Introduction

Leading scientists and engineers from around the world convened in Washington, DC, in late 1957 to coordinate rocket launches for the unfolding International Geophysical Year (IGY). Among the dozens of countries partnering in this effort to study the Earth, several deployed powerful new rockets to carry scientific instruments to the highest reaches of the atmosphere. This cooperative use of high-tech equipment, spun-off from recent military developments, exemplified the international scientific collaboration that flourished during the Cold War (1947–1991) at the same time that science and its technological offspring were central to this global conflict. An even more dramatic measure of that collaboration was the commitment by the United States and the Soviet Union to beat their ballistic swords into plowshares and orbit the world’s first satellites—scientific satellites—for the IGY. Such a prospect led United States president Dwight D. Eisenhower to call the IGY “one of the great scientific adventures of our time” and a “demonstration of the ability of peoples of all nations to work together harmoniously for the common good” (Eisenhower 1957).

Many of the specialists then in Washington gathered at the Soviet embassy on 4 October to celebrate the scientific adventure of using rockets for the common good. Expecting the U.S. to be the first to launch a satellite in as little as two months, they were thus surprised when their hosts interrupted the revelry to share some stunning news: the U.S.S.R. had just orbited Sputnik, the world’s first satellite. The assembled guests toasted the Soviet Union for its stunning achievement. They heralded Sputnik as a scientific triumph for humanity.

This high-minded tribute proved rare in the United States, as Americans largely treated Sputnik as a potent threat to the nation’s security and standing in the world. They worried that Russia’s path-breaking rocketry had upended America’s military advantages, counterbalancing its superior nuclear weaponry and long-range bombers. They were even more concerned that people bedazzled by Sputnik would buy the “communist swindle” that “Moscow has taken over world leadership in science” (New York Times 1957). This prospect undercut a critical pillar of American Cold War ideology, namely, that science could only thrive in a free and democratic society. This ideology held that in an age of fearsome high-tech weapons and of life-transforming innovations, the security and prosperity of the “Free World” depended on America’s scientific leadership, which was naturally sustained by the country’s political and economic liberties.

By challenging this conventional wisdom and indicating that communist societies could excel in science and technology, Sputnik triggered a redoubling of America’s substantial investment in
military and civilian R&D (NCSES 1993). The United States had been an emerging leader in science and technology for many decades. It achieved that position during the Second World War, when Washington mobilized scientists and engineers and America’s unrivaled industrial capacities to help win the war. After a brief pause during postwar demobilization, U.S. investment in R&D resumed early in the Cold War as a “government-academic-industrial complex” oriented to basic science, and applied research and development grew across the country (Leslie 1993). Sputnik magnified these trends, enhancing the strategic importance of science and prompting the federal government to advance U.S. security, economic growth, and international influence and prestige by expanding the country’s capacity for advanced research and development.

A good deal of that capacity was then oriented to basic and applied research as well as small-scale and Big Science projects that supported the U.S. military and space program. Even as federal R&D spending declined in the 1970s (before reviving in the 1980s) and was then distributed more equally to a wide range of fields such as agriculture, environmental and human health, energy security, and industrial competitiveness, U.S. Cold War investment in science continued to build an enduring legacy. That legacy has included a network of national laboratories as well as federally funded student scholarships and faculty research that bolster the world’s premier university system. It has also entailed government R&D contracts for American industrial firms, many of which adopted lasting strategies of research-based innovation and of military production and support services. Thus, while America’s economy, national security, and foreign policy have evolved in the past 30 years, they continue to rely on a research infrastructure and R&D intensive military production that emerged during the Cold War.

Science and Cold War Security, Economics, and Prestige

At the height of the Cold War in the early 1960s, a prominent government official celebrated science as America’s “third revolution.” While its first revolution graced Americans with liberty and democracy and the second, an industrial revolution, furnished them with “the means for a happier life envisioned by the Founders of the Nation,” American science now promised to “raise the stature, dignity, and capacity of humanity.” The official believed this third revolution to cure diseases, boost agriculture, transform industry, and defend the U.S. and its allies was then unfolding because science had “moved from the periphery to the center of society” (Seaborg 1962). Since WWII, science had indeed become a strategic resource intensively cultivated by the federal government. Universities, philanthropies, and industrial corporations remained important patrons of scientific research. But now that national leaders deemed R&D critical for military security and economic growth, international aid and trade, and America’s standing in the world, Washington invested heavily in a national complex of government agencies, industries, and universities that propelled this third revolution of scientific research and technological innovation.

As was the case in the Second World War, national defense was the driving force for steadily rising government R&D funding during the first 20 years of the Cold War. During WWII, the federal Office of Scientific Research and Development (OSRD) had invested hundreds of millions on applied weapons research at hundreds of corporations and dozens of university facilities. These included the Massachusetts Institute of Technology (MIT) Radiation Laboratory, which designed radar that tracked Axis bombers and exposed Japanese naval forces, and the Johns Hopkins University Applied Physics Laboratory, which invented the anti-aircraft proximity fuses that cleared European skies of Nazi warplanes. The OSRD also had a hand in the most significant R&D program to date. When its director Vannevar Bush recommended the plan, the United States started a crash Big Science program to build an atomic bomb. This costly wartime Manhattan Project, which employed legions of expert staff and high-tech apparatus at laboratories across the country, produced the bombs that obliterated two Japanese cities in August 1945 (Sherwin 2020). National leaders understood well
that government funded research was critical to the development of the atomic weapons and radar systems that helped win the war. That research had also been key in other wartime innovations, such as electronic computing, jet aviation, and ballistic missiles, which fundamentally changed the calculus ever since of national security planning.

Vannevar Bush recognized that the proliferation of fearsome weapons and delivery systems compelled the United States to prioritize scientific research. Sobered by the speed at which advances in theoretical physics led to the atomic bomb, Bush called on the country to heed the lessons of WWII by supporting the basic science as well as applied R&D that would lead to subsequent breakthroughs in military technology. Another lesson of that war was that scientific research helped boost the United States economy and make it the powerhouse of the world. Whereas Depression-era analysts thought the U.S. economy had exhausted its expansionary energies, they discovered during the war that research and innovative technologies led to new advances in medicine, supercharged the farming sector, and promised whole new industries—among them synthetic materials and pharmaceuticals, commercial air travel, television entertainment, and electronic computing and information management. Bush said as much in his influential blueprint for postwar science policy, *Science—The Endless Frontier*, in which he called on the federal government to foster this limitless frontier. Without government support for scientific progress, he wrote, “The national health would deteriorate; . . . we could not hope for improvement in our standard of living or for an increased number of jobs for our citizens; [and] we could not have maintained our liberties against tyranny” (Bush 1945). His report provided intellectual rationale for unprecedented, peacetime federal investment in applied R&D conducted in small labs and through big science initiatives, and Bush’s advocacy led directly to the creation of the National Science Foundation (NSF) in 1950, which has provided grant-support for basic scientific research ever since.

If science policy makers like Vannevar Bush deemed pathbreaking R&D as essential to domestic security and Americans’ health and economic well-being, they also saw it as an important tool of U.S. foreign policy. Advanced research and weapons development helped the United States emerge from the war as the preeminent power. America’s towering strength enabled a new foreign policy of international engagement and leadership, in which it sponsored reconstruction in war-torn Europe and Asia and promoted a more peaceful and economically integrated world order. As that emerging order divided at the outset of the Cold War into global alliances led by the United States (the “Free World”) and the U.S.S.R., American R&D continued its wartime footing. Federal agencies like the National Advisory Committee for Aeronautics (NACA) built on wartime advances in aviation and coordinated research on supersonic flight; the new Atomic Energy Commission (AEC) inherited much of the Manhattan Project and produced fissile material for a growing atomic arsenal; and branches of the new Department of Defense oversaw R&D for advanced naval and missile systems, automated command and control technologies, and signal intelligence. These heavy investments in R&D enabled the U.S. to maintain military advantage over its Soviet adversary, which did not yet have atomic capabilities but whose sizable conventional forces threatened U.S. interests in Europe and Asia. That threat grew dramatically in 1949, when the Soviet Union detonated an atomic weapon, and then in 1950, when communists consolidated power in China and tried to unify a divided Korea by force of arms.

Already conditioned to fear communism as an existential threat and the Soviet Union as bent on world conquest, Americans responded to these alarming events by building up hundreds of overseas bases and enlarging U.S. armed forces and military arsenals. As national security budgets swelled to an unprecedented 10% of gross domestic product for much of the 1950s (it is about 3.5% today), so too did U.S. investment in military R&D. The “intensity” of federal R&D spending (i.e., that spending as a percentage of the total economy) was then at its highest point (matched only in 2009 due to federal stimulus funds), as Washington poured money into a swelling government-industrial-academic complex to conduct the R&D that would preserve America’s strategic edge against a now
nuclear-armed enemy (Mandt 2020). During the 1950s, for example, the AEC mobilized its own scientists as well as university researchers and industry engineers across the country to develop a thermonuclear arsenal to preserve U.S. strategic advantage and deter Soviet military action. The U.S. Air Force and its military contractors contributed by using the fruits of aerodynamic research conducted by NACA as well as applied study of chemical propellants, computer control, and electronic navigation by the DOD and industry partners to design the planes, submarines, and missiles that could deliver nuclear bombs to all possible enemy targets. In an effort to prevent the Soviet Union from doing the same, the DOD and university partners from coast to coast (MIT in the East to Stanford University in the West) developed an integrated system of radar sites across North America, called the Semi-Automatic Ground Environment (SAGE), to provide early warning of incoming Soviet bombers (Reynolds 2010).

SAGE was an example of Cold War R&D projects that impacted the civilian economy while also sustaining U.S. military power. In this case, a primary industrial contractor involved in the project—IBM—developed the largest electronic computer to date to process SAGE data feeds from multiple radar sites. This undertaking set IBM on a path of dominance in a growing and profitable computer industry that transformed everyday life and economic activity. Like IBM, hundreds of industrial corporations sought military R&D contracts as a way to diversify their business operations, build in-house R&D expertise, and spin off patent-protected technologies that helped them secure market advantage. In many cases, government agencies like the AEC sponsored scientific research to directly benefit the broader society and economy. In fact, its 1946 founding legislation compelled the AEC to do so, calling on it to study and use nuclear materials not only for military purposes but also “toward improving the public welfare, increasing the standard of living, [and] strengthening free competition in private enterprise” (Hewlett 1972). As the AEC sponsored research in the 1950s on atomic power plants, nuclear propulsion for ships, and isotopes for use in factories, farms, and hospitals, a leading corporate booster saw immense business opportunity and professed industrial America’s “faith that the atom will become man’s greatest benefactor” (Booth 1956). President Eisenhower professed that faith as well and promoted an “Atoms for Peace” initiative in the mid-1950s to share civilian applications of America’s nuclear R&D with allies around the world.

Eisenhower’s Atoms for Peace initiative reflected national leaders’ understanding that science played an important role in the economic as well as military strategies at the heart of U.S. foreign policy during the Cold War. According to one historian, America’s “grand strategy” to modernize the global economy entailed building “a world trading system hospitable to the unrestricted movement of goods and capital” (Leffler 2017). They believed this system would prevent the economic nationalism and imperial conquest that triggered WWII. It would also contain the spread of communism that was mimical to this grand strategy. It would do so by tying countries together through growing trade and cross-border investment. Each would see its fortunes rise by opening its market in a way best suited to its level of development. The least-developed countries would focus on exporting natural resources. Those further along in economic development would process basic industrial goods to sell in other countries. The United States, which aimed to revive its advanced industrial partners in Europe and Asia, would then lead them in supplying critical investment to less-developed countries and producing high-tech equipment, consumer goods, and professional services for global consumption. According to this grand strategy, each nation would benefit through economic specialization, and the U.S. would use its superior science and technology to help them do so.

President Harry Truman outlined this ambitious foreign policy in 1949 and called on the U.S. to “embark on a bold new program for making the benefits of our scientific advances and industrial progress available for the improvement and growth of underdeveloped areas.” This program turned to American engineers to build modern infrastructure in underdeveloped countries and on scientists to help them transition from traditional to commercial forms of agriculture, forestry, and mining.
In terms of more advanced industrial countries, the president pointed to those in Europe when he promised American support so that “the free people of that continent can contribute once more to the security and welfare of the world” (Truman 1949).

In need of capital, dislodged from many former colonies, and separated from traditional trading partners by an Iron Curtain, Western European countries relied on American resources to rebuild their industrial economies so that they could, in Truman’s words, resume their places at “the forefront of civilization.” While scientific research helped spawn many of the technologies that aided European reconstruction, the United States directly supported what one historian calls the “rehabilitation” of science in those countries with scholarships for their young people to study in American universities. Those graduates returned home as close colleagues of American scientists and engineers, and they helped revive European universities and build cross-Atlantic research networks with grant funding from the U.S. government. Having concluded that “science had become a significant component of foreign policy,” the U.S. State Department provided millions of dollars in grants through the Marshall Plan to bolster the homegrown science that would strengthen the economies of countries like Great Britain, France, and Germany and cement their ties to America (Krige 2006). Rather than supporting military R&D there—the U.S. aimed to maintain dominance in this strategic field—Washington focused on building capacity for basic science and applied industrial research throughout Western Europe.

During this period of the Cold War, U.S. officials exerted what one scholar calls the “hard power” of America’s “economic and military might” to contain the Soviet Union and strengthen its global alliances. Advanced science and technology bolstered that hard power and they facilitated U.S. foreign policy by enhancing its “soft power” as well (Nye 2004). Recognizing that it was generally better to entice than coerce other countries to ally with the United States and adopt its grand strategy, Washington endeavored to build up the soft power of international prestige that came from its credible strength and attractive principles. Publisher Henry Luce famously noted that an “American Century” of U.S. global leadership depended on such prestige, on the international community’s “faith in the good intentions as well as in the ultimate intelligence and ultimate strength of the whole American people” (Luce 1941). As engines for military defense and economic development, American science and technology featured prominently among public officials’ declarations of U.S. designs for a secure and prosperous Free World. As noted, those officials cultivated scientific cooperation with America’s allies so as to strengthen its global relationships and cast a favorable light on its internationalist agenda.

As one historian of science explained, “national prestige” often motivated such scientific cooperation and was in fact “widely admired” overseas (Krige 2006). Most importantly, public officials reckoned that pathbreaking R&D occurred only when scientists and engineers enjoyed the liberty to develop their individual insights and vet their findings democratically with one another. Thus they tried to enhance U.S. prestige with examples of America’s prowess in science and technology. These examples reinforced the contention that the U.S. would always outpace its communist rival and share the fruits of its leading R&D with its allies.

The national interests—military, economic, and international prestige—sustaining U.S. R&D during this period of the Cold War were evident in the country’s leading role in the most important scientific undertaking of the age, the International Geophysical Year (IGY) of 1957–1958. At the very time that the U.S. and Soviet Union engaged their vast R&D capabilities in a thermonuclear arms race, both signed on to the IGY and encouraged their allies to do so as well. This global network of researchers, national science associations, and international scientific congresses, sufficiently built up since WWII and equipped with new and powerful observational tools, worked together to study the Earth and its oceans, atmosphere, and near space environment. The people who participated in this milestone event, which gave momentum to international scientific collaboration lasting to this day, were plainly motivated by their love of science and desire to work with foreign colleagues. A prominent American scientist evoked this idealism by describing the IGY as an opportunity for
“men of all nations tired of war and dissension” to turn to “mother earth for a common effort on which all find it easy to agree” (Dryden 1965). While many public officials in the U.S. expressed this idealism as well, they also had in mind the national interests listed in the previous section when allocating huge sums for its IGY programs.

Rightly suspicious about the Kremlin, which had prevented Soviet scientists from freely interacting with their foreign counterparts, the New York Times exclaimed that “one of the chief reasons for full Soviet participation in the International Geophysical Year was to increase Soviet prestige in science” (New York Times 1957). This was true of course for the United States as well, which spent mightily on its IGY program to demonstrate its scientific leadership. Public officials also expected that hundreds of millions of dollars in IGY research would pay economic dividends. For instance, IGY meteorologists collected data on atmospheric conditions such as the jet stream that was needed by America’s burgeoning commercial aviation industry. Scientific observations of solar storms during the IGY were essential to the communications and entertainment industries, since those storms periodically disrupted their radio signals and television broadcasts. Because energy companies used magnetic anomalies to locate petroleum deposits, they stood to profit from the IGY as well, in this case from its geomagnetic surveys. National security advisors also heartily approved of U.S. involvement in this international scientific undertaking. As a Navy admiral noted, the IGY “can be expected to yield basic information not only of general technical value but of value to our national defense.” More specifically, a classified intelligence report determined that without the IGY’s “synoptic observation of certain geophysical phenomenon of increasing relevance to the Department of Defense”—namely atmospheric properties that affect ballistic missile trajectories and ocean attributes that influence submarine warfare—that agency would have to make “such observations in its own behalf and at its own expense” (CCGS 1954).

National security, economic development, and prestige were paramount in the most costly and anticipated part of America’s IGY program, its effort to orbit a scientific satellite. Once again, this initiative was officially designed to advance basic geophysical research. The White House emphasized that it presented a “unique opportunity for the advancement of science” and suggested the U.S. satellite “will for the first time in history enable scientists throughout the world to make sustained observations in the regions beyond earth’s atmosphere” (Hagerty 1955). Indeed, the Explorer satellites it eventually sent into space transformed people’s understanding of the near-space environment, discovering belts of energetic charged particles that surround the planet and protect it from constant streams of deadly cosmic energy. However, the military significance of the satellite program was foremost in the minds of government officials. That significance was evident, albeit only to those with the highest security clearance, when secret U.S. atomic tests conducted during (but not part of) the IGY demonstrated that nuclear weapons could energize those belts and thereby destroy future enemy surveillance and communications satellites. The defense establishment had also anticipated that IGY satellites would pave the way for more precise measurements of the shape of the planet and properties of its oceans and atmosphere, data critical for accurate targeting by American bombers, ballistic missiles, and submarine forces. Most importantly, that establishment hoped that since a scientific satellite “constituted no active military offensive threat to any country over which it might pass,” it would successfully “test the principle of Freedom of Space” (Day 2000). In other words, it would set a legal precedent for the United States to orbit other satellites, including military reconnaissance satellites, over secretive adversaries like the Soviet Union.

More than a decade of government planning and analysis by organizations like the RAND Corporation—the first of many nonprofit R&D (thus the name “RAND”) think tanks that emerged during this era—made clear that satellites were not only critical to America’s national security but also to its economy. Conducting the R&D for a satellite program would help the U.S. maintain its economic leadership and ensure that its university researchers and industrial designers stayed ahead in many promising fields of science and engineering. In a 1946 study, RAND also highlighted the
soft power of prestige the country would enjoy if it led the world in developing orbital satellites. The 
“achievement of a satellite craft by the United States,” the RAND report forecast, “would inflame 
the imagination of mankind.” The Central Intelligence Agency (CIA) offered a similar take, albeit 
using the language of Cold War spy craft, asserting that the “psychological warfare value of launching 
the first earth satellite [makes] it a crucial event in sustaining the international prestige of the United
States.” DOD analysts pointed out that the U.S.S.R. could reap these rewards if it beat America into 
space. “Failure to maintain technological superiority by the U.S. could result in loss of confidence 
by the Free World in U.S. technology and power;” they warned, “accelerated Soviet expansion geo-
graphically and economically; swing of important uncommitted nations into the Soviet orbit; [and] 
defection of important countries now members of the Free World” (Day 2000).

As they predicted, the Cold War entered a new phase when the Soviet Union orbited Sputnik 
on 4 October 1957, before the U.S. launched its first satellite, provoking anxiety about America’s 
once unquestioned technical superiority and global leadership. Its scientists and engineers had 
delivered life-enhancing products, agriculture- and industry-boosting technologies, and advanced 
weapons that tilted the global balance of power toward the United States. In those cases in which 
the U.S.S.R. replicated these innovations, Americans discounted Soviet “achievements in science 
and technology as simply the fruits of espionage” (Sullivan 1961). But Sputnik and subsequent 
Soviet pathbreaking achievements in space put that common refrain into question. As 
*Life* magazine exclaimed, it “was becoming all too apparent Russian scientists are as good as any in the 
world, or even better” (*Life* 1957). Although President Eisenhower resisted early calls to dramati-
cally increase spending on military and aerospace R&D, many political officials worried about the 
optics of failing to do so after Sputnik. As a ranking government official explained, because “the 
achievements of a nation in outer space may be construed by other nations as dramatically symbol-
ilizing national capabilities and effectiveness,” the international community might come to believe 
that “the Soviets ride the wave of the future” (Merchant 1960). This danger seemed real as Kremlin 
publicists cast Sputnik as the “embodiment of the genius of the Soviet people and the great might 
of socialism” and the beginning of a “new era in human progress” (Foreign Languages Publishing 
House 1961).

As U.S. State Department officials reported extraordinary excitement about Sputnik around the 
world, Vice President Richard Nixon countered this message by casting that satellite not as a beacon 
of human progress but as a stark example that “a dictator state” can force its scientists and engineers 
to make occasional breakthroughs. In addition, Nixon called on the American people to prove 
once again that “free men in the long-run will out-plan and out-produce a slave economy” (Nixon 
1957). The director of the National Science Foundation specified how they should prove this point. 
“Whether our primary objective as a nation is to deter our enemies, to sustain the Free World’s 
leadership, to extend a helping hand to less favored nations, or merely maintain peace and prosperity 
at home,” he exclaimed, “the first essential is a real determination to achieve better education, better 
science and technology” (Waterman 1959). President Eisenhower broadcast that very determination 
when he announced in November 1957 the appointment of a presidential science advisor and forma-
tion of the President’s Science Advisory Committee (PSAC) to furnish national officials with expert 
counsel on critical scientific issues. One of its key recommendations was to improve American edu-
cation so that the country prepared many more scientists and engineers. Such was the intent of the 
1958 National Defense Education Act (NDEA), which doubled federal education expenditures and 
significantly boosted university scholarships, particularly in the fields of math, science, and engineer-
ing. By expanding student scholarships and grants for research faculty, the NDEA accelerated what 
was already dramatic growth of American colleges and universities.

In the wake of Sputnik, federal expenditures for R&D swelled from $2.7 billion to more than $15 
billion between 1955 and 1965. A good deal of that money flowed through existing agencies like 
the NSF, which broadened its support for basic university research across the natural sciences, and
especially for the National Institutes of Health (NIH), whose funding for medical research increased many fold to more than $1 billion in 1966, a high–water point for federal R&D spending at the time. Washington’s post–Sputnik spigot of funding also covered start-up costs in 1958 for the Department of Defense, whose new Advanced Research Projects Agency (which later invented the basic structure of the internet) spearheaded efforts “to conduct advanced R&D to meet military needs and to ensure against future ‘technological surprise’” akin to Sputnik (Spiller 2015). Washington’s most visible new R&D venture was, of course, the National Aeronautics and Space Administration (NASA). In line with PSAC’s call for a national space program that would “enhance the prestige of the United States among the peoples of the world,” the U.S. Congress charged this civilian agency with making the U.S. “a leader in aeronautical and space science and technology” and dedicating itself “to peaceful purposes for the benefit of all mankind” (NASA 1958).

In the following years NASA devoted enormous annual budgets—which topped out at nearly $6 billion (again in 1966) and helped temporarily lift Cold War funding for civilian R&D above military R&D spending—to erect tracking stations around the world and research facilities, launch sites, and command and control centers across America. NASA partnered with university centers like Caltech’s Jet Propulsion Laboratory. The agency absorbed the NACA and its five research, flight test, and rocket sounding facilities, and it converted the Army’s ballistic missile operation in Alabama into one of several space flight centers (the others in Maryland and Houston, Texas). NASA built R&D complexes in Massachusetts, Louisiana, and Mississippi, and converted a military rocket site at Florida’s Cape Canaveral into the famous launch pads for its orbital, lunar, and planetary missions. This arc of aerospace development hastened the industrialization of America’s South and West, boosted American pride and prestige, and stimulated innumerable fields of scientific research and technological development of economic and military value.

Among NASA’s early and most valuable innovations were telecommunications and weather satellites. The space agency supported R&D in optics, electronics, digital computation, and extreme-temperature materials that enabled NASA to field test such satellites in the early 1960s. Those satellites quickly transformed everyday life—enabling people to better prepare for the weather and communicate instantly across vast distances and otherwise impenetrable borders—and they opened new horizons of economic enterprise and military activity. On the latter point, satellites not only reshaped military communications and operational planning, they provided critical navigational support and photographic intelligence of enemy capabilities by late in the decade. The basic science and applied R&D across dozens of disciplines that coalesced in the satellite revolution made possible the planetary observatories that NASA propelled across the solar system in the ensuing years. It also enabled the U.S. to undertake the highest profile project of the age, sending astronauts into space and to the moon.

Those astronauts had not yet left the ground in early 1961 when a retiring President Eisenhower, who famously alerted Americans to protect their country’s precious finances from a bloated “military–industrial complex,” determined that a crash program to send men to moon would be an impractical waste of taxpayer money. Advisors to newly elected President John Kennedy agreed and warned that such a program “may hinder the development of our scientific and technical program, even future manned space program by diverting manpower, vehicles and funds” (Report to the President-Elect 1961). Nevertheless, in May 1961 Kennedy called on the nation to “commit itself to achieving the goal, before the decade is out, of landing a man on the moon and returning him safely to earth.” In those intervening months, the U.S. had suffered the humiliations of the Soviet Union’s pioneering orbit of a cosmonaut and of the failure of American–backed counterrevolutionaries to storm Cuba’s Bay of Pigs and topple its Soviet-leaning government. Having been counseled that “dramatic achievements in space” like lunar landings were possible and would counteract those humiliations and “symbolize the technological power and organizing capacity of the nation,” Kennedy stated the obvious about his lunar goal: “No single space project . . . will be more impressive
James A. Spiller

Even as the U.S. devoted its unmatched R&D capabilities on human spaceflight during this peak period of Cold War spending, that program continued to have detractors who shared Eisenhower’s concern that it was an impractical drain on the public purse. But national leaders largely supported NASA as it spent tens of billions of tax dollars on this epochal undertaking, which pump-primed an already red-hot economy, employed more than 400,000 Americans, and financed R&D across the sciences and throughout the country. America’s Apollo lunar program excited people around the world, millions of whom flocked to world’s fairs and expositions around the world to see the genius of American science and technology in displays of NASA rockets and spaceships. Hundreds of millions more watched live broadcasts of Apollo missions as they soared into space and landed astronauts on the moon. As the United States pulled off this incredible undertaking with dizzying speed, it seemed possible that American scientists and engineers would soon bring about other world-transforming achievements. Assuming the U.S. would continue to support R&D as it had since the beginning of the Cold War, and especially at the heightened levels since Sputnik, the editors of *Time* magazine gave voice to the optimism of the moment and declared in early 1967 that Americans would soon “cure cancer and the common cold, lay out blight-proof, smog-free cities, enrich the underdeveloped world, and, no doubt, write finis to poverty and war” (*Time* 1967).

**Shifting Priorities and Allocations for Science in the Late Cold War**

Now more than a half century later, it is clear that *Time* was wildly mistaken; cancer and the common cold persist (as do crippling pandemics), urban centers still have crime and pollution, and humankind continues to struggle with poverty and inequality. The magazine erred in wildly extrapolating fantastic advances in U.S. science and engineering during the Cold War, and it failed to account for the mounting problems they caused. For example, it turned out to be much harder to safely harness the atom for civilian purposes than expected, and Americans learned that radioactive fallout from Cold War nuclear weapons tests imperiled the natural world. By the end of the 1960s, they also recognized the environmental risks of indiscriminate use of industrial chemicals like pesticides, and many demanded that their country and others contain these risks by tempering Cold War competition and regulating industrial activity. Similarly, although stunning breakthroughs in aerospace science and technology positively affected every corner of American life, commonplace predictions of industrial production in space and the use of satellites to control the weather and eliminate enemy threats failed to unfold. This became apparent at the same time that a substantial majority of Americans questioned spending billions in space when they faced a host of prosaic problems on Earth—racial discrimination and urban decay, pollution and energy scarcity, economic competition, and unsustainable Cold War military buildup.

America’s unrivaled economic strength provided the resources for its expansive R&D, and its engagement in a worldwide competition with the Soviet Union justified massive investments in science and technological innovation. That justification nearly collapsed in the late 1960s as the United States economy weakened and its costly military preponderance faltered. As the U.S.S.R. achieved parity with U.S. nuclear weapons stockpiles, many Americans decided they could no longer afford to maintain nuclear superiority, which incidentally had not prevented taxing skirmishes around the world or full-blown military action in Vietnam. Thus, President Richard Nixon pursued détente and arms control agreements with the Soviet Union. In addition, his astonishing outreach to China in the early 1970s signaled a more pragmatic and affordable Cold War posture. That posture was evident in Nixon’s approach to the Vietnam War. He effectively conceded that America’s overwhelming advantages in science, technology, and military power did not apply to this unconventional battle against unyielding guerrilla forces. The president began extricating an exhausted nation from this
unsustainable commitment in 1969 by conducting military operations from the air while transferring the deadly ground war back to the South Vietnamese Army. This so-called “Vietnamization” of the war was part of the broader Nixon Doctrine, which minimized U.S. military deployments and boosted the sale of weapons that allies needed to carry on their own fights.

Those weapons sales were designed not only to fortify U.S. allies but also to bolster its flagging economy. After two decades of strong economic performance and success building an expanding international trading community, the United States faced mounting economic competition and imports from the very countries it helped reconstruct in Europe and Asia. The sale of weapons helped offset a growing trade deficit tied to rising imports as well as lost exports due to a growing trend among U.S. corporations to offshore factory production. Owing to a trade imbalance that coincided with enormous spending on the Vietnam War and expanded social welfare services, the U.S. economy faltered in the late 1960s, triggering economic uncertainty for the next decade. Exacerbated further by political events in the Middle East that sent energy prices soaring, Americans became understandably gloomy about the nation’s economy and ability to finance transformative R&D, and many questioned whether U.S. science could even solve its many challenges. Vice President Nelson Rockefeller praised science in 1975 as key to solving America’s “unprecedented challenges—in energy, in health, in food production, and in the enhancement of our environment.” But he conceded that public faith in the power of American science and technology to do so “seems to some out-of-date, old fashioned, or just plain wrong” (Rockefeller 1975). Another public official offered a starker warning of “a climate of irrational hostility that seems to be growing in this country . . . regarding science and technology” (Von Braun 1971).

While this warning was overwrought, political winds fueled by economic exigency resulted in a significant drop in federal support for science (the intensity of Cold War federal R&D spending hit its lowest point in 1978) as well as a shift of government funding toward applied R&D throughout the 1970s (Smith 1990). The NSF, for instance, which came into being in 1950 following Vannevar Bush’s call for the U.S. to support basic science, followed a new congressional charge to also sponsor applied research through novel initiatives such as its Research Applied to National Needs Programs. This drop in federal funding and shift toward practical R&D led a prominent scientist to warn that the “scientific revolution of the 1950s and 1960s has given way to a counter-revolution which deems pure science irrelevant if not inimical to the real concerns of society” (Lewis 1973). A political consultant agreed and advised NSF officials that because Bush’s Science—The Endless Frontier was “being parodied in Congress as ‘Science: The Endless Expenditure,’” research institutions needed to “look for and cultivate major support from the public at large in order to achieve a public base of support” (Redecke 1976, April 5). The NSF did so by promoting the societal benefits of the basic research it supported at universities across the country. In addition to regional economic and academic workforce development stemming from NSF spending, the agency promoted its grant-funded research as the basis for future innovations in medicine, energy and natural resource development, agriculture, and environmental sustainability.

This utilitarian ethos and federal R&D cost cutting was especially evident in the emerging road map for the U.S. space program. Even as astronauts prepared to land on the moon at the end of the 1960s, a secret State Department report found “no compelling reasons” to follow the Apollo lunar program with a continuing and costly space race with the Soviet Union (U.S. State Department 1966). This aligned several years later with President Nixon’s attempt to achieve détente with America’s Cold War adversaries and shift its more limited resources from military- and space-related R&D to science that promised immediate benefits for the country. Thus in a 1970 address on U.S. space policy, Nixon highlighted the “many critical problems here on this planet that make high priority demands on our attention and our resources,” and he called on NASA to focus on “practical application—turning the lessons we learn in space to the early benefit of life on earth” (Nixon 1970). Although his administration even considered redefining the agency’s R&D mission to focus
on prosaic national concerns about pollution, poverty, and urban blight, NASA retained its aerospace orientation albeit with practical-minded budgets that bottomed out at 40% below its mid-1960s peak.

The agency’s director acknowledged that “with the lunar landing achieved, with America’s concerns turning increasingly inward, and with competing budgetary demands by rapidly growing social programs, the current congressional mood was for diversified and practical space goals pursued at a moderate and economical pace” (Paine 1970). Since industrial productivity and innovation were then championed as keys to economic revival, these goals led NASA to step up its transfer of pathbreaking technologies to private industry. As part of a wider government effort to foster the commercialization of civilian technology, NASA freely licensed its patents to industry,
shared research and innovative production and quality control processes, and advertised the myriad ways its taxpayer-funded R&D fostered economic development and life-enhancing science and technology. With world attention then focused on environmental pollution and natural resource scarcity, NASA expanded its R&D in these fields and developed satellites that could “illuminate the obstacles to restoring productive harmony between man and nature.” Its brochure Improving Our Environment summarized NASA’s effort to help “manage the quality of our environment” by designing spacecraft “to observe and measure pollution locally, regionally, and globally” (NASA 1973). Those spacecraft included a fleet of Earth Resources Technology Satellites that tracked pollution and surveyed natural resources. They also included the Skylab space station and even planetary probes, whose findings about Venus and Mars, NASA suggested, would enable the U.S. to better understand Earth and sustainably develop its natural resources. Attuned to American anxiety about spiking energy prices, agency officials further asserted that NASA R&D would lead to “economically attractive, renewable, and environmentally acceptable sources of fuel . . . as well as more efficient uses of [existing] fossil fuels” (NASA 1974).

NASA’s growing emphasis on the practical benefits of its science, and especially its work on the environment and energy, reflected a wider trend among federal R&D agencies. Established agencies like the NSF enhanced support for environmental research, sponsoring scientists who studied a fast-changing natural world across the United States and in such far-flung places as Antarctica and Greenland. New federal agencies like the Environmental Protection Agency and the National Oceanic and Atmospheric Administration added to that research and supported growing programs that continue to monitor the environmental health in the U.S. and conditions of the atmosphere and oceans. As energy diversification and security became heightened national priorities, the Atomic Energy Commission was divided into a nuclear energy regulatory body and a new Department of Energy, which coordinated the government’s growing network of federal, university, and industry partners pursuing energy-related R&D. The DOE became a major sponsor of research on alternatives to fossil fuel power production as well as energy conservation.

Even as federal expenditures for R&D declined during much of the 1970s, its investment in medical and health sciences increased, particularly through the National Institutes of Health (NIH). The NIH budget grew substantially over the decade as the federal government launched a “moon shot” war against cancer and an array of new initiatives targeting heart disease, diabetes, and other chronic ailments (Kaster 2010). These diverse efforts, which grew to match federal investments in energy research by 1980 (and surpass them thereafter) appealed to an aging and relatively well-to-do population, and they promised to provide the basic scientific knowledge that America’s pharmaceutical industry needed to produce effective and profitable drugs. Thus, these growing public investments in medical science not only shaped the expanding complex of university-based research hospitals, they also fueled growth of America’s pharmaceutical industry, which played an increasingly important role in the domestic economy and in boosting exports to other countries. However, drug companies were not simply free riders on public investment in science. They also increased their stake in applied research and technology development. In this regard, drug companies were similar to many other U.S. corporate firms—especially in dynamic service sectors of telecommunications, computing, and software—which increased spending on in-house applied research and technology development (Lamoreaux 2007). Until this point, Cold War federal allocations for R&D (particularly for military and space applications) had exceeded nongovernmental spending. Ever since the mid-1970s, however, private backing has surpassed federal investment in scientific research.

This private spending reflected corporate strategy to stay profitable amidst mounting international competition through research-generated innovation. It also stemmed from federal measures in the 1980s designed to enhance U.S. economic competitiveness by incentivizing industrial R&D through tax breaks for research and depreciation allowance for costly apparatus. Government incentives
touched the constellation of American research universities as well. The Bayh-Dole Act of 1980, for instance, enabled them to retain patent rights for innovations resulting from government-supported research, and it triggered an expansion of university research and patent offices. These offices sought and managed grants not only from government for basic science but also from industry for applied research, and they licensed their research-generated technologies to create new streams of money for their universities. These substantial revenue streams widened the gulf in higher education between teaching-oriented colleges and a select strata of research-intensive universities, whose academic portfolios reflected changing priorities of Cold War America. Whereas departments of physics, electrical and aerospace engineering, and material sciences thrived in the early Cold War, this decade witnessed the dramatic expansion of medical-related disciplines and departments of chemistry and biochemistry, and software and computer engineering.

During the 1980s, the latter two disciplines benefitted not only from industrial sponsorship and patent-generated revenues but also the U.S. military buildup associated with escalating Cold War tensions. Those tensions revived in 1979 when the Soviet Union invaded Afghanistan, and they continued in the ensuing decades as President Ronald Reagan spent heavily on the military, nearly tripling federal outlays for defense R&D by the end of his second term in office. Federal allocations flowed to software and computer science and engineering, along with traditional fields of Cold War R&D, as the U.S. pursued a high-tech military buildup that included radar-resistant stealth planes, enhanced intercontinental ballistic missile and nuclear weapon systems, and a so-called Strategic Defense Initiative (SDI). Critics of SDI argued that this exorbitant space-based missile defense system was a technical impossibility that would further imperil the world by inciting the Soviet Union—and then the United States in kind—to build even larger stockpiles of nuclear weapons. Although SDI never came to fruition and it contributed to unsustainable federal budget deficits of that era, boosters suggested it laid the foundation for future ground-based U.S. missile defense and that it hastened the end of the Cold War (Fitzgerald 2000). Whether or not the SDI and U.S. military buildup did so, they occurred at an unexpected, epoch-defining moment, when the Soviet Union teetered at the end of the 1980s and dissolved in December 1991. After nearly 45 years of geopolitical contest between the United States and the Soviet Union, a conflict that dramatically boosted American investment in research and profoundly shaped the way science was conceived and conducted in the country, the Cold War suddenly came to an end.

Although the Cold War ended suddenly and surprisingly more than three decades ago, the imprint of American science from that era is enduring. Its strategic importance never abated, and it fueled the growth of a still-evolving complex of R&D facilities in government laboratories, industrial corporations, and university centers across the country. That strategic importance triggered a continuing national focus on educational achievement (particularly in the STEM fields of science, technology, engineering, and math) and on scientific expertise in government and industry, as well as investment in research and innovation to bolster national security, economic competitiveness, and U.S. influence and prestige on the world stage. As Vannevar Bush predicted in his influential report *Science—The Endless Frontier* (1945), American science during the Cold War gave rise to fearsome weapons that remain part of the U.S. arsenal (and imperil the world), as well as innovations that shape the world of today, such as the internet, global positioning system, and artificial intelligence; medical advances that made genetic engineering of mRNA vaccines possible during the COVID-19 pandemic; and environmental data and modeling that revealed mounting planetary challenges like climate change. Fueled by the Cold War, U.S. science was shaped by narrow national interests, but it also engendered American internationalism and support for the global scientific collaboration on display during the International Geophysical Year. In this last instance, American science during the Cold War has left one of its finest legacies, the scientific internationalism that President Eisenhower hoped would enable “peoples of all nations to work together harmoniously for the common good.”
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