

## Nuclear Energy in Canada

**Nucleus.** The History of Atomic Energy of Canada Limited. ROBERT BOTHWELL. University of Toronto Press, Toronto, 1988. xx, 524 pp., illus., + plates. \$34.95.

Robert Bothwell traces the development of nuclear energy in Canada from its origins during World War II to its status during the late 1980s. He shows how the enterprise evolved from an isolated adjunct to British research on atomic weapons into a uniquely Canadian program, featuring a heavy-water cooled and moderated power reactor called CANDU. Bothwell focuses on the activities of Atomic Energy of Canada Limited (AECL), the publicly owned company that shaped and guided Canada's initiatives in and experience with nuclear energy. AECL, in fact, hired Bothwell, a professor of history at the University of Toronto, to research and write its history, and by standards of historical scholarship it made a wise investment. The author delivers a thoughtful, balanced, and readable account that makes good use of a rich supply of sources.

The atomic project in Canada made little contribution to the American success in building the first nuclear weapons, and after the war the Canadian government was uncertain what to do with its research facilities at Chalk River and the scientific talent it had assembled there. It soon elected to make a major commitment of resources and money to the promotion of nuclear energy, partly in anticipation of long-term power needs but mostly for more immediate bureaucratic and diplomatic reasons. The government wanted to keep its atomic scientists occupied and their expertise intact, and this could be done only by maintaining a well-supported program. It also was determined that Canada retain its international status as a nuclear power, a goal that later prompted AECL to join in an undeclared race with the United States and Great Britain to develop the technology. Thus, in Canada as elsewhere, the political aspects of nuclear energy quickly overshadowed the scientific and technical ones.

Bothwell excels in analyzing the high-level political considerations and motivations behind AECL's decisions, and the book is strongest in this regard. He provides absorbing portraits of the leading personalities in Canada's atomic energy programs and explains convincingly the concerns that drove them. He is especially skillful in showing how political events and realities outside the control of AECL, such as the cancellation of a supersonic jet fighter called the Avro Arrow, the energy crisis of the 1970s, and the Indian detonation of an allegedly

peaceful nuclear device, influenced nuclear developments in Canada. Bothwell concludes that despite problems and mistakes, AECL was largely successful in carrying out public policy and organizational objectives.

Bothwell's book displays many virtues, but it is regrettably weak in some respects. It is sketchy in outlining the scientific and engineering side of AECL's story. A discussion of how the CANDU reactor differs from more common light-water plants, for example, would have been a useful addition. Bothwell attempts at one point to describe the hazards of ionizing radiation, but the result is neither clear nor entirely accurate. Even more disappointing is a failure to delineate regulatory issues in detail. Bothwell offers an enlightening account of a serious accident at Chalk River in 1952 but little information on other safety or siting matters. An explanation of the attitudes, assumptions, and policies of the AECL on regulatory questions would have enhanced the value of the book. Finally, although Bothwell alludes to controversy over nuclear power in his introduction, he deals with it only to a limited extent in the text. This is unfortunate, because a fuller discussion would have provided a basis for comparison with public views of nuclear power in the United States and Europe.

Those shortcomings notwithstanding, Bothwell has told an important story well. It is a tribute to the strength of what he has done that one wishes he had done even more.

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## An Industry Restructured

**Divide and Prosper.** The Heirs of I.G. Farben under Allied Authority, 1945–1951. RAYMOND G. STOKES. University of California Press, Berkeley, 1989. xiv, 290 pp. \$40.

*Divide and Prosper* is an excellent, penetrating, and sober account of the fate of the infamous German chemical giant I.G. Farben in the era following World War II. At the end of the war the firm and its managers were charged with war crimes, but by 1950 the German chemical industry had experienced a resurgence. Stokes explains how and why this recovery was possible, in the process demonstrating a mastery of the historical tools necessary for the study of business, economics, technology, and politics.

Stokes focuses on three major questions. What was the relationship between Allied occupation policy and the reconstruction

and resurgence of the West German chemical industry? What accounted for this recovery and resurgence? What is the connection between this resurgence and broader issues associated with postwar European reconstruction? There were three major successor firms to I.G. Farben, BASF, Bayer, and Hoechst, each located in a different zone of occupation. Thus the postwar West Germany chemical industry provides a good opportunity for the historian to compare, contrast, and trace connections among the occupation policies of the three Western Allies.

In a sophisticated analysis of American occupation policy, Stokes points out that there was a great deal of ambivalence and difference of opinion concerning the proper policy toward German industry and that the initially strong antitrust element did not carry the day. The Americans forced the former I.G. plants in their zone to be independent of each other and adopted a severe line toward the chemical industry. Great Britain did not break the interdependence of former I.G. plants but kept on former managers and let them run the firm as they wished. The financial weakness of the British Empire after the war forced Britain to encourage exports from their zone in order to lessen the burden on British taxpayers. Initial French policy aims were clear: permanent elimination of the dangers of German aggression, decentralization, and dismemberment of Germany into smaller political units. But the French also desired to exploit their zone and in the end refrained from killing the goose that laid the golden eggs. One of the many strengths of this book is the way in which Stokes places each of the three Allied policies in its particular political context.

By 1948 the politics and economics of the Allied occupation had been changed by the currency reform, the American European Recovery Program, and the beginnings of the West German economic recovery. Within two years German industry began a resurgence and the United States and its Cold War interests dominated West German occupation policy. The Americans desired to keep the occupation as short and inexpensive as possible and relied on Germans to bear some of the administrative burden, thereby giving them more power and influence over the process of reconstruction.

The formal disentanglement of I.G. did not take place until the 1950s, but Stokes argues persuasively that one must look to 1945 and the division of Germany into four zones to see why I.G. was divided into three major firms. The British and French prejudiced the outcome, since they had allowed Bayer and BASF respectively to remain intact and even expand during the first few

years after the war. It was inevitable, Stokes argues, that the United States would be forced to allow Hoechst to attain a comparable size. This policy fit well with the interests of West Germans, who wanted I.G. to be broken up into a few firms large enough to compete well in the international market.

Why were the successor firms so successful? Stokes concludes convincingly that the continuities from the preceding era—in organizational structures, managerial acumen and structures, systems of technology and information, leading personnel, and even physical plant—were most crucial. In addition, the new firms and their strategies adapted themselves to the dominant postwar American worldview. Their emphasis on export fit well into the ideology of free trade and assuaged the long-standing American fear of German autarky.

Stokes stresses the ability of former I.G. managers to be creative and adaptive in the postwar era, pointing out the irony that the same men often had exhibited the same qualities while serving the National Socialist state. But Stokes does not address one important issue in his fine book: did the close collaboration with National Socialism permanently alter I.G. Farben managers and thereby influence the postwar West German chemical industry? Stokes emphasizes that I.G. was willing to “howl with the wolves” during the Third Reich, but he does not say whether the reversion was permanent.

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## Technology of Warfare

**The War of Invention.** Scientific Developments, 1914–18. GUY HARTCUP. Brassey's (Pergamon), McLean, VA, 1988. xii, 226 pp. + plates. \$43.

In his introduction to this book, Guy Hartcup observes that, though World War I was the first major technological war in history, historians have not really attempted to assess the totality of the scientific and technological equipment developed in that struggle. In *The War of Invention* Hartcup attempts to fill this void by discussing not only well-known innovations like the tank and chemical warfare but also “less familiar advances involving physical, chemical and medical research which changed the face of warfare” (p. viii). He is further intent upon illuminating the role of the first “boffins,” the scientists and engineers who invented the new equipment.

In this effort, Hartcup has relied primarily

on documents in the British Public Record Office, explaining that Continental archives yielded much less information on technical aspects of the war and space permitted only brief references to American developments. The book is thus primarily an examination of British developments in the realms of chemical research in munitions, weapons for trench warfare, chemical warfare, naval and air warfare, medicine, and industrial research and does not fulfill the jacket's claim that it provides “a comprehensive view of the application of science and technology to military, naval and air operations in the 1914–1918 war.” Only a much longer study of such developments in *all* the major powers could do that. If this work were taken as comprehensive, it would appear that the British were the primary innovators, though its tantalizing glimpses of French, German, and American events seem to suggest that such was not necessarily the case. Though Hartcup attempts to draw certain comparative conclusions at the end, it would seem necessary and appropriate to base such comparisons on more than the often cursory

glimpses of developments on the part of the other warring powers.

The examination of aviation, a topic this reader knows better than others treated in the book, is occasionally problematic. In his discussion of the National Physical Laboratory's role in prewar aircraft research, Hartcup cites as a particular success story its collaboration with the Royal Aircraft Factory in the development of the prototype of the BE2C, the Royal Flying Corps's standard reconnaissance craft, which he then credits with a speed of 140 miles per hour (pp. 18–19). Yet contemporaries complained that the NPL's research was only belatedly disseminated to the aircraft industry as a whole. Furthermore, the BE2C, though a success when introduced in 1912, was a deathtrap for its wartime pilots, possessing a speed some 60 miles per hour less than that cited by Hartcup.

Hartcup's approach to the topic of aircraft engines is rather idiosyncratic. In concentrating solely on the rotary engine and specifically W. O. Bentley's improvement of the French Clerget he ignores important devel-

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