition that scientific affairs belonged to the individual German states, not the Reich. The imperial Chancellor hoped the Reichsanstalt would help to strengthen the new Empire by making Berlin the Reich's scientific center.

Siemens and his many scientist friends, especially Hermann von Helmholtz, believed in science as the foundation of technology. Science, they argued, deserved government's support for its potential in bringing economic benefits and raising Germany's national prestige. They envisioned primarily a scientific research institute financed by the government. It was to be a scientist's heaven, to do whatever research he saw fit without the burden of teaching. The legislative Reichstag was initially unconvinced. The powerful technological community (engineers, instrument makers, etc.) demanded a more practical orientation for the Reichsanstalt. To compromise, the institute had to do more for the economy. Two sections evolved: The Scientific Section conducted research of interest to both science and industry, while the Technological Section carried out the more directly useful research and routine testing work.

The Reichsanstalt was to serve academic and industrial quarters, not to compete with them.

By all standards, the Reichsanstalt became a great success. Under the famous Helmholtz, president from its formal opening (1887–1894), the imperial institute was built at a matchless expense of 3.7 million marks (excluding the gift from Siemens, valued at about 1 million marks). Helmholtz was succeeded by another respected experimental physicists, Friedrich Kohlrausch, whose tenure (1895–1905) was a time of great upheaval in physics. In this, the Reichsanstalt's work played an important role. Its talent-concentrating Optical Laboratory included Otto Lummer, Wilhelm Wien, Ernest Pringsheim, Ferdinand Kurlbaum, and Heinrich Rubens. Their blackbody radiation measurements led to Max Planck's quantum theory, which in turn revolutionized physics. It was surely the Reichsanstalt's best-known scientific contribution; yet the work was sponsored largely for practical reasons, Cahan argues convincingly (pp. 145–157). The institute hoped, in undertaking this project, to establish a suitable unit of luminous intensity and an absolute temperature scale. Both were eagerly requested by the optical industry. So this and other research work not only brought the Reichsanstalt international fame in science but also helped to fulfill its utilitarian missions. More directly, the institute tested and certified numerous measuring devices and developed new technologies for the then "high-tech" industries (mainly electrical, optical, and mechanical).

Emil Warburg, the third physicist-president of the Reichsanstalt (1905–1922), furthered these traditions. In 1912 he brought Hans Geiger to the institute. With his staff, Geiger, formerly a favorite assistant to Ernst Rutherford at Manchester, opened standardizing and testing services to the new profession of radiation medicine. In the meantime he managed to do some research in radiation and invented his famous counter.

The success of the Reichsanstalt brought imitators abroad. Among them were Britain's National Physical Laboratory in 1899 and the United States' National Bureau of Standards in 1901.

All was not well, however. Several problems became very serious for the Reichsanstalt under Warburg. As a "kind of postdoctoral institution" for German science with its superb research facilities, the Reichsanstalt had attracted many talented young scientists. In different periods, such gifted physicists as Wien, Rubens (as guest), Geiger, Walter Meissner, Walter Bothe, and James Chadwick (as guest) worked in the institute. But as a government agency it allowed limited career opportunities. Therefore, many who started their scientific reputations at the Reichsanstalt began to leave it. Some went for the more prestigious positions in the universities, where research conditions were steadily improved. Some took better jobs in industry and even in other governmental agencies. The overwhelming testing burden from industry also made it increasingly difficult for the Reichsanstalt to spare people and resources to do original research.

Warburg sought reforms, but the government refused to provide the necessary financial support. Nevertheless, he attempted to restructure the Reichsanstalt and raise funds from the private sector to boost research efforts. But then came World War I. During the conflict, the Reichsanstalt was not utilized as fully as its counterparts in Britain and the US, according to Cahan. Half of its personnel, including scientists, left for the front or went elsewhere for war-related work. Only minor war work of a testing nature was assigned to the institute itself. With the end of the war came the demise of the German Empire, to which the Reichsanstalt had contributed so much by its scientific and technological achievements. Under this circumstance, not only Warburg's reform became stillborn; the Reichsanstalt itself was left in shambles. Its postwar history, even to this day, is unfortunately lacking, for this volume carries the story to 1918 only.

One may see in this story an ultimate dilemma of Big Science with its dependence on external forces. The Reichsanstalt flourished with a powerful nation-state as its patron, but it also suffered when the Empire fell. The conflicts the scientist had with both the technologists and the government were also revealing. They felt the need for each other. But, unfortunately for the scientists, they had, and still have, to reconcile the ever-demanding necessity for outside financial support with their own scientific freedom.

Zuoyue Wang is a Ph.D. student in the History of Science Program at the University of California, Santa Barbara. His interests include the history of modern physics and science and society. He is currently working on a dissertation on science and government in America in the 1960s.

POST-USE REVIEW: Physics. Richard Wolfson and Jay M. Pasachoff. 1081 pp. Little, Brown, Boston, 1987. Price: $43.20. (Reviewed by Amy J. Kolan and James Cederberg.)

Our department at St. Olaf College has several pet topics that we investigate in reviewing a new introductory physics textbook. One of these topics is the unification of the weak and the electromagnetic forces. Evaluating this subject is a fairly heavy-duty check. Of the textbooks currently on our shelves, all of them, with one exception, fail to pass our simple test. Ohanian has sections on "the four fundamental forces" in the body of his text and an interlude. While the index mentions the electroweak force, we could not find it in the text. Stanford and Tanner, Tipler (2nd ed.), Eisberg and Lerner, and Giancoli all have sections on the *four* basic interactions. Halliday and Resnick mention Glashow, Salam, and Weinberg's work on unification in a table. However, they persist in describing the electromagnetic and weak interactions as separate forces in the text. The only text that does a good job in recognizing the linking of these two forces is Wolfson and Pasachoff's *Physics*. These authors discuss what unification means, give a summary of