large, able group of the best British scientists came to the United States to help in every phase of the project at the many different laboratories and factories.

It was about this time that Churchill, feeling that the Americans under General Groves were intent on "squeezing out" the British, made the "somber decision" to go it alone by setting up an independent effort at Chalk River, Canada. This conduct on our part which, in my judgment, was clearly aimed at hampering Britain's development of atomic energy for industrial purposes after the war, put a severe strain on Anglo-American cooperation.

Another topic that needs fuller exploration, as Amrine indicates, is the kind of specific detail about the bomb that was available to our policy makers at the time policy decisions on how to use the bomb were being made. Amrine tells us (page 132) that General Groves, in a memorandum to General George Marshall dated 30 December 1944, vastly underestimated the power of the bomb. He estimated the power of the bomb at only 500 tons of TNT, whereas it was actually 20,000 tons when used on Hiroshima. As Amrine says, our military planners "were only given reason to think it was a spectacular improvement in bombs, not another kind of warfare."

Now I know that General Groves did not know enough physics to make his own estimate; and I do not believe that anyone at Los Alamos would have made such a low estimate. How then could Groves have erred by a factor of 40? Could it have been intentional, so that the top policy planners would not be aware of the horribly serious nature of the decision they were taking?

It would have been quite easy to mislead the White House especially since Admiral Leahy—the staff military adviser, who "had had a long experience with explosives"—long thought the project a gigantic "boondoggle" because "this bomb did not fit anything he knew about explosives" (page 134).

Moreover, it would be natural for Leahy to discount the bomb because the thing, if a reality, horrified him. To use it, he believed, was to adopt "an ethical standard common to the barbarians of the Dark Ages. . . . I was not taught to make war in that fashion . . . these new and terrible instruments of uncivilized warfare represent a modern type of barbarism not worthy of Christian men" (page 170).

I believe that an erroneous view of the magnitude of their responsibility was planted in the minds of the nation's leaders by the 30 December 1944 memo of General Groves and that this erroneous view was not changed by the later, brief, coded messages. Truman learned of the Alamogordo test on 17 July by this message which was sent to him at the Potsdam Conference, "Babies satisfactorily born." This was certainly designed to minimize the seriousness of a new development of which the President had first become aware in sketchy outline just three busy months earlier.

At Potsdam it was decided that Truman should inform Stalin of the new weapon. We do not know exactly what he said when he did this. Truman has written (page 187), "On July 24 I casually mentioned to Stalin that we had a new weapon of unusual destructive force. The Russian Premier showed no special interest . . ."

But apparently, Truman had not used the key words "nuclear" or "atomic" and, perhaps because of the 30 December 1944 memo, may not have himself at that time fully realized the magnitude of the revolution in warfare that had occurred.

Amrine's account of this affair (page 190) is fascinating: "No one at Potsdam had time to think much about the lack of reaction from Stalin to the news. Perhaps they thought that (like Admiral Leahy) Stalin found it hard to believe in these superweapons." But had he really been told of a *super*weapon? "Perhaps, like James Byrnes, he found it hard to understand scientific matters."

The book tells in detail of the sustained efforts of the scientists on the project to get our government to give some kind of demonstration or warning to the Japanese before actually using the atomic bomb against them. It has often been said that the Potsdam Declaration met this minimal moral demand. But one may very well ask whether it really did so, when this is all that it said that might be so construed (page 191): "We call upon the government of Japan to proclaim now the unconditional surrender of all Japanese armed forces, and to provide proper and adequate assurances of their good faith in such action. The alternative for Japan is prompt and utter destruction."

The last chapter, "Conscience and questions," is a searching analysis of the troublesome questions that still perturb the thoughtful, about whether or not the bomb should have been used.

Because the entire attack on Hiroshima involved only three planes, the air raid alarm was not sounded and people did not take shelter. Amrine writes: "That accidental happening cost the lives of tens-of-thousands of women and children who were not military targets and whom we had no intention of killing" (page 229).

Amrine says that his "personal observation is that many Asians and Americans thought differently about Western man's supposed respect for human life. These bombs did not improve our reputation and win us allies in Asia" (page 233).

It is a sad story, one that many would like to forget or, if possible, never to learn. But it only involved two bombs of the type, now called conventional, which we stockpile by the hundreds or thousands and recklessly issue to our ally, West Germany, where "ex"-Nazis get greater political power day-by-day. In the meantime hydrogen bombs, which are a thousand times more powerful than the obsolescent toys of World War II, are in the hands of Americans, British, and Russians, and the means to deliver them half way around the world are being perfected by both sides.

Thus there is probably no exaggeration in the assertion by Congressman Charles O. Porter (D.-Ore.) in his May newsletter to his constituents when he says: "Two very prominent authorities, one on disarmament and the other on science, stated in my presence the other day their belief that we would all be dead in 10 years and that the earth would be an incinerated relic."

There is no doubt whatever that the technical means of achieving such a goal do exist at the present. Amrine's story of a few months in 1945 gives one a foretaste of how this larger catastrophe may come about, and not as a result of a free choice by the peoples of the world.

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The Sociological Imagination. C. Wright Mills. Oxford University Press, New York, 1959. 234 pp. $6.

C. Wright Mills is caught up in the present-day dilemma of scientists: the "scientific" and the "moral" are obviously inextricable on the one hand, but on the other they are apparently at odds. Out of the depth of his feeling and the

breadth of his knowledge, he has written a fascinating but ultimately unsatisfactory book. He suggests that social scientists probably have done themselves the ultimate disfavor by linking themselves terminologically with the older sciences, and certainly have stultified themselves by analogies with the "natural" sciences. He also believes, and I agree, that the social-science attitude—which he calls the sociological imagination—is the pervading *Geist* of our age.

The first half of this book, in which Mills tries to get his own position straight, is a critique in broad strokes of some features of several of the foremost schools of sociology. He makes good cases, but unfortunately he writes in a style essentially popular about matter in which there is only specialist interest. The style will alienate rather than persuade his colleagues. At the same time, it is doubtful if the general reading public cares to be edified with denigration of the particularities of system building or opinion factoring.

The second half of the book explores Mills' thesis that the sociological imagination concerns itself with the converging points of history, biography, and society, and that it should distinguish *troubles* from *issues* and face the issues of modern society squarely. This section can be read as a clarion call for a successor to Max Weber.

Mills' romp through the theoretical fields is not as giddy or as enlightening as Sorokin's. His *engagement* is not as compelling as Raymond Aron's. And what he has to say is ill-matched with the way in which he chose to say it.

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Semiconductors. N. B. Hannay, Ed. Reinhold, New York; Chapman and Hall, London, 1959. xxiii + 767 pp. Illus. $15.

This volume is the most recent addition to the American Chemical Society's "Series of Chemical Monographs." Written and edited by 17 members of the technical staff of Bell Telephone Laboratories, the volume is a happy balance of chemistry, metallurgy, physics, and electronics and should prove useful to a wide circle of readers.

Essentially, the book is a collection of authoritative and up-to-date review articles on divers aspects of semiconductor physics and chemistry. The introductory article by the editor, N. B. Hannay, summarizes the basic concepts and principles of semiconductor physics. The article by J. J. Lander provides a survey of some of the problems of semiconductor chemistry; these are dealt with in more detail in subsequent sections.

The next five contributions are concerned with the physical chemistry of semiconductor systems: M. Tanenbaum discusses semiconductor crystal growing; C. D. Thurmond describes the control of composition in semiconductors by freezing methods; C. S. Fuller considers the theory of defect interactions; H. Reiss and C. S. Fuller discuss diffusion processes in germanium and silicon and illustrate the important advantages offered by semiconductors in general for the study of diffusion processes; and D. G. Thomas concludes this section by reviewing the chemistry of some compound semiconductors.

The eight articles that follow deal with the physical properties of various semiconductors. T. H. Geballe describes the progress that has been made in understanding the physical behavior of group IV semiconductors, while J. M. Whelan does the same for other covalent semiconductors, particularly group III–V, II–IV, and V–VI compounds, boron, selenium, and tellurium.

H. J. Hrostowski discusses infrared absorption and demonstrates how our knowledge of semiconductors has been furthered by optical studies. R. G. Shulman considers trapping and recombination processes arising from nonequilibrium distributions of mobile carriers. J. N. Hobstetter examines the nature and role of structural defects, particularly dislocations, in controlling plastic deformation and other properties of semiconductors.

A. R. Hutson presents a critical survey of the semiconducting properties of some oxides and sulfides, including alkaline earth oxides, sphalerite-wurtzite compounds, and the lead sulfide family. F. J. Morin provides a most illuminating discussion of the electrical, optical, and magnetic properties of oxides of the third transition metals. In the final article on bulk properties, C. G. B. Garrett reviews most competently the subject of organic semiconductors.

The remaining two contributions are concerned with the physics and chemistry of semiconductor surfaces. J. T. Law deals primarily with solid-vapor and solid-vacuum interfaces, while J. F. Dewald treats semiconductor electrodes and hence the semiconductor-electrolyte interface. At the end of the book there is a subject index, but, surprisingly, no author index.

In my opinion this volume is the finest, best organized, and generally most useful collection of survey articles on semiconductors yet assembled. It is easier to gain an over-all picture of the present state of our knowledge of semiconductors by reading this volume than by reading scattered review articles published elsewhere. The individual articles in the present volume are comparable, with respect to quality and method of exposition, to the excellent reviews appearing in the Seitz and Turnbull "Solid State Physics" series.

It is perhaps worth mentioning that the subjects of luminescence and photoconduction, which are closely related to that of semiconduction, might have been treated in an additional chapter or two. As it is, these subjects are not given the comprehensive coverage they deserve. But this is a minor criticism of an otherwise excellent book.

To conclude, this volume is warmly recommended to graduate students and to professional scientists in the several disciplines which constitute the field of semiconductors.

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Cumulative Record. B. F. Skinner. Appleton-Century-Crofts, New York, 1959. x + 427 pp. Illus. $6.50.

When B. F. Skinner was scarcely 22 he read a series of articles in which Bertrand Russell examined John B. Watson's behaviorism. Many years later he told Russell that these articles had been responsible for his interest in behavior. "Good Heavens!" exclaimed Lord Russell, "I had always assumed that these articles had demolished behaviorism." Russell may have demolished Watson's theories—not a difficult task; but Watson's spirit is indestructible. Cleaned and purified, it breathes through the writings of B. F. Skinner. Watson rejected philosophic speculation and demanded an objective science of behavior as rigorous as Newton's science of the physical universe; Skinner defends the rejection of speculation with the sharpness of a trained philosopher and presents us with an analysis of behavior that Newton might have envied. Probably no psy-