Strengthening American Scientific Manpower: The National Science Foundation's Postwar Science Education Programs and the Limitations of Federal Desegregation Policy

Emily K. Gibson

The October 4, 1957, Soviet launch of *Sputnik I* spurred interest in space and cast in stark relief the perceived weakness of American national defense and prestige. The "red baby moon" also reignited a conversation about the state of the nation's scientific manpower. Mounting Cold War tensions effectively linked scientific education and training to the national defense effort as scientists and policy makers alike championed the need to improve America's scientific and technical workforce in the face of Soviet advancements. Though education was historically the concern of state and local governments, in the post–World War II geopolitical milieu it increasingly became a federal concern. It was within this context that in 1950 Congress gave the National Science Foundation (NSF) a broad mandate to strengthen and support American science education, specifically, "to develop and encourage the pursuit of a national policy for the promotion of basic research and education in the sciences."[1] The agency's early efforts to improve the quality of science education at the secondary and post-secondary levels played a key role

NSF's summer institute programs worked to raise the standard of high school teaching. Gaining crucial laboratory experience, these teachers interacted with biology models during a summer training course.

Emily K. Gibson is a historian and science policy analyst at the National Science Foundation in Washington, DC. She is currently writing a book on the agency's history.

[1] Public Law 507, U.S.C. S 247 (1950), *https://www.nsf.gov/about/history/legislation.pdf*. President Harry Truman signed the National Science Foundation Act on May 10, 1950, establishing NSF as an independent federal agency devoted to funding basic research across all non-medical fields of science and engineering.

in the development of the 1958 National Defense Education Act (NDEA), which represented the first example of comprehensive federal education legislation. The act formed the cornerstone of a federal strategy that continues today, focused on strengthening the American scientific and technological workforce through education and training.

In a 2018 Policy Companion Statement to the *Science and Engineering Indicators* report, the National Science Board outlined a clear call to action: "Our nation's future competitiveness relies on building a STEM-capable U.S. workforce," with "STEM" standing for science, technology, engineering, and mathematics.[2] Though the document cited the growing threat posed by China, rather than the Soviet Union, the message contained echoes of an earlier time. The persistence of efforts on behalf of the National Science Foundation and its governing body, the National Science Board, to create a "STEM-capable workforce" in the name of global economic competition invites a careful reconsideration of the historical roots of such endeavors.[3]

This article examines the early successes and limitations of NSFs support for STEM education and training amid efforts to strengthen American scientific manpower in the wake of *Sputnik.* It traces how NSF's science education efforts foregrounded key aspects of the 1958 National Defense Education Act, shedding light on operational patterns and bureaucratic responsibilities that still distinguish NSF and the Department of Education's support for STEM education and training today.[4]

Though Cold War-era efforts focused on improving the *quality* of science education, they fell short of adequately broadening *access* to STEM education in America. An examination of one of the agency's efforts to improve American STEM education—its teacher training institutes program—reveals how the postwar political context,

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[2] The acronym "STEM" is short for Science, Technology, Engineering, and Mathematics. I use STEM throughout the article when discussing policies from the 1950s and ''60s although the term did not exist at that time. The acronym did not come into widespread use until the late 1990s/early 2000s. It is not entirely clear who first coined the term, but several accounts credit NSF for its creation and popularization.

[3] "Our Nation's Future Competitiveness Relies on Building a STEM-Capable U.S. Workforce," A Policy Companion Statement to the National Science Board's *Science and Engineering Indicators 2018*, National Science Board, NSB-2018-7, *https://www.nsf.gov/nsb/sei/companion-brief/NSB-2018-7.pdf*.

[4] "Common Guidelines for Education and Research and Development," A Report from the Institute of Education Sciences, U.S. Department of Education, and the National Science Foundation (August 2013), *https://www.nsf.gov/pubs/2013/nsf13126/nsf13126.pdf*.

fraught with racial inequality, placed limitations on foundation efforts to extend education programming in the South. NSF's early decision to fund only those teacher training institutes at southern universities that were racially integrated met with resistance from southern universities and state governments as well as the Dwight D. Eisenhower administration. When the administration failed to fully develop and enforce federal integration policies in the South, NSF officials tempered their stance.

Scholars and policy makers typically consider education reforms, epitomized by the NDEA and NSF programs, alongside other postwar social and economic policies aimed at giving rise to a new American middle class. This examination of Cold War STEM education, however, adds a new dimension of analysis to studies that highlight the racial inequality and deep-rooted structural barriers that such federal programs often perpetuated. Without guaranteeing equal access to educational programs and services, the impact of NSF's teacher training institutes program remained limited until the early 1960s when the national political landscape shifted. NSF's struggle to make programmatic decisions on the fair and effective implementation of education initiatives in the postwar political context illustrates the challenges many federal institutions faced in an era of profound social change. In the end, the racial policies of the Eisenhower administration, while somewhat progressive, still limited access for African Americans to educational reforms, compromising the overall effectiveness of early STEM education and training efforts and impeding the nation's technological and scientific readiness.

Science Education Becomes a Central Concern

Prior to the 1958 National Defense Education Act, the federal government made limited incursions into the realm of education policy and funding for science education. Though leaders had recognized the importance of science to American prosperity since the Constitutional Convention, entrenched traditions of state autonomy ensured that federal funds did not flow liberally toward strengthening science education. Until World War II, the federal government's interest in supporting agricultural and vocational training remained a notable exception to the general idea that the federal government should not fund education. The Morrill Land Grant Acts of 1862 and 1890 facilitated the gifting of federal lands to states to finance universities that provided instruction in the agricultural and mechanical arts. Later acts provided funds for vocational and agricultural training in high schools.[5] The American tradition of local control over education persisted,

[5] On the Morrill Land Grant Acts and their impact on scientific research, see Hunter Dupree, *Science in the Federal Government: A History of Policies and Activities to 1940,* revised edition (New York: Harper & Row, 1986), 169–70.

however, forcing primary and secondary education to rely on local property taxes for funding.[6]

Advocates of federal support for education pointed to the ever-widening gap in quality that existed between relatively wealthy and disadvantaged states or communities. By the 1950s, even the most ardent supporters of local education control could not deny the growing pressure placed on resources by the baby boom generation, which was quickly entering the public school system. The need to secure funds to build additional classrooms and hire new teachers became a major concern.[7] Legislation seeking federal funds for school construction nonetheless faced regular defeats in Congress throughout the mid-1950s.[8] An era of fiscal conservatism and trenchant disagreements over providing federal aid to parochial and racially segregated schools combined to uphold the status quo for education funding until the late 1950s, when dramatic events intervened. The growing Cold War geopolitical struggle drastically shifted the terms of the debate. As scientific expertise and innovation became closely tied to national security, the concern over improving American science education began to chip away at the long-held resistance to federal intervention in education.

Improving science education and training in America became a key focus for solving perceived manpower shortages as well as strengthening the nation's scientific enterprise more generally. Pointing to the importance of federal support for scientific research during World War II, Vannevar Bush, director of the Office of Scientific Research and Development, wrote to President Franklin D. Roosevelt near the end of the war to propose a plan for a new postwar federal science organization.[9] Chief among Bush's concerns was the need to produce a scientific and technological workforce capable of maintaining American scientific preeminence. Writing in

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[6] Additionally, federal funds funneled through WPA projects and the GI bill funded school construction and the education of returning WWII veterans, respectively. Barbara Barksdale Clowse, *Brainpower for the Cold War: The Sputnik Crisis and National Defense Education Act of 1958* (Westport, CT: Greenwood Press, 1981), 41.

[7] Roger Geiger, *Research and Relevant Knowledge* (New York: Oxford University Press, 1993), 164.

[8] Clowse, *Brainpower for the Cold War,* 43.

[9] During World War II, Bush had led the creation of the Office of Scientific Research and Development (OSRD) and served as its director. OSRD had represented a major shift in federal funding and management of scientific research during the war and facilitated the development of many advances, such as the development of atomic weaponry that had secured an allied victory. For more on the history of OSRD, see Larry Owens, "The Counterproductive Management of Science in the Second World War: Vannevar Bush and the Office of Scientific Research and Development," *The Business History Review* 68 (Winter 1994): 522; and Irvin Stewart, *Organizing Scientific Research for War* (Boston: Little, Brown, 1948).

1945, Bush warned in *Science—the Endless Frontier,* the title of his report to FDR, that America would emerge from World War II with a grave shortage of scientists. "With mounting demands for scientists both for teaching and for research," Bush explained, "we will enter the post-war period with a serious deficit in our trained scientific personnel."[10] Bush recognized the importance of STEM education and argued that the federal government had an important responsibility to broaden access to science education and to improve its quality.[11]

Though the National Science Foundation, created in 1950, differed in significant ways from the type of organization Bush called for in his report, it did take up support for science education as a central concern. Congress not only tasked NSF with supporting basic science research, but also with promoting a national policy for science education and awarding "scholarships and graduate fellowships in the mathematical, physical, medical, biological, engineering, and other sciences."[12] Highlighting the increasing demands placed on the American education system, Alan Waterman, the agency's first director, explained that the foundation's education activities focused on a primary objective: "to insure an adequate supply of competent scientists and engineers by maintaining a high level of excellence in science education in the face of expanding enrollments [and] rapid changes in science itself."[13] Foundation support for the improvement of science education ranged from supporting advanced graduate training in STEM fields and improving science curriculum, to providing instructional training to high school and college STEM teachers, as well as strengthening the general public's understanding of science.[14]

Recognizing the urgent need to produce greater numbers of trained scientists capable of advancing the frontier of scientific knowledge, in 1952 NSF inaugurated the Graduate Research Fellowship Program (GRFP). The GRFP budget for predoctoral and postdoctoral fellowships totaled $1.4 million during the program's first year, comprising almost half of the foundation's 1952 appropriations.[15] NSF's diverse

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[10] Vannevar Bush, *Science—The Endless Frontier*, NSF 40th Anniversary Edition (Washington, DC: National Science Foundation, 1990). See especially ch. 4, "Renewal of our Scientific Talent."

[11] Ibid., 26. Many scientists echoed Bush's concerns over the state of American scientific manpower in the popular press. See, Karl T. Compton, "Engineers," *Scientific American* 185 (September 1951): 65–70; and, Arthur S. Flemming, "Mobilization," *Scientific American* 185 (September 1951): 89–100.

[12] Public Law 507, U.S.C. S 247 (1950), *https://www.nsf.gov/about/history/legislation.pdf*.

[13] Alan Waterman, "National Science Foundation: A Ten-Year Résumé," *Science* 131, no. 3410 (May 6, 1960): 1347.

[14] Ibid.

[15] During the first year of the GRFP, the agency awarded 624 fellowships—569 predoctoral and 55 postdoctoral. Milton Lomask, *A Minor Miracle: An Informal History of the National Science Foundation* (Washington, DC: National Science Foundation, 1976), 88.

Alan T. Waterman, physicist and science administrator, served as NSF's longest-serving director. His leadership guided the agency through key policy decisions during its first 12 years.

fellowship offerings represented an important federal investment in graduate science education and a supplement to the fellowships already being offered by the National Academy of Sciences, private foundations such as the Rockefeller Foundation, as well as other federal agencies like the Atomic Energy Commission (AEC) and the National Institutes of Health (NIH).[16] In contrast to existing programs, NSF supported graduate fellowships across all fields of science and engineering.

While fellowships encouraged students to pursue advanced training and represented a politically noncontroversial mechanism by which to address national scientific manpower concerns, a growing number of scientists and educators argued that an earlier intervention in the education process was necessary to address widespread deficiencies.[17] Initially hesitant to venture into the comparatively more contentious

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[16] Predating NSF's fellowship program, the AEC and NIH also sponsored graduate and post-graduate fellowships (mostly postdoctoral) to support research and education in the scientific fields related to their respective missions. In 1948, the AEC began graduate fellowships for study in the biomedical sciences and for technical training in health physics and industrial safety. The AEC also issued a smaller number of fellowships for postdoctoral research using atomic energy in the basic biomedical sciences, clinical medicine, and surgery. A fellowship program in the physical sciences quickly followed, both to be administered by the National Research Council. For more on AEC fellowships, see Richard G. Hewlett, *History of the United States Atomic Energy Commission: Atomic Shield, 1947–1952* (University Park: Pennsylvania State University Press, 1970), 253.

[17] Bush argued for improved high school science instruction in *Science—the Endless Frontier* and joined Edward Teller in urging the importance of better secondary STEM education when testifying during Johnson's Satellite and Missile Hearings. See, "Inquiry into satellite and missile programs," Hearings before the Preparedness Investigating Subcommittee of the Committee on Armed Services, United States Senate of the 88th Congress (Washington, DC: Government Printing Office [GPO], 1958), 24.

realm of pre-college education, NSF officials recognized the need to assist the generation of postwar science, math, and engineering teachers whose training had been outdated by the rapid technological and scientific advancements that emerged from the war.[18] One NSF-supported study from the period found that course-content knowledge was dated—nearly one-half of math courses taken by math teachers were taken prior to World War II. The study also revealed that the average public high school math teacher held less than a college major in the subject area in which he or she taught.[19]

Beginning as an experiment in 1954, scientists and mathematicians joined with NSF staff members to organize training programs for high school and college STEM teachers at university campuses across the country.[20] These "Institutes Programs" sought to improve science education by updating teachers' subject knowledge to include the latest scientific advancements, upgrading teachers' basic training in their subject areas, reorienting teachers' approach to science instruction to include new course-content improvement programs funded by NSF, and advancing teacher training through teacher certification and programs leading to advanced degrees.[21] To address outdated training, institutes offered courses designed to incorporate the advances made in atomic energy research during World War II, including modern physics, radiation biology, and radiation biochemistry. To bring teachers who had received minimal training up to speed in their respective subjects, institutes also provided an array of general courses ranging from "basic mathematics for general science" to "weather and climate."[22] Training programs included hands-on experience for teachers, introducing them to laboratory experiments that could be replicated in their own classrooms.

The most popular of NSF's institutes programs took place in the summer, over the course of 4–12 weeks, and offered financial assistance to teachers in order to cover the cost of attendance, health fees, and living expenses while enrolled in the institute. NSF also granted teacher-participants an allowance for dependents during the institute—making it possible for teachers with children to enroll.

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[18] Krieghbaum and Rawson, An Investment in Knowledge (New York: NYU Press, 1969), 4.

[19] "Inquiry into satellite and missile programs," Hearings before the Preparedness Investigating Subcommittee of the Committee on Armed Services, United States Senate of the 88th Congress, Pt. 2 (Washington, DC: GPO, 1958), 2199.

[20] Teacher training institutes for high school science teachers had previously been organized by industry, universities, and private foundations. Merton England, *A Patron for Pure Science: The National Science Foundation's Formative Years, 1945–57* (Washington, DC: The National Science Foundation, 1982), 240.

[21] Krieghbaum and Rawson, *An Investment in Knowledge,* 8–9.

[22] Ibid., 7.

Representative Albert Thomas, chair of the House Appropriations Subcommittee for Independent Offices, reversed his resistance to NSF's education programming after learning about the growing threat posed by the Soviet Union's science education program.

The "Scientific Manpower" Crisis and the Growing Soviet Threat

As NSF began to wade into the realm of federal involvement in secondary education, the agency elicited criticism from Congress. Representative Albert Thomas from Texas became a particularly vocal critic of NSF's education programming. Thomas served as committee chair of the House Appropriations Subcommittee for Independent Offices, which, along with the Senate, fixed the agency's annual budget. During a 1955 budget hearing, Thomas responded harshly to NSF Director Waterman's description of the national scientific manpower crisis as well as the agency's plan to address shortages with support for science education. Thomas warned that NSF's education efforts would elicit charges of a federal "take over" of the "education and training of college students and scientists."[23] Despite Waterman's insistence that NSF had no interest in "mastermind[ing] the educational pattern from Washington," the House subcommittee recommended a large cut to the agency's budget for the year.

By 1956, however, world events had lent greater urgency and weight to the importance of NSF's education programming. The successful Soviet detonation of its first megaton-range hydrogen bomb, coupled with the publication of an NSF-sponsored exposé of the Russian education system titled *Soviet Professional Manpower: Its Education, Training, and Supply*, set the stage for a very different atmosphere during the agency's 1956 House budget hearing. Though only a year had passed, Thomas had completely changed his tune, reversing his criticisms and calling for NSF to invest *more* in improving high school science education.

What accounted for this rapid change of heart? Holding up a copy of the book before the House Appropriations Committee, Thomas confessed, "This little

[23] Quoted in John L. Rudolph, *Scientists in the Classroom: The Cold War Reconstruction of American Science Education* (New York: Palgrave, 2002), 71.

book, *Soviet Professional Manpower*, I read word for word . . . and after reading it I completely reversed my thinking." Written by Nicholas DeWitt and published in 1955 by the National Science Foundation and the National Research Council, *Soviet Professional Manpower* put extensively researched data behind growing fears that the Soviet Union's development of scientific manpower outpaced that of the United States. Concluding his report, DeWitt explained that over the past two decades the Soviet Union had made great strides in manpower development. "As a result of its efforts," he explained, "[the Soviet Union] has reached a position of close equivalence or even slight numerical supremacy over the US" in terms of the number of trained specialists and professionals in science and engineering fields.[24]

While just a year prior Thomas had viewed warnings about Soviet scientific competition as overstretched and alarmist, DeWitt's book convinced him that Soviet manpower gains, especially their emphasis on secondary science education, presented "the most alarming situation" that he could imagine.[25] Rather than blocking NSF's science education programming, Thomas explained, "I think I speak for the committee that if we are going to be with the Foundation when the Foundation starts out on some new programs, we are going to encourage and help you."[26]

With cries of falling behind the Soviets reaching a fever pitch by the late 1950s, Congress saw in NSF a prime opportunity to invest federal dollars in science education while largely sidestepping the specter of federal control. As Waterman had argued during budget hearings before the House, NSF teacher training institutes relied on local science professors and NSF program officers and scientists to plan and staff the institutes, not federal bureaucrats. The changing perception of NSF's education efforts in Congress paved the way for the program's expansion—the number of institutes doubled between 1955 and 1956, from 11 to 27.[27] In a major show of support, Congress increased NSF funds for science education (not including fellowships) nearly eightfold for fiscal year (FY) 1957, the year after Thomas's dramatic conversion.[28]

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[24] Nicholas DeWitt, *Soviet Professional Manpower: Its Education, Training, and Supply* (Washington, DC: National Academies Press, 1955), 257.

[25] Quoted in Rudolph, *Scientists in the Classroom,* 75.

[26] Ibid.

[27] England, *A Patron for Pure Science,* 241.

[28] From $1,434,275 in 1956 to $10,947,711 in 1957, budget numbers reported in NSF Annual Reports from 1956 to 1957. So eager was Congress to boost NSF teacher training efforts, that NSF found itself in the unexpected, yet familiarly cautious role, of cautioning against further budget increases. The agency feared that Congress's newly acquired zeal for high school science education might cause basic research budgets to languish or even constrict. The "red baby moon" that was soon to be eerily beeping across the sky, however, would somewhat allay those fears as budgets for basic research also received a substantial bump.

The October 4, 1957, Soviet launch of *Sputnik I* solidified the growing conviction within Congress that education—science education, in particular—was a national tool that must be utilized in the ever-intensifying geopolitical struggle with the Soviet Union. Just as studies of a robust Soviet education system alarmed American politicians, *Sputnik* served as a potent symbol of the potential costs of American underinvestment in science education. The advice of the nation's leading scientists and the steady stream of reports on American education combined to cast a national spotlight on the state of American STEM education, highlighting the need for a strong policy response from the White House.

To help craft that response, the White House turned to NSF, which by the time of the *Sputnik* launch could boast a well-established record in science education improvement efforts. Just a few months after the launch, the White House issued a press release announcing substantial increases for NSF education budgets. After highlighting ongoing agency activities directed at improving science education, the statement revealed President Dwight D. Eisenhower's intention to request that Congress join him in supporting NSF's education improvement efforts. With total agency appropriations equaling $49,750,000 for 1958, the president requested a total of $79 million for education activities alone in 1959.[29] Once Congress weighed in on the FY 1959 budget, NSF ended up with a total budget of $132,940,000, nearly triple the total 1958 budget. As evidence of the tremendous boost, NSF's education programming received a total of $62,070,000—almost $11 million more than NSF's *total* appropriations from the previous year.[30]

NSF, the Office of Education, and the NDEA

In addition to serving as a boost for NSF's education and research budgets, *Sputnik* also served as the impetus behind the first and most broad-ranging U.S. federal education legislation, the 1958 National Defense Education Act (NDEA). The act transferred $1 billion to the U.S. Department of Health, Education, and Welfare (HEW) over four years for the administration of a need-based loan and college fellowship program. It also provided support for the expansion of school science labs, the expansion of foreign language instruction, and the creation of state programs to improve science and mathematics education.[31]

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[29] "For Immediate Release December 30, 1957," Press Secretary Haggerty, Folder: "Office of Education," Box 25, Waterman's subject files, Records of the National Science Foundation, Record Group (RG) 307, National Archives at College Park, MD (hereinafter NACP).

[30] Waterman, "National Science Foundation," 1344.

[31] Randolph, *Scientists in the Classroom,* 108.

With NSF receiving increasing funds for the support of science education in the wake of *Sputnik*, where did that leave the U.S. Office of Education? Created in 1867 and organized under the cabinet-level HEW in 1953, the Office of Education (OE) had, up to that point, focused largely on collecting statistical data relating to American schools and administering various programs such as the Morrill Land Grant Acts. Operating with relatively circumscribed power, OE relied heavily on state education offices, which were entrusted with greater authority as far as local education matters were concerned. The 1958 passage of the NDEA, however, effected a massive expansion for the office. As the office grew, questions began to surface over the proper place of STEM education support within the federal government, raising new jurisdictional challenges between NSF and OE.

The path to the NDEA's passage began on November 6, 1957, three days after the Soviet launch of *Sputnik II*, when Eisenhower met with HEW Secretary Marion Folsom, U.S. Commissioner of Education Lawrence Derthick, and OE Director Elliot Richardson to discuss plans for education reform. Although HEW and the Office of Education had been focusing efforts on drumming up support for school construction projects, which received little traction in Congress, Eisenhower reiterated the concerns of his science advisors over the paltry state of American science and math education. Eisenhower advised HEW to sideline controversial school construction bills and "get something new and in the present public mood" on the table.[32] Strongly opposed to the idea of an extensive program for education, Eisenhower urged education officials to steer aid efforts in the more narrowly defined direction of science education.

With the White House and the scientific community's interest in science education getting more public attention, however, OE feared that its broad-based plan for education reform would be derailed. In a November 24, 1957, memo, HEW administrator Rufus Miles expressed his concern over the growing emphasis on science education to OE Director Elliot Richardson. Miles confessed, "I am greatly concerned about the tendencies being exhibited by the National Science Foundation, the Bureau of the Budget and even the White House to treat our crisis in education almost entirely in scientific and weapons terms."[33] Heeding the president's advice, however, in the following month HEW submitted a reconceived education proposal to the White House. The memo, dated December 30, 1957, outlined an "emergency program to help stimulate the State, local, and private

[32] Clowse, *Brainpower for the Cold War,* 43–49, 55.

[33] Quoted in Wayne Urban, *More than Science and Sputnik: The National Defense Education Act of 1958* (Tuscaloosa: University of Alabama Press, 2010), 86.

action" to meet critical security needs.[34] The program contained many of the key features that would eventually comprise the NDEA.

On January 27, 1958, the White House released to Congress the president's plan for strengthening American education. Eisenhower's message explained that his administration had developed the proposed program in consultation with the directors of NSF and OE and that it would expand ongoing NSF activities and establish new programs in OE.[35] A section detailing NSF's activities in science education improvement began with high praise for the agency. "The programs of the National Science Foundation designed to foster science education," the president's message read, "have come to be recognized by the educational and scientific communities as among the most significant contributions currently being made to the improvement of science education in the United States."[36] The message also reiterated the administration's request to Congress for increased NSF appropriations to "enable the Foundation, through its various programs, to assist in laying a firmer base for the education of our future scientists."[37] The remainder of the document outlined the programs to be initiated by the Office of Education through matching grants made to states.

After Eisenhower's proposal to Congress in January, it took seven months of hearings and debates to merge congressional proposals with the administration's vision for reform. The resulting product, the National Defense Education Act, was signed into law on September 2, 1958. Because NSF already possessed a congressional mandate for its science education activities and had received a major boost in funds to support their expansion, the only specific mention of NSF in the legislation pertained to Title IX—which established a new Science Information Service within the agency.[38] The NDEA focused primarily on creating new powers within OE, including the power to award matching grants to states to employ more STEM teachers, purchase laboratory equipment, expand high school career guidance services, and to implement a federal scholarship program. The once puny office emerged from 1958 an equal partner to NSF in the realm of federal agencies.[39]

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[34] "Memorandum for the President" from Secretary Folsom, Folder: "Office of Education," Box 25, Waterman's subject files, RG 307, NACP.

[35] "White House Message, January 27, 1958," Folder: "NSF 1957," Box 27, Alan T. Waterman Papers, Manuscripts Division, Library of Congress, Washington, DC (hereinafter LOC).

[36] Ibid., 2.

[37] Ibid.

[38] Urban, *More than Science and Sputnik,* 4.

[39] Ibid., 98; "White House Message," 2.

With a newly strengthened OE, questions emerged over the proper jurisdiction about STEM education in the federal government. Though individual pieces of correspondence internal to OE and NSF reveal evidence of tension over implementing the NDEA, official correspondence between the two agencies reveals an amicable working relationship. As early as June 1957, Waterman and Derthick, began arranging meetings to discuss the possibility of better cooperation and coordination between the two offices.[40] One 1959 NSF memo concerning NDEA jurisdiction highlighted the general operational differences between OE and NSF. The document explained that the Office of Education's responsibility was general in character, applying equally to all phases of education in the United States. By contrast, NSF's education mandate related specifically to strengthening science education and policy, the administration of graduate fellowships, as well as the operation of an information service to catalogue scientific and technical personnel. Additionally, while the OE tended to work through the state education departments, NSF more commonly worked directly with institutions and individuals.[41]

Title II of the NDEA directed OE to award grants to support a wide variety of improvement measures ranging from hiring additional STEM teachers to increasing their pay and improving existing instructional or laboratory equipment, all contingent on matching state funds.[42] In contrast, NSF's successful teacher training programs and course content development efforts focused primarily on *improving the quality* of scientific content in teacher training and instructional materials. Thus, despite fears that a newly expanded Office of Education might encroach upon NSF's territory, NSF maintained its congressionally mandated, leading role in federal STEM education support. By 1960, NSF had obligated around $175 million in support of education programs and fellowships through its Scientific Personnel and Education Division (SPE).[43] NSF directed around half of the total money spent on education efforts to training secondary school math and science teachers through its teacher institute programs.

NSF Teacher Training Institutes in the Segregated South

Though NSF and NDEA programs combined to improve the infrastructure and quality of science education in America during the postwar period, federal efforts

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[40] Derthick to Waterman, June 26, 1957, Folder: "Office of Education," Box 25, Waterman's subject files, RG 307, NACP.

[41] "General working relationships between the National Science Foundation and the US Office of Education," Howard F. Foncannon, June 22, 1959, in ibid.

[42] Memo from HEW secretary to Waterman, January 2, 1958, p. 8. Folder: "Office of Education," in ibid.

[43] Waterman, "National Science Foundation," 1347.

failed to ensure equal access to improved STEM education evenly throughout the country. Just as African Americans were largely barred from other postwar initiatives aimed at improving the American standard of living, such as federal housing and loan programs organized by the Veteran's Administration and Federal Housing Administration, STEM education improvement efforts also remained largely out of reach for many African Americans who lived, worked, ate, and learned in racially segregated facilities.[44]

The institutes program started off small. Prior to 1955, only a handful of training programs for high school teachers took place in states such as Washington, Wyoming, and Oregon.[45] As heightened tensions with the Soviet Union encouraged Congress to devote increasing funds to the program, NSF sought to broaden the geographical reach of the teacher training institutes. Seeking to fulfill the agency's mission to improve science education throughout the country, agency officials faced a dilemma, however, when encouraging the organization of training institutes in the South. When segregated southern universities began submitting applications for teacher training institutes, the agency was forced to confront the issue of segregation head on. Though agency officials realized that segregated training would yield unequal, inferior, and incomplete results, they also felt a special responsibility to extend training to STEM teachers in the South, as it was widely acknowledged to be a region greatly in need of educational assistance. Ultimately, the agency's policies and the overall effectiveness of postwar STEM education efforts would hinge on the evolution of federal civil rights legislation.

The ensuing Cold War struggle cast a bright spotlight on the issue of American civil rights, and a growing social and political movement in the decades following World War II began to expose the fissures in American national identity. American leaders could no longer remain silent and inactive in the face of massive demonstrations calling for federal enforcement of African American civil rights. Though the 1954 *Brown* v. *Board of Education* decision had found school segregation unconstitutional, the lack of an accompanying enforcement mechanism had allowed desegregation plans to be stalled or ignored, prompting a second Supreme

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[44] Ira Katznelson, *When Affirmative Action Was White: An Untold History of Racial Inequality in Twentieth-Century America* (New York: Liveright Publishing, 2017), 14–17. Katznelson documents the effects of public policies that were crafted during the 1930s–40s and administered in a discriminatory way. As a result, the gap between whites and African Americans grew during the 1950s, with African American median incomes declining, unemployment rates rising, and infant mortality rates growing.

[45] Krieghbaum and Rawson, *An Investment in Knowledge,* 143.

Court decision insisting that such programs proceed with "all deliberate speed"—the vagueness of which effectively allowed for plans to move forward with no deliberate speed. Frustrated by inaction, in early fall 1957, nine African American students sued for the right to attend Little Rock High School to force Arkansas's compliance with the Supreme Court ruling. Rather than complying, Governor Orval Faubus summoned the National Guard on September 4, 1957, to block the students' entry. When Faubus failed to instruct the National Guard to protect the students from the volatile crowd, as he had personally promised Eisenhower, the president called in the 101st Airborne Division and federalized the Arkansas National Guard to ensure safety—at least for the rest of the school year.[46] The moderate Eisenhower reportedly felt dismayed by having been compelled to make such a drastic move.[47]

President Dwight D. Eisenhower addressed the nation on the resistance to integration at Little Rock High School in a televised broadcast from the Oval Office on September 24, 1957.

Just two weeks after federal troops marched into Little Rock High School, *Sputnik* captured the nation's attention. It is impossible to fully understand the impact of NSF and NDEA STEM education programs when they are considered apart from the larger social context that shaped their implementation. The NDEA, for instance, took shape as wars over school integration grew increasingly hostile. Massive resistance campaigns broke out throughout the South, sometimes forcing public school closures as a mechanism by which to resist desegregation. Though NSF's teacher institutes programs were designed to spread NSF resources more evenly throughout the country, school segregation in the South posed a difficult challenge for foundation officials. They questioned whether the foundation should support teachers' institutes

[46] Faubus would order Arkansas public schools to close the following year to interrupt integration. William I. Hitchcock, *The Age of Eisenhower: America and the World in the 1950s* (New York: Simon & Schuster, 2018), 372.

[47] Ibid.

that were held at segregated universities. Ultimately, forming foundation policy on the matter involved complex negotiations between the wishes of Congress, the directives of the Eisenhower administration, and the mandate of the agency's educational mission.

Early in the program, foundation staff encountered difficulty in choosing a location for its first institute to be held in the South. While research grants and graduate fellowships were awarded based on merit and tended to cluster foundation resources in the northeast and around top universities, the institutes program was created to improve STEM teaching and research in relatively underdeveloped regions of the country. Though foundation officials were eager to avoid political controversy, it was widely recognized that the South was especially in need of improved instructional resources for STEM fields.

In 1953, one foundation representative identified three main criteria for selecting a location to hold a mathematics institute in the South. In a letter to a colleague, he wrote that the location should have three qualities: a resort-like appeal so that mathematicians attending the institute could also bring their families along for a vacation, be within the price-range of a teacher's budget, and provide a place where "negro and white teachers can meet together."[48] After spending part of the summer searching for such a place in the North Carolina–Tennessee area, he reported to the foundation that the prospects of finding a suitable location in the South looked grim. "We are not trying to cure any social ills," he reported, "but we feel it would be a mistake to start such a summer institute on a segregated basis; if it is segregated, it ought to be for negroes."[49]

To many at the foundation the practice of segregation in the South posed a major roadblock to extending its institutes program in the region—the *Brown* v. *Board of Education* court ruling, which would declare racial segregation on the basis of "separate but equal" unconstitutional, was a few months away. The lure of federal support ultimately proved persuasive, however, to the University of North Carolina, which announced that it would submit an institute proposal and that it could provide access to all university facilities on a nonsegregated basis. The university received an NSF grant in 1954 to hold an integrated summer institute—the foundation's first in the South. The following year, NSF began explicitly stating its antisegregation policy in letters of understandings, which were required to be

[48] Krieghbaum and Rawson, *An Investment in Knowledge,* 260.
[49] Ibid., 261.

signed by institute directors. The statements read: "It is further understood that no person be barred from participation or be the subject of other unfavorable discrimination solely on the basis of race, creed, color, or religion."[50]

Despite taking a strong stance against fully segregated institutes, the foundation debated how to respond to proposals for partially segregated summer institutes. Foundation officials worried that refusing to support segregated institutions would limit the reach of their efforts to improve STEM education throughout the country. This tension became the subject of debate within NSF in 1954 when Florida State University expressed interest in submitting a proposal for a conference on biology instruction. When NSF responded that the agency would not support a segregated program, the university responded that African American teachers would be invited to participate but would be required to use the living facilities at nearby Florida A&M College.

Worried that discouraging all proposals from southern institutions would hinder the agency's ability to do useful work in the region, Harry C. Kelly, head of the SPE, reached out to Robert Barnes to discuss the situation. A chemistry professor at Howard University in Washington, DC, Dr. Barnes served as one of only two African American members on the first National Science Board. Barnes affirmed the foundation's position that teacher institutes functioned most effectively when participants lived, ate, and worked together during the program. Arguing that Florida State's proposal reflected conditions across the South, Barnes warned that refusing to fund proposals because of segregation would cause "both white and Negro science teachers [to] suffer."[51]

Florida State ultimately decided not to submit a formal institute proposal after learning that a similar initiative was taking shape elsewhere in the state. In January 1954, the National Association of Biology Teachers garnered NSF support for a biology program held on the University of Florida's campus. The successful proposal led to what was reportedly the first integrated scientific conference to take place in Florida.[52] For the next several years, the agency continued to discourage segregated universities from submitting proposals. In 1955, agency officials advised the University of Chattanooga that "the chances for approval of a summer institute were too small" to warrant submission, due to the university's segregation policies. The University of Texas faced a similar fate after submitting two proposals

[50] Ibid., 263.

[51] Barnes quote in Kelly memo to Waterman, dated December 2, 1953. Quoted in Krieghbaum and Rawson, *An Investment in Knowledge,* 262.

[52] Krieghbaum and Rawson, *An Investment in Knowledge,* 262.

for institutes anticipated to take place during the summer of 1956. NSF rejected both proposals after the university's president announced his intention to ensure that the institutes would be segregated.[53]

The already complex situation grew more difficult for foundation officials in 1956. When seeking White House approval of NSF's policy against funding segregated institutes, Director Waterman received a lukewarm response. In a memo describing a conversation with a White House aide, Waterman reported being told that "the important thing is of course to avoid having a burning issue arise" with regard to the policy.[54] In a second conversation, another White House representative elaborated, explaining that while the agency was expected to dispense funds in accordance with federal policy, any plans made by individuals outside of the agency for living arrangements, and other needs would "not be a concern of the Foundation."[55] Though the *Brown* decision had ruled separate but equal facilities unconstitutional just two years prior to the exchange, the lack of a clear message opposing segregation from the presidential administration placed severe limits on the speed with which federal policy evolved. Rather than taking a firm stance against issuing institute grants to segregated institutions, the Eisenhower administration encouraged the foundation to disavow responsibility by removing themselves from the institute planning process.[56]

Careful not to get out in front of the Eisenhower administration or to attract undue ire from a politically divided Congress, the foundation followed the White House's lead. In 1957 the agency amended its initial policy, which had stated that institute participants should be accepted without regard to race. The amended policy, notified institute directors that "each institute will establish its own criteria for admission within the general Foundation policy that candidates shall be considered primarily on the basis of professional competence and promise as teachers of science and or mathematics."[57] Discussing the massive resistance to desegregation

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[53] Ibid., 263.

[54] "Diary Note: Conversation with Mr. Maxwell Rabb, Secretary to the Cabinet, The White House Office," November 9, 1956, Folder: Daily File-Office of the Director, Personal and Confidential, 1951–1956, Box 1, Alan T. Waterman Papers, LOC.

[55] "Diary Note: Telephone call to Dr. Gabriel Hauge," October 22, 1956, Folder: Daily File—Office of the Director, October 1956, Box 3, RG 307, NACP.

[56] Handwritten notes by President Eisenhower on the decision to send troops to Little Rock reveal his hesitance to enforce integration, September 1957, DDE's Papers as President, Administration Series, Box 23, Little Rock, Arkansas, *https://www.eisenhowerlibrary.gov/sites/default/files/research/online-documents/civil-rights-little-rock/dde-troops-to-arkansas.pdf*.

[57] Krieghbaum and Rawson, *An Investment in Knowledge,* 268.

in the South and the challenge it posed to foundation operations, Kelly (SPE division director) reasoned in a March 1957 memo: "I am recommending . . . that we do not attempt to use Foundation grants as a means of forcing integration of the races."[58]

Two high school teachers from a 1957 NSF-sponsored summer institute held at Iowa State College experimented with a pH meter during a chemistry course.

Universities that did not qualify for institute grants based on their segregation policies a few years prior, suddenly began receiving grants. In 1957, the Universities of Texas, Mississippi, and Alabama received institute grants; all three did not integrate until the early 1960s and, even then, under great duress.[59] In responding to complaints made against the shift in policy, Waterman maintained that NSF's "proper" function was not to tell the institutes how to select its participants—disavowing responsibility just as he had been instructed.[60]

Though the foundation started with a strong policy against funding segregated teachers' institutes, national political concerns pushed the agency to walk back its position. A shift in foundation policy back to an explicit statement barring segregation did not come until the early 1960s, owing to a crucial report from the U.S. Commission on Civil Rights that critiqued federal financial support of segregated institutions, as well as a clearer executive mandate coming from the newly elected Kennedy administration. Though initially hesitant to take a firm stance on civil rights issues, the shift in policy coming from the White House that Kennedy began, and Johnson's administration expanded, provided the political backing for a return to the foundation's earlier antisegregation policies.[61]

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[58] Ibid., 269.

[59] Ibid., 270.

[60] Ibid.

[61] United States Commission on Civil Rights, *Equal Protection of the Laws in Public Higher Education* (Washington, DC: U.S. Commission on Civil Rights, 1960).

The institutes program flourished during this period. The reach of the foundation's efforts to improve science education—now on a more equitable basis—extended further throughout the country. One 1963 report identified the program as the "largest Federal activity in direct support of education in the sciences."[62] During the same year, NSF awarded grants to support teacher training institutes at 256 education institutions in all 50 states as well as Puerto Rico and Washington, DC.[63] In 1963 alone, over 2,100 college teachers, 1,050 elementary school teachers, and 21,000 secondary school teachers attended summer training institutes—the most popular of the teacher training programs.[64] With the backing of the White House, NSF moved closer to fulfilling its educational mission.

Conclusion

This article has explored how the post–World War II growth of the modern security state necessitated greater federal control over scientific education and training. As scientific and technological developments increasingly underpinned American national defense, the federal government became aware that national security hinged on the development and maintenance of a sophisticated STEM workforce. In this spirit, Congress created the National Science Foundation in 1950, directing it to support scientific education and research. Foundation support for the improvement of science education ranged from funding advanced graduate training in STEM fields and improving science curriculum, to providing instructional training to high school and college STEM teachers. The foundation's early efforts to improve high school and college STEM instruction paved the way for increased federal involvement in American education. Agency efforts not only succeeded in improving STEM classroom instruction, but also served as a model for elements of the 1958 National Defense Education Act.

Though Cold War concerns over scientific manpower animated early STEM education efforts, restrictive social and legal policies of the 1950s and '60s ultimately blunted such initiatives. Even though NSF officials recognized the importance of funding training programs for STEM teachers in the South at integrated institutions, executive direction from the White House forced a shift in policy. Serving at the pleasure of the president and fearing a negative response from Congress, the NSF director, along with the agency's senior leadership, decided

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[62] NSF 1963 Annual Report (Washington, DC: GPO, 1963), 95.

[63] Ibid., 97.

[64] Ibid., 98.

to walk back its stance against funding racially segregated STEM programs. Only after national policies began to take a firmer stance against racial segregation in the early 1960s did NSF have political and administrative support to pursue its initial policy decisions.

Hindsight offers a better vantage point from which to assess the complex, and often contentious, process of federal policymaking. This examination of how NSF education policies took shape within the confines of a larger executive agenda offers a view into the ways in which executive agencies work to fulfill statutory obligations in an ever-changing social and political landscape. Though NSF policies evolved based on internal requirements and decision making, they needed to remain responsive to legislative and executive concerns alike. The process by which the agency set policies regarding funding segregated institutes in the South highlights this tension and offers a unique perspective on executive agency governance.

As the 1960s progressed, questions of equity and access to science education and professions began to attract greater attention. NSF's STEM education efforts responded with the introduction of programming and studies that specifically served minorities and women over the course of the late 1960s and early 1970s.[65] In the decades that followed, NSF's conceptions of a more fully realized STEM workforce have grown to encompass attention to geographic, racial, and gender diversity. Whether largely progressive or mostly pragmatic, such shifts in federal STEM education policies have deeply shaped current strategies to strengthen the American scientific and technological workforce.

Today, concerns over producing a "diverse STEM workforce" drive STEM education policies, not only at NSF, but throughout the federal government and private institutions.

The history of how federal STEM education policies took shape, as well as their initial limitations, however, serves as a reminder that science and education

[65] In 1971, NSF inaugurated the College Science Improvement Program with the stated goal of providing "specific opportunities for colleges and universities historically directed toward the education of racial minority groups." A year later, NSF directed its Student Science Training Program to increase the number of projects supported that were designed to address talented secondary school students from rural and inner-city schools who "may belong to minority groups as well as to other segments of the educationally disadvantaged population." See NSF 1971 Annual Report (Washington, DC: GPO, 1972), 3; and NSF 1972 Annual Report (Washington, DC: GPO,1973), 75.

policies don't take shape in a vacuum. Efforts to develop a truly robust American scientific workforce must be inclusive. The lessons of the past warn contemporary policymakers that STEM education reforms must be grounded in equitable social and economic policies in order for such reforms to achieve national goals of progress and preparedness.

Picture credits: Summer Institute Images, NSF 1957 Annual Report; Director Alan T. Waterman, NSF History Files; Representative Albert Thomas, Collection of the U.S. House of Representatives; President Dwight D. Eisenhower, National Archives Identifier 7865620.