Canada's NRC

National Research in Canada. The NRC, 1916–1966. WILFRID EGGLESTON. Clarke, Irwin, Toronto, 1978. viii, 470 pp. + plates. $22.50.

Physics at the National Research Council of Canada, 1929–1952. W. E. K. MIDDLETON. Wilfrid Laurier University Press, Waterloo, Ontario, 1979. x, 238 pp. $9.

Such institutions as the National Research Council of Canada, Wilfrid Eggleston writes in the first of the books under review here, "do not grow up in a vacuum: they respond to constantly changing aims, priorities, emphasis, staff, technologies, available funds, personal direction. They are always subject to the sway of their social and cultural environment, within the national community and sometimes more profoundly in the international environment. They prosper and decay in harmony with the health and malaise of the larger society of which they are a part" (p. 98). The careful attention devoted to this aspect of the development of the NRC in *National Research in Canada* makes it an outstanding institutional history.

The volume may be considered in parts covering three chronological periods: prior to World War II, wartime, postwar. The principal theme of the first part is the establishment of the NRC and its laboratory facilities. The NRC came into existence on 6 June 1916 as a Canadian version of the British Department of Scientific and Industrial Research. Although set up principally to mobilize scientific resources for World War I, it was also given the task of assessing Canadian science, stimulating work of value, and planning for the future. With dismally few resources to attack immediate problems, it had its principal impact in meeting these secondary responsibilities.

Conclusions drawn about Canadian science in 1916 would become perennial motifs in discussions of the relation between the government and science. Canada, it was argued, was overdependent on foreign countries for knowledge, training, and research facilities. Not only was this damaging to present economic and social welfare, its perpetuation would keep the nation in a colonial status. Increasing government support for science was the only answer. The best initial step, the NRC thought, was the creation, under its jurisdiction, of national research laboratories. There work could be done for and in cooperation with industry and the universities, and hence Canadian economic and social development could be spurred. As it turned out, winning support for this plan was a long and difficult political process. First proposed in 1918, the laboratories would not become a reality until the early 1930's.

Once the laboratories were created, the NRC changed from an organization that only funded science through scholarships and grants to one that did its own. This, of course, required a considerable increase in the size of the staff. In the initial years, Eggleston explains, the laboratory work that was done was both limited and somewhat routine. Perhaps the most significant characteristic of early projects was their close tie to definite Canadian problems: increasing output from farms, forests, and mines; improving industrial technology; answering pressing questions pertaining to medicine and health.

The years of war brought a drastic change. Many highly important and secret projects were undertaken in NRC laboratories for the military, principally in the fields of radio and radar, nuclear physics, chemistry, and medicine. Growth in staff and facilities came very rapidly. Through its contributions during the war, the NRC both proved its lasting value to Canada and consolidated its position as a leading national institution.

Planning for the postwar years posed numerous problems, particularly in view of the NRC's heightened role in national affairs. To what extent, if at all, should it remain in military research? How should the field of nuclear physics, now vital to national prominence and power, be managed? How could Canadian industrial research, always judged insufficient for a major industrial power, be fostered? To what extent should the NRC turn from applied research, which had previously constituted most of its work, to basic research? In the final part of his book, Eggleston explains how these questions were answered during the 1950's and 1960's. And with his discussions of science policy he deftly combines description of some of the scientific results that were continually flowing out of the institution.

One of the obvious limitations of a broad historical account is that it must skim lightly over particular developments. For a complete picture, it must be augmented by detailed studies. In his book W. E. K. Middleton has given us one of the NRC Division of Physics. He discusses the work of the Division from its establishment in 1929 until its bifurcation, in 1952, into Divisions of Applied and Pure Physics. Described summarily but comprehensively are the activities of the various sections comprising the Division (Acoustics and Ultrasonics, Radio, Electricity, Metrology, Optics, Radiology, General Physics, and so on) in three historical periods, the same into which Eggleston's book divides. There is one significant omission in the coverage. The work of the Radio Section after 1939 is not included. The author decided that this should be the subject of a separate account. Surrounding the principal parts of the study are brief chapters discussing, in general terms, the origin of the Division, administrative changes, working conditions, and the author's evaluation of the contributions made to physics and to Canadian well-being.

Overall, Middleton is much less concerned than Eggleston with the relation of NRC activities to broad trends in Canadian history. His work is basically a review of projects and results. But he too draws a few interesting general conclusions. For the most part, these accord with Eggleston's views. Both men see World War II as the most important period of change. Both agree that the NRC's original purpose largely restricted its work to applied science. Both believe that the promised interactions between the NRC and industry were more dream than reality during the early decades. Yet there are also several interesting disagreements between the two authors. Perhaps the most notable relates to the Depression. Eggleston calls this a "time of cruel irony" when the promise inherent in the new laboratories, just being finished, was crushed by national economic disaster. Middleton, on the other hand, argues that despite the hardships there were many favorable effects. The Depression, he says, allowed the NRC to recruit young scientists of great talent who otherwise would have been unavailable. Additionally, there was a minimum of administration because there were so few resources to account for. Hence the staff was free to devote itself fully to science, and consequently productivity was high. In a similar way—looking from the

bottom up rather than the top down—Middleton is able to give insight into such matters as the morale of the Division at various stages.

The National Research Council is Canada's leading scientific institution, and from these two studies of it Americans can learn much about the development of national science in their northern neighbor. The story is an interesting contrast to that of this country as presented, for example, in Hunter Dupree's *Science in the Federal Government* (1957) or Daniel Kevles's recent book, *The Physicists* (1978).

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A View of the Soviet Scene

Manipulated Science. The Crisis of Science and Scientists in the Soviet Union Today. MARK POPOVSKY. Translated from the Russian by Paul S. Falla. Doubleday, Garden City, N.Y., 1979. xviii, 244 pp. + plates. $10.95.

Before coming to the West from the U.S.S.R. in 1977 the author of this book was a prominent scientific journalist and biographer with a wealth of acquaintances within the Soviet scientific community. He has drawn deeply upon his personal experiences in order to write a polemical account of how the Soviet scientific system works or, to be more accurate, fails to work. Unlike Western accounts of the economics and administration of Soviet science, which are dependent upon open sources, impressions from study visits to the U.S.S.R., and selected interviews with Soviet research administrators, Popovsky's seeks to convey by wealth of anecdote and rumor the "real" flavor of the Soviet scientists' working life. Popovsky is remarkably uninhibited about naming the major culprits in high official positions in the Soviet scientific establishment, so that by the end of the book the reader is provided with a kind of rogues' gallery complete with identikit photographs. The book is written in a lively and persuasive style and is clearly motivated by a passionate desire to expose "the truth" that lies behind appearances and misleading official representations. Thus the critical Western reader, although he or she will read Popovsky's book with interest, is faced with the problem of deciding how much of it is typical or true, what relative weights should be attached to anecdotal compared with published sources (often critical but invariably restrained), and whether such a damning indictment of the political leaders' intentions is plausible in view of their expressed desire for rapid technical progress. In other words, is the case overstated?

The picture of Soviet scientists drawn by Popovsky is the exact opposite of Merton's classic view of the scientific community as a self-regulating group of independent scholars whose internalized norms of open-mindedness and peer evaluation are central to the promotion of scientific advance. According to Popovsky the political offensive against the technical intelligentsia began not in the late 1920's, as most Western historians would have it, but abruptly after the Bolshevik seizure of power in 1917. The political authorities made war on the old scientific establishment by a policy of deliberate starvation and intimidation and subsequently replaced them by politically loyal but often poorly trained cadres. All this served their primary objective of *political control* over opposition groups, real or potential. The unfortunate combination of obsessive control with long-standing Russian traditions of hierarchy and rank served to displace collegial relationships in science. A new generation of institute directors grew up eager to do the bidding of their political masters, unscrupulous in the pursuit of their own careers, and ruthless in their control over subordinate staff. Even those of genuine ability and conscience were able and are able, in various convoluted ways, to rationalize the compromises of their scholarly integrity that the Soviet system imposes; the rank-and-file scientific workers, on the other hand, derive what enjoyment they can from their scientific work but otherwise react to their administrative superiors with tact, private cynicism, and calculated apathy.

There are several factual errors in Popovsky's account, but much more important than these are the glaring omissions of counterevidence that would have necessitated some modification of the central message. For example, it is difficult to take seriously a history of Soviet science and technology that gives the government *no* credit for the industrialization of a backward country, the promotion of widespread literacy, the improvement in health and living standards of ordinary people, or the funding of science on such a generous scale. If this sounds like the insistence of the censor that the positive side should outweigh the negative it is certainly not intended as such. The technological and economic achievements of the Soviet regime can still be reconciled with the predicament of the individual scientist, but the interpretation needs to be based on a much more subtle understanding of the trade-off between economic and political goals. Moreover, the assertions that the authorities are willing to sacrifice efficiency in order to achieve maximum control (p. 49) and are hostile to good ideas because they highlight their own mediocrity (p. 142) do not allow for the frantic and evidently sincere concern the leadership has shown about the current slowdown in the rate of economic growth in the U.S.S.R. and about the wide technology gap that has opened up with the West in many key sectors.

Notwithstanding some doubts about its objectivity, this book maintains the interest of the reader throughout and has many new things to say. The chapters on research institutes in the defense sector and on the deterioration of the working atmosphere in the new science cities find no equivalent in other works on the subject, and Popovsky's classification of the different psychologies of research workers in the face of political interference is illuminating. Zhores Medvedev's recent book *Soviet Science*, which covers much the same ground as Popovsky's, is a cooler and more thoughtful book than Popovsky's but less rich in anecdotal material. In this sense, the two books are complementary. The restrained systemic analysis of the former tempers the fiery journalism of the latter.

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Galileo as Scientist

Galileo at Work. His Scientific Biography. STILLMAN DRAKE. University of Chicago Press, Chicago, 1978. xxiv, 536 pp., illus. $25.

Scientists have found Galileo Galilei most congenial, in the sense that they have been inclined to find their own "roots" in his work. The practice goes back at least to Isaac Newton, who in his *Mathematical Principles of Natural Philosophy* credited Galileo with knowledge or discovery of several concepts used in his own system of the world, specifically the law of inertia, the law of force, the principle of superposition of motion, the times-squared law of fall, and the parabolic path of projectiles. The list also includes Albert Einstein, who wrote a foreword to Stillman Drake's English translation of Galileo's *Dialogue Concerning the Two Chief World Systems* (1953) in which he summarized the main