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Science, Education, and Antebellum Reform: The Case of Alexander Dallas Bache

Hugh R. Slotten

As primary civilizing forces, science and formal education have achieved a position of dominance and prestige in modern society. In the United States, efforts to institutionalize these two cultural commitments became especially strong during the decades preceding the Civil War. Historians of science, such as Robert Bruce, have argued that the antebellum period saw the “launching” of American science.¹ During the years before the Civil War, many institutional forms were established, patterns of patronage were begun, and the scientific community was organized around professional ideals. Writing about the same period, historians of education have stressed the origins of government-supported common school systems, the rise of educational professionals and professional societies, and the growth of specialized training in higher education.² Despite these parallel concerns, there has been little exploration of the place of science in educational reforms of this period or of the importance of education in efforts to upgrade the antebellum scientific community.

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¹ Robert V. Bruce, *The Launching of Modern American Science, 1846–1876* (New York, 1988). Also see, for example, George H. Daniels, ed., *Nineteenth-Century American Science: A Reappraisal* (Evanston, Ill., 1972); Sally Gregory Kohlstedt, *The Formation of the American Scientific Community: The American Association for the Advancement of Science* (Urbana, Ill., 1976); Nathan Reingold, *Science in Nineteenth-Century America: A Documentary History* (Chicago, 1964); Stanley M. Guralnick, *Science and the Antebellum American College* (Philadelphia, 1975); George H. Daniels, *American Science in the Age of Jackson* (New York, 1968).

² See, for example, Carl F. Kaestle, *Pillars of the Republic: Common Schools and American Society, 1780–1860* (New York, 1983); Lawrence A. Cremin, *American Education: The National Experience, 1783–1876* (New York, 1980); David B. Tyack, *The One Best System: A History of American Urban Education* (Cambridge, 1974); Jonathan Messerli, *Horace Mann: A Biography* (New York, 1972); Michael B. Katz, *The Irony of Early School Reform: Educational Innovation in Mid-Nineteenth-Century Massachusetts* (Cambridge, Mass., 1968); David F. Labaree, *The Making of an American High School: The Credentials Market and the Central High School of Philadelphia, 1838–1939* (New Haven, Conn., 1988); David B. Tyack and Elisabeth Hansot, *Managers of Virtue: Public School Leadership in America, 1820–1920* (New York, 1982).

This essay explores the interrelationship of antebellum educational and scientific reform by focusing on the work of Alexander Dallas Bache, who not only played a central role in organizing and advancing American science but also zealously supported educational reform. Bache's activities serve as a lens through which the connections between science and education can be examined.³ After briefly sketching Bache's contributions to antebellum science and education, this article will demonstrate that Bache participated in a culture of "Whiggery," in which scientific and educational reform were mutually reinforcing. This essay will explore the connections between the rise of scientific and educational reform, first, in institutional terms by analyzing the place of science in educational institutions and of education in scientific institutions, and, second, in ideological terms by examining the changing meaning of science and its relationship to educational reform. Finally, this article will compare Bache's educational vision with later developments in the history of education and science.

* * * * *

A great-grandson of Benjamin Franklin and a member of a politically influential Philadelphia family, Alexander Dallas Bache shared his relatives' interest in intellectual, civic, and organizational concerns. Born in 1806, Bache attended the U.S. Military Academy at West Point and received one of the most specialized and advanced scientific educations available in the United States during the early nineteenth century. The Military Academy helped define Bache's interest in science as a cultural enterprise closely linked to engineering, internal improvements, economic development, and the practical world.⁴

³ Notwithstanding his historical importance, Bache has received very little scholarly treatment. Moreover, those who have analyzed Bache's role in antebellum America have not sufficiently acknowledged the interrelationship of Bache's work as both a scientist and an educator. See Nathan Reingold, "Alexander Dallas Bache: Science and Technology in the American Idiom," *Technology and Culture* 11 (Apr. 1970): 163–77; Merle M. Odgers, *Alexander Dallas Bache: Scientist and Educator, 1807–1867* (Philadelphia, 1947); Mark Beach, "Was There a Scientific Lazzaroni?" in *Nineteenth-Century American Science: A Reappraisal*, ed. Daniels, 115–32; Robert C. Post, "Science, Public Policy, and Popular Precepts: Alexander Dallas Bache and Alfred Beach as Symbolic Adversaries," in *The Sciences in the American Context: New Perspectives*, ed. Nathan Reingold (Washington, D.C., 1979), 77–98; George V. Fagan, "Alexander Dallas Bache, Educator," *The Barnwell Bulletin* 18 (Apr. 1941): 9–46; Bruce Sinclair, *Philadelphia's Philosopher Mechanics: A History of the Franklin Institute, 1824–1865* (Baltimore, 1975); Bruce, *Launching of Modern American Science*; Kohlstedt, *The American Association for the Advancement of Science*.

⁴ On the Military Academy, see Edgar Denton, "The Formative Years of the United States Military Academy, 1775–1833" (Ph.D. diss., Syracuse University, 1964); and James L. Morrison, "*The Best School in the World*": *West Point, the Pre-Civil War Years, 1833–1866* (Kent, Ohio, 1986). Also see Reingold, "Alexander Dallas Bache."

After graduating first in his class from the Military Academy, Bache eventually returned to Philadelphia to accept an appointment as professor of natural philosophy and chemistry at the University of Pennsylvania. Bache soon became a leader of the Philadelphia scientific community. Through his family connections and his involvement with the prominent institutions of the city, including the American Philosophical Society, the Franklin Institute, and the socially exclusive Wistar Club, Bache became acquainted with the city's elite scientists, engineers, manufacturers, and civic leaders.⁵

Because of his experience as both an organizational leader and a specialist in geophysical research, Bache was appointed, in 1843, superintendent of the most important scientific institution of the antebellum period, the Coast Survey of the United States. Begun as a coastal mapping project under the Jefferson administration, the Coast Survey was broadened by Bache to include numerous scientific activities. Until his death in 1867, Bache used the Coast Survey to set the highest scientific standards, to provide research opportunities for American scientists, and to influence, if not control, other scientific institutions, including the Nautical Almanac, the Bureau of Weights and Measures, the American Association for the Advancement of Science, the Smithsonian Institution, and the National Academy of Sciences.

As the acknowledged "chief" of the Coast Survey and of a group of ambitious scientists who called themselves the "Lazzaroni," or "scientific beggars," Bache worked to improve institutional support for the advancement of science in the United States. Bache's activities in support of American science were part of a process that historians and social scientists have termed "professionalization." Analyses of the professionalization of science have emphasized the development of a scientific profession committed to full-time employment opportunities, a research ethic geared toward advancing an esoteric and specialized body of knowledge, a service ideal aimed at gaining support from the public, commonly shared high standards of quality, and formal means of certification.⁶ In

⁵ On Bache's work in Philadelphia, see Odgers, *Alexander Dallas Bache*, 18–37; Benjamin Apthorp Gould, *An Address in Commemoration of Alexander Dallas Bache, delivered August 6, 1868, before the American Association for the Advancement of Science* (Salem, Mass., 1868), 5–18; Joseph Henry, "Memoir of Alexander Dallas Bache, 1806–1867," *National Academy of Sciences Biographical Memoirs* 1 (1877): 186–93; Sinclair, *A History of the Franklin Institute, 1824–1865*; archival material in box 6, Alexander Dallas Bache Papers, RU 7053, Smithsonian Institution Archives.

⁶ Nathan Reingold, "Definitions and Speculations: The Professionalization of Science in America in the Nineteenth Century," in *The Organization of Knowledge in Modern America, 1860–1920*, eds. Alexandra Oleson and John Brown (Baltimore, Md., 1979), 33–69; Daniel J. Kevles, "American Science," in *The Professions in American History*, ed.

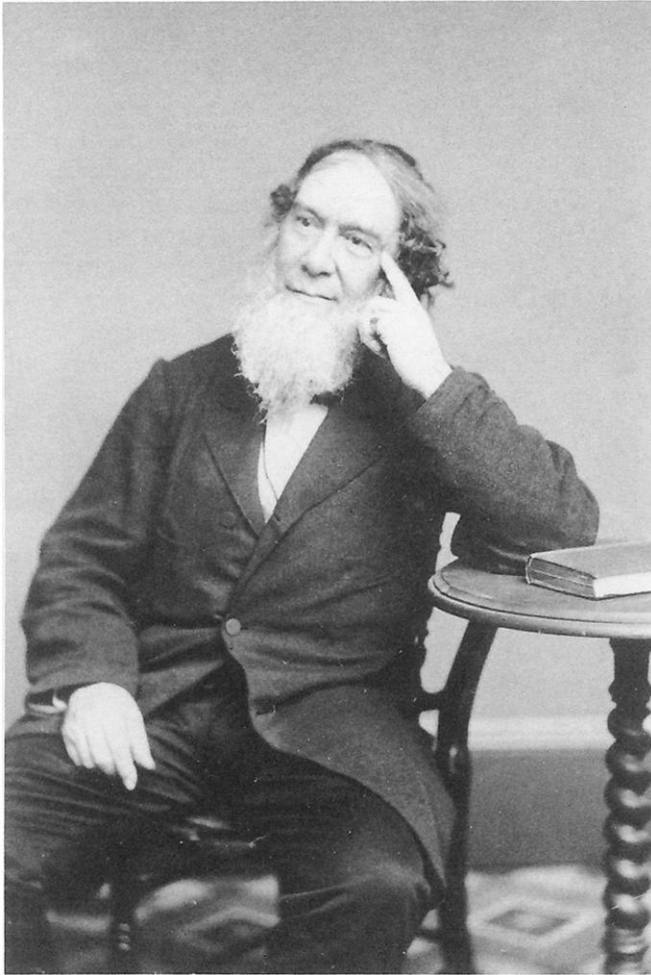
his organizational work for what he called the “cause of American science,” Bache sought to institutionalize these professional standards and goals. For example, Bache worked to control and “professionalize” the American Association for the Advancement of Science by preventing individuals he considered amateurs or “charlatans” from dictating the standards of science. As one of the most influential regents of the Smithsonian, Bache helped orient the institution toward supporting the advancement rather than the diffusion of knowledge. And as the major force behind the founding of the National Academy of Sciences, Bache sought to create an institution that would channel government support to the country’s “best” professional scientists. In many ways, Bache’s influence on the development of science in the United States during the nineteenth century was unrivaled.

Bache’s devotion to science, however, did not preclude involvement in other cultural activities. Even while working to become a scientific leader in Philadelphia, Bache helped organize and promote a variety of civic and philanthropic institutions, including public libraries and an institute for the blind. But especially from 1836 until 1843, Bache actively supported the cause of educational reform. With his election to the presidency of Girard College in the fall of 1836 and his appointment as the principal of Philadelphia’s Central High School three years later, Bache combined a commitment to science with an equally strong interest in general education.⁷

As the president of Girard College, Bache sought to follow the instructions of the founder Stephen Girard, a wealthy Philadelphia busi-

Nathan O. Hatch (Notre Dame, Ind., 1988), 107–25; George Daniels, “The Process of Professionalization in American Science: The Emergent Period, 1820–1860,” *Isis* 58 (Summer 1967): 63–78. On Bache’s program for reforming or professionalizing American science, see especially Bache, “Address of Professor A. D. Bache, President of the American Association for the Year 1851, on Retiring from the Duties of President,” *Proceedings of the American Association for the Advancement of Science, Sixth Meeting, Held at Albany (N.Y.), August 1851* (Washington, D.C., 1852), xli–lx and his untitled draft of an address at the 1844 meeting of the National Institute for the Promotion of Science, which begins “What are the wants of science in the United States?” in box 5, Bache Papers.

⁷ On Bache’s involvement with the Philadelphia Institute for the Blind, see Bache to John Fries Frazer, 30 Apr. 1849, John Fries Frazer Papers, American Philosophical Society Archives. On Bache’s interest in a school for the deaf and dumb, see the second volume of Bache’s European diary, 23 Oct. 1837, box 1, Bache Papers. On his concern for the plight of the industrial poor of Manchester, England, see *ibid.*, 1 Nov. 1837. On his involvement with general cultural improvement, see Joseph J. McCadden, *Education in Pennsylvania, 1801–1835 and Its Debt to Roberts Vaux* (New York, 1969), 32–33. On antebellum reform, see, for example, C. S. Griffin, *The Ferment of Reform, 1830–1860* (Arlington Heights, Ill., 1967); Ronald G. Walters, *American Reformers, 1815–1860* (New York, 1978).



Alexander Dallas Bache. Courtesy of Record Unit 95, Photograph Collection, Smithsonian Institution Archives, Washington, D.C.

nessman who had left a large endowment for the establishment of a school for orphans from early youth through young adulthood. Soon after offering Bache the position, the trustees of Girard College requested that the new president visit Europe and report on educational practices that might be useful for the school. After studying more than 250 educational institutions in over a dozen countries, Bache published a 600-page study of European education, entitled *Report on Education in Europe, to the Trustees of the Girard College for Orphans*. Bache's *Report*

analyzed a broad spectrum of institutions, from infant schools to colleges and universities.⁸

For various reasons, including a delay in the opening of Girard College until 1848, Bache never had a chance to apply his European observations directly to shape the school's curriculum. Instead, his *Report* indirectly became a blueprint for the educational policy of Philadelphia's Central High School, which he superintended from 1839 until 1842. According to David Labaree, Bache's impact on Central High "was enormous. . . . More than anyone else he established the long-term character of the school—developing its curriculum, pedagogy, discipline, internal organization, and (most important) its sense of purpose." Bache also served as the superintendent of Philadelphia public schools and helped educate both children and adults at the Franklin Institute. Bache's educational work was part of the broader common school movement in this period, which sought to establish unified systems of government-supported public education. Indeed, Labaree has characterized the Central High School as the "culmination" of the common school movement in Philadelphia.⁹

In his roles as an educator and "man of science" supporting the professionalization of science and education, Bache most clearly represented what Daniel Walker Howe has called the "Whig culture" of antebellum America. Although Jacksonian Democrats may have been more successful at winning elections, the Whigs, according to Howe, "probably contributed more to shaping the new industrial society of Victorian America."¹⁰

Howe argues that "Whiggery" encompasses more than a set of political views or a specific allegiance to the Whig political party. The Whiggish cultural system developed through several generations and formulated its values (social, political, religious, and philosophical) as a

⁸ Alexander Dallas Bache, *Report on Education in Europe, to the Trustees of the Girard College for Orphans* (Philadelphia, 1839).

⁹ On Girard College, see Cheesman A. Herrick, *History of Girard College* (Philadelphia, 1927). Labaree is quoted from his *Making of an American High School*, 10, 12. On Bache's educational work, also see Alexander Dallas Bache, *Report to the Controllers of the Public Schools, on the Reorganization of the Central High School of Philadelphia* (Philadelphia, 1839); Alexander Dallas Bache, *Address of Prof. A. D. Bache, before the Alumni Association of the Central High School, Delivered February 10, 1859* (Philadelphia, 1859); the Twenty-second through the Twenty-fourth *Annual Reports of the Controllers of the Public Schools of the City and County of Philadelphia, Composing the First School District of Pennsylvania, with their Accounts* (Philadelphia, 1840–42); Sinclair, *Franklin Institute*, 108–34; James Mulhern, *A History of Secondary Education in Pennsylvania* (New York, 1969), 493–500, 518, 556–57.

¹⁰ Daniel Walker Howe, *The Political Culture of the American Whigs* (Chicago, 1979), 3. My discussion of Whig culture is mainly drawn from *ibid.*, esp. 1–42.

complex response to the American experience. Not all individuals who can be linked to Howe's "Whig culture," including Bache, had close ties to the Whig party, because, as Howe has argued, "the culture was more powerful than the party." Although many of Bache's relatives belonged to the Democratic party, their cultural values were clearly Whiggish. Bache was especially close to his uncle, George Mifflin Dallas, who served as vice president in Polk's administration. But as John Belohlavek has argued, "no amount of effort could convert Dallas into an authentic Jacksonian." He was a Democrat purely as a matter of expediency rather than because of political principles, moral convictions, or cultural temperament. Especially through the influence of his uncle, his mother, and other friends and relations who belonged to the Philadelphia social elite, Alexander Dallas Bache learned to appreciate a Whiggish cultural outlook.¹¹

According to one contemporary, Whiggery desired "conservatism and progress to blend their harmonious action."¹² From this perspective, the Whig culture included two complementary elements: an innovative side supporting economic and industrial growth and a conservative side favoring social order and moral absolutism. The conservative element supported economic development by reinforcing social and moral authority. Whiggery thus combined an interest in innovation with a desire for order.

Bache's cultural convictions reflected both aspects of Whiggish culture. As an innovator, Bache favored economic growth and technological development, which, he believed, would lead to general progress and prosperity. "Increased production," according to Bache, "whether in agriculture or manufactures, is so obvious and powerful a source of prosperity to a country, that we naturally look with interest upon every circumstance which may effect it, endeavoring as far as may be, to understand, that we may aid." According to Bache, private institutions would not be sufficient by themselves to support economic and commercial development: "Voluntary Associations may do much, but not everything." Bache accordingly favored active intervention by the public sector in national issues such as internal improvements, public schools, and commercial policy. In discussing education, Bache argued that "all the institutions of every name for the promotion of knowledge" should "be put upon a *truly republican* basis . . . all the schools; from the lowest to the highest" should "be supported from the public purse."¹³

¹¹ *Ibid.*, 3; John M. Belohlavek, *George Mifflin Dallas: Jacksonian Patrician* (University Park, Penn., 1977), 23.

¹² *American Review*, quoted by Howe, *The Political Culture of American Whigs*, 210.

¹³ Alexander Dallas Bache, *Address Delivered at the Close of the Twelfth Exhibition of American Manufactures Held by The Franklin Institute* (Philadelphia, 1842), 2, 9, 15.

Drawing on the complementary nature of the two sides of Whiggery, Bache assumed that progress included interrelated material and spiritual components. Technological innovations and material growth ideally benefited the moral as well as the material character of the nation. In the vocabulary of Whiggery, “improvement” referred to an entire set of activities or projects, including economic and moral development, which went hand in hand. Habits such as industry and prudence that individuals developed in the process of working toward material ends also supported the higher moral growth of the individual. Using natural theology as a foundation for analysis, Bache argued that progress in religion necessarily accompanied progress in science. Bache “fully recognized,” according to his colleague and friend Joseph Henry, “the union of science and religion, and held with unwavering constancy the belief that revelation, properly interpreted, and science, rightly understood, must ultimately join in perfect accord in reference to the great truths essential to the well-being of man.” Bache expressed similar views both publicly and privately: “What God hath joined together let no man put asunder. Let mutual love penetrate the hearts of those who study the works and the Word of God. By Him they were both given,—by Him we were made capable of their study. Both are, in fact, His Works.”¹⁴

As a member of the Episcopal church in Philadelphia, Bache was exposed to the values of the city’s aristocratic, cultured elite. Bache’s religious ties thus reinforced his conservative Whiggish views.¹⁵ Bache shared the convictions of other educational reformers, such as Horace Mann and Henry Barnard, that the common school should provide moral education for children. On a political level, moral education was also demanded by the traditional ideals of republicanism, which emphasized that the social health of the country depended on proper cultivation of

¹⁴ Howe, *The Political Culture of American Whigs*, 48. Henry, “Memoir of Alexander Dallas Bache,” 205. Alexander Dallas Bache, *Anniversary Address before the American Institute, of the City of New York* (New York, 1857), 60. Also see, for example, Bache to Henry Barnard, 27 June 1844, Barnard Papers, Fales Library, New York University (copy in University of Pennsylvania Archives); and Bache to Joseph Henry, 28 May 1839, in *The Papers of Joseph Henry*, ed. Nathan Reingold (Washington, D.C., 1981), 4: 224–26.

¹⁵ E. Digby Baltzell, *Philadelphia Gentlemen: The Making of a National Upper Class* (New Brunswick, N.J., 1989), 244. Bache supported the evangelical branch of the church. See his letters to Alonzo Potter, bishop of Philadelphia: Bache to Alonzo Potter, 2 June 1845 and 21 Aug. 1843, Bache folder, Gratz Collection, Historical Society of Pennsylvania. Also see William Wilson Manross, *A History of the American Episcopal Church* (New York, 1935), 213–46, 279–81. On republicanism, see, for example, Robert E. Shalhope, “Republicanism and Early American Historiography,” *William and Mary Quarterly* 39 (Apr. 1982): 334–56; and Harry Watson, *Liberty and Power: The Politics of Jacksonian America* (New York, 1990). Bache, *Report to the Controllors of the Public Schools, on the Reorganization of the Central High School of Philadelphia*, 4.

individual virtues such as discipline, reason, and intelligence. In his educational work, Bache accordingly placed a strong emphasis on developing systems of moral discipline and moral control. "Sound moral instruction should be given and good habits carefully fostered in all schools," he argued. Some of the most important values that made up Bache's moral vision included self-control, sobriety, cautiousness, regularity, punctuality, industry, rationality, and accuracy.

The Whiggish emphasis on planning and control was central to Bache's institutional proposals for the professionalization of both science and education. According to Bache, "in the United States almost everything is done on the voluntary plan." Although he thought these plans had "produced splendid results," Bache argued that they were "wanting, of course in system." Centralized planning and systematic organization and control would ensure continuous national progress. Despite optimism about the dynamic growth and social change occurring in the country during the antebellum decades, Bache also realized that these developments needed to be guided and directed to prevent an undermining of republicanism and its balance of order and liberty. Bache maintained that as long as citizens remained alert to potential threats and developed effective programs, such as moral education, to deal with these threats, virtue and liberty could be sustained.¹⁶

As part of his desire to guide national progress, Bache favored introducing science into the institutional structure of education and stressed the scientific functions of educational institutions. Bache's attempt to professionalize or reform American science operated at all educational levels. He especially disliked a classical curriculum that he complained took the best students "capable of carrying all science" and "stuffed" their heads with "words—words—words."¹⁷ Besides emphasizing specialized scientific study at the college and university level, Bache also stressed scientific and technical education in the high school curriculum. In his *Report on Education in Europe, to the Trustees of Girard College*, Bache had written favorably of the Prussian system and its *Realschule* in which science, modern languages, and practical training for life were emphasized. When he had a chance to put these ideas into practice at Central High, he developed a curriculum unusually strong in the study

¹⁶ Bache, *Anniversary Address before the American Institute*, 7; Bache, *Address at the Twelfth Exhibition of American Manufactures*, 16.

¹⁷ Bache to Frazer, 23 Feb. 1848, Frazer Papers. On Bache arguing that Greek and Latin had no place in his educational plans for the Central High School, see Bache, *Report to the Controllers of the Public Schools, on the Reorganization of the Central High-School of Philadelphia*, 23–24.

of science, mathematics, and modern languages.¹⁸ Bache's Central High School gave students an opportunity to learn book-based theoretical science and participate in the practice of science, using the school's chemical laboratory and astronomical observatory, one of the best observatories in the country during this period.¹⁹

As an educational reformer with a special interest in scientific and technical education, Bache influenced both institutional developments and individual initiatives. Henry Barnard and Horace Mann read Bache's *Report on Education in Europe* in preparation for their own European tours, and, in 1840, both educators visited Bache's Central High School.²⁰ The *Report*, which was republished together with Barnard's educational works, helped popularize the Prussian educational model in the United States.²¹ As a leader of educational reformers, Bache chaired the 1840 National Convention of the Friends of Public Education and served as president of the American Association for the Advancement of Education in 1854.²²

The emphasis Bache placed on combining a commitment to science with a commitment to education was echoed in the discussion of groups such as the American Association for the Advancement of Education. It was widely acknowledged that scientific men reflected the progress of the age. Educational institutions like the common school ideally sought to produce new Galileos, Newtons, and Franklins. "The School House," according to Alonzo Potter, president, in 1851, of the American Association for the Advancement of Education, "is the proper avenue to improvement in the . . . advancement of Scientific Discovery. How much might not be done, even in the humblest district school, (if it were rightly taught and governed) to awaken that Active and undying love for *truth*, which is the surest precursor to Discovery in Science."²³

¹⁸ See Bache, *Address of Prof. A. D. Bache, before the Alumni Association of the Central High School*, 4; Bache, *Report on the Reorganization of the Central High-School of Philadelphia*, 31–32; Bache, *Twenty-Third Annual Report of the Controllers of the Public Schools of the City and County of Philadelphia, Composing the First School District of Pennsylvania*, 19.

¹⁹ John S. Hart, "Description of Public High School in Philadelphia," *American Journal of Education* 1 (Aug. 1855): 93–102.

²⁰ Fagan, "Alexander Dallas Bache, Educator," 37.

²¹ Bache to Barnard, 23 Aug. 1843, Bache folder, Gratz Collection.

²² Bache succeeded his scientific colleague Joseph Henry as president. Although Henry Barnard read Bache's *Report on Education in Europe*, he did not include Bache in his *American Educational Biography*.

²³ Alonzo Potter, "Proceedings of the Association [Presidential Address]," *Proceedings of the First Session of the American Association for the Advancement of Education, Held at Cleveland, Ohio, August 19th, 20th, 21st, & 22d, A.D. 1851* (Philadelphia, 1852), 10. Also see Joseph Haven, "Mental Science as a Branch of Education," *American Journal of Education* 3 (Mar. 1857): 125.

Bache's program of scientific and technical education at the high school was not meant to provide job-specific skills for students. Although Bache's Central High endeavored to prepare students for the active pursuits of life, a distinctly Whiggish moral and political vision pervaded all aspects of the educational curriculum. As central concerns, moral education and citizenship training dominated even the more practically oriented classes at Central High School. The practical-technical side of the curriculum reflected the innovative element of Whiggery, while the moral-political side reflected the conservative element. Within the unifying Whiggish vision, the two sides of Bache's educational philosophy became integrated. For instance, in the program established by Bache at Central High, the grades that students received, even for work in science and mathematics, were based on moral conduct and behavior as well as on intellectual and technical performance. In order to instill discipline and develop character in line with Bache's Whiggish commitment to moral stewardship, teachers formally evaluated students during each term sixteen hundred different times.²⁴

For individuals such as Bache committed to character training and moral stewardship, all aspects of life represented an ongoing educational experience. "Life itself [was] but one long day-school," and "education [was] the business of life," as one commentator wrote. When Bache moved to Washington in 1843 to become the superintendent of the Coast Survey, he took along his past educational experiences, goals, and values. Education remained a lifelong interest for Bache, not something that he left behind in Philadelphia. He continued to stay active in professional societies, such as the American Association for the Advancement of Education, and continued to provide advice on the administration of educational institutions. But his educational interests were placed in a new context, and new ways of relating education to science resulted. Just as his scientific concerns were reflected in his educational interests, Bache's educational concerns were embedded in his scientific work, especially with the U.S. Coast Survey.²⁵

As the superintendent of the Coast Survey, Bache ran what an 1849 report of the Franklin Institute called America's "great national scientific school." "The education of a body of young men in the strictest school of modern experimental science," according to the American Philosophical Society, was one of the most important services that the Coast Survey

²⁴ Labaree, *Making of an American High School*, 16–23.

²⁵ Commentator on education quoted by Daniel Walker Howe, *The Unitarian Conscience: Harvard Moral Philosophy, 1805–1861* (Cambridge, Mass., 1970), 257. On Bache's involvement with educational reform after joining the Coast Survey, see Bache to J. A. Deloutte, 24 Sep. 1849, Bache folder, Gratz Collection.

had accomplished for the advance of American science. A report of an official visit to the Washington office of Bache's Coast Survey by members of the American Association for the Advancement of Education similarly declared that "while the principal objects of the survey are universally appreciated its influence on education should not be overlooked, and deserves special notice at our hands."²⁶

Under Bache's supervision, work on the Coast Survey complemented a theoretical scientific education. Bache recognized that the Coast Survey was in an excellent position to give "hands-on" research experience in fields such as geodesy, hydrography, terrestrial magnetism, meteorology, tidology, oceanography, and the natural history of the ocean. According to Bache, Coast Survey employees, including both civilians and military officers, were extremely fortunate to receive a "professional education" from the Survey. "In other countries," Bache contended, "a young man has to pay for such instruction."²⁷

Bache drew heavily from his own Central High School for Coast Survey employees. During the 1850s enemies of the Survey even accused Bache of practicing favoritism in hiring Central High graduates. According to one alumnus, George Davidson, a Coast Survey employee for fifty years, Bache had sought to make Central High "equal to West Point in all points pertaining to a thoroughly practical education, to fit a man for the duties of his professional or civil career." At least in one sense, therefore, Central High ideally functioned like the Military Academy or the German *Realschule*, providing students with an opportunity to learn the fundamentals of advanced science and mathematics. Government agencies, such as the Coast Survey, would then offer an advanced scientific and practical education to the best graduates. Davidson argued that the Central High graduates, because of their superior training in science and mathematics, were often better prepared than students from colleges such as Yale and the University of Pennsylvania. Bache's educational curriculum at the high school was still academically oriented,

²⁶ "Report on the Survey of the Coast of the United States," *Journal of the Franklin Institute* 47 (Mar. 1849): 213. "Report of a Committee of the American Philosophical Society of Philadelphia on the Coast Survey," reprinted in *Speech of Mr. Jefferson Davis, of Miss., on the Subject of the Coast Survey of the United States: Delivered in Senate of the U.S., Monday, Feb. 19, 1849* (Washington, D.C., 1849), 31; "Notice of the Visit of the American Association for the Advancement of Education to the Coast Survey Office," *American Journal of Education* 1 (Aug. 1855): 103.

²⁷ Alexander Dallas Bache, "On the Progress of the Survey of the Coast of the United States," *Proceedings of the American Association for the Advancement of Science, Second Meeting, Held at Cambridge, August, 1849* (Boston, 1850), 164. Quotation from Bache to A. R. Lantin, 21 Dec. 1854, microfilm roll 109, Correspondence of Alexander Dallas Bache, U.S. Coast and Geodetic Survey Records, R.G. 23, National Archives.

with a dominant emphasis on moral education and citizenship training, but it offered training in the technical details of modern scientific theory and practice that provided an excellent educational foundation for the student wishing to pursue science and engineering further.²⁸

Bache's educational work and the role of education in his scientific work can be understood in ideological terms as well as institutional terms. The social and cultural meaning of science helped reinforce the Whiggish ideology of educational reform, which, according to Carl Kaestle, derived from a shared commitment to the values of "republicanism, Protestantism, and capitalism." By looking at the ideological role of science in the context of education, we gain an understanding of the changing meaning of "science" and its use by educational reformers and scientists alike.²⁹

The early- and mid-nineteenth century saw a fundamental shift in science as a cultural activity. As its meaning narrowed from natural philosophy or the general pursuit of knowledge to a more technical and empirical definition, the ideological role of science also changed.³⁰ The newly formed meaning of science reflected specific values that helped determine why scientists and nonscientists alike, such as the members of the American Association for the Advancement of Education, increasingly valued science as a superior cultural commitment. Other historians have mainly assumed that educational reformers only valued science because it would help prepare students for work in an industrial society of increasing commercial complexity.³¹ But the relationship between science and industry during the first half of the nineteenth century was by no means as close as we find it today.³² The industrial or business value of science only partly explains the close connection between science and education in this period.

For Bache, science provided ideological support for both the conservative and innovative elements of the Whiggish cultural vision. Bache

²⁸ Franklin Spencer Edmonds, *History of the Central High School of Philadelphia* (Philadelphia, 1902), 78. Davidson quoted in *ibid.*, 80.

²⁹ Kaestle, *Pillars of the Republic*, 76–77. On the role of ideology in educational reform, see Carl F. Kaestle, "Ideology and American Educational History," *History of Education Quarterly* 22 (Summer 1982): 123–37. For the science side, see, for example, Jack Morrell and Arnold Thackray, *Gentlemen of Science: Early Years of the British Association for the Advancement of Science* (Oxford, 1981), 223–96; Charles E. Rosenberg, *No Other Gods: On Science and American Social Thought* (Baltimore, Md., 1976); Hugh R. Slotten, "Humane Chemistry or Scientific Barbarism? American Responses to World War I Poison Gas, 1915–1930," *Journal of American History* 77 (Sep. 1990): 476–98.

³⁰ See, for example, Laurence R. Veysey, *The Emergence of the American University* (Chicago, 1965), 133–49.

³¹ See, for example, Labaree, *Making of an American High School*, 20–23.

³² See, for example, Arnold Thackray, "Natural Knowledge in Cultural Context: The Manchester Model," *American Historical Review* 79 (June 1974): 672–709.

stressed that science was innovative not only technologically but also instrumentally. Scientific methods and practices were instrumental innovations, Bache believed, that could help transcend the political, religious, and financial controversies in which educational institutions became embroiled. Science, because it was seen as untainted by much of the extreme bias, bigotry, and sectarian debate common to this period, became a useful element of the planned curriculum of such schools as Girard College. Stephen Girard had founded his school with a stipulation that it remain nonsectarian. He thought the divisiveness of religious controversy would always be a bad influence on a child's development. Girard's will emphasized the importance of a school environment free of sectarian bias: "to keep the tender minds of the orphans free from the excitements which clashing doctrines and sectarian controversy are so apt to produce."³³ A scientific curriculum provided common school reformers with a mode of inquiry that would inculcate such values.

Defining science as an objective inquiry based on the immutable and eternal laws of nature, Bache stressed an innovative, instrumental meaning of science that could help lay a foundation for the professionalization of education. While in Switzerland examining educational institutions for Girard College, Bache praised the educator Pestalozzi as the "Bacon of education" for helping to introduce a scientific method and a scientific outlook into educational reform.³⁴ In private correspondence with his friend Joseph Henry, Bache revealed that "the deductions" of his *Report on European Education* "are to me like the deductions from any complex set of phenomena observed, arranged and studied with a desire to come at truth."³⁵ In his optimistic assessment of the role of a scientific approach to education, Bache argued that his *Report* could be applied experimentally to any situation in the United States. "It remains," he contended, "to apply the experimental deductions thus obtained from the old world with the vigour characteristic of the new."³⁶

Scientific management of education demanded the establishment of a new class of professionals—individuals working full-time for the needs of education. Bache lamented that education remains "one of the few subjects in regard to which men do not yet resort for advice to those

³³ Quoted by Herrick, *History of Girard College*, 171–72.

³⁴ Quoted by Odgers, *Alexander Dallas Bache*, 70. On the call for another "scientist" to do for education what Bacon had done for natural science, also see Potter, "Proceedings of the Association [Presidential Address]," 9.

³⁵ Bache to Joseph Henry, 28 May 1839, Joseph Henry Papers, RU 7001, Smithsonian Institution Archives.

³⁶ Quoted by Odgers, *Alexander Dallas Bache*, 80. Also see "Address of President Mahan," *Proceedings of the First Session of the American Association for the Advancement of Education*, 49.

who make it their study and profession.”³⁷ A scientific approach to education would not only benefit the student but also open up new positions of influence and prestige. Science, therefore, partly supported the creation of a self-sustaining profession of educational reformers active in creating professional societies, such as the American Association for the Advancement of Education. The close relationship between the professionalization of education and the professionalization of science was perhaps most obvious with this association, whose leaders self-consciously modeled their society on the similarly reform-minded American Association for the Advancement of Science.

For Bache, however, science not only supported Whiggish innovation but also, in a complementary sense, Whiggish moral, political, and religious conservatism. As a foundation for natural theology and therefore a close ally of religious piety, science could resolve the conflict Bache faced in attempting to organize Girard College according to Stephen Girard’s will, which stipulated that the school remain nonsectarian. As an evangelical Episcopalian, Bache indeed valued religious education and all efforts to inculcate piety in children. In correspondence with the educational reformer Henry Barnard, Bache revealed his “cardinal provision of moral and religious instruction,” which was “no sectarianism but Christian culture.” Bache needed an educational practice that would resolve his dilemma over the organization of Girard College, that is, how to impart religious morality and piety when the school lacked a formal denominational connection. He wished to placate both sides in the dispute and satisfy his own personal religious commitment.³⁸

In the context of education, science served Christian moral ends through its connection to natural theology: in contemplating nature, the student of science was contemplating God’s handiwork. The study of natural history, according to Bache, “leads so directly to that of natural theology, that the propriety of introducing them in connexion is obvious.”³⁹ “The teachings of Science should, and I am convinced, are in the main such as to lead Man to a closer Walk with God,” Bache argued. “He who muses with the Psalmist on God’s works, will not neglect the

³⁷ Quoted by Odgers, *Alexander Dallas Bache*, 85.

³⁸ Bache to Barnard, 27 June 1844, Barnard Papers. Bache’s interest in avoiding denominational preferences in schools was shared by other educational reformers, most notably Henry Barnard. See, for example, the prospectus to the first volume of Absalom Peters and Henry Barnard’s *American Journal of Education and College Review* 1 (1856): vi.

³⁹ Bache, *Report to the Controllers of the Public Schools, on the Reorganization of the Central High-School of Philadelphia*, 22.

higher musings on his Word.”⁴⁰ Thus by emphasizing science in education, reformers such as Bache were imparting religious sensibilities to students while avoiding divisive sectarian debates.

Bache’s concern for science in the public school curriculum also existed as a fitting aspect of republican ideals.⁴¹ As we have seen, common schools, such as Bache’s Central High School, placed a heavy emphasis on a curriculum and an educational philosophy that emphasized moral training and the notion that, in Bache’s words, “character could be moulded.”⁴² The moral-training movement emphasized individual values that would help assure the survival of the republic. By emphasizing science and mathematics in the curriculum, educational reformers such as Bache were providing a program of moral education that stressed republican values. The ethos of science in which students were immersed in the classroom involved the same moral values of discipline, efficiency, sacrifice, honesty, and intelligence. Chemistry, according to Bache, “may readily be taught in a way eminently calculated to improve the faculties of observation, the memory, and the reasoning powers.” Similarly, scientific drawing “is desirable for all, on account of the correctness of eye and facility of hand which it tends to give.” Above all, Bache and other reformers believed that science would inspire the student to the “love for truth.” Republican citizens could learn from the example and methods of science how to avoid self-interest and demonstrate respect for the highest ideals of sacrifice and virtue. According to one of Bache’s colleagues writing in the *American Journal of Education*, “the contests which sometimes arise among men of science, are seldom acrimonious or protracted; differing in this respect from political and ecclesiastical quarrels. Theirs is a sphere of competition where no local jealousies or sectional interests, or political rivalry, can array them against each other, or em-

⁴⁰ Alexander Dallas Bache, “A National University: Remarks at the Opening of the Fifth Session of the American Association for the Advancement of Education,” *American Journal of Education* 1 (May 1856): 479. Also see Bache, *Report to the Controllers of the Public Schools, on the Reorganization of the Central High-School of Philadelphia*, 22. For another example of the importance of the use of science for teaching religious and moral lessons, see Charles Brooks, “Moral Education,” *American Journal of Education* 1 (Mar. 1856): 340.

⁴¹ On Bache’s belief in the importance of public education for republican values, also see, for example, Bache to Deloutte, 13 Aug. 1842, Bache folder, Gratz Collection. For the views of other reformers on the link between science and republican values, see “Abstract of Mr. Bates’s Lecture, and the Discussion Thereon,” *Proceedings of the First Session of the American Association for the Advancement of Education*, 34; Horace Mann, *Proceedings of the National Convention of the Friends of Public Education, Held in Philadelphia, October 17, 18 & 19, 1849* (Philadelphia, 1849), 12.

⁴² Kaestle, *Pillars of the Republic*, esp. 75–103; Bache, *Address before the Alumni Association of the Central High School*, 5.

bitter their feelings.” Thus a scientific education meant a moral education that would mold the individual republican citizen.⁴³

A Whiggish commitment to moral stewardship also infused Bache’s educational and scientific activities on the Coast Survey. The practice of science on the Coast Survey was intimately bound up with the development of moral character and moral discipline. Many Coast Survey employees started out young, often right out of school, and were exposed to a continuous system of moral education. Bache promised that only the most estimable habits of “punctuality, regularity, and persevering attention” would be developed in Coast Survey workers. College professors writing recommendations for Coast Survey applicants and concerned parents applying on behalf of their children commonly emphasized the disciplinary function of the Coast Survey. Recommendations from college professors stressed applicants’ moral character, sometimes as if this were more important than their acquired scientific and technical skills. Like Bache’s Central High School, where academic grades depended on moral performance, the Coast Survey served a broad educational role. Parents often saw the Coast Survey as an ideal place for their sons to combine the development of character and moral worth with valuable educational participation in scientific work. The Coast Survey, according to one parent, was “an excellent school for improvement.” The moral and intellectual training of an antebellum scientific education thus operated on a number of different levels: from the common school through the postgraduate institution.⁴⁴

For Bache, science not only helped legitimate but also integrate the innovative and conservative elements of Whiggish culture. A scientifically oriented curriculum, for example, incorporated older and newer concepts

⁴³ Bache, *Report to the Controllers of the Public Schools*, 22–23. On the disciplinary function of scientific instruction, also see “Address of President Mahan,” *Proceedings of the First Session of the American Association for the Advancement of Education*, 44, 48. Potter, “Proceedings of the Association [Presidential Address],” 10. “American Association for the Advancement of Science,” *American Journal of Education* 3 (Mar. 1857): 152. On the moral value of nineteenth-century science, also see David A. Hollinger, “Inquiry and Uplift: Late Nineteenth-Century American Academics and the Moral Efficacy of Scientific Practice,” in *The Authority of Experts: Studies in History and Theory*, ed. Thomas L. Haskell (Bloomington, Ind., 1984), 142–56; John Servos, “Mathematics and the Physical Sciences in America, 1880–1930,” *Isis* 77 (Dec. 1986): 614.

⁴⁴ Bache to Benjamin W. Richards, 7 July 1847, roll 19, Bache Correspondence, Coast and Geodetic Survey Records. On grading at the Central High School, see Labaree, *Making of an American High School*, 17. For the parent’s remarks, see Edward W. David to Bache, 12 Aug. 1857, roll 172, Bache Correspondence, Coast and Geodetic Survey Records. Many scientists were anxious to have their sons work on the Coast Survey, viewing it as an ideal place to combine a scientific and a moral education. See, for instance, John Locke to Alexander Dallas Bache, [1846?], roll 9, Bache Correspondence, Coast and Geodetic Survey Records.

of education. On the one hand was the call for a traditional, classical education, which seemingly had limited “practical” value. Educators had long favored theoretical and abstract studies as part of a classical education. They valued science and mathematics as ways of utilizing difficult theoretical material to exercise the mind, in other words, as contributions to mental discipline. On this point Bache argued further that “the amount of intellectual culture to be gained by the exercise of arithmetic and algebra appear to me to be undervalued.”⁴⁵

On the other hand was the call for a practical education that offered technical knowledge appropriate to industrializing society. Science fit well into this alternative educational curriculum, given the technical knowledge it offered. Bache connected “technology” to “physics and chemistry” and argued that all three together “would be of service” in later life.⁴⁶ In Bache’s scientifically oriented curriculum innovative technical training dovetailed with conservative programs of mental discipline.

Rather than being contradictory, Bache’s innovative emphasis on scientific objectivity and scientific method reinforced his conservative emphasis on the organic community. In the view of educational reformers such as Bache, objective scientific standards would eliminate some of the petty social and sectarian divisions that threatened to undermine the organic society. Scientific progress was viewed in republican terms that subordinated individual interests to the common good. Scientific innovations would come through a community of like-minded truth seekers building on each other’s work and sharing a commitment to the good of the whole. Science, according to Bache’s colleague Joseph Henry, affords “the means of a community of feeling between persons the most widely separated. Its tendencies are republican in the proper sense of the term.”⁴⁷ Thus, in Bache’s view, scientific innovations strengthened the larger republican order.

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Under the impact of new forces and developments in the late nineteenth century, the innovative side of Whiggery became separated from the conservative side and took on a life of its own. At the same time, the technical-instrumental meaning of science became detached from and then grew to dominate the moral-political meaning. The cultural balance was upset mainly by structural changes, such as industrialization, urbanization, and the development of corporate capitalism. Market mech-

⁴⁵ Bache, *Report on Education in Europe*, 322.

⁴⁶ *Ibid.*, 267.

⁴⁷ Henry quoted in Reingold, ed., *The Papers of Joseph Henry*, 5: xiii.

anisms also acted within institutions, such as Bache's Central High School, to initiate change. Labaree has argued that an internally defined market component, which "took the form of an intensely meritocratic pedagogy in which students competed on equal terms for scarce academic rewards in an idealized model of the capitalist market," eventually helped undermine Bache's original moral-political common school curriculum.⁴⁸

This general tendency resulted in the replacement of antebellum "aristocrats of character" with early twentieth-century "administrative progressives," who sought to remove education from the political-moral realm by treating it as a technical problem to be handled by scientific professionals or experts using rational and efficient scientific methods and procedures.⁴⁹ John Higham has used the phrase "technical unity" to describe this new ideology or "system of integration."⁵⁰ For Bache, science held explicit moral-political connotations; the new leaders, however, often used the "gospel of science" to legitimate less explicitly their own political, social, and cultural interests by appealing to the objectivity and rationality of the "science of education."⁵¹ Like Bache, many of these leaders had taught science prior to turning to educational study and administration.⁵² But while Bache combined the moral-political and technical-instrumental approaches, the administrative progressives treated education as primarily a technical problem.

As part of the process of bureaucratization, a stratification of the curriculum has taken place with separate tracks for academically and vocationally oriented students. The high school, according to Labaree, has become more like a "market-place, as market forces have transformed republican politics into consumer politics."⁵³ For the administrative progressives, science primarily functioned as an efficient mechanism for social differentiation and vocational training rather than as a tool for building community and character.

Although Bache connected Central High to employment on the Coast Survey, his educational vision was primarily academic. Bache did not

⁴⁸ John Higham, "Hanging Together: Divergent Unities in American History," *Journal of American History* 61 (June 1974): 5–28. Labaree, *Making of an American High School*, 64.

⁴⁹ Tyack and Hansot, *Managers of Virtue*, 100; Tyack, *The One Best System*.

⁵⁰ Higham, "Hanging Together," 19.

⁵¹ Tyack and Hansot, *Managers of Virtue*, esp. 119–54.

⁵² *Ibid.*, 120.

⁵³ On vocational education, see Harvey Kantor, "Vocationalism in American Education: The Economic and Political Context, 1880–1930," in *Work, Youth, and Schooling: Historical Perspectives on Vocationalism in American Education*, eds. Harvey Kantor and David B. Tyack (Stanford, Calif., 1982). Labaree, *Making of an American High School*, 177.

desire job-specific courses, because he believed a practical, scientific education provided the habits of mind and body of knowledge necessary for the real world, which, ideally, would share his Whiggish concerns. In pursuing the scientific and technical goals of the Coast Survey, for example, Bache sought to build character and instill communal values in his subordinates. For Bache, science, mathematics, and modern languages not only prepared students for general problems of modern society, but also replaced classical languages and literature as new symbols of traditional liberal culture embracing moral, political, and social goals.

Although Bache's educational vision was distinct from that of the administrative progressives, the observation can still be made, at least retrospectively, that the seeds of later developments were embedded in Bache's activities as an educational and scientific reformer. As David Tyack and Elisabeth Hansot have argued, the new leaders of the early twentieth century were not rejecting traditional values but were "selectively emphasizing certain parts of their heritage."⁵⁴ By the Progressive Era distinctions between practical and classical education and between science and moral education were sharper. No longer seeing these types of education as complementary, Progressives turned especially to the technical-scientific heritage. Through an analysis of the scientific and educational work of Alexander Dallas Bache, roots of later intellectual alignments and distinctions become clearer and the sources for present categories within educational thought become more understandable.

⁵⁴ Tyack and Hansot, *Managers of Virtue*, 116.