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Excerpt
More Information

Introduction

Commissioned to find a northwest passage by the British crown, Captain James Cook sailed into political headwinds – part of the empire was in rebellion. Thankfully, Benjamin Franklin, patron of "useful knowledge" and a prominent colonist, asked the colonial navy to "not consider the HMS *Resolution* [Cook's ship] as an enemy."[1] Mapping the Arctic and Pacific oceans was in the greater interest of mankind; such a scientific voyage was above the fray. Joseph Banks, president of the British Royal Society, returned the favor, thanking Franklin for being a "Friend of disinterested Discovery."[2] But Franklin's plea fell upon deaf ears: The rebellious Continental Congress thought the *Resolution* should be captured if possible.[3] The story raises a key question: Is science bound by national interest? The answer was academic at the time, but that would change.

In January of 1939, Germans Otto Hahn and Fritz Strassmann published a paper outlining nuclear fission. The revelation sent shockwaves around the world: four American teams, as well as Frederic Joliot-Curie's

[1] Franklin's original proposal for the American Philosophical Society in 1743 suggested "the promoting of Useful Knowledge," and his letter is reprinted in A. Kippis, *A Narrative of the Voyages Round the World Performed by Captain James Cook, with an Account of His Life during the Previous and Intervening Periods* (Philadelphia: Porter & Coates, [N.D.]), 391–392. The narrative was first published in 1788.

[2] Banks quoted in Deborah Allen and Deborah J. Allen, "Acquiring 'Knowledge of Our Continent': Geopolitics, Science and Jeffersonian Geography, 1783–1803," *Journal of American Studies* 40 (August 2006): 205–232, quote on 208.

[3] On the Congressional reaction, see Kippis, *A Narrative*, 392–393; J. C. Beaglehole, *The Life of Captain James Cook* (Stanford: Stanford University Press, 1974), n.685; Alan Villiers, *Captain James Cook* (New York: Charles Scribner's Sons, 1967), 231.

lab in Paris, verified the paper before the end of the month.[4] Nazi scientists alerted the War Office in the spring; a German newspaper asked whether nuclear energy could be put to "practical uses" in June.[5] The openness of the period is revealing in hindsight: stories about fission and possible chain reactions appeared frequently, including in more than 100 scientific papers.[6] Worried about possible military implications, scientists tried to impose a voluntary ban on publications but Joliot-Curie's team ignored it. Europeans imposed secrecy only after German tanks rolled into Poland in September; a self-imposed censorship became effective in the United States the following year.[7]

The conversion of knowledge into power during World War II altered international relations. The US government funded research critical to victory and the destruction of Hiroshima and Nagasaki testified to the effectiveness of the approach. After the conflict, nations sought the benefits of applied research, but research remained concentrated in a few countries. Indeed, World War II exacerbated imbalances by advancing American scientific capability while reducing the capabilities of European and Asian rivals. The United States had been a leading scientific power before the war; the country occupied a singular position after.

Science became central to American diplomacy. Although tensions over nuclear, biological, and chemical weapons are familiar, the larger story remains unknown. *Science and American Foreign Relations since World War II* provides the first history of science in American foreign relations alongside analysis of science as a tool of American statecraft. Agricultural research, export controls, and genetics, for example, played key roles in postwar diplomacy, as the United States leveraged its scientific and technical preeminence to secure alliances and markets. American funding underwrote international scientific undertakings and diplomats offered developmental assistance to curry favor: Middle Eastern nations, for example, benefited from extensive scientific and technical aid, whether under the Shah of Iran (1950–1979), through the JECOR initiative with

[4] Lawrence Badash, *Scientists and the Development of Nuclear Weapons* (Atlantic Highlands, NJ: Humanities Press, 1995), esp. 22–24.

[5] Regarding the German scientists, see Mark Walker, *German National Socialism and the Quest for Nuclear Power, 1939–49* (Cambridge: Cambridge University Press, 1989). Regarding the newspaper, see L. Badash, et al., "Nuclear Fission: Reaction to the Discovery in 1939," *Proceedings of the American Philosophical Society* 130 (June 1986): 196–231, quote on 215.

[6] Badash, *Scientists and the Development of Nuclear Weapons*, 29.

[7] Badash, "Nuclear Fission," 196–231.

Saudi Arabia (1975–2000), or via multiple programs with Israel (1950 to the present). This assistance boosted American soft power and prestige overseas: Polls indicate foreigners view American science and technology more favorably than other aspects of American society.[8] The growth of commercial research led the United States to promote intellectual property rights, while environmental sciences, the rise of Asian competitors, and collapse of the Soviet Union reshaped American priorities. Science remains essential to American foreign relations today, whether in cooperative activities such as weather prediction and disease prevention or in geopolitical disputes over climate change, genetically modified organisms and rogue nuclear programs.

Science and American Foreign Relations since World War II builds upon a growing body of work on science in international relations.[9] In 2008, the American Association for the Advancement of Science (AAAS) established a Center for Science Diplomacy and suggested a three-tiered framework to separate different approaches:[10]

Diplomacy for science – using diplomacy to advance a scientific goal or project
Science for diplomacy – using science to build international relations (aka "science diplomacy")
Science in diplomacy – using science to inform and shape diplomacy

For illustration, consider the US/Saudi solar energy project in the 1980s: First, American politicians secured support for solar energy research in Saudi Arabia (*diplomacy for science*); the resulting project benefited the

8 Regarding polls, see NSF Director Arden L. Bement, "Prepared Statement of Arden L. Bement," in Committee on Science and Technology, House of Representatives, 110th U.S. Congress, 2nd Session, April 2, 2008, *International Science and Technology Cooperation* (Washington: GPO, 2008), 19.

9 Recent overviews include National Research Council, *U.S. and International Perspectives on Global Science Policy and Science Diplomacy: Report of a Workshop* (Washington: National Academies Press, 2011) and Lloyd S. Davis and Robert G. Patman, *Science Diplomacy: New Day or False Dawn?* (Hackensack, NJ: World Scientific Publishing, 2015). See also British Royal Society, *New Frontiers in Science Diplomacy: Navigating the Changing Balance of Power* (London: Science Policy Centre, 2010). For an overview of different national approaches, see Tim Fink and Ulrich Schreiterer, "Science Diplomacy at the Intersection of S&T Policies and Foreign Affairs: Toward a Typology of National Approaches," *Science and Public Policy* 37 (November 2010): 665–677.

10 I have modified the AAAS framework: The AAAS framework stresses large projects like the International Space Station or International Thermonuclear Experimental Reactor under "Diplomacy for Science," while I include much smaller projects as well. See the Center's website for a more detailed explanation: www.aaas.org/program/center-science-diplomacy.

Saudi people and government, bolstering US–Saudi relations (*science for diplomacy*); finally, the data guided US international energy policy (*science in diplomacy*). In this case, a single project – Saudi solar energy research – involved all three approaches. Or not. Rather than learn from the project, the Reagan administration minimized the potential of solar research at home while advertising its potential abroad, leading to a fourth consideration: the politicization of science. History shows data alone are rarely determinative of policy or cooperation.

Instead, international scientific relations are shaped by a variety of actors and considerations, such as cost/benefit analyses, geopolitics (including national security, economic competitiveness, and diplomacy), and scientific merit (often the last consideration). The motivations of various participants, whether nation-states, scientists, scientific societies, international and nongovernmental organizations, or industry representatives, are instrumental and each has their own agenda. No country is a "disinterested" patron. Since World War II, for example, the American government has engaged in significant "science for diplomacy," but has demonstrated less interest in supporting international science projects (*diplomacy for science*) or in allowing science to shape foreign policy (*science in diplomacy*) contrary to American interests. Finally, in addition to the approaches above, this study also considers American diplomacy to limit access to science, whether through export controls, intellectual property rights or non-cooperation.

A complete picture of science and American foreign relations requires an inclusive definition of "science," incorporating commercial and medical research, engineering and advanced technology. Disputes over access to American industrial research and Soviet cancer research, for example, chilled US–Soviet relations in the early Cold War and the United States established an export control system to deny advanced technology and technical know-how to the Soviet bloc. Research with national-security or commercial applications – "applied" science – became a focus of American intelligence and diplomacy. "Basic" science, defined by the government as systematic study "without specific applications towards processes or products in mind," was of interest, but less concern.[11] However, these

[11] In general, the United States government separates "science" into "basic research," "applied research," and "development." For an overview of the various definitions and federal regulations, see National Science Foundation, "Definitions of Research and Development: An Annotated Compilation of Official Sources," available at: www.nsf.gov/statistics/randdef/fedgov.cfm.

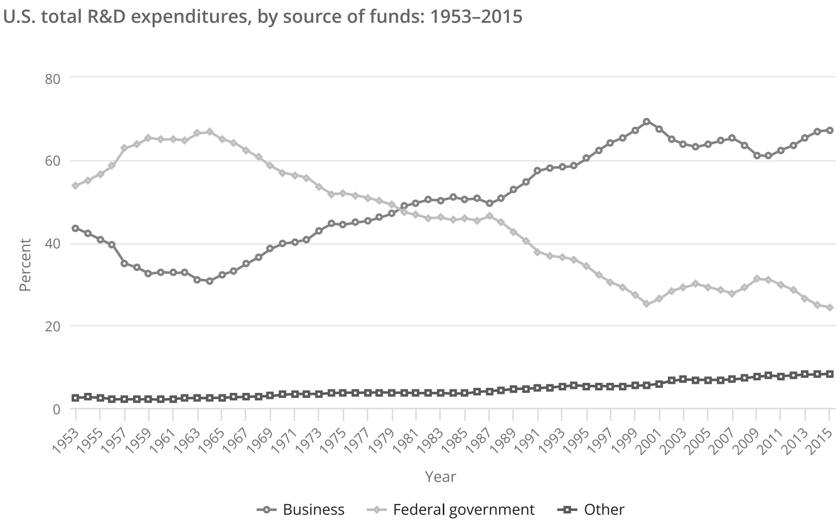
categories have been accepted as man-made and fluid since their creation: in the 1950s and 1960s, the Department of Defense provided both justifications for the same research and fields like genetic engineering defy easy classification.[12] As such, whenever possible, I will specify a scientific field rather than use "science."

It is important to be field-specific because American diplomacy is field-specific. After the development of genetic engineering and an American biotech industry, for example, the CIA began tracking research and foreign proficiency in the field. Access to genetic material became part of Cold War diplomacy, as the United States hoped to limit Soviet programs while offering genetic aid to entice China toward normalization. The profitability of the field led the United States to undermine a UN center for genetic engineering in the 1970s and refuse cooperation with G7 partners the following decade. Nor were genetic engineering and biotechnology alone; the importance of commercial research to American diplomacy increased throughout the postwar period.

Commercial research and related technologies have a long history in American diplomacy. American acquisition of enemy patents began during World War I; the occupations of Germany and Japan after World War II provided the United States with thousands of commercially valuable properties. When newly independent nations asked for access to advanced science and technology, the United States helped introduce intellectual property rights to protect commercial research. As domestic R&D became more market-driven, American diplomacy for science became more demanding of legal protection and less cooperative. Although biotech is the foremost example studied here, other similar fields include pharmaceuticals, nanotechnology and computer sciences or information technology.

The shift from public to private funding of domestic R&D (Figure I.1) shaped American diplomacy and the text's organization. The first three chapters chronicle the period from World War II to the 1970s, when the government was the dominant source of funding. In the early Cold War, federal funding guaranteed influence over research at home and abroad as the United States played the dominant role in international scientific endeavors (Chapters 1 and 2). At the same time, anti-communism ensured "science for development" a prominent place in American diplomacy

[12] Regarding the DOD's "two-title" policy, see Deborah Shapley, "Defense Research: The Names Are Changed to Protect the Innocent," *Science* 175 (February 25, 1972): 866–868.



Note(s)

Data for 2015 are preliminary and may later be revised. The other category includes nonfederal government, higher education, and other nonprofit organizations.

Source(s)

National Science Foundation, National Center for Science and Engineering Statistics, National Patterns of R&D Resources (annual series).

Science and Engineering Indicators 2018

FIGURE I.1 US total R&D expenditures, by source of funds: 1953–2015.

(Chapter 3). Chapter 4, titled "The Crossing Point," covers the transition to more private funding of R&D. During this critical era, the intersection of ecology and geopolitics led to fears of industrial regulation, while the Vietnam War sparked campus protests over defense research (Chapter 4). In the 1970s, genetic engineering exemplified the boom in commercial research which led American diplomats to refuse allied cooperation in biotechnology and advance global patent protections instead. The final three chapters bring the story into the present, when private industry became the primary source of domestic R&D funding. As policy-makers came to view research and development as critical to national prosperity (the "knowledge economy"), American diplomacy focused on implementing intellectual property rights (Chapters 4 and 6) and keeping pace with rivals (Chapters 6 and 7). Participation in international scientific projects declined (Chapters 4 and 5) while domestic politics complicated relations with allies and international institutions (Chapter 7).

A handful of blocs and nations – NATO allies, the Soviet Union and affiliates, China, Japan, Iran, Saudi Arabia, and Israel – played prominent roles in postwar American science diplomacy. Iran, for example, became one of the first and largest recipients of scientific and technical aid and the United States encouraged the Iranian nuclear program until the Islamic revolution. Both Saudi Arabia and Iran received assistance to recycle American payments for high oil prices back into the American economy. The United States also provided unique scientific support for Israel – including access to top-secret research and shielding the Israeli nuclear program from international oversight – while President Reagan funneled hundreds of millions of dollars in research contracts to the country. But relations with China may be the most remarkable: The United States attempted to limit Chinese access to advanced science and technology until the 1970s; a decade later the People's Republic was America's largest bilateral science partner. New State Department and intelligence documents highlight the central role scientific exchanges played in normalizing Chinese–American relations. The relationship grew throughout Reagan's presidency and expanded after the Tiananmen protests and China's membership in the World Trade Organization. In 2011, amid worries about corporate espionage and satellite warfare, the House of Representatives held hearings on "Efforts to Transfer America's Leading-Edge Science to China."[13] One benefit of the current approach is the ability to see, for the first time, the arc of US–Chinese scientific relations from World War II to the present.

American diplomacy reflected the geopolitical realities unique to each era and field. The Soviet Union, for example, was America's primary scientific rival after World War II, leading to concerns of espionage and export controls (Chapters 1 and 2), while Japan became a commercial competitor in the 1970s (Chapter 6) and the People's Republic of China in the twenty-first century (Chapter 7). Although nuclear physics was one of the earliest and most influential examples of the relationship between science and state power (Chapters 1 and 2), the field evolved so far past application the United States lost interest in maintaining world-class

[13] Committee on Foreign Affairs, House of Representatives, 112th Cong., 1st sess.s, November 2, 2011, *Efforts to Transfer America's Leading-Edge Science to China* (Washington: Government Printing Office, 2011). On concern over corporate espionage and satellite warfare, see Caroline S. Wagner, Lutz Bornmann, and Loet Leydesdorff, "Recent Developments in China–U.S. Cooperation in Science," *Minerva* 53 (2015): 199–214.

research facilities after the Cold War (Chapter 6). Environmental sciences and biotechnology played only a minor role in American diplomacy until the 1970s (Chapter 4), while meteorology first became controversial with weather modification (Chapter 5) and global warming only became problematic in the late 1980s (Chapter 7).

A final theme is the relationship between scientific universalism and American diplomacy in three critical areas: national security, commercial research and environmental sciences. Aspects of scientific universalism – especially the free sharing of knowledge and the apolitical evaluation of research – conflict with American interests. In national security-related fields, for example, the United States accepts global oversight on its own terms. In commercial research, the United States supports a global system to enforce intellectual property rights. Environmental sciences provoke the most conflict, because they underlie global regulations threatening to American sovereignty and industry, whether over climate change or genetic engineering. International organizations, including the United Nations, scientific societies, and NGOs, have challenged American positions on environmental grounds. However, before discussing the postwar period, we must briefly revisit Captain Cook's time for three key histories: the relationship between scientific universalism, privilege and geopolitics; the American focus on applied research, commerce and agriculture; and the impact of World War I and the interwar period on science worldwide.

SCIENTIFIC UNIVERSALISM, PRIVILEGE, AND NATIONAL SERVICE

The idea science is universal has a long and distinguished pedigree. Rule number two of Isaac Newton‘s *Mathematical Principles of Natural Philosophy* (1687) stresses universality, requiring the same cause – gravity – control "the descent of stones in both Europe and in America."[14] Newton aspired to uncover universal knowledge, i.e. knowledge able to transcend politics, religion, and culture, and the evolution of shared practices, journals and societies across borders eventually created a global community working toward the same ideal. The experimental method, historian

[14] Isaac Newton, *Mathematical Principles of Natural Philosophy* (1687), Book III, Rule II.

John Henry points out, is "a means for generating and maintaining consensus in a self-ordering community without any arbitrary authority."[15] But intellectual autonomy complicates state relations: Benjamin Franklin's American Philosophical Society (1745), for example, predated the existence of an independent "America" and welcomed British members during the Revolution.[16] Indeed, Franklin's letter supporting Cook speaks to the potential tension between American nationalism and scientific internationalism since the country's founding.

Researchers asked for and often received special privileges. Scientists, specimens and equipment, including Harvard astronomer John Winthrop and his telescope, crossed battle lines without interruption during the French and Indian War and Thomas Jefferson suggested maintaining the tradition, writing: "These [scientific] societies are always at peace, however their nations may be at war … their correspondence is never interrupted by any civilized nation."[17] International interaction was common, whether for visiting medical and laboratory facilities or collaborating on the periodic chart of elements and a universal system of weights and measures.[18] Throughout the nineteenth century, the British admiralty launched a series of protected scientific voyages, instructing its captains: "You are to refrain from any act of aggression towards a vessel or settlement of any nation with which we may be at war, as expeditions employed on behalf of discovery and science have always been considered by all civilized communities as acting under a general safeguard."[19] From 1872 to 1876, the HMS *Challenger* traveled 69,000 nautical miles, cataloging new species and measuring the oceans (depth, temperature,

15 John Henry, *The Scientific Revolution and the Origins of Modern Science* (New York: Palgrave Macmillan, 2008), 53.
16 Gilbert Chinard, "The American Philosophical Society and the World of Science (1768–1800)," *Proceedings of the American Philosophical Society* 87 (July 14, 1943): 1–11.
17 On scientists in the French and Indian War, see Gavin de Beer, *The Sciences Were Never at War* (London: Thomas Nelson & Sons, 1960) and Badash, *Scientists*, 8. Thomas Jefferson's letter of 1809 is available at: www.let.rug.nl/usa/presidents/thomas-jefferson/letters-of-thomas-jefferson/jefl190.php.
18 Maurice Crosland, "Relationships between the Royal Society and the *Academie des Sciences* in the Late Eighteenth Century," *Notes and Records of the Royal Society of London* 59 (January 22, 2005): 25–34.
19 The Admiralty quoted in A. V. Hill, "The International Status and Obligations of Science," *Science* 38 (February 1934): 146–156, quote on 146.

current, etc.).[20] The Royal Society published frequent accounts, as the *Challenger* captured international attention and helped launch the field of oceanography (the United States paid homage a century later with its namesake space shuttle). Scientists soon inaugurated the First International Polar Year (1882–1883), when researchers from twenty nations studied the high northern latitudes, focusing on surface meteorology, geomagnetism, and the aurora borealis.[21] The community also policed itself: After the eminent German bacteriologist Robert Koch stated bovine tuberculosis presented no human health risk via milk consumption, American and British scientists tested Koch's claim, eventually proving a link to children's tubercular disease and helping educate the public about the benefits of pasteurization.[22]

Yet science served national interests as well. Early state support for research focused on practical concerns like astronomy to aid navigation and mineralogy to exploit natural resources. Scientists and engineers participated in imperial crusades from Napoleon's invasion of Egypt (1798) to the establishment of British and French rubber plantations a century later. Biology provided a system for the acquisition of raw materials for commerce. "Botanical knowledge concerning useful plants," historian Lucile Brockway argued, "was a counterpart of today's academic-industrial research . . . as important in furthering the national welfare as our modern research laboratories today."[23] Advances in science and technology shaped European attitudes, seemingly testifying to European superiority as well as the backwardness of the non-European "other."[24] The imperial powers collaborated when it was to their benefit, such as coordinating weather observations at sea, and often cloaked colonial expeditions in a scientific purpose, lending an air of danger to nineteenth-century research: On Cook's return trip to the newly

[20] Anon., "The Exploring Voyage of the Challenger," *Science* 3 (May 9, 1884): 576–580.
[21] US House of Representatives, *Science, Technology and Diplomacy in the Age of Interdependence* (Washington: Government Printing Office, 1976), 46.
[22] Susan D. Jones, "Mapping a Zoonotic Disease: Anglo-American Efforts to Control Bovine Tuberculosis before World War I," *Osiris* 19 (2004): 133–148.
[23] Lucile Brockway, *Science and Colonial Expansion: The Role of the British Royal Botanic Garden* (New Haven: Yale University Press, 2002), 7. See also Zaheer Baber, *The Science of Empire: Scientific Knowledge, Civilization and Colonial Rule in India* (New York: State University of New York Press, 1996), 158.
[24] Michael Adas, *Machines as the Measure of Men: Science, Technology and the Ideologies of Western Dominance* (Ithaca, NY: Cornell University Press, 1989).