

**Beyond "Curriculum and Enrollments":
MIT and the Expansion of the American Science Community, 1820-1880
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ABSTRACT: This paper revisits a long-standing historiographical debate over the curriculum in early to mid nineteenth century American higher education. It addresses themes that have been largely overlooked by both traditional and recent scholarship, themes that include the expansion of the American scientific community, the founding of the Massachusetts Institute of Technology, and the educational reform efforts of William Barton Rogers, conceptual founder of MIT.

Curriculum historians have long written about the development of nineteenth century American higher education. Scholarly attention given to transformations of the early to mid nineteenth century, in particular, has generated two differing interpretations. One interpretation, dubbed as the "traditional view" or the "established interpretation," describes the largely classical curriculum of the era as unpopular and impractical. For the most part, traditionalists have linked broader societal changes of the antebellum and mid nineteenth century periods with perceptions about the college curriculum. Societal changes included rapid urbanization, industrialization, the rise of the Jacksonian era, and the push for democratic reform movements. In this light, the curricular experimentation that occurred at such institutions as Harvard in the 1830s and Brown in the 1850s serve as indicators of grassroots demand for curricular change. In both cases, traditionalists have tended to view the experiments as attempts to accommodate a practical (i.e., scientific and practical studies) and democratic (i.e., electives) spirit of the times.¹

A second, more recent interpretation has sought to challenge the traditional account. An exemplar of this line of scholarship is David Potts' recently republished "Curriculum and Enrollments: Assessing the Popularity of Antebellum Colleges" in Roger Geiger's *The American College in the Nineteenth Century* (Nashville, 2000). Potts, among others, has argued that traditionalists have relied too heavily on anecdotal accounts and too little on such hard data as statistics. According to Potts, statistics tell us that the experiments at Harvard and Brown were failures and, thus, cannot be cited as examples of the demand for curricular change. What's more, Potts argues, statistics reveal that Yale College was not only responsible for the influential Report of 1828—an oft-cited document for the defense of the classical curriculum—but also enjoyed the status of being one of the most well-attended colleges in the nation. The hard data centered on enrollment figures suggests that students preferred classical studies. Based on this body of evidence, Potts concludes that little

demand for scientific and practical studies existed during the early to mid nineteenth century. Following the same line of interpretation, Roger Geiger has argued that nowhere "can enrollment data be invoked to demonstrate that significant numbers of antebellum students yearned for a more practical collegiate curriculum."²

Both traditional accounts and recent scholarship, however, have overlooked an important mid-nineteenth century indicator of curricular change: the founding of the Massachusetts Institute of Technology in 1861. The oversight is, in part, the result of a lack of scholarship on both MIT and its conceptual founder. Only one published study to date—Samuel C. Prescott's *When MIT was Boston Tech*—offers sustained attention on MIT and its founding. Prescott, head of MIT's biology department during the Great Depression, provides a narrative account of some of the milestones in MIT's history. But lacking in his review is an analysis of the Institute in relation to the broader literature on American higher education. Likewise, William Barton Rogers (1804-1882), conceptual founder of the Institute, has received very little attention in the historiography. At present, no biography on the educational reformer exists.³

William Barton Rogers and MIT offer case studies with which to reassess the historiographical debate. During the early to mid nineteenth century, Rogers operated within a social and intellectual context defined by the expansion of the American science community. Statistical data derived from Rogers' context and from the first decades after the founding of MIT provide insight into widespread interest in science instruction unaccounted for in both the traditional as well as recent interpretations.⁴

ENROLLMENT FIGURES VS. STUDENT INTERESTS AND REFORM ACTIVITY

There is no disputing the robust enrollments at such institutions as Yale during the antebellum period. For most of the early to mid-nineteenth century, classical colleges not only attracted a dominant share of the student population, but also, through their alumni-turned-educational leaders, helped shape America's undergraduate course of study more broadly. With Yale's antebellum enrollments hovering around 300, Harvard's around 200, the impact extended well-beyond New England. When the University of Georgia opened its doors at the start of the nineteenth century, for instance, its leadership came from New Haven as did its curriculum (almost verbatim). The recent view has provided a much-needed corrective to undocumented and under-documented claims of the unpopularity of

classical colleges.⁵

But enrollment statistics alone present an incomplete, if not misleading, picture. Given the equally robust number of science-related reform efforts of the era, one could hardly conclude that satisfaction with the classical curriculum was complete. Scientists, in particular, agitated for professional and educational changes in ways that call for greater attention in the curriculum historiography. Missing from recent scholarship is an adequate incorporation of the history of science literature that cites the antebellum period as one of the most important for the professionalization of American science. With professionalization came the desire to codify areas of scientific knowledge and to regulate instruction of that knowledge. Of particular relevance are the following statistics found in the history of science literature. The American Association for the Advancement of Science attracted approximately 2200 members--presenters and attendees at annual meetings--between 1848 and 1860. This is a conservative figure that indicates the size of the first nation-wide professional science organization that met annually in major urban areas across the country. The total number of American scientists and science enthusiasts between 1800 and 1860, meanwhile, has been estimated at over 14,000, including researchers, practitioners, and cultivators of science.⁶

With the formal and informal expansion of the science community came a broader diffusion of scientific knowledge through the popular science lecture. Of the many institutions offering public lectures, Boston's Lowell Institute was perhaps the most well-known of the era. From 1840 to 1850, the Lowell Institute hosted 878 lectures on topics ranging from religion, history, literature, art and science. By far the most popular (over 74%) consisted of scientific topics as delivered by such scientists as Benjamin Silliman, Asa Gray, Louis Agassiz, Charles Lyell, and others. During the decade, all of the science lecturers (100%) repeated their lectures to over-flow audiences. For a single year alone (1841-1842), a series of scientific lectures at Lowell drew 33,000 listeners from a city of approximately 100,000. Only three of eighteen non-science lecturers (17%) were asked to repeat their presentations for a second audience.⁷

The popularization of science caught the attention of traditional college students as well. Indeed, they recorded their responses to the expanding antebellum science community, responses that are of more value than student enrollments when assessing the popularity of the traditional course of study. Classical college students not only attended classes, but also debated the value of what they were learning. If the recent view is correct, campus sentiment would have registered general satisfaction with the classical curriculum during the antebellum period. But 117 debates on education-related topics held by 23 debating societies at 19 colleges (drawn from a sample of each section of the country: northeast, southeast, west) held

between 1815 and 1861 reveal that opinion was sharply divided. Out of the total number of education-related debates, forty-nine were directly related to the classical curriculum. In approximately 45% of these college society debates, students either disagreed with the state of the classical curriculum or the amount of attention devoted to it or affirmed the need to change the traditional college curriculum to attend to more practical and scientific studies.⁸ Students recorded "Negative" verdicts to such questions as the following:

Do the dead languages deserve so much time, as is required, in our present course of study (Harvard, 1834)?

Should the Dead Languages form a part of a collegiate [sic] course (Ohio University, 1837)?

Are the Classics worthy of the study devoted to them (University of North Carolina, 1848)?

Is the study of the dead languages, as now pursued, the best disposition of one's time (Dartmouth, 1850)?⁹

Students reached "Positive" verdicts to such questions as the following:

Is the study of Mathematics more beneficial than the study of Ancient Languages (Hobart College, 1846)?

Ought the present system of collegiate education be changed (Shurtleff College, 1855)?

Resolved that the student in college should direct his studies with reference to some particular profession (University of Wisconsin, 1857)?¹⁰

The debates themselves indicate that students were well-aware of the expansion of the scientific community and the development of alternative forms of higher education. What their verdicts and conclusions tell us is that they were almost evenly divided in their views toward science and practical knowledge. Antebellum satisfaction with the classical curriculum, thus, cannot be accurately measured in terms of enrollments alone.

While a combination of changes in faculty composition (i.e., a ten-fold increase in science faculty at select colleges between 1828 and 1860) and additions to libraries (i.e., an almost eight-fold increase in science and medical journals in publication between 1805 and 1849) offered traditional college students greater exposure to science, members of the scientific community called for more comprehensive reforms. William Barton Rogers, one such scientist, taught natural philosophy and geology as well as conducted scientific research for approximately twenty-five years in antebellum Virginia. His experiences at the College of William and Mary, the University of Virginia, and as director of the state-sponsored Geological Survey of Virginia informed his ideas about college-level reform. Like many of his scientific peers, he concluded that

traditional classical colleges were not conducive to the advancement and diffusion of scientific knowledge.¹¹

In two reform proposals, Rogers argued that the advancement and diffusion of science required independent institutions of higher learning. The first proposal, "For the Establishment of a School of Arts, Franklin Institute, Philadelphia," appeared in 1837 while he taught at the University of Virginia. His second, "A Plan for a Polytechnic School in Boston," followed less than a decade later. Common to both proposals was a four-part view about science and American higher education. First, he highlighted the problem that scientific knowledge had far outstripped the offerings of most classical colleges. The knowledge explosion of early to mid nineteenth century, to his mind, prompted the need for new institutions that placed scientific studies at the center of the curriculum. Second, he proposed a comprehensive system of science instruction. By comprehensive, he referred to the idea of specialization and sub-specialization. Third, Rogers placed the laboratory at the center of the curriculum. Traditional institutions, he lamented, failed to adequately fund such instruments or allow student access to them. Fourth, he valued practical and theoretical studies equally. Rogers considered both essential to the expansion of scientific knowledge. Fueling his four-part ideal was an ambitious effort to meet the needs of a growing base of scientists and practitioners. Underlying the proposals was his desire to "soon overtop the universities of the land in the accuracy and the extent of its teachings in all branches of positive knowledge." His plans failed to establish the proposed institutions, but they laid the groundwork for the founding of MIT.¹²

Rogers, of course, was hardly alone. West Point came close to achieving what Rogers had in mind, as did the Rensselaer School (later a Polytechnic Institute). Neither, however, had as its aim the preparation of researchers for the scientific community.¹³ Other reformers of the 1850s groped for a handle on the public's apparent desire for science and technology, but many of their ideas fell on hard times or unfortunate circumstances. Henry Tappan promoted the idea of graduate-level science instruction at the University of Michigan, but he had difficulty shaking off a tenuous start. During Tappan's administration, few students participated in his programs that, unlike West Point and the Rensselaer School, emphasized theory over practice. Cornell's President Andrew D. White later dubbed the practical offerings at Ann Arbor as "wretchedly meagre." Similarly, James Hall, A. D. Bache, and the Lazzaroni (a circle of elite nineteenth century scientists) backed the idea of a University in Albany, New York. Focused on advancing theoretical science, the plan sought to bring together the Lazzaroni in one place to create a center for scientific research and teaching. Economic and political set-backs ultimately torpedoed their effort. Other short-lived and long-lasting institutions such as Norwich (1820), Gardiner Lyceum

(1823), Franklin Institute (1824), the Citadel (1843), the U.S. Naval Academy (1845), Polytechnic College of Pennsylvania (1853), Brooklyn Polytechnic Institute (1855), Cooper Union (1859), and schools in Cleveland, Ohio (1857) and Glenmore, New York (1859) lacked one or more elements of Rogers' idea of a comprehensive, laboratory-based, theoretical and practical institute of science.¹⁴

Nevertheless, of those that succeeded, the vast number of reform efforts within and external to the classical college suggest the existence of more than a mild interest in scientific and practical instruction. The cumulative enrollment at twenty-three programs of science in traditional and independent institutions exceeded 2800 students between 1864 and 1865. As such, the reform efforts and science enrollments of the early to mid nineteenth century reveal a strong desire for curricular change, particularly among a rapidly expanding base of scientists. The desire for change was not based on a vague interest in progress (as traditional interpretations have portrayed), but rather on the immediate needs of scientists for the advancement of knowledge that depended on a future generation of trained generalists and specialists. Rogers, among other scientists, believed that support for the advancement of scientific knowledge necessitated changes in the diffusion of the same. Thus, recent scholarship based on enrollment figures at America's oldest and most respected institutions provide an important, yet incomplete analysis of what students sought from the antebellum college. Calls for changing the college curriculum emanated from students, faculty, and researchers and were stimulated by the expansion of American science.¹⁵

INTERPRETING FAILED REFORMS IN THE ANTEBELLUM COLLEGE

How then should we interpret the failed reform efforts in the antebellum college? According to recent scholarship, failed experiments at Harvard and Brown signaled a weak spirit of support for curricular change. Under former congressman Josiah Quincy in 1835, Harvard made dramatic changes to its undergraduate curriculum partly in an effort to increase enrollments. The new policy established that after the freshman year all courses would be considered electives, thus freeing students to choose among the institution's offerings. While the aim was to appeal to the changing needs of society, the result had little impact on enrollments. By 1843, Harvard viewed the experiment as a failure and reintroduced the prescribed classical curriculum. Brown University tried its hand at reform under Francis Wayland in 1850. As president of Brown in the 1840s and 1850s, Wayland advocated large-scale changes to the traditional undergraduate course of study in light of an emerging middle class. As a political economist, Wayland analyzed the condition of American colleges and concluded that because they offered superficial, rigid, and antiquated courses, they stood on the brink of

bankruptcy. Wayland resigned the presidency of Brown in protest of the university's resistance to change. After some negotiations, he retracted his resignation on the condition that the Brown corporation would willingly enact a wholesale revision to the institution's program. The trustees agreed, raised \$125,000 for the new curriculum at Brown, and welcomed Wayland back to campus. Among the most controversial elements of the Report, Wayland announced an end to the fixed curriculum, the beginning of a free elective system, and the establishment of a program of applied science, in addition to courses in agriculture, law, and teaching. Five years after the publication of the Report, Brown trustees ousted Wayland and returned the institution to its pre-Wayland years.¹⁶

To such scholars as Potts, the Harvard and Brown failures indicate that antebellum society did not have as much interest in scientific and practical knowledge as traditional interpretations have suggested. Enrollments at Harvard were relatively unchanged by Quincy's effort. As for Brown, the reform was discontinued after five years. Although Wayland witnessed a sixty percent increase in enrollments during the change in curriculum, Potts assumes the surge was largely the result of lax academic requirements and not a sign of interest in science or applied subjects.¹⁷

Recent scholarship on the failed reforms, however, faces two difficulties. First of all, the source of reform behind the two notable examples came from non-scientists. Josiah Quincy, a former politician, spent the bulk of his career in politics, as Boston's Mayor, a state legislator, and a Congressman. He had no particular interest in science and was opposed to introducing utilitarian or applied forms of studies into the curriculum. Quincy considered himself an ally of the humanistic studies, more so than as an ally of scientists. His reform effort, therefore, had more conservative than reformist elements. In the words of his son, he wanted Harvard to be "a nursery of high-minded, high-principled, well-taught, well-conducted, well-bred gentlemen." The changes he proposed for Harvard touched on structural, rather than curricular issues that addressed problems of student discipline. Due to riots and sustained conflicts between students and classicists in the year before Harvard's reform, Quincy dismissed the entire Sophomore class and lost many other students as a result. The campus tensions forced Harvard's enrollments to plummet, causing it to trail Yale, Union, Princeton, and Dartmouth in student numbers. An elective system, thus, offered one way for Quincy to both quell student unrest and raise enrollments. The reforms, motivated by student disorder, lacked substantive interest in the expansion of curricular offerings. Although students were at liberty to select their course work after their first year, Harvard made no substantial changes in actual offerings. The reform had little to do with expanding scientific and practical studies. Rather, it established an elective system that existed on paper, rather than in practice.¹⁸

In the case of Francis Wayland at Brown, the elective system was coupled by curricular change. Wayland, drawing from his expertise in political economy, sought to expand the market value of the college course of study. To this end, he broadened the scope of offerings yielding a significant increase in student population. Potts rightly concludes that Brown provided a greater measure of practical scientific course work and that the program requirements were relaxed. "The evidence points," he argues, "primarily to a market for lower academic standards in any subject studied." As with Quincy, the motivation behind the Brown reform influenced the nature and character of the reform itself. With enrollments as the leading concern in Wayland's decision-making, Brown gained a reputation of mediocrity instead of excellence.¹⁹

Strong, credible backing for science and practical studies stood at the center of neither reform. Given that a significant base of support for curricular change came from the scientific community, this point should not be left unacknowledged. Electives and minor adjustments to course offerings were hardly the earmarks of reform motivated by the advancement and diffusion of scientific knowledge. Reforms of this kind would not have generated much enthusiasm from such scholars as Rogers and his generation of researchers. What they demanded and agitated for was more comprehensive. Rogers refers to this problem in reference to Harvard's Lawrence School of Science in the 1850s. Harvard's science program "should be in reality a school of applied science, embracing at least four professorships, and it ought to be in great measure independent of the other departments of Harvard." Only a truly independent program, he believed, would have enough freedom to develop studies along the lines of theory and practice, to make science more than an "aside" in the curriculum, and to offer alternative modes of instruction. Such a program, Rogers continued, would "embrace experimental physics," for example, to expose students to "applied mechanics" and the "principles" underlying such applications. The changes made at Harvard and at Brown, according to Rogers, failed to adequately address demands for science in the college curriculum.²⁰

A better measure of popular interest in scientific and practical studies centers on the founding of MIT--the second difficulty facing the recent interpretation. The Institute differed from previous reforms in origins and scope. Rogers' scientific background informed the educational reform effort. In preparing the founding documents and advocating the merits of the Institute, his primary motivation was neither student unrest nor expanding the market scale of applied instruction. Instead, Rogers drew on his personal and professional experiences as a science professor and researcher, articulating what he perceived to be the academic needs of the scientific community. During his years in Virginia, he had participated in professionalization movements, including founding or

leadership roles in the American Association of Geologists and Naturalists, the American Association for the Advancement of Science, and, later, the National Academy of Science. Rogers drew on his affiliations and his professionalization activities to animate support for the Institute effort. Equally important, he successfully lobbied politicians who granted MIT's charter on April 10, 1861, tapping into a broader public desire for advanced science instruction. The establishment of the Institute can be distinguished from the Harvard and Brown experimentations in terms of its relationship to the scientific community.²¹

Rogers' plan for MIT contained three parts. One division, the Society of Arts, centered exclusively on research. Its aim was to join students, faculty, and independent scholars in the enterprise of scientific inquiry. The topics explored ranged in scope, from the practical to the theoretical, and were presented at regularly held meetings as well as published in the Institute's *Journal of Industrial Science and Art*. A second division called for the creation of a Museum of Industrial Art and Science. Rogers' goal was to create a public display of innovations of "prominent importance" derived from science. The products and processes to be displayed were also to address practical and theoretical topics. For the final division, Rogers proposed a School of Industrial Science and Art. The school would offer systematic instruction in both the "applied sciences" as well as "fundamental principles" or theoretical foundations of science. In each of the five originally proposed departments—Design, Mathematics, Physics, Chemistry, and Geology—specialization and sub-specialization were encouraged and taught by way of laboratory instruction to inculcate "habits of close observation and exact reasoning." Through the three divisions, particularly the teaching branch, Rogers' aim

was to promote "the highest grade of scientific culture."²²

MIT AND HARVARD'S LAWRENCE SCHOOL OF SCIENCE COMPARED

Despite Rogers' intentions, the central question remains: Was there a demand for an institution like MIT? The final test for Rogers and MIT as counter case studies to the recent interpretation centers on whether the Institute was favorably received in terms of enrollment data. David Potts and Roger Geiger have turned to a limited body of enrollment data to support the view that students showed little interest in curricular change. As this paper has argued, the broader antebellum context and the nature of the failed reforms tend to conflict with the recent interpretation. But what of MIT?

Enrollments during the Institute's first two decades reveal a strong desire for the kind of scientific studies the Institute offered. It suggests that demand for science instruction of this sort did not appear overnight and was most likely an interest prevalent during the antebellum period. In the first analysis (Table One), the comparison of enrollments between MIT and Harvard's Lawrence Schools of Science casts doubt on the assertion that there was an absence of popular interest in scientific studies.²³ MIT, as proposed by Rogers, established a departure from previous collegiate norms by proposing an institution for the advancement and diffusion of scientific knowledge. As such, the Institute did not attempt to conflate old traditions and new innovations. Rather, it attempted a break from the past with an independent form of higher learning. Enrollment trends at MIT demonstrate that a sustained yearning for a rigorous program of practical, scientific studies existed from the Institute's inception.

TABLE ONE. ENROLLMENTS COMPARED²⁴

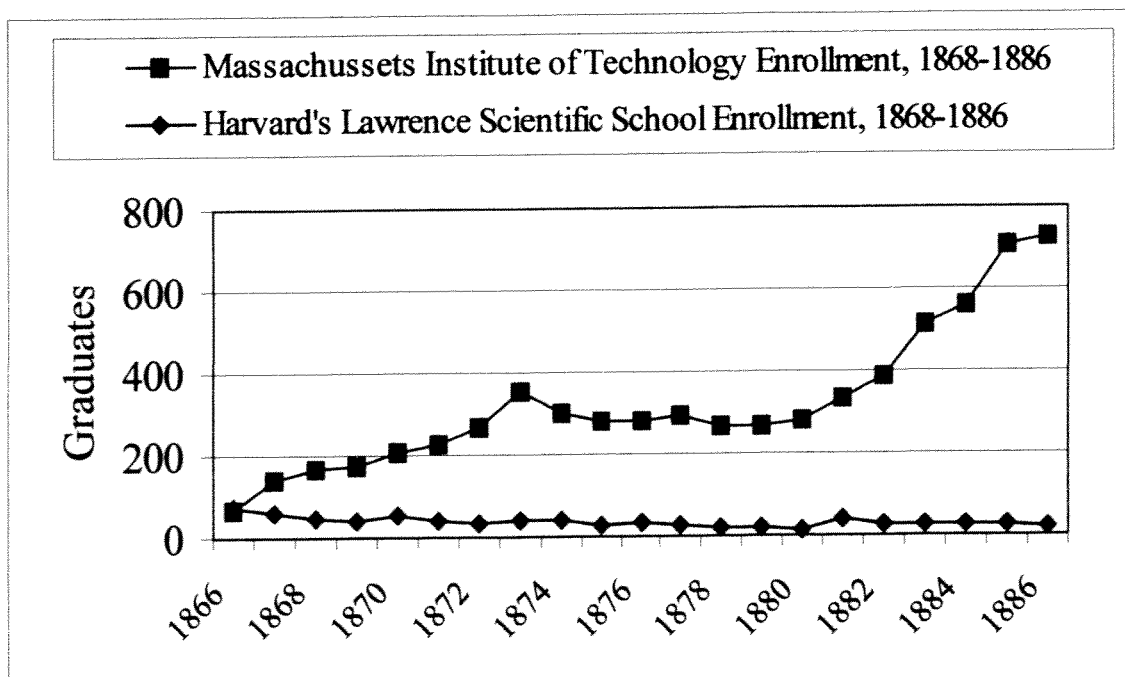
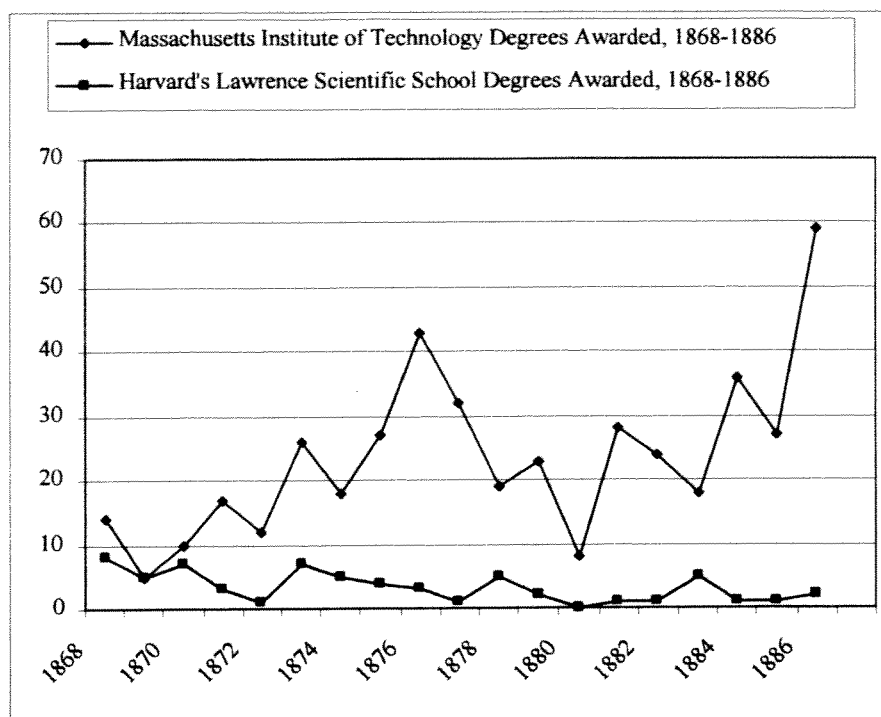


TABLE TWO. COMPARISON OF DEGREES AWARDED²⁴



In the second analysis (Table Two), enrollment statistics confirm that a fraction of the number of students enrolled at MIT finished the program. This is due to the large number of non-degree seeking students who attended public science lectures. The interest level shown here as well as the differences between MIT and Harvard's Lawrence School of Science are still substantial. Recent scholarship suggests that the low graduation rate from science-centered institutions indicate a flagging general interest in science. Contrary to this assertion, the enrollments and degrees awarded at the Institute during the period reflect a more widespread popular fervor for science than recent interpretations allow.

The number of non-traditional students attending MIT indicate that even students uninterested in a formal course of study were still willing to patronize science instruction. Interest levels of this degree had long since existed in the antebellum period as revealed by the popularity of the Lowell Institute lecture program.

CONCLUSION

Neither traditional nor recent interpretations of science in early to mid nineteenth century American higher education offer satisfactory conclusions about the college curriculum. Both have tended to overlook Rogers, MIT, and the expanding base of scientists as relevant points for consideration. The traditional historiography depicts the Institute and its founder as seekers of progress for the sake of progress, without

attending to the subtleties of Rogers' conception of MIT as rooted, to his mind, in the needs of the American science community. Previous interpretations invoke MIT as part of the crusade against the stodgy classical curriculum, rather than offering an analysis of the internal logic behind the Institute's founding. Current historiography of the recent view rightly encourages a rethinking of the previous scholarship and its interpretation about the unpopularity of the classical antebellum college. At the same time, the recent interpretation overextends the conclusion—as based on enrollment figures and failed reform efforts at classical colleges—when making assertions about science and society in early to mid nineteenth century America. For the purposes of this debate, what Rogers and MIT suggest for current scholarship is that enrollment figures must be considered within the context of science-based reform movements and failed reforms must be analyzed in relation to the needs of the scientific community. While recent scholarship has faulted traditional accounts for overemphasizing antebellum excitement for curricular reform, we would do well not to underestimate it either.

Notes

¹ Richard Hofstadter and Frederick Rudolph are perhaps the two most often cited traditionalists in the curriculum history debate. In *Academic Freedom in the Age of the College* (Rev. ed., New Brunswick, 1996), Hofstadter

argued that "while there was much dissatisfaction with the Old College curriculum among educators and many attempts at reform were made, it was not until the university era that the prescribed classical curriculum really broke down" (227). Fredrick Rudolph came to a similar conclusion in *Curriculum: A History of the American Undergraduate Course of Study Since 1636* (San Francisco, 1977). Rudolph stated that "the future of the [antebellum] American college, a definition of what should be going on there, and a stable sense of the curriculum would have to be determined by Yale" (65). Yale's Report of 1828, he reminded readers, provided a widely-read defense of the classical college at a time when most American were clamoring for something else. To Rudolph, the defense of the classics contributed to the "unpopularity" of most American colleges "into the 1870s and beyond" (99).

² Two studies that incorporate the recent interpretation include Christopher J. Lucas, *American Higher Education: A History* (New York, 1994) and Roger Geiger, ed., *The American College in the Nineteenth Century* (Nashville, 2000). Lucas, for example, states that "allegations that the typical antebellum college was unresponsive to popular demands for curricular reform throughout the first half of the nineteenth century do a serious injustice to the historical record. In point of fact, the American college's course of study was never rigid, and it evolved continuously over time in both form and content" (131). Additional studies addressing antebellum higher education include the following: James Axtell, "The Death of the Liberal Arts College," *History of Education Quarterly* 9 (1971), 339-352; Natalie A. Taylor, "The Ante-Bellum College Movement: A Reappraisal of Tewksbury's Founding of American Colleges and Universities," *History of Education Quarterly* 13 (1973), 261-274; James McLachlan, "The American College in the Nineteenth Century: Toward a Reappraisal," *Teacher's College Record* 80 (1978), 287-306; David Potts, "American College in the Nineteenth Century: From Localism to Denominationalism," *History of Education Quarterly* 11 (1971), 363-380; David Potts, "Curriculum and Enrollments: Some Thoughts Assessing the Popularity of Antebellum Colleges," *History of Higher Education Annual* 1 (1981), 88-109; Martin Finkelstein, "From Tutor to Specialized Scholar: Academic Professionalization in Eighteenth and Nineteenth Century America," *History of Higher Education Annual* 3 (1983), 99-121; Jurgen Hurbst, "American Higher Education in the Age of the College," *History of Universities* 7 (1988), 37-59; Colin Bradley Burke, *American Collegiate Populations: A Test of the Traditional View* (New York, 1982); J. Bruce Leslie, *Gentlemen and Community: The College in the "Age of the University," 1865-1917* (State College, 1992); Caroline Winterer, in *The Culture of Classicism: Ancient Greece and Rome in American Intellectual Life, 1780-1910* (Baltimore, 2002). Geiger, ed., *College in the Nineteenth Century*, 5.

³ While there is very little historical scholarship on MIT, research articles on Rogers are also rare and center mostly on his geological research. Some representative works include: William Ernst, "William Barton Rogers: Antebellum Virginia Geologist," *Virginia Cavalcade* 24 (1974), 13-20; Michele L. Aldrich and Alan E. Leviton, "William Barton Rogers and the Virginia Geological Survey, 1835-1842," in James X. Corgan, ed., *The Geological Sciences in the Antebellum South* (Tuscaloosa, 1982), 83-104; Robert C. Milici and C. R. Bruce Hobbs, Jr., "William Barton Rogers and The First Geological Survey of Virginia, 1835-1841," *Earth Sciences History* 6 (1987), 3-13; Sean Patrick Adams, "Partners in Geology, Brothers in Frustration: The Antebellum Geological Surveys of Virginia And Pennsylvania" *Virginia Magazine of History and Biography* 106 (1998), 5-34.

⁴ David Potts, "Curriculum and Enrollment: Assessing the Popularity of Antebellum Colleges," in Roger Geiger, ed., *The American College in the Nineteenth Century* (Nashville, 2000), 37-45; Geiger, ed., *College in the Nineteenth Century*, 5.

⁵ Thomas G. Dyer, *The University of Georgia: A Bicentennial History, 1785-1985* (Athens, 1985), 1-23.

⁶ George H. Daniels, "The Process of Professionalization in American Science: The Emergent Period, 1820-1860" in Nathan Reingold, ed., *Science in America Since 1820* (New York, 1976) contains the oft-cited comment that summarizes the history of science view of the antebellum period: "The emergence of a community of such [science] professionals was the most significant development in nineteenth century American science" (63). Statistics on the AAAS can be found in Sally Kohlstedt, *The Formation of the American Scientific Community: The American Association for the Advancement of Science, 1846-1860* (Urbana, IL, 1976). General statistics for the scientific community are described in Nathan Reingold, "Definitions and Speculations: The Professionalization of Science in America in the Nineteenth Century" in Alexandra Oleson and Sanborn C. Brown, eds., *The Pursuit of Knowledge in the Early American Republic: American Scientific and Learned Societies from Colonial Times to the Civil War* (Baltimore, 1976), 33-69.

⁷ Benjamin Silliman's notes on Lowell enrollees during 1841-1842 are drawn from Margaret W. Rossiter, "Benjamin Silliman and the Lowell Institute" *New England Quarterly* (December, 1971), 610. I drew my statistics on the Lowell Institute lectures by compiling and analyzing the list of lectures catalogued in Harriette Knight Smith, *The History of the Lowell Institute* (Boston, 1898), 49-53. At Lowell, there were 649 science lectures out of a total of 878 between 1840 and 1850. My analysis differs slightly in period and number from Rossiter's.

⁸ Statistics on college student society debates were compiled from the listing in Thomas S. Harding, *College Literary Societies: Their Contribution to Higher Education in the United States, 1815-1876* (New York, 1971), 340-343, 358-358, 374-376, 400-403, 444-446, 483-485. Twenty-two of the forty-nine education-related debates reached conclusions that registered discontent with the classical curriculum or support for change toward practical and scientific studies. The nineteen colleges and twenty-three societies surveyed are: Yale (Linonian Society; Brothers in Unity); Dartmouth (United Fraternity; Society of Social Friends); University of Pennsylvania (Philomathian Society; Zelosophic Society); Harvard (Institute of 1770); College of New Jersey (American Whig Society); Hobart College (Hermean Society); University of North Carolina (Dialectic Society); Wake Forest (Euzelian Society); College of William and Mary (Licivyrionian Society); Trinity College (Columbian Literary Society; Hesperian Society); Ohio University (Athenian Literary Society); Transylvania University (Union Philosophical Society); Hanover College (Union Literary Society); Indiana Ashbury University (Philological Society); Wabash College (Calliopean Society); Shurtleff College (Alpha Zeta Society); Northwestern University (Hinman Literary Society); University of Michigan (Phi Phi Alpha); University of Wisconsin (Athenaeon Society).

⁹ Harding, *College Literary Societies*, 342, 375, 445, 401.

¹⁰ Harding, *College Literary Societies*, 402, 484, 485.

¹¹ Stanley M. Guralnick, *Science and the Antebellum American College* (Philadelphia, 1975), ix; George H. Daniels, *American Science in the Age of Jackson* (New York, 1968), 231-232.

¹² Bruce Sinclair, *Philadelphia's Philosopher Mechanics: A History of the Franklin Institute, 1824-1865* (Baltimore, 1974), 230; William Barton Rogers, "For the Establishment of a School of Arts, Franklin Institute, Philadelphia," Folder 14b, Box 1, MC 1, MITA; William Barton Rogers, "A Plan for a Polytechnic School in Boston (1846)," in Emma Savage, ed., *Life and Letters of William Barton Rogers* (2 vols., Boston, 1898), 420, 421. This volume by Savage will be cited hereafter as LL.

¹³ Frederick Rudolph, *The American College and University: A History* (Athens, 1962), 238; RER to WBR, January 7, 1833, LL I, 101; James L. Morrison, Jr., "Educating the Civil War Generals: West Point, 1833-1861," *Military Affairs* 38 (1974), 108-111; other works that discuss the early years at West Point include: Stephen Ambrose, *Duty Honor, Country: A History of West Point* (Baltimore, 1966); Sidney Forman, *West Point: A History of the United States Military Academy* (New York, 1950); R. Ernest Dupuy, *Sylvanus Thayer:*

Father of Technology in the United States (New York, 1958). Palmer C. Ricketts, *History of the Rensselaer Polytechnic Institute, 1824-1894* (New York, 1895); other works on RPI include: Ray Palmer Baker, "Rensselaer Polytechnic Institute and the Beginnings of Science in the United States," *The Scientific Monthly* 19 (October 1924), 337-356; Palmer C. Ricketts, *Rensselaer Polytechnic Institute: A Short History* (Troy, 1930); Palmer C. Ricketts, *Rensselaer Polytechnic Institute* (Troy, 1933); Samuel Reznick, *Education for a Technological Society: A Sesquicentennial History of Rensselaer Polytechnic Institute* (Troy, 1968); Benjamin Franklin Greene's ideas on the "True Polytechnic" was published as *The Rensselaer Polytechnic Institute: Its Reorganization in 1849-50; Its Condition at the Present Time: Its Plans and Hopes for the Future* (Troy, 1855).

¹⁴ Richard J. Storr, *The Beginnings of Graduate Education in America* (New York, 1969), 116; Andrew D. White, "Scientific and Industrial Education in the United States," *Popular Science Monthly* 5 (June 1874), reprinted in Carroll W. Pursell, Jr., ed., *Readings in Technology and American Life* (New York, 1969), 182. According to Yale President Noah Porter in *The American College and the American Public* (New Haven, 1870), the University of Michigan had been cited as "a decisive argument in favor of radical reform," although his inspection of the curriculum showed that it was "on the whole very old-fashioned and conservative in its most distinguishing features. . . . [which] does not differ materially from that of any college which is provided with a scientific and technological school" (22); Robert Silverman and Mark Beach, "A National University for Upstate New York," *American Quarterly* 22 (1970), 701-713; S. Edward Warren, *Notes on Polytechnic or Scientific Schools in the United States: Their Nature, Position, Aims and Wants* (New York, 1866). A discussion on science and engineering programs can be found in Terry S. Reynolds, "The Education of Engineers in America before the Morrill Act of 1862," *History of Education Quarterly* 32 (1992), 459-482.

¹⁵ For a traditionalist interpretation of MIT, see Frederick Rudolph's *Curriculum* that refers to MIT in reference to the practical American desires as found in the Land Grant movement (117). A similar view can be found in Rudolph's *American College and University*. In this work, he argues that MIT, among others, were the result of "state legislatures [that] were supporting higher education of a more popular nature than the old-time college with its religious orientation and adherence to the classical course of study" (188). Cumulative enrollment figures drawn from catalogue listing in S. Edward Warren, *Notes on Polytechnic or Scientific Schools in the United States; Their Nature, Position, Aims and Wants* (New York, 1866), 6-8.

¹⁶ On Wayland, see Rudolph, *American College and University*, 237-240; Rudolph, *Curriculum*, 109-112; Lucas, *American Higher Education*, 136-137; Francis Wayland, *Thoughts on the Present Collegiate System in the United States* (Boston, 1843); Francis Wayland, *A Memoir of the Life and Labors of Francis Wayland, D.D., Ll. D., Late President of Brown University* (New York, 1867), 92; WBR to HDR, April 18, 1850, *LL I*, 313.

¹⁷ David Potts, "Curriculum and Enrollment," 44.

¹⁸ Samuel Eliot Morison, *Three Centuries of Harvard, 1836-1936* (Cambridge, 1936), 251, 260-263.

¹⁹ David Potts, "Curriculum and Enrollment," 44.

²⁰ WBR to HDR, October 3 and 13, 1847, *LL I*, 274. According to Linda Armstrong Chisholm, "The Art of Undergraduate Teaching in the Age of the Emerging University" (Ph.D. diss., Columbia University, 1982), laboratories for student use were not a central part of college science until the post-bellum period. Princeton's first laboratory advocate, president James McCosh, stated in 1877 that "there is a growing feeling that scientists cannot be trained by mere lectures" (201). Only during his tenure did a drive emerge at that institution to provide for laboratory instruction beyond the lecture demonstration. At Yale, argues Chisholm, students did not use laboratories until the twentieth century, in part, because non-undergraduate programs such as the Sheffield Scientific School delayed developments at the college. Harvard laboratories for instruction remained a scattered and unofficial part of the undergraduate program until the last quarter of the nineteenth century. At Amherst, facilities for laboratories appeared in the 1890s. And Columbia made its first official declaration of support for the laboratory in 1897.

²¹ William Barton Rogers, *Objects and Plan of an Institute of Technology* (Boston, 1860); William Barton Rogers, *An Account of the Proceedings Preliminary to the Organizations of the Massachusetts Institute of Technology* (Boston, 1861); William Barton Rogers, *Scope and Plan of the School of Industrial Science, Massachusetts Institute of Technology* (Boston, 1864).

²² Rogers, *Objects and Plan*, 6, 8, 13, 15, 21-22, 25, 27, 28.

²³ A comparison of MIT and Harvard's Lawrence School of Science is logical, given their similarity in mission (despite their structural differences). Indeed, Rogers' ideas may have contributed to the Lawrence School's founding statement. See Akira Tachikawa, "The Two Sciences and Religion in Antebellum New England: The Founding of the Museum of Comparative Zoology and the Massachusetts Institute of Technology" (Ph.D. diss.,

University of Wisconsin-Madison, 1978), 128-130.

²⁴ These figures are based on a review of the enrollment figures listed in the MIT's *Course Catalog* and Harvard's *Presidential Reports* for the dates surveyed. The figures used for the table are as follows. MIT enrollments: 1866, 69; 1867, 137; 1868, 167; 1869, 172; 1870, 206; 1871, 224; 1872, 264; 1873, 356; 1874, 303; 1875, 283; 1876, 280; 1877, 293; 1878, 267; 1879, 264; 1880, 279; 1881, 335; 1882, 390; 1883, 516; 1884, 561; 1885, 706; 1886, 730. Harvard enrollments at the Lawrence School of Science: 1866, 75; 1867, 61; 1868, 49; 1869, 41; 1870, 52; 1871, 41; 1872, 32; 1873, 40; 1874, 42; 1875, 29; 1876, 34; 1877, 29; 1878, 22; 1879, 17; 1880, 16; 1881, 37; 1882, 30; 1883, 25; 1884, 26; 1885, 28; 1886, 22.

²⁵ Records for degrees awarded can be found in MIT's *Course Catalog* and Harvard's *Presidential Reports* for the dates surveyed. The figures used for the table are as follows. MIT degrees awarded: 1868, 14; 1869, 5; 1870, 10; 1871, 17; 1872, 12; 1873, 26; 1874, 18; 1875, 27; 1876, 43; 1877, 32; 1878, 19; 1879, 23; 1880, 8; 1881, 28; 1882, 24; 1883, 18; 1884, 36; 1885, 27; 1886, 59. Harvard Lawrence School of Science degrees awarded: 1868, 8; 1869, 5; 1870, 7; 1871, 3; 1872, 1; 1873, 7; 1874, 5; 1875, 4; 1876, 3; 1877, 1; 1878, 5; 1879, 2; 1880, 0; 1881, 1; 1882, 1; 1883, 5; 1884, 1; 1885, 1; 1886, 2.