

BOOKS

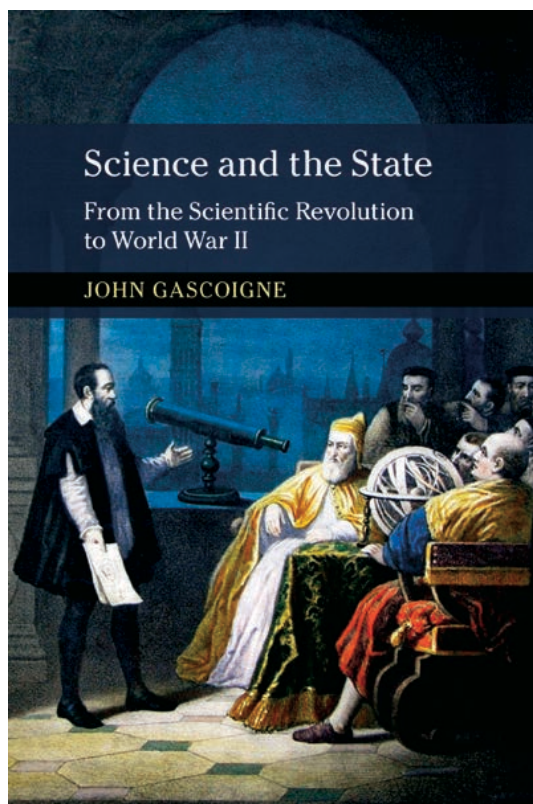
Powerful Knowledge

G. PASCAL ZACHARY

The animating questions behind this timely, concise, and ambitious book are immediately compelling: How did the persistent partnership between science and the modern nation-state arise and evolve around the world over the past five hundred years? How did the state and the science community coevolve from the early modern world of Kepler, Newton, Galileo, and Bacon to the radically disruptive, enormously costly experience of World War II?

The relationship between government and scientific research, broadly conceived, is central to the quest for human betterment and the sustainability of the planet. Only the state has the resources, legitimacy, and authority to identify, fund, and deploy the important advances developed by research in the public interest. A concise history has long been needed that surveys the diverse ways nations fund and manage research activities and to what ends.

John Gascoigne, an emeritus professor of history at the University of New South Wales, has provided a brilliant introduction that should become essential reading for policy-makers, researchers, and concerned citizens. Gascoigne is a specialist on the rise of science and government in modern Europe and the role of science and technology in European global expansion. Drawing on a wide range of sources, Gascoigne presents a portrait of his subject in clear and at times brisk



Science and the State: From the Scientific Revolution to World War II

by John Gascoigne. New York, NY: Cambridge University Press, 2019, 262 pp.

prose, while at the same time providing a nuanced perspective on the politics of science and the role of government in funding and prioritizing research.

Given his profound knowledge of the history of science, Gascoigne's grasp of the emergence of the modern nation-state is steady, broad, and occasionally revelatory. He views the state and science in the *longue durée*, and presents both national government and the scientific community as parallel offshoots of the premodern focus on

conquest and war. The apparatus of the state found science of value to building military prowess and administrating the machinery of government. The French government, for example, formed a Paris-based academy in 1666 that recruited scientists from around Europe to create accurate maps that, Gascoigne writes, were "particularly valuable to the state for military purposes." Around the same time, the Royal Society of Britain was attempting to improve the supplies of timber that were so crucial for shipbuilding. And the scientific enterprise valued the patronage and legitimacy granted to it by the nascent state. To Gascoigne, the state and science coevolved for hundreds of years in ways that boosted the efforts of each to expand control over their respective domains.

By the nineteenth century, the state and the scientific community were robust enough to begin to directly interact on a routine basis.

Distinct national differences took shape. In Great Britain, "science was often a pursuit for leisured gentlemen," most famously Charles Darwin, born to a wealthy family and able to pay his own way on the history-making voyage of the *Beagle*.

The needs of empire influenced scientific institutions. In an illustration of what Gascoigne cleverly describes as "imperial botany," Britain's Royal Gardens at Kew became the model for colonial gardens in Jamaica (1775), Calcutta (1787), and Penang (1800). These far-flung botanic research gardens fired the imaginations of colonial administrators who, Gascoigne writes, pondered "what benefits could be obtained for Britain through the

cultivation of botanical transfers.”

France went furthest in marrying the state and science during Europe’s Age of Enlightenment, with French scientists and theorists—many of them, such as Diderot and Voltaire, household names to this day—attempting to apply scientific reason to social institutions. But the state’s efforts were complicated by the French Revolution in 1789, which dismantled existing state science structures while at the same time unleashing support for the “professionalization of science.” Post-revolutionary France introduced the metric system in the “spirit of scientific precision and rationality,” although metric did not become the French standard until 1837.

In Germany, science-state relations took a different trajectory. Prior to unification in 1871, each German province “sought to maintain a university as part of its local identity,” Gascoigne writes, and these universities promoted research, “in contrast to the French universities where the professor was first and foremost a teacher.” This emphasis on research helped to ensure German scientific leadership in physics, chemistry, mathematics, and other important fields.

From 1850 to the eve of World War I in 1914, nation-states widened their scope of responsibility, which raised the attention given to research and what Gascoigne shrewdly calls “political arithmetic,” the application of statistical and scientific methods to governance. Germany began hiring medical officers in 1899 and formed a census bureau in 1905. Britain’s Royal Society, though a voluntary association, supported nearly one thousand scientists during the 60 years prior to the war. Whereas the British held fast to the belief that “science should be self-supporting,” the French state provided more direct support, viewing “the spread of science and technology as a central element of the ‘civilizing mission’ that was at the

core” of justifying France’s growing enthusiasm for colonies near and far.

Gascoigne’s examination of the historical trajectories of Britain, France, Germany, and Russia should strike American readers as deeply informed and richly insightful. At the same time, his handling of the American story is highly familiar yet enormously valuable because of his commitment to brevity and his affection for the writings by and about Vannevar Bush, America’s science “czar” during World War II (including my own biography of Bush, *Endless Frontier*), and seminal sources such as Hunter Dupree’s *Science in the Federal Government: A History of Policies and Activities to 1940*.

Until 1940, the American government, at the national and state levels, showed scant interest in the value of research for its own sake. The National Academy of Sciences, which formed during the Civil War, didn’t secure congressional funding until 1941. By the onset of World War I, the US government played “only a small part in original research,” Gascoigne writes, leaving the task of providing funding and setting priorities for scientists to “philanthropic foundations” operating “without the constraints imposed by the state.” Of these, the most important were the Rockefeller Institute for Medical Research, founded in 1901, and the Carnegie Institution of Washington, formed in 1902.

World War II marked a decisive shift in relations between government and science. Despite its defeat in World War I, the German state retained strong engagement with science and engineering. During the Weimar Republic from 1919 to 1933, the government provided fully half of science funding, Gascoigne writes, and “science became what the Germans called a ‘Macht-Ersatz,’ a substitute for power”—power that was denied the country under the terms of the Treaty of Versailles. Under

the Nazis, despite efforts to eliminate Jews and terrorize Germany’s own population, “scientists proved capable of doing good work,” Gascoigne drolly concludes. That good work might have continued with greater effect had not Adolf Hitler’s “belief in early victory” halted ambitious research. Yet during the war, Gascoigne notes, Germany made major innovations in rocketry and “became world leaders in the development of synthetic fuel.”

Under the leadership of Vannevar Bush as President Franklin Roosevelt’s science adviser, the United States responded by providing unprecedented funds for research. Facilitated by the novel instrument of “the research contract,” the government gave “a fair measure of independence” to scientists, Gascoigne observes. Aided by British scientists, the Americans made remarkable advances in radar, bombing accuracy, and, finally, the creation of the atomic bomb. The use of atomic weapons on two Japanese cities in August 1945 permanently altered the world’s view of the role of science in war and national security.

Gascoigne offers only a glimpse of the world after 1945, noting that the United States “set the pace for linking science and the state,” and did so—in contrast to the Soviet Union, where the government was the sole funder of research—by relying on a “largely decentralized” approach that undercut the trend toward domination of science by the federal government. Gascoigne sees stability in the science-government relationship carrying into the twenty-first century. “The modern state and science now form an inseparable bond that is embodied in the structures of government,” he writes.

However, the “fruitful partnership” between science and government that Gascoigne considers the legacy of the twentieth century continues to face tests and challenges. Had Gascoigne pushed his account into the 1970s, he would have found that the cozy

relationship between researchers and the military came under countercultural attack. And in the new century, the political consensus around the American model has fractured, although this has not led to a reduction in federal research funds. In this sense, Gascoigne's overarching position that "science and the state were bound together in a reciprocal relationship" cannot be denied. Yet fragmentation and renewed efforts to expand pluralistic approaches to who does science and to what end raise questions about the boundaries and rules of the reciprocity that have served scientists and policy-makers so well for so long.

The breakdown of the postwar consensus around the logic of government-science relations raises the unsettling possibility that just as World War II engendered a radical disruption in the relationship, so too might some future global crisis around disease (the coronavirus?), climate change, or excessive population engender profound changes in both science and the state. In closing, Gascoigne insists that "science has proved remarkably adaptable" to changing political conditions, and that despite diversity in governmental systems, "what is common to them all is a recognition of the importance of science as a part of the state structure."

Yet the prospect of future upheavals remains. In admitting that the state "can help shape the nature of science," Gascoigne rarely asks how government actually influences the goals of research, not to mention shapes the character and nature of scientific careers, rewards, and outcomes. To these thorny questions, politics may increasingly turn.

G. Pascal Zachary is the author of *Endless Frontier: Vannevar Bush, Engineer of the American Century* (1997). He is a professor of practice in the School for the Future of Innovation at Arizona State University.