Not "A Hundred Millionaires"
Federal Science in the Civil War and the Gilded Age

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Shortly before the nation's centennial, the physicist Joseph Henry, long admired abroad as well as at home, a onetime Princeton professor and now, for a quarter of a century, the Secretary of the Smithsonian Institution, was stirred to reflect: The surprise is not "that science has made comparatively *little* advance among us, but that . . . it should have made *so much.*"[1]

A good deal of what Henry noticed arose from the new dispensations for science by the federal government. The federal initiatives had begun of course in 1862, when the first-Civil War Congress passed the Morrill Act, with its grant of lands to the states for colleges and universities that would offer studies in the agricultural and mechanical arts. In 1863, the same Congress created the National Academy of Sciences, a private agency with the public role of advising the government on policy-related technical issues.

No less important, in the years following the Civil War – the Gilded Age, as the era is known -- the federal government authorized multiple new research efforts and agencies, enough to constitute a huge expansion in federally sponsored scientific research and scientific services to the American people, including four different topographical and geological surveys of the Far West. By the mid-1880s, federal science had accumulated sufficient prominence and power to warrant that telltale hallmark of arrival in the capital -- the scrutiny of a lengthy Congressional investigation.[2]

Henry's surprise at the expansion was altogether understandable. Before the Civil War, astronomy, natural history, and natural philosophy (the term then used for physics and

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[1] Henry to the Committee of Arrangements . . . , Feb. 3, 1873, in *Proceedings of the Farewell Banquet to Professor Tyndall* . . . Feb. 4, 1873 (New York, 1873), p. 19.

[2] U.S. Congress, Joint Commission to Consider the Present Organization of the Signal Service, Geological Survey, Coast and Geodetic Survey, and the Hydrographic Office of the Navy Department, with a View to Secure Greater Efficiency and Economy of Administration of the Public Service . . ., *Testimony,* 1886, 49th Cong., 1 Sess., Sen. Misc. Doc. 82, Series 2345 (hereafter, Allison Commission, *Testimony*).

chemistry) was part of the required college curriculum. But science was in the main taught only at an elementary level along with the classics and theology as a tool of liberal education rather than for its own sake. In all but a few institutions – notably the two service academies, RPI, and curricularly segregated parts of Harvard and Yale -- its uses for practical purposes were by and large not only ignored but held in contempt.[3]

Federal science was miniscule. It comprised only the U.S. Coast Survey, which had been established in Jefferson's administration, the Army Corps of Engineers and the Naval Observatory, and an agricultural section in the Patent Office. All were devoted primarily to research for practical purposes. In contrast, the Smithsonian Institution, a hybrid of public and private enterprise, was committed to the advancement as well as the diffusion of knowledge, and Henry emphasized the progress of abstract knowledge as best he could within his severely limited budget. Notable among his achievements was to make the agency a center for the gathering by telegraph of far-flung meteorological data, the collation and analysis of the data, and the issuance of daily weather reports.[4] Practical or abstract, governmental research was a pauper of national investment, and scientists were scarcely considered indispensable to the conduct of federal business.[5]

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[3] See Frederick Rudolph, *The American College and University: A History* (New York: Alfred A. Knopf, 1962), reprinted with an *Introductory Essay and Supplemental Bibliography* by John R. Thelin (Athens: University of Georgia Press, 1990), esp. chapter 12. The defining curricular document of the pre-Civil War decades was the Yale Report of 1828. See "Original Papers in Relation to a Course of Liberal Education," *American Journal of Science,* XV (1820), 301, 325.

[4] Wilcomb E. Washburn, "Joseph Henry's Conception of the Smithsonian Institution," in Whitfield J. Bell, ed., *A Cabinet of Curiosities* (Charlottesville, VA: 1967) pp. 111-12, 119, 141-42; *Annual Report of the Board of Regents, Smithsonian Institution, 1865,* p. 107; James Rodger Fleming, *Meteorology in America, 1800-1870* (Baltimore: Johns Hopkins University Press, 1990), pp. xix-xxiii, 20-21, 141.

[5] See A. Hunter Dupree, *Science in the Federal Government: A History of Policies and Activities to 1940* (Cambridge, Mass., 1957).

Measured against its point of departure on the eve of the Civil War, the expansion of federal science in just the few decades after the firing on Fort Sumter was huge, and it was game-changing for the scientific enterprise in the United States.

Unlike the expansion that occurred after World War II, this nineteenth-century transformation had little to do with national defense. Its root cause was that the nation's circumstances were changing in ways that established a mounting need for scientific and technological knowledge. Agriculture was growing ever more dependent upon mechanization, chemistry, and biology. The United States had expanded to the Pacific at the end of the Mexican War, in 1848, and the encouragement of settlement in the new territories entailed the mapping of the new lands, the assessment of their natural resources, the establishment of military posts and transportation routes, the building of railroads and the stringing of telegraph wires. Withal, an increasing number of Americans recognized the need for an infrastructure of technical education and research that would foster the progress of the emerging knowledge-based and technologically driven economy.

These Americans comprised a loosely connected but determined coalition for training and knowledge. They included the educational reformers who found a champion in Senator Justin Morrill of Vermont, eager to invoke the resources of the federal government to democratize higher education and orient it towards meeting the needs of the emerging age. At the center of the coalition were the leaders of American science, a small, internationally respected group, among them, in addition to Joseph Henry, Harvard's Louis Agassiz, a native of Switzerland and a brilliant student of rocks and fossils; and the geophysicist Alexander Dallas Bache, Benjamin Franklin's great-grandson, the head of the Coast Survey, and an authority on terrestrial magnetism. In concert and separately, these men had shaped the course of American

science since the 1830s, when Henry had returned from a kudos-filled tour of Europe vowing to Bache that "the real working men . . . of science in this country should make common cause . . . to raise their own scientific character."[6]

By the end of the 1850s, Henry and his allies had been further energized in their ambitions by the rising intellectual ferment in science, especially the recent theories of the evolution of the physical Earth, and in, in 1859, Charles Darwin's extension of evolutionary theorizing to the Earth's living inhabitants. Eager to enlarge the contributions that Americans might make to these great subjects, the advocates of science wanted to improve its condition in institutions of higher learning and enlarge its opportunities in the federal government.

During the decade before the Civil War, defenders of limited government, especially Southerners, feared any expansion of federal power. They had resisted most initiatives along these lines, just as they had blocked federal investment in the building of transcontinental railroads, the promotion of industrial development, and Justin Morrill's land-grant bill. But after the South's secession from the Union, in 1861, the way was cleared for the East and the burgeoning Middle West to form an imposing alliance determined to satisfy pent-up demand for federal promotion of Western settlement and national economic development under the leadership of the recently formed Republican Party. This was a GOP that was committed to industrial and economic expansion and was comfortable with the federal government's assisting the achievement of that goal across a broad spectrum of activities, including the investment in human capital and the capital of knowledge.

The advocates of science, their agenda fully in resonance with Republican aims, found considerable support in Washington during the boom years of the Civil War and beyond. The

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[6] Henry to Bache, Aug. 9, 1838, in Nathan Reingold, ed., *Science in Nineteenth-Century America: A Documentary History* (New York, 1964), p. 85.

Morrill Act sailed through the Congress with large majorities, and so did the elevation of the agricultural section in 1862 from its subordinate place in the Patent Office into an independent department. In short order, training in the agricultural and mechanical arts became formally a part of public higher education in the United States, breaking apart the standard uniform curriculum for liberal education by allowing for specialized study to advanced levels in science and engineering, among other subjects.[7]

The Morrill Act goaded all American colleges and universities into becoming democratically accessible "engines of modernity" in the apt phrase of a discerning student of their development. Indeed, private institutions of higher education, embracing a similar curricular reform after the Civil War, gave comparable new attention to the sciences and their uses – so much so that Ralph Waldo Emerson remarked "that a cleavage is occurring in the hitherto granite of the past and a new era is nearly arrived." [8]

Among the prime movers behind the creation of the National Academy of Sciences were Agassiz and Bache. Agassiz the academic saw in a national academy an institution that would raise the quality of science in the United States by granting the imprimatur of membership not to men of mere learning but only to men of original scientific achievement. Bache, the longtime federal scientist, felt the need for an institution of authoritative scientists that would safeguard public policymaking in an increasingly technical age from charlatans and pretenders.[9]

Joseph Henry opposed the creation of a highly selective national academy, suspecting that it might be considered "at variance with our democratic institutions" and might become

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[7] Rudolph, *The American College and University,* chapter 12; Dupree, *Science in the Federal Government.*

[8] Rudolph, *The American College and University,* pp. 263, 241.

[9] Rexmond C. Cochrane, *The National Academy of Sciences: The First Hundred Years, 1963-1963* (Washington, D.C.: National Academy of Sciences, 1978), pp. 38, 41-42, 46.

"perverted . . . to the support of partisan politics."[10] However, without Henry's knowledge Agassiz, Bache, and their like-minded allies drafted legislation to establish the academy and enlisted the support for it of Senator Henry Wilson of Massachusetts. A leader in the new Republican Party, Wilson was a passionate abolitionist, an ardent advocate of strengthening American prestige and progress, chairman of the Senate Military Affairs Committee. In all, he was a skilled and respected politico (and later vice president in Ulysses S. Grant's second term).[11] If Wilson spoke, the Congress listened, and when he introduced the bill for the Academy on March 3, 1863, the last day of the session, it cleared the House and Senate by voice vote.

Bache was elected the first president. Agassiz, elected foreign secretary, was thrilled, holding that the nation's men of science now had a "standard for scientific excellence." [12] Henry was far from pleased, but he agreed to membership in the Academy, attending its first regular meeting in January 1864 and joining 21 other members at a White House reception with Lincoln, whom he greatly admired. Lincoln returned the compliment, noting that the Smithsonian Institution "must be a grand school if it produces such thinkers as he is. . . . I wish we had a few thousand more such men." Henry eventually came around to the idea of the Academy, accepting the presidency in 1867, upon Bache's death. As president, Henry did not press for federal funds and kept the Academy scrupulously out of politics. The membership ceiling was removed so that five scientists could be added to the rolls each year. Patronizing research by rewarding success with titles and pensions was the European way and unacceptable in America, Henry noted. Still, he concluded that an "intelligent democracy" could properly bestow honors for achievement and

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[10] Henry to Louis Agassiz, Aug. 13, 1864, in Reingold*, Science in Nineteenth-Century America,* pp. 213-14.

[11]Cochrane, *The National Academy, p*p.50, 53, 58.

[12] *Ibid.,* p. 78.

the creation of the Academy had opened in America another "avenue for the aspirations of a laudable ambition."[13]

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Henry, however, was overly optimistic. During the post-Civil War years, a variety of circumstances militated against the National Academy's playing a significant role in American science. Its financial resources were severely limited, insufficient to publish more than an occasional proceedings and obituaries of its members. It met in the Smithsonian, having no headquarters of its own, and the meetings were poorly attended. American scientists were dispersed over the eastern and Midwestern United States and Californians felt hopelessly isolated. Federal scientists tended to dominate the Academy's affairs, particularly elections to the ranks. Scientists in Cambridge and New Haven, wary of the centralization of science, worried that it was developing into a Washington clique.[14]

Federal requests for the Academy's advice were few and far between. But in mid-1878, Congress appropriated funds for the organization to prepare a report on the consolidation of the multiple surveys and to provide an overall plan for assessing and mapping the nation's territories.[15]

Within months the Academy submitted its recommendations. In one part, it called for the unification of the four geological and topographical surveys, two of which were run by the military, into a single civilian geological survey. In another part, it incorporated the scientifically informed proposals for management of the public lands in the West that had been advanced by

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[13] *Ibid.* pp. 58, 90, 99; U.S. Congress, Senate, *Report of the National Academy of Sciences,* 1867, 40th Cong., 2d Sess., S. Misc. Doc. 106, Series 1319, p. 3.

[14]Daniel J. Kevles, *The Physicists: The History of a Scientific Community in Modern America* (Cambridge: Harvard University Press, 1995), pp. 42-43.

[15]Cochrane, *The National Academy,* pp. 130-131.

the famed geologist John Wesley Powell in his *Report on the Lands of the Arid Regions of the United States*.[16] Not yet a member of the Academy, Powell had written his report for his superiors in the Department of the Interior. Nevertheless, by embracing its proposals, the Academy found itself embroiled in a political firestorm, what amounted to the first contest over climate science and public policy in the nation's history.

Fame had come to Powell as a result of his intrepid journeys into territories hitherto unknown to most Americans as head of several successive western surveys. Despite having lost his right forearm at Shiloh during the Civil War, he had scaled Long's Peak, braved the canyons of the Colorado River, and returned with valuable knowledge of the region, including maps. Powell was a staunch supporter of material development and economic opportunity, but he was also a social reformer. He empathized with the Native American tribes in the West and initiated what became a major program of ethnology to learn about their languages and customs. He was also convinced that scientific knowledge had to be deployed to accommodate democratic social progress to the realities of the land and its limits. Powell knew the American West well. Partly because of the Smithsonian's meteorological and weather program, to which Joseph Henry had given him access, he was aware especially that the West beyond the hundredth meridian – a region accounting for some 40 percent of the land in the Continental United States -- experienced too little rainfall to sustain the conventional 160-acre homesteading agriculture that had long marked public land policy. Drawing on these data, Powell knew, in short, that most of the good public land, the kind "a poor man could turn into a farm," had already been sold.[17]

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[16] *Ibid.,* pp. 130-132; J. W. Powell, *Report on the Lands of the Arid Region of the United States* . . . (2nd. ed.; Washington, D.C.: Government Printing Office, 1879); William H. Goetzmann, *Exploration and Empire: The Explorer and the Scientist in the Winning of the American West* (New York: Alfred A. Knopf, 1966), pp. 583-588.

[17] Powell, *Report,* p. ix. On Powell's career as a geologist and reformer, see Wallace Stegner, *Beyond the Hundredth Meridian: John Wesley Powell and the Second Opening of the West* (Boston: Houghton Mifflin, 1954) and Goetzmann, *Exploration and Empire,* Chapter XV.

However, a number of earth scientists, including some who were also veterans of the western surveys, thought differently. Drawing on European theories and their own experience, they contended that settlement and cultivation, especially the planting of trees, would transform arid regions, notably the Great Plains beyond the hundredth meridian, into fertile, loamy expanses bathed in rain, like the agriculturally fecund Mississippi Valley. During the 1870s, as settlement spread westward through the Great Plains, rainfall happened to increase, providing these arguments with a seeming plausibility and later giving rise to the summary phrase: "Rain follows the plow."[18]

Powell dismissed these claims in his *Report* on the arid lands, noting the "many conjectures and hypotheses" that had been advanced to account for the increased rainfall. He went on: "Many have attributed the change to the laying of railroad tracks and construction of telegraph lines; others to the cultivation of the soil, and not a few to the interposition of Divine Providence in behalf of the Latter Day Saints." But he had to add that "in what manner rainfall could be affected through the cultivation of the land, building of railroads, telegraph lines, etc., has not been shown."[19]

In his *Report,* Powell called for an end to the apportionment of public land in 160-acre tracts. He urged instead the scientific classification of the land and in ways that allowed for large sections suitable for dry-land ranching and irrigation farming. Their contours would be shaped by their access to water and their size – up to 2,500 acres -- and would be determined by the use to which the land could be put -- mining, grazing, farming, or irrigation.[20]

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[18]Daniel J. Kevles, "A Fistful of Wishful Thinking," *Nature,* 401(16 Sept. 1999), 215.

[19] Powell, *Report,* p. 90.

[20] Goetzmann, *Exploration and Empire,* pp. 572-573.

The Academy's recommendations – both for the consolidation of the surveys and Powell's reform of the public-land system in the arid region – were made the basis of a Congressional bill in February 1879 that Representative Abram S. Hewitt, a respected ironmaster and friend of science, commended to the House, declaiming that the plan came from "the highest scientific authority of the land." The measure was hailed by Easterners on both sides of the aisle as wise, realistic, and scientifically compelling.[21]

But representatives from the western states and territories, ambitious inhabitants of a developing and settler-hungry region, ripped into the proposal. Had scientists said that the land was too arid for small farms? Congressman Martin Maginnis, from the Montana Territory, cried that theorists had pronounced the homestead system dead before, yet settlers had gone west and, "practical men" all, had "seen the capabilities of this land which had escaped the notice of our scientists and statesmen." Did the proposal enjoy the imprimatur of the highest scientific authority in the land? Congressman Thomas MacDonald Patterson, from Denver, Colorado, argued that the National Academy of Sciences had "never published but one work, and that was a very thin volume of memoirs of its departed members." He added to the laughter of the House, "And if they are to continue to engage in practical legislation, it would have been very well for the country if that volume had been much thicker."[22]

In the end, Congress combined the surveys into a new U.S. Geological Survey, but it left the 160-acre based public land system intact. Congressman Dudley C.Haskell, a Yale graduate from Lawrence, Kansas, did not mind giving science its "little appropriation," but he had to say: "Now, if you want a geographical survey, if you want a lot of astronomical figures, if you want a lot of scientific material, then organize yur geographical surveys and authorize them to get out

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[21]U.S. Congress, House, *Congressional Record,* 45th Cong, 3d Sess., Feb. 11, 1879, p. 1207.

[22]*Ibid.,* Feb. 11, 1879, p. 1202; Feb. 18, 1879, p. 1564.

there and dig and hunt bugs and investigate fossils and discover the rotundity of the earth and take astronomical observations. But if you please, while you are there acting in the interest of science and in the interest of professional bug-hunting, leave the settlers upon our frontier alone."[23]

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In fact, time would prove that Macginnis and his settlers had the matter wrong and that Powell and the Academy had it essentially right. On the Plains during the 1880s, rain ceased following the plow, ruining numerous farmers; and irrigation would prove indispensable to agriculture in the region. The battle would not be the last to join contested theories of climate with passionate convictions of political economy.

Yet for all their disagreements with Powell and the Academy, the Congressmen from the West were not anti-science. What they objected to was the deployment of scientific authority to the end of a radical change in their region's land-distribution system. Their interests were economic, based on expectant hopes for rapid population growth and development. While they had their climatology wrong, they valued federal science highly for all the research, analysis, and information it was providing for the practice of agriculture and the exploitation of natural resources.

Indeed, there were multiple indicators of Congress' ongoing enthusiasm for an expansive federal science. In 1871, it had authorized the Coast Survey to encompass geodesy by measuring the curvature and gravitational force of the Earth at its surface throughout the continental United States, which meant along an arc equal to about a full eighth of the circumference of the globe; in 1878, it affirmed this sizable expansion in the agency's activities and renamed it the U.S.

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[23] *Ibid.,* Feb. 11, 1879, p. 1211.

Coast and Geodetic Survey. A key contributor to this effort was Charles Sanders Peirce, the famed founder of philosophical pragmatism. During his thirty years with the Survey, Peirce produced a stream of brilliant papers on formal logic and philosophy while earning an international reputation for his scientific work, especially the development of highly accurate methods for measuring gravity with a pendulum.[24]

Congress also remained highly enthusiastic about an earlier initiative in the expansion of federal science, the U.S. Weather Service, which it had established in 1870 in the Army Signal Corps. The Weather Service, which took over the meteorological work and methods of the Smithsonian, served the needs of agriculture and the military, not to mention the American people in general. Army and civilian observers at stations around the country would wire reports of local conditions to the Service's Division of Telegrams and Reports, housed in the quarters of the Army Signal Corps on G Street, in Washington. There, the next day's predictions were drawn up, then telegraphed across the United States. The reports were published in newspapers and tacked up at local post offices. Many farmers learned of cold waves, sunshine, or storms from signal flags hoisted on a passing train or a public building (the flags would remain a commonplace of the American landscape until the days of radio). The Service also supported research in meteorology, encouraging the enlistment of college graduates and hiring civilian scientists. To the end of improving weather prediction, they explored the dynamics of storms and tornadoes and investigated the mysteries of the atmosphere.[25]

Congress's creation of the U.S. Geological Survey, in 1879, was a clear vote of confidence for what the civilian surveys had done to date. Perhaps the best known of them apart from Powell's venture down the Colorado had been the Geological and Geographical

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[24] Kevles, *The Physicists,* pp. 47-48.

[25] *Ibid.*, pp. 48-49.

Exploration of the Fortieth Parallel, which followed one of the expected routes of the transcontinental railroad and was headed by Clarence King. Then only 25 years old, King was handsome, well connected, and in Henry Adams' judgment "the best and brightest man of his generation."[26] King, who had studied at Yale under some of the country's leading geologists, staffed the exploration with first-rate scientists. Their work was fruitful scientifically, and much of it was also economically pertinent, especially the geological investigation of the region in the neighborhood of the rich Comstock silver lode.

King's survey along with all the others included artists and photographers. Their work, displayed in popular lectures with stereopticons and published in handsome books, provided untold numbers of Americans with their first visual impressions of the West. The illustrations of the canyon country the mesas, and the high peaks – by turns majestic, cathedral-like, and forbidding -- held them in thrall, much as pictures from space would rivet Americans a century later.[27]

King was appointed the first head of the new U.S.Geological Survey, but he resigned the post in 1881 and was succeeded by John Wesley Powell. His exploring days over, his body paunching but his beard still a bristling red, Powell fired the entire operation with enthusiasm. He employed topographers, geologists, and paleontologists; he farmed out work to university consultants, a number of them at the land-grants in the Midwest and the West. Through its consultantships and field expeditions, the Survey provided important research opportunities for many American geologists. Its access to the Government Printing Office enabled it to publish hundreds of bulletins valuable to both basic and economic geology. No disdainer of Washington

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[26] Goetzmann, *Exploration and Empire,* p. 431.

[27] See Goetzmann, *Exploration and Empire,* for examples of the illustrations and a discussion of the artists and photographers.

politics, Powell could usually find a position in the Survey for the relative of a well-placed congressman. He also distributed the Survey's attractively, sometimes lavishly illustrated publications around the capital. With its numerous publications and consultants spread through nineteen states and territories, the Survey made its influence felt in numerous academic localities, and its work gained world-class distinction. [28]

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By the mid-1880s, the federal government, with its venerable Naval Observatory, expanded Coast and Geodetic Survey, new Weather Service, and jewel of the U.S. Geological Survey had become the home of much of American science. The Government Printing Office, which since 1870 had issued hundreds of memoirs for the scientific bureaus, was the nation's principal publisher of research. Relative to population, more scientists were working in the capital than in any other city, including Cambridge, Massachusetts. Washington scientists formed a congenial community, gathering at meetings of the various scientific societies then proliferating in the capital and conjoining at the Cosmos Club, which Powell, Henry Adams, and friends had founded in 1878 for people devoted to science, art, and literature. [29] It was an intellectually stimulating community, and its members felt secure in the knowledge that through their work under federal auspices they were contributing to the advancement of science, the nation's economic and cultural development, and the overall welfare of the American people.

They were thus jolted in the mid-1880s when the showpieces of the expanded federal scientific establishment, including the Geological Survey, were subjected to the scrutiny of that

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[28] Kevles, *The Physicists,* p. 49.

[29] *Science,* V (April 17, 1885), 328-29; G. Brown Goode, "The Beginnings of American Science, The Third Century," *Report of the United States National Museum,* in *Annual Report of the Board of Regents of the Smithsonian Institution, 1897* (Washington, D.C.: Government Printing Office, 1901), 462-63; J. Kirkpatrick Flack, *Desideratum in Washington: The Intellectual Community in the Capital City, 1870-1900* (Cambridge, Mass., 1975), pp. 60, 62.

Congressional investigation. No mere formality, this was an extended inquiry by a joint bipartisan commission of the House and Senate headed by the Republican warhorse Senator William B. Allison, of Iowa, the powerful chair of the Committee on Appropriations. The investigation had been prompted in part by charges of scandal, favoritism, and wastefulness in the scientific agencies. Treasury auditors were reportedly investigating claims that John Wesley Powell himself had been doing useless research, overpaying favorites, publishing lavish books on irrelevant subjects, buying his way into the National Academy with patronage, and giving away federally owned fossils to a paleontologist at Yale.[30]

But the fundamental issue was not scandal. It was whether the scientific agencies had developed beyond the limits of what the federal government should support. Critics contended, variously, that the scope of federal science had grown too broad, that the scientific agencies were engaging in abstract work of no utility -- for example, meteorological studies that might not lead to more reliable weather prediction or paleontological investigations that seemed to satisfy no public want. Such objections came from states-rights Southern Democrats, newly returned to the Congress from their exile, and from some northerners, including several leading scientists. In the outspoken view of the critics, much of the research done by agencies like Powell's should be left to the states and to private enterprise.

Federal scientists vigorously defended their work before the Allison Commission, insisting, as one put it, that they were "not fomenting science"; they were doing practical work for practical purposes. The National Academy, once again asked for an opinion, urged that federal research should be removed from politics by consolidating all of it under an apolitical

[30] Kevles, *The Physicists,* pp. 51-52.

Department of Science.[31] The Commission rejected that recommendation, but Senator Allison and his Republican allies remained strong friends of federal science, and after two years federal research emerged from the probe unscathed.

A few years later Powell and federal science would suffer severe cutbacks at the hands of Southern Democrats, Western Republicans angered again by his insistence on managing public lands in accord with the need for irrigation, and even some Eastern Republicans in thrall to cost-cutting in the face of hard economic times. But the setbacks to federal science were temporary. At the opening of the twentieth century, with the Depression of the 1890s ended and the United States emerging as a world power, the expansion of federal science resumed. Within a half century it would reach levels undreamed by Powell, and the federal government would call upon the advice of the Academy to a degree that Alexander Dallas Bache could hardly have imagined.

The foundations of that future had been laid in the Civil War, when Congress established the Academy, and during the Gilded Age, when the Allison Commission sanctioned the purposes and practices of an expansive federal role in science as proper functions of government. It was only a short step in time and principle from the affirmations of the Allison Commission to Congress's passage of the Hatch Act, in 1887, which created federally funded agricultural experiment stations at the land-grant colleges and universities and marked the beginning of an explicit commitment to federal patronage for scientific research in the academic world. Powell had explicated the issue of the federal role in research before the Commission with clarity and passion. Not even "a hundred millionaires" could support the current research of the federal agencies, he declared, adding that the progress of American civilization should not have to wait on the philanthropic inspiration of a hundred rich men. Surely, he insisted the national

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[31] Julius E. Hilgard, statement; *Report of the National Academy . . . ,* both in Allison Commission, *Testimony,* pp. 54, *1-*10.

government should support and publish whatever science might advance the welfare of the American people.[32]

[32] Powell to William B. Allison, Feb. 2, 1886, in Allison Commission, *Testimony,* pp. 1075, 1078.