thing of reality, and not just a socially useful set of conventions propounded by a self-perpetuating group of highly trained but epistemologically backward scientists. Nevertheless, I consider *Constructing Quarks* an important and fascinating book.

New Eye for the Navy: The Origin of Radar at the Naval Research Laboratory

David Kite Allison
228 pp. Naval Research Laboratory, Washington, D.C., 1981. $13.00

Radar Development in Canada: The Radio Branch of the National Research Council of Canada 1939–1946

W. E. Knowles Middleton
147 pp. Wilfrid Laurier Univ. Press, Waterloo, Ontario, 1981. $9.75

Each of these books is concerned with an aspect of the development of radar before and during World War II. *New Eye for the Navy* deals mostly with the work at the United States Naval Research Laboratory from its beginning in the early twenties until the entry of the US into World War II in 1941. The other book describes the work of the National Research Council of Canada, which was an important part of that country's role in World War II. My own involvement with radar development began late in 1940, initially with the Submarine Signal Company in Boston and, from the Summer of 1941, with the Radiation Laboratory at the Massachusetts Institute of Technology, where I played a part in the advance of microwave technology.

The first of these books is based on a doctoral dissertation in the history of science presented to Princeton University in 1980. In it David Allison uses the pioneering work at the Naval Research Laboratory, on what later came to be called radar, as a theme around which he presents the story of the establishment and growth of the Naval Laboratory itself in the years between the two World Wars. He relates the establishment of NRL, in 1923, to the appearance not very many years earlier of research and development laboratories in corporate industry. He tells the story with the support of much documentation—of both formal and informal character.

The pioneering discoveries and developments of Albert Hoyt Taylor, Leo C. Young and Robert Morris Page are described in some detail. The story is conveyed in part through extracts from recollections recorded by Young in 1953. As early as 1922, Taylor and Young interpreted a "slow fading in and out" of the 60-MHz signal, sent from a transmitter at the Naval Air Station in Anacostia, D.C. and received at a point across the Potomac River, as an interference effect caused by a ship moving up the river. Taylor foresaw several possible applications and sought further support to pursue them, but he did not get it. No further work was done until a similar discovery relating to the detection of aircraft was made in 1930 at the Naval Research Laboratory, which had been established soon after the original observation.

For Young and Taylor, this new discovery marked the beginning of several years of work, although at a slow pace, on an apparatus capable of exploring this "bistatic" form of continuous wave, or "Doppler" radar. In the course of the year 1934, drawing parallels to the well-developed pulse-echo underwater sound-detection equipment (later called sonar), the team went over to the use of pulses of transmitted rf power. Success with pulsed-echo detection of a small airplane was achieved in December of 1934. More intensive efforts to improve on that initial apparatus led to a working experimental set demonstrated on several occasions in May and June of 1936, with the result that the furtherance of the project toward actual shipboard installation became a priority item at NRL. Allison's story continues with the development of a prototype shipboard radar, called the XAF, operating at 200 MHz, which was put into production by RCA and codenamed the CXAM. An appendix in the book indicates that six of these production units were being installed in ships of the fleet in October, 1940.

Later chapters of the book describe the relationship of the projects at NRL to those of industrial laboratories, those of the US Army and, most importantly, those of the British. The latter had gone to war in 1939 and, according to the same appendix, already had an impressive assortment of radar devices in operation on land, at sea and in the air by the time of the visit to Canada and the US of a mission headed by Henry T. (later Sir Henry) Tizard in September and October of 1940. The Tizard Committee had been created in Britain in 1935 and had initiated very soon thereafter, at the recommendation of Robert Watson-Watt, broad development work on radar in response to the sensed imminence of war. The mission led to a major change in the organization and an intensification of US work on radar development resulted from that exchange. The civilian Radiation Laboratory at MIT was established especially to exploit the possibilities of microwaves opened up by the pulsed multicavity magnetron shown to the US representatives by the British mission. The magnetron was immediately recognized as opening up entirely new standards of performance by radar. (See the article by James E. Brittain on page 60.)

Throughout his book, David Allison makes frequent reference to other documents and many sources that support and expand his exposition. The book is a fascinating story of an activity and a period in the development of science and technology that made an enormous contribution not only to the war effort, but also to the way "big science" and technology has developed since that time.

The second book, also written by a historian of science, W. E. Knowles Middleton, is concerned with the administrative structure, the personalities and the technical details of the contribution by the Canadian National Research Council to the development of radar during the years of World War II. The Tizard mission in September of 1940 brought about a considerable expansion of the Canadian effort, a development much encouraged by the British. This book also describes the background of the Tizard mission and the efforts made by Archibald V. Hill, a British physiologist, to bring about such an exchange. This book devotes much space to descriptions of the several radar systems developed by the Canadian group as the needs of the war evolved. Many of these projects were related to parallel or similar projects in the US, and the continuous liaison between the two groups is made apparent. Middleton's book is also interesting to read, and especially in connection with Allison's book. In the shadow of the much-larger-scale efforts of both the British and, after 1940, the US, the important Canadian work has been given little attention.

Both books make frequent reference to the still unpublished work of Henry Guerlac, *Radar in World War II*, the history of Division 14 of the wartime National Defense Research Committee, under which the MIT Radiation Laboratory operated. Very soon after it was established—as a result of the Tizard mission—that laboratory became a major participant in radar development. Its technical accomplishments were preserved in the 28-volume "Radiation Laboratory Series," but little of the political, administrative or human drama of those years is conveyed in those volumes. The books reviewed here provide some of that—especially for their subject institutions. I hope Guerlac's book, too, will soon become available.

ROBERT V. POUND
Harvard University