

# The History of Science in the United States

## *An Encyclopedia*

Edited by  
Marc Rothenberg  
*Smithsonian Institution*

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Office routine work and admiralty exploring expeditions, marine science centered around the British Association for the Advancement of Science Dredging Committee from 1839 until the mid-1860s, after which time a Royal Society-admiralty partnership took over the lead and dispatched a series of summer expeditions. These culminated in the four-year circumnavigation of HMS *Challenger* (1872–1876), the first expedition sent out with a mandate to study the world's oceans. Both the United States and Britain quickly followed the example of the Naples Zoological Station and set up coastal marine biological laboratories in the 1880s and 1890s.

In the last quarter of the nineteenth century, many nations sponsored oceanographic voyages modeled after the *Challenger*'s. The United States, Russia, Germany, Norway, France, and Italy contributed to the effort to define the limits and contents of the oceans. Late in the nineteenth century, however, leadership in marine science shifted to Scandinavia. Mounting concerns about depleted fisheries inspired national efforts in many countries to study the biology of fish species as well as their migration. Sweden initiated the formation of what became, in 1902, the International Council for the Exploration of the Seas, which coordinated research undertaken by member nations. Although not a member, the United States also continued active biological research. Victor Henson's discovery of plankton and the subsequent realization of how to use physical oceanography to investigate the movements of fish populations gave oceanographers a method with which to study the ocean as an undivided system.

World War I disrupted the international community of oceanographers but provided the impetus for developing echo-sounding technology for submarine detection, which had been pioneered for ice detection, partly in response to the *Titanic* disaster. By the late 1920s, echo sounders revolutionized the study of underwater topography and helped scientists recognize the rift valleys of midocean ridges, showing them to be active, unstable regions. Although government funding of oceanographic research dropped back almost to pre-war levels, the late 1920s saw the appearance of the first oceanographic institutions, sponsored mostly by foundations and private individuals. Scripps Institution changed its mission from biological research to oceanography in 1925 and, five years later, the Woods Hole Oceanographic Institution was established on the Atlantic coast. Economic depression affected practical

government science such as fisheries research as well as private projects, so oceanographic work, which was particularly expensive, slowed down dramatically until preparations began for World War II.

As with other sciences, World War II partnerships helped forge a new relationship between governments and oceanography. Oceanographic work during and after the war carried the imprint of wartime government support and policy in both its problem selection and its scale. Physical studies gained and maintained precedence over biological ones. The areas of inquiry promoted by wartime efforts related to submarine and antisubmarine tactics. New research began on underwater acoustics, while ocean floor sediment charts were compiled from existing data. Wave studies also received precedence for their value in predicting surf conditions for landings. After the war, oceanographers and institutions, newly accustomed to generous funding, learned to accept and even encourage government support. Oceanography became characterized by large-scale, expensive research projects such as the 1960s deep-sea drilling by proponents of the theory of seafloor spreading. Oceanography's multifaceted attempt to understand the oceans as integrated biological and physical environments has made it attractive to ecologically and environmentally minded scientists since the 1970s and 1980s, resulting in projects such as Sea-Lab as well as studies of the ocean's role in global warming and weather production. The development of autonomous deep-diving vehicles, an international endeavor, has brought the greatest depths into sharper focus.

#### BIBLIOGRAPHY

- Deacon, Margaret. *Scientists and the Sea, 1650–1900: A Study of Marine Science*. London: Academic Press, 1971.
- Mills, Eric. *Biological Oceanography: An Early History, 1870–1960*. Ithaca: Cornell University Press, 1989.
- Schlee, Susan. *On the Edge of an Unfamiliar World: A History of Oceanography*. New York: E.P. Dutton, 1973.

Helen M. Rozwadowski

#### Office of Naval Research, United States

A federal agency created in 1946 to promote scientific research in and out of the navy. As a major source of financial support for academic basic research, especially in its early years, the Office of Naval Research (ONR) played a key role in American science policy in the post-World War II period. The driving personalities

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behind the establishment of the ONR during World War II included Vice Admiral Harold G. Bowen, former head of the Naval Research Laboratory (NRL), who wanted the ONR to develop nuclear propulsion for the navy, and several reserve naval officers with technical background, known as the “Bird Dogs,” who sought to continue the close and fruitful wartime cooperation between the military and university scientists. The Bird Dogs’ vision soon dominated the ONR’s mission when Bowen lost the battle for nuclear propulsion to the Bureau of Ships. Although formally headed by a naval officer, civilian scientists administered the ONR, with the help of a Naval Research Advisory Committee composed of prominent scientists outside the navy. What distinguished the ONR from other funding agencies was its liberal support of research projects at universities, other nonprofit institutions, and industrial laboratories, usually through contracts. The great latitude the ONR allowed in the choice of research topics, often without direct military or naval relevance, and in the use of funds, allayed the fear of scientists of undue bureaucratic and military control. The encompassing coverage of all major scientific fields made the ONR into an “Office of National Research” before the founding of the National Science Foundation in 1950. Besides its extramural programs, the ONR also supervised the NRL and other intramural projects and operated several branch offices, including one at London and another at Tokyo.

The ONR’s patronage of academic basic research was not without its critics. In the late 1940s, naval officers questioned the necessity of such effort when the navy’s budget for research and development was being cut back. Although the Korean War and the *Sputnik* crisis in the 1950s helped the ONR deflect such criticism, the agency became more cautious in its justification for such support. In the 1960s, the ONR’s research support programs, like those in many other government agencies, suffered from the deteriorating relationship between the military and the universities caused by the Vietnam War.

Historians have debated whether the ONR’s apparent generosity made American scientists feel more autonomous from military control than they actually were during the Cold War. Critics of the postwar science-military relationship argue that such ONR support, with “no strings attached” formed only part of the military design to attract scientists into more practical and military-relevant research. Pure research was also

supported, with long-term military applications in mind and with harmful effects on the development of scientific disciplines. In response, other historians have pointed to the diversion toward practical topics as a healthy development of a scientific discipline and to many scientists’ willingness to contribute to the American defense effort during the Cold War. More detailed studies of the scientific research sponsored by the ONR, of scientists’ attitude toward military patronage, and of the audience-specific rhetoric and justification for military support of science employed by scientists and science administrators are needed for a better understanding and evaluation of the ONR’s role in the development of American science.

## BIBLIOGRAPHY

- Forman, Paul. “Behind Quantum Mechanics: National Security as Basis for Physical Research in the United States, 1940–1960.” *Historical Studies in the Physical and Biological Sciences* 18 (1987): 149–229.
- Sapolsky, Harvey M. *Science and the Navy: The History of the Office of Naval Research*. Princeton: Princeton University Press, 1990.
- Schweber, Samuel S. “The Mutual Embrace of Science and the Military: ONR and the Growth of Physics in the United States after World War II.” In *Science, Technology and the Military*, edited by Everett Mendelsohn, M. Roe Smith, and Peter Weingert. Boston: Kluwer Academic, 1988, pp. 3–45.

Zuoyue Wang

## Office of Scientific Research and Development

Principal agency for the mobilization of civilian science and engineering in the United States during World War II. By the end of the war, the Office of Scientific Research and Development (OSRD) had spent nearly half a billion dollars and accelerated a revolution in modern warfare. From OSRD-sponsored research in university and industrial laboratories came a host of new and improved weapons, including radar and the proximity fuse that helped create a new electronic combat environment. Other contributions included rockets and high explosives; the *Dukw* and the *Weasel*; medical advances such as antimalarial drugs, blood substitutes, and the quantity production of penicillin. OSRD’s most notorious involvement was with the atomic bomb, for which the agency bore primary responsibility until its transfer to the army at the end of 1942. By and large, OSRD was a great if somewhat