PROMOTING THE BOOK OF NATURE

PHILADELPHIA'S ROLE IN POPULARIZING SCIENCE FOR CHRISTIAN CITIZENS IN THE EARLY REPUBLIC

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ABSTRACT: In the early republic, Americans witnessed the popularization of the natural sciences in the midst of the religious growth of the Second Great Awakening. Inspired by republican rhetoric and natural theology the natural sciences found a broad audience in Philadelphia and throughout the young nation. At museums and public lectures, Americans were invited to inspect the "book of nature"—God's created universe—up close in an effort to understand the nature of the creator himself. Beyond the elite world of religious scholars and naturalists, this view of science was popularized among Americans as a benefit to the republican moral order as well. This article looks at the ways in which that understanding of the relationship between science and religion was packaged and marketed to the citizens of Philadelphia and the broader United States as the key to preserving the moral and civic order required for a strong republic.
KEYWORDS: Science and religion, republicanism, Philadelphia, early federal period, Peale's Museum, early American museums

In 1819 Philadelphia minister William Staughton beheld a comet with the religious reverence of a cleric and the excited interest of a naturalist. In a poem shared with friends and students, he noted the comet's "lunar-like orb" and "illustrious trail!" Referencing the great astronomers, he stated that "A Tycho, a Newton, may measure thy course / Determine thy fervors and value thy force." He lamented that astronomers had not yet determined the full extent of the comet's orbit. Reflecting that such knowledge would "sing the loud praises of God," Staughton considered the scientifically definable comet as a religious symbol as well, one that might have significance for a nation experiencing the Second Great Awakening. Perhaps, he opined,

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the comet's purpose was "To feed with new fires the diminishing sun? / Over nations in guilt to exhibit the rod? / Or invite to the high contemplation of God?" Regardless of the spiritual or physical purpose of the comet, Staughton reveled in the sight, believing it gave men like him an opportunity to advance their knowledge of the natural world while also celebrating that "Revealed in yon firmament . . . the God of creation—of comets, is mine."[1]

The dual nature of Staughton's reaction to the comet reveals the perceived spirituality and usefulness of scientific inquiry that made studying the natural sciences increasingly popular in the early American republic. Throughout the young nation, men like Staughton—a minister, public lecturer, and later college president—presented the natural sciences as civic and moral education that would nurture good Christians and good citizens at the same time.

While many modern Americans assume a division between science and religion, historians have demonstrated over the past few decades that this was not typical prior to the mid-nineteenth century. Naturalists in the early modern Atlantic world saw every form of scientific inquiry as part of an effort to understand the entire "book of nature"—God's work revealed through creation, which, once observed, could be "read" in a fashion similar to the Bible. As such, no field of study was beyond inductive reasoning, and no field of scientific inquiry was beyond an artistic and metaphysical understanding.[2] The natural sciences were often discussed in a religious context, and religion often played a part in the growing scientific community. Contrary to the "warfare thesis" assumption that religion and science have always been at odds, historians have increasingly argued that the relationship between science and religious belief, especially Protestant Christianity, has never been so simple. While a "harmony thesis" gained some traction in the 1970s and 1980s, more recent works by scholars such as John Hedley Brooke, David C. Lindberg, and Ronald L. Numbers have argued for a "complexity thesis" that identifies the interplay between religious and scientific worldviews.[3] In recent years, the complexity thesis has been further complicated by scholars such as David N. Livingstone, who argued that the geography of scientific inquiry is an important aspect for understanding why and how discoveries were made.[4] While Livingstone was concerned with how location affects knowledge creation, locale is also important for how that knowledge is shared with its audience.[5] The unique intellectual geography of the early American republic shaped a discourse of science and religion that, while informed by the larger Atlantic world, was distinctively American, for the ideology of republicanism necessitated the dissemination of these ideas

among the public. As the home of the nation's oldest scientific institutions and the early capital, Philadelphia held significant sway over the development of the discourse of popularized science throughout the young republic.

Many scholars have pointed out that American science was largely dependent upon European sources in the late eighteenth and early nineteenth centuries. Yet the American context created uniquely American approaches to science. As Conevery Bolton Valencius and others have demonstrated in their recent article, the "scientific community" in the early republic was much more amorphous than its European counterpart. While scientific institutions existed, close reading of print culture shows a "broader range of participants in science." These authors have called for more consideration of the science of territoriality and the role of popular culture in shaping that discourse. Focused on print culture, they argue that creation and compilation of scientific knowledge and professionalization in the early United States was diffused because it was often linked to efforts for economic gain and political, intellectual, or physical control of territory.[6]

Popular science in the early republic was also driven by ideology. Philadelphians promoting science for popular audiences emphasized the moral and civil benefits of studying the natural world. While a new proto-professional scientific community was taking shape across the United States, the long-established scientific community of Philadelphia inspired popularization of science as a moral and civic asset in the experiment in republican government. Conscious of the failings of the French Revolution, some popularizers argued that a godless republic would fall into the chaos and corruption found in the Terror and the rise of Napoleon. Others, swept up in the religious winds of the Second Great Awakening, promoted science as a devotional tool and protection against the natural religion promoted by deists and skeptics like Thomas Paine. In both cases, promoters of the natural sciences described their subject as an aid to teaching religious morality and piety, which would be needed in the New Jerusalem and young America.

As a colonial hub of knowledge creation and distribution, early national capital, and economic center, Philadelphia had a unique political and social structure that helped shape the way scientific ideas were shared with the American public. While some historians have argued that there was a growing tendency among naturalists throughout the Atlantic world to emphasize natural causes over supernatural intervention, the popularized science growing out of its Philadelphia roots rarely challenged the assumption that the laws of nature were written by God.[7] The discourse of popularized science

that came out of Philadelphia in the late eighteenth and early nineteenth centuries was uniquely American in the way it tied Protestant and republican ideologies together, making the story of American science ideological as well economic.

Between 1776 and 1840 an increasing number of Americans had access to the natural sciences. Public lectures, museums, and textbooks emphasized the usefulness of such knowledge for both good citizens and good Christians. Scientific inquiry found an ever-broader audience, functioning as both an educational and entertaining endeavor. Educated individuals in towns and cities throughout the young nation founded lyceums, arranged mineralogical cabinets, and established science/natural history museums and societies.[8]

Nowhere was this truer that in Philadelphia, a community that helped shape the American discourse of science, religion, and citizenship in the early republic. As recent scholarship has demonstrated, the city had a long history of scientific inquiry.[9] Already a major node of the Atlantic world intellectual web by the end of the eighteenth century, it had a well-established scientific community. The Library Company of Philadelphia, the American Philosophical Society, the Academy of Natural Sciences, as well as a medical school and the University of Pennsylvania supported an elite community of men who sought to engage with the transatlantic republic of letters.[10] In the early national period, the audience for science expanded as popularizers drew upon this milieu to market the study of the natural world as an essential tool for creating the religious and civic virtue necessary for a flourishing republic.

The men and women behind popular science institutions advertised their endeavors as more than entertainment. The natural sciences were useful and essential to a Christian education for virtuous citizens. Lecturers and textbook authors repeatedly reminded Americans of the utility of scientific study in a growing nation that celebrated innovation in farming, mining, surveying, and manufacturing. The development of science could bolster economic enterprise and demonstrate the potential of the American experiment. Scientists and naturalists themselves very self-consciously studied American phenomena to prove that America and its natural world were anything but degenerative.[11]

Informed by the tradition of European natural theology, American Protestant writers and speakers supported the popularization of science, arguing that the collection of more scientific data would inevitably prove the greatness of the creator God. Christian periodicals as diverse as the *Methodist Monthly Magazine*, the Presbyterian *Christian Advocate*, and the Episcopal

Sunday Visitant promoted natural sciences as a means to better understand the Creator.[12] Devotional literature from both sides of the Atlantic incorporated lessons from Isaac Newton and William Herschel into descriptions of the sovereignty of God. Protestant colleges and academies—on the rise in the early republic—enthusiastically included the natural sciences into their curricula. They hired scientists to "teach young students that nature . . . revealed the perfections and sovereignty of God."[13]

With Philadelphians often leading the charge, the combined impetuses of religious fervor and republicanism shaped a public discourse promoting study of the natural sciences to an ever broader audience as a support to civil and religious virtue. Promoters of natural theology encouraged audiences to see the book of nature as a source for civic virtue. At the heart of this discourse rested the core beliefs of natural theology: The creator God displayed the evidence of his activity obviously in the natural world and revealed equally reliable additional information about himself in the Bible, which would be borne out as truth the more people studied nature. Guided by this hermeneutic, American Protestant educators, ministers, and authors argued that the combined efforts of naturalists and philosophers to catalog and systematize a broad base of facts about the world would reveal a fuller picture of the divine actions and character of God—the book of nature.[14]

The message of natural theology was not restricted to religious spaces. In public venues like museums and lectures the rhetoric of republicanism and the involvement of Protestant clerics blurred the line between secular and Christian education, as well as that between civic and religious virtue. Many popularizers of science agreed that an introduction to the natural sciences could bring people into the fold. Public lecturers and museum proprietors emphasized the usefulness of such knowledge for both good citizens and good Christians. In these cases, seemingly secular venues served the same purpose as religious ones—to encourage the laity (scientific or religious) to view the natural world as evidence of God's power and love. Thus, even Americans who did not hear it from the pulpit learned about the inviolability of nature as God's handiwork.

Through the ostensibly secular venues of museums, public lectures, and science textbooks, Americans increasingly began to share a preconception of the natural world as God's creation—a place where they could meet the Creator by simply applying human reason to scientifically observed phenomena. These venues, in conjunction with a growing number of explicitly religious devotionals by the 1830s, facilitated the dissemination of Christian

scientific knowledge to a wide audience. At the heart of it all, the Philadelphia religious and scientific community often set a unique example in propagating Christian scientific knowledge to a wide audience.

SCIENCE AND RELIGION IN PUBLIC LECTURES

While much has been made of the lyceum movement in the 1820s and 1830s, the popularization of science began much earlier in American cities. Even before it reached its peak in the 1830s, Philadelphians frequented scientific lectures taught by famous "scientists" and local experts.[15] The Philadelphia region played host to a number of lecturers and courses open to the public as early as the 1780s. A few miles to the south, the Philosophical Society of Delaware regularly invited the ladies and gentlemen of Wilmington to take part in scientific lecture series offered as early as 1799 (when, it is rumored, the society nearly blew up town hall with a working model of a volcano).[16]

While the Library Company and American Philosophical Society had begun hosting lectures for their own members by the 1760s, access to (and interest in) lectures for public consumption grew substantially after Independence. By 1826 John Sanderson lamented that "Of all our intellectual pursuits the most fashionable and prevalent in this city is science . . . it has spread amongst the people like an epidemic" and had "not even spar[ed] the fair sex."[17] Science lectures, it seemed, were everywhere. For example, in 1782 John Macpherson advertised that he would deliver a series of lectures at his home in Philadelphia. The lectures covered "astronomy and every other branch of natural philosophy" and were open to the paying public.[18] Benjamin Rush offered a course of chemistry lectures for students at the Young Ladies' Academy in Philadelphia in 1787 wherein he highlighted the role of chemistry in housework.[19] Benjamin Tucker offered a course of chemistry lectures for young ladies in 1810. Tucker's audience was so large that he expanded his offerings to young men and women in 1811 and continued his courses through the 1820s.[20] Mr. S. Gordon taught a course of mineralogy lectures at "the hall of the Philosophical Society in the spring of 1811." William Staughton delivered his first course of lectures on natural history in 1816, and Dr. M. Mossoman offered a course at the "German schoolhouse" in 1818.[21] By the time Sanderson was complaining in the 1820s, there were competing lectures on geology offered by Dr. Gerard Troost (at the courthouse) and Mr. Finch (at the Philosophical Society's hall) in 1823. That same year, the Friends' schoolhouse hosted Joseph Roberts Jr. for a series of lectures

on natural philosophy.[22] In November 1823 Drs. John Godman and Elijah Griffith delivered lectures on anatomy and philosophy "intended as a popular rather than a scientific course" at the Masonic Hall. Drs. Middleton, Charles D. Meigs, and Benjamin Horner Coates also taught at popular lecture halls throughout Philadelphia on medical science topics in 1823, and 1824 at "Dr. Parrish's lecture-room" on Second Street.[23]

By the 1820s the epidemic had spread throughout the city, infecting even the less respectable. While Godman's 1823 course of lectures cost $10, a mere 25 cents could gain admission to a demonstration of "comparative anatomy" at the Lailson Circus. In 1803 Thomas Swann, a riding instructor and farrier, advertised that he would hold a horseback-riding exhibition at the old Lailson Circus building in Philadelphia at which a horse would be dissected for the public. Tapping into the prevailing rhetoric about the usefulness of the book of nature, Swann advertised the event as educational and uplifting. The evening's program included a lecture on the possibilities of lameness in horses and how to treat equine injuries, followed by the dissection of one incurably lamed horse, while "at the same time a real skeleton of a horse will be presented, [for] gentlemen of the faculty and others, who may not think comparative anatomy beneath their notice or study." The 25-cent price of admission to the lecture and dissection was the same as admission at most of the budding museums in the Philadelphia area.[24] While these lectures made scientific knowledge relatively accessible to Philadelphians of moderate means, even those who could not afford it might hear about science from an equally trusted source. For many, the most persuasive voice encouraging Christian citizens to study natural sciences was likely the one they encountered every Sunday.

PREACHING FROM THE OTHER GOOD BOOK: MINISTERS ENCOURAGE CONTEMPLATION OF NATURE

In an era of growing religious and social upheaval, ministers promoted science as an aid to religious and civic stability. For many, science could contribute to the religious awakening the nation was experiencing. Couching science as an avenue for personal interaction with the Creator, some promoted study of the natural world as a form of pious devotion. With the rise of evangelicalism in the Second Great Awakening, many believers looked for an increasingly emotional and personal experience of God in their lives.

Yet reason, rationality, and Enlightenment science also permeated American Christianity in the late eighteenth and early nineteenth centuries. The popularization of Enlightenment ideology and the natural sciences emphasized the importance of "Reason" in even the most unreasonable sects. Evangelicals and nonevangelicals alike embraced science. As the American republic took shape, most Protestants embraced science as a means for deepening their experiential knowledge of an increasingly personal and immanent God.

Philadelphia experienced this as much as any other city. As Dee Andrews has demonstrated, Philadelphia was a city experiencing significant socioeconomic changes, exemplified by the large poorhouse (known as the "bettering" house), a building standing larger than those housing the new government or the religious congregations of the city.[25] The Second Great Awakening, like republican ideology, was a social ordering effort that occurred in a world that seemed to be unnervingly disordered.[26] The seeming chaos and comfort of religious revivals, whether Methodist, Baptist, Christian, or Presbyterian, made all men equal before the Lord. While this Great Awakening sparked emotional revivals across the countryside, historians like Bruce Dorsey have demonstrated that much of the revivalist energy in urban centers was funneled into benevolence societies and reform movements. Philadelphia's religious milieu mirrored that of many other urban centers in the early national period. The city was certainly experiencing the market revolution and growing importance of the voluntarism that defined the religious landscape of cities like New York, Boston, or Baltimore.[27]

But for many religious leaders the republic needed more than religious fire, it needed republican virtue. Promoters of science in early national Philadelphia tended to come from more established sectors of the religious marketplace. Overwhelmingly these men represented Presbyterian, Episcopalian, Congregational, Lutheran, and Quaker backgrounds. Yet, one of the loudest voices for science as source of both religious and republican virtue in Philadelphia was a Baptist, William Staughton, an outspoken preacher of the book of nature. For him, "the natural sciences presented a wide field to his view," which he studied and shared "with fervor and advantage." In addition to his regular course of natural history lectures, Staughton often brought students along on "a morning visit to the Museum of Mr. Peale," reinforcing the lesson that the book of nature served as a devotional aid. As one friend later eulogized, this lover of botany and natural history believed that flora and fauna demonstrated "the power of their author," God. As he described the nature of plants

"from the delicate germ to the finished fruit," he reminded his students, "The hand that made *us is divine*."[28] In 1816 Staughton invited the "ladies and gentlemen" of Philadelphia to his own course of scientific lectures that winter on natural theology and natural history.[29]

Staughton enjoyed popularity as both an evangelical preacher and reformer and as a scholar. Professor Thomas D. Mitchell of the University of Pennsylvania described Staughton as a well-loved minister of both the Good Book and the book of nature. "No pastor of any other denomination in Philadelphia retained so large a popularity in so long a period of years. Many a time have I seen the enlarged house most uncomfortably packed. . . . The people came from every corner of the city." When he taught botany at Columbia College, Staughton's students noted the interconnectedness of theological and scientific fields of study from the very first day of class, when he explained that the earliest botanical studies could be found in the divisions of "plants, grass, herbs, and trees" described by Moses in the Good Book.[30] Staughton had been the minister of the First Baptist Church of Philadelphia since 1805, where he often preached in the style of the new revivalism, without the appearance of notes.[31] His popularity was such that meetings and prayer groups had to be set up throughout the city, hosting the pastor in order to share the word. Staughton was an advocate of the Sunday School movement in Philadelphia and baptized many young men and women in the Schuylkill River.[32] Staughton's service to the Lord was not limited to the pulpit and lecture hall. In addition to his weekly sermons and science lectures, he wrote hymns, several of which appeared in the 1819 hymnal compiled by John Rippon.[33] Deeply committed to the benevolence work central to the Second Great Awakening in American cities, Staughton was active in the founding of the Philadelphia Bible Society and involved in organizing his congregation's missionary efforts into the western territories.[34]

Those presenting popular science often chose deists and atheists as their foil. Study of the book of nature, they argued, uncovered the moral and physical order of an immanent God. The emphasis upon reason may also have acted as a defense against what seemed to be reason-less enthusiasm found at many revivals and camp meetings. Even as popularizers encouraged audiences to engage with the awe-inspiring and emotionally charged natural wonders of the created world, the reason/enlightenment discourse shaping this approach seemed to discourage a purely emotional faith.

While one might see the efforts of the older denominations as part of the larger backlash against the enthusiasm and anticlerical (even anti-intellectual) strains of the Second Great Awakening, these men tended to couch their efforts as a defense against threats from the other side. Promoters of science and natural theology typically described their efforts as a bulwark against doubt, infidelity, and deism. Amanda Porterfield has demonstrated that skepticism appeared to pose a significant threat to many elites in the early national period. Often focused on Thomas Paine's *Age of Reason*, fear of deism as a road to infidelity (and unchecked democracy) loomed large in early national politics as Federalists painted Jeffersonians as godless (and thus immoral) deists in the school of Paine and the French Revolution.[35] In an effort to assuage such fears, those most likely to flirt with deistic tendencies increasingly emphasized their own embrace of scripture and revelation. Promoters of science, a group who might be lumped in with promoters of natural religion and deism, were especially concerned to demonstrate their embrace of scripture and revelation.

Religious leaders from other cites learned from Philadelphia institutions to preach the book of nature as well. Presbyterian leader and member of the American Philosophical Society Samuel Miller encouraged Christians to visit Peale's Museum and study the latest scientific discoveries in his 1803 book, *A Brief Retrospect of the Eighteenth Century*, based upon a sermon he delivered to a New York City congregation on the first Sunday of the century.[36] As a member of the American Philosophical Society, Miller drew upon his Philadelphia-based knowledge of the natural world to encourage his readers and listeners to study the book of nature for themselves. Confessing himself "indebted to Professor [Benjamin] BARTON," a professor of natural history and botany at the College of Pennsylvania, Miller encouraged the faithful to study the mammoth at Peale's museum to judge the wonders of God's design for themselves.[37]

Like Staughton, Miller believed that study of the natural world could be a form of religious devotion that allowed students to more fully understand the Creator. In fact, Miller argued that even when geologists set out to work without the knowledge given through the Bible, their research had still proven the veracity of scripture as they added new findings to the universal book of nature defined by natural history. Miller believed that even those French scholars who "embraced geological principles unfriendly to revelation" and Christianity "have all brought to light facts, and given views of the subject, which remarkably confirm the sacred history."[38]

Not all congregations relied exclusively upon their pastors to teach the book of nature. Between 1806 and 1808, a group of English-speaking Lutherans broke away from the German Lutheran churches in Philadelphia to found their own congregation: the Evangelical Lutheran Church of St. John. The church purchased a lot on Race Street between Fifth and Sixth streets where they built a large church as well as a schoolhouse. Under the direction of a few outspoken parishioners—mostly scholars like Dr. John Goodman—the schoolhouse became something more ambitious than an ordinary church school and came to be known as "St. John's Lyceum" or "St. John's College." In 1812 Professor James Cutbush gave lectures there on chemistry, natural philosophy, and mineralogy. The schoolhouse was too small for the ambitions of Cutbush, who wished to attach the school to the church to provide more space for lessons. Instead, the congregation constructed a larger building, where Cutbush added demonstrations of the effects of nitrous oxide gas (laughing gas) to the Lyceum's offerings.[39] Whether led by the pastor or the congregation, then, Philadelphia religious institutions demonstrated the reach of the growing discourse among Protestants that endorsed the book of nature as devotional aid that promoted republican virtue in the early nineteenth century.

SHOWCASING THE BOOK OF NATURE: MUSEUMS IN PHILADELPHIA AND BEYOND

The most visible promoters of the book of nature in early US cities were the proprietors of the nation's budding museums. For those who could not afford public lectures, a growing number of museums offered city-dwellers a view of God's creation in a collection of "curiosities." While Philadelphia was not the first city to host a museum, it set a national example leading the way in successfully displaying the book of nature through museums. America's first public museum, founded by the Charleston Library Society in 1773, displayed donated samples of flora and fauna, minerals, and accounts of how best to use plant samples for medicinal and agricultural purposes. The museum was destroyed by fire and war during the Revolution.[40] Though a group of Charlestonians continued to support the museum throughout the nineteenth century, it had little regional or national impact. Philadelphia's earliest forays into museum making, on the other hand, inspired imitation. In fact, the Literary and Philosophical Society of South Carolina did

not know of the Charleston museum's existence when the president called for the creation of a museum in 1814 that would emulate Philadelphia's example.[41]

The clearest argument for science as a religious aid to the republic was made by Philadelphia artist, naturalist, and museum proprietor Charles Willson Peale. In 1784 Peale opened the doors of his museum in Philadelphia, where he displayed many of his own paintings alongside a great variety of natural specimens (best depicted in his 1822 self-portrait, *The Artist in His Museum*). Much like the earlier one in Charleston, Peale's museum was an eclectic collection of natural phenomena and curiosities, held together by enlightenment ideology about the importance of collecting all information about nature to understand God's created universe.[42] The museum offered visitors a glimpse at some of nature's greatest wonders alongside wax statues and portraits of great men and women of Western history. For example, visitors could see a "sea-serpent" from Massachusetts—on loan from the New England Philosophical Society—in 1817, three live chameleons from Spain in May of 1818, a "devil-fish" in October of 1823, and an orrery—displaying the workings of the solar system—from Partridge's Academy in Connecticut in 1826. The Peale family often offered additional incentives to visit: Rubens, Franklin, and Titian Peale gave public lectures and experiments covering chemistry, philosophy, and electricity.[43]

While financial gain certainly played a role in his promotional efforts, Peale advertised his museum as a place to study the book of nature. In public lectures and published tracts Peale argued that the nation needed science museums. Visiting a museum was an opportunity for moral uplift, gained through observation of God's work through the book of nature. From the outset Peale insisted upon keeping the museum open on Sundays. Reasoning that an exhibition of the works of nature should be open on the Lord's day, he placed a placard in front of the museum entrance on Sundays that read: "Here the wonderful works of the Divinity may be contemplated with pleasure and advantage. Let no-one enter to-day with any other view."[44] Though Peale himself tended toward deism, he believed that "Nature was a book whose structure was a display of both the original 'Word' and the confining law of its Maker."[45] This book of nature, displaying the work of God, was surely an appropriate site for Christians and citizens to visit on Sundays. Whether motivated by profit or principle, Peale's call for public access to God's book of nature on the Sabbath must have had an audience, for it appears that the museum remained open on Sundays until his death in 1827.

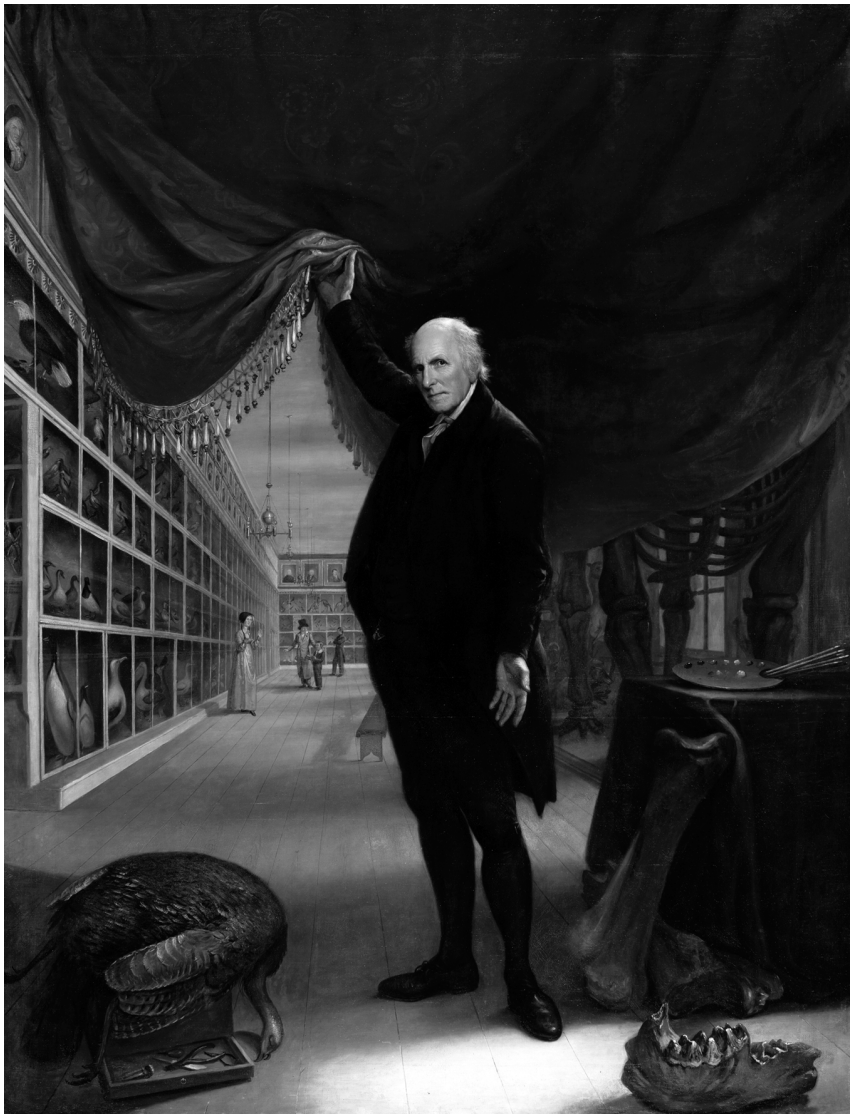

FIGURE 1 *The Artist in His Museum*, 1822, Charles Willson Peale. Courtesy of the Pennsylvania Academy of Fine Arts, Philadelphia. Gift of Mrs. Sarah Harrison (The Joseph Harrison, Jr. Collection).

Christian traditions and imagery played a large role in Peale's museum. The "sea-serpent" displayed in 1817 had been deemed a "Leviathan" (as described in the Book of Job) by the people of Gloucester, Massachusetts,

who captured it.[46] Tickets to the museum themselves invoked the words of Job 12:7 with the phrase, "The Birds & Beasts will teach thee." But nowhere did Peale invoke religion more clearly than in the room that displayed the famed mammoth skeleton. Mammoth bones had been on display in America since the days of Cotton Mather, who believed them to be the remains of Nephilim, described in the Genesis story of the Noachian flood. The name "mammoth" itself derived from the Russian word for Behemoth—the creature mentioned in Job 40:15. While the mammoth was a mythical figure, Peale's expedition to uncover a full skeleton in 1801 proved that "mammoth" bones were in fact those of a mastodon. Yet Peale often referred to the mastodon as a mammoth, probably to drum up larger crowds who would be drawn to the legendary—even biblical—proportions of the skeleton.[47]

Museums lasting the longest in the early nineteenth century followed Peale's example of leaving the pages of the book of nature open to the view of all visitors by displaying natural curiosities and scientific discoveries. For example, Jesse Sharpless's Washington Museum, founded in 1807, remained open for at least a decade in Philadelphia. Much like Peale's museum, the Washington boasted scientific attractions such as "a complete electrical machine, with extensive philosophical [i.e., scientific] apparatus" and "ten different pieces of anatomical preparations in wax, executed in the first style." In 1818 and 1819 Sharpless exhibited the further curiosity of a live trained elephant. Meanwhile, the Phoenix Museum—moved from Boston to Philadelphia in 1813—displayed "panoramic views" and wax statues for only a few months before it failed. Similarly, the Columbian Museum of Wax Statuary—featuring only wax statues of luminaries like Jefferson and Napoleon along with some allegorical pieces—"did not achieve sufficient success to warrant a long continuance."[48] Neither the Columbian nor the Phoenix displayed natural curiosities or other scientific discoveries that made the book of nature accessible, which seemed to be an integral component to a successful museum. Without the natural sciences, the educational and moral value of a museum seemed questionable.

Peale's belief that museums and public knowledge of the natural sciences were central to the creation of an enlightened and virtuous citizenry was borne out by his perennial entreaties to Congress for funding.[49] In public lectures, Peale represented the book of nature as instructive for both good Christians and good citizens. Stating that "the study of natural history . . . [would] make us acquainted with the perfection of all created beings," he argued that a publicly funded and accessible museum like his would be "a powerful aid to

the truly religious mind." After all, "*no man* can attentively view and study the infinite variety and perfection of the origination of Creation and *be an infidel*." For Peale, the spiritual virtues of the museum contributed to the strength of the republic. Studying the book of nature would remind visitors of their civic responsibilities "to fulfill every duty to our associates, exercising all our powers to promote love and harmony with those to whom we are connected in domestic life, to sustain the salutary measures of civil government, desiring to promote our lives, liberty and property."[50]

Peale's argument that museums and science were good for the republic had an audience beyond his hometown. The rhetoric of science as religious and republican support to the nation played a role in a much more openly politically motivated museum that followed Peale's Philadelphia model—the Tammany Museum. When the Society of St. Tammany established a museum in New York City, its goals were similar to Peale's. Inspired by the optimism of American independence and the ratification of the Constitution, Tammany's membership sponsored activities that would foster a strong American identity based upon republican virtue and morality. With this in mind, they founded a museum of history and natural science in 1790, showcasing a collection of American historical and natural specimens—all aimed at celebrating America and encouraging virtue in her citizens. By the end of the decade, however, Tammany shifted its interests from culture to politics, and abandoned the museum to its caretaker, Gardiner Baker. When Baker took over, he modeled the exhibits directly after those Peale created in Philadelphia. They included displays of stuffed animals in reproductions of their natural habitats—an exhibition method developed by Peale. Much like his Philadelphia counterpart, Baker relied on his museum for his livelihood. Yet he worked hard to encourage New Yorkers of all financial capabilities to visit and learn from the book of nature—inviting all men over age twenty-one in the city to visit the museum's library for free, and striving to keep the admission price low after Tammany withdrew its support. Like the Peale family, Baker endeavored to make the natural sciences widely available, believing his work would strengthen a Christian American society.[51] Like Peale's museum, the Tammany Museum (later Scudder's American Museum) served a political purpose. Even after Tammany left the museum in Baker's care, the society required free or reduced admission for its members. Baker, it seemed, was a true believer, providing access to the museum's library to all of the city's young men, free of charge, regardless of political affiliation.

A similar message was available to visitors of Daniel Bowen's museum, operating in Philadelphia between 1790 and 1795. Not wanting to continue to compete with Peale's museum, Bowen removed his museum of paintings, wax figures, and natural curiosities to Boston where he opened the Columbian Museum in 1795. Though the Columbian Museum burned down twice before 1812, each incarnation brought large audiences.[52] A later commentator described it as "the only museum of character" in Boston."[53] A veteran of the American Revolution, Bowen was as strong an advocate of republican virtue as his fellow proprietors in Philadelphia and New York. Bowen was an active member of Old South Church so religion also shaped his work.[54] With a deep commitment to both his faith and his nation, Bowen modeled his natural history exhibits after those he saw in the great museums of England while advertising them with the same call to civic and religious virtue that Peale relied upon in Philadelphia. Thus, museum proprietors hawked their wares as access to the book of nature, using Peale's Philadelphia model to perpetuate the narrative that science would promote both the religious and civic virtue of the republic.

GOOD LITTLE REPUBLICANS: PHYSICIANS PROMOTE THE BOOK OF NATURE

While ministers claimed a spiritual benefit, and Peale and his colleagues represented the group with the most obvious economic stake in its success, physicians regarded the book of nature as an aid to educational reform that would serve the medical profession. Medical doctors and professors used the same rhetoric of science and religion that ministers and museums used to promote the expansion of science education as well as the popularization of natural sciences for lay audiences. Much like museum proprietors, physicians and medical scholars stood to gain from the advancement of scientific education in the young nation. Seeing the popularization of science as an extension of their own profession, some doctors and medical professors gave public lectures reinforcing the argument that science supported the Christian faith and the virtue of the republic. Those most deeply involved in promoting science as devotional and civic aid were often the ones calling most loudly for increased professional (academic) training for practitioners. The most visible example was noted Philadelphia doctor and politician Benjamin Rush; religious instruction was a key component of his vision of a virtuous republic.

He argued that "the only foundation for a useful education in a republic is to be laid in Religion. Without this there can be no virtue, and without virtue there can be no liberty, and liberty is the object and life of all republican governments."[55] Like William Staughton, Rush was actively involved in benevolence organizations like the Philadelphia Bible Society.

Religious instruction was only half of Rush's formula for virtuous citizens. Citizens also needed a practical education, steeped in "useful knowledge." A term originating in Europe to describe a classical education, "useful knowledge" had come to mean something different in late eighteenth-century America. Men like Rush and Benjamin Franklin used the phrase to describe "applied knowledge." Useful knowledge was meant to support the practical as well as intellectual needs of the nation by creating the space for objective discourse and debate.[56] For Rush such an education had to include both religious and scientific instruction. In his 1798 *Essays, Literary, Moral & Philosophical* Rush proposed plans for schools and colleges in Pennsylvania that would ensure students could read, write, and figure confidently. Students should also be equipped to contribute to the scientific and agricultural progress of the young nation. To that end, Rush promoted a religious approach to science: "I cannot help remarking . . . that [C]hristianity exerts the most friendly influence upon science, as well as upon the morals and manners of mankind." An oft-cited advocate of female education in the 1780s, Rush promoted a version of useful knowledge that gave preference to literature, government, and figures for girls as well as boys. But both sexes would also benefit from lessons in the natural sciences. "A general acquaintance with the first principles of astronomy, natural philosophy and chemistry" would be "calculated to prevent superstition by explaining the causes, or obviating the effects of natural evil, and such."[57] Taken with religious instruction, natural sciences like astronomy and chemistry would equip young citizens with the practical and moral understanding necessary for a virtuous republic. To meet these goals, Rush promoted expanded education in Pennsylvania and gave courses of public lectures.

In addition to his medical practice and public service, Rush also served as a professor of medicine. Many professors of anatomy and medicine at the College of Pennsylvania and the Philadelphia School of Anatomy offered public courses and demonstrations throughout the city (even at Peale's museum). Some also published (or edited) textbooks aimed at children and lecture audiences. When Drs. Middleton, Charles D. Meigs, and Benjamin Horner Coates, delivered public lectures on medical science topics at popular

lecture halls throughout Philadelphia in 1823 and 1824, they likely built upon the success of Dr. John D. Godman of the Philadelphia School of Anatomy.[58] Along with Dr. Elijah Griffith, Godman gave a popular lecture series on anatomy and philosophy in November 1823. Godman, who had been "*a known infidel*" in the school of "French philosophers," experienced a conversion in 1827 upon the death of one of his students. Even before this event, Godman's lectures and writings encouraged observation of the book of nature on a popular level for well-informed citizens of the republic. He was a member of the Franklin Institute, author of *American Natural History*, and he had translated an account of Lafayette's travels in America. He was also a regular contributor to the Quaker magazine, *The Friend*. In the face of his renewed faith, Godman continued to write scientific treatises, give lectures on scientific topics, and publish articles that emphasized the veracity of the New Testament from a "scientific" approach.[59]

Some physicians shared this message beyond the boundaries of Philadelphia. One such physician was Dr. James Tilton of Delaware, who believed that scientific learning made good Christians and, therefore, good republicans. For example, Tilton explained in his lecture before the Philosophical Society of Delaware that "by hasty & surprizing [sic] advances in human knowledge, all the arts & sciences contribute their [support] towards the growth & progressive improvement of human society."[60] Tilton, who had served as the surgeon for the First Delaware Regiment in the Revolution, been a representative to the Confederation Congress in 1783–85 and the Delaware state legislature, and would later become a trustee of the College of Wilmington, was particularly concerned with the use of scientific education in helping each child and citizen to develop into "a good little republican."[61] Tilton was also a founding member of the Patriotic Society of New Castle County, one of many democratic societies to emerge in this era, and served as president of the Delaware Society of the Cincinnati in the 1790s.[62] In his 1799 lecture to the young ladies and gentlemen assembled in Wilmington's town hall, he informed his listeners that the sciences could be "justly . . . compared to a well ordered republic, where there is no jarring or discord, and where every constituted member renders the most amicable aid & assistance to his neighbor."[63] Being an example of the good republic, science itself would improve civic and moral virtue in young Americans.

The republic of science supported Tilton's millennial theology as well as his political ideology. Believing that the millennium may be near at hand, Tilton conjectured that reading the book of nature would help prepare

humanity for God's reign. "Will the progress of science and the universal diffusion of useful knowledge be sufficient, under providential direction, to give righteousness such a prevalence, as to fit men for peace & happiness?" Tilton confessed that he believed man's happiness and enlightenment closely tied to the rise of scientific understandings of creation. Believing humanity's spiritual happiness so closely entwined with the progress of the sciences, he argued that faith "ought to be a powerful incentive with every virtuous man, to aid and incourage [*sic*] the progress of science, by every means in his power."[64]

Science's role in shaping "good little republicans" lay in its ability to educate Americans in both civic and Christian morality. As Wilmer Worthington explained in 1835 to his listeners at the Chester County Cabinet of Natural Science in Pennsylvania, "Whether we confine ourselves to the investigation of one branch of [Natural Science], or extend our researches into every portion hitherto . . . we find indubious traces of Almighty wisdom and design." Such discoveries within the book of nature would "lead us to contemplate the exquisite skill and benevolence of their Author with emotions of deepest admiration."[65] Following in the footsteps of Tilton, Worthington was an influential physician in his native Pennsylvania. Born after the Revolution, he was part of the inheriting generation described by Joyce Appleby.[66] Worthington was an active promoter of his profession, serving as a founder of county and state medical societies and as a delegate to the first meeting of the American Medical Association in Baltimore in 1847.[67] Worthington appears to have regarded popularized science as an extension of his work in medicine. His own interests led him to botany, but he actively promoted the diffusion of all of the natural sciences through his lectures at the Chester County Cabinet and as a founder of the Pennsylvania Lyceum.[68] Like Tilton, Worthington was active in politics and was elected to the Pennsylvania legislature in 1833, where he helped to pass the school law of 1834, expanding access to public education in the state.[69]

EXPORTING THE PHILADELPHIA MILIEU: TEXTBOOKS AND THE BOOK OF NATURE

By linking the natural sciences to Christian morality, Philadelphia popularizers encouraged the spread of the prevailing discourse among elites: that the book of nature could serve as a devotional practice that would promote

religious piety and republican virtue. As Mark Noll has demonstrated, founders like Benjamin Rush argued "that religion could and should contribute to the morality that was necessary for the virtuous citizens, without which a republic could not survive." Evangelicals beyond Philadelphia, like Staughton and Tilton, adopted the republican view that religion and morality functioned as the basis for republican virtue.[70] Without Christianity, one could not have republican virtue. And, proponents of science argued, knowledge of the book of nature strengthened Christianity.

This growing appreciation of the civic and Christian morality of the natural sciences fed a rise in educational opportunities and textbook publication in the early nineteenth century, with Philadelphians again playing an outsized role. In textbooks, students found that the natural sciences offered learning that could be applied to improve humanity's condition in the world, and—as emphasized by public lecturers—knowledge that would bring one closer to God. Students, parents, and teachers regarded such an education as crucial to sustaining the republic in the early nineteenth century because it built a moral and useful citizenry. Thus, schools, academies, and colleges introduced an increasing number of American children to the natural sciences as the early republic grew—encouraging them to become familiar with the book of nature that others encountered at lectures and museums.[71]

By the 1820s Philadelphia authors and publishers offered a wide array of textbooks, hoping that all Americans sought an education in the natural sciences, whether they engaged in formal schooling or not. Part of a larger boom in early American print culture, booksellers in the first half of the nineteenth century offered an increased number of textbooks written and published strictly for the use of schoolchildren.[72] In the first few decades following Independence, they featured mostly reprints and abridged versions of British works—James Ferguson on astronomy, the Reverend David Blair's textbooks, and George Adams on natural history. After about 1815, an increasing number of American textbooks had American authors or editors. Publishers continued to offer the familiar British works by marketing them as "American Editions" with notes and abridgements made by an American man (or woman) of science, and particular attention paid to the needs and interests of American readers. For example, when instrument-maker William Jones and University of Pennsylvania professor William Patterson offered a reprint of George Adams's *Lectures on Natural and Experimental Philosophy* (commonly known as Adams's *Natural History*) in 1807, they advertised it as the "American Edition, printed from the last London Edition" with changes

and additions made for American audiences.[73] The Philadelphia publishers of the 1819 edition of Blair's *The Universal Preceptor* made the same claim.[74] Title pages of such works also made clear the authors' connection to the American scientific community in Philadelphia, listing affiliations with the American Philosophical Society and the University of Pennsylvania. In the case of the pseudonymous "Tom Telescope," the author was identified as "a teacher of Philadelphia," even though the 1803 *The Newtonian System of Philosophy* was likely a reprint of a British text.[75] The Philadelphia imprint was widely circulated throughout the United States, but carried the implied connection to Philadelphia, which remained a center of learning for Americans.

Philadelphia writers and editors of textbooks portrayed science as both a useful and morally uplifting subject, necessary for all Americans. Like the popularizers in museums and lecture halls of American cities, textbook authors believed the knowledge they imparted would help shape "good little republicans" by encouraging Christian devotion. But they also emphasized that the practical nature of their subjects promoted morality—civic and religious—among readers. For example, Jones and Patterson's edition of Adams's *Natural History* held that a correct knowledge of nature could promote religion, the welfare of society, and a "love of order"—qualities essential for those "good little republicans." Just as the leaders of many American lyceums thought the natural sciences would guard against vice among the working classes, Adams's American editor, William Jones, claimed that "Researches in philosophy tend to make the minds of its students cheerful, tranquil, and happy: and the science itself may be considered as the most sublime and refined species of drama."[76]

CONCLUSION: PHILADELPHIA'S OUTSIZED IMPACT

Recent scholarship has demonstrated that Philadelphia led the way in building the United States' early scientific community. Through the efforts of public lecturers, ministers, museum proprietors, and physicians, Philadelphia also helped shape the discourse of popular science and religion in the early republic, in part because the city had the institutional legacy to take the lead in setting the national discourse on the role of science in American society. It had several long-standing organizations that already had a tradition of publishing scholarly papers in books, journals, and newspapers: the American Philosophical Society, the Library Company of Philadelphia, the

American Philosophical Society, the Franklin Institute, and the University of Pennsylvania. The city's long commitment to education was visible in classrooms and lecture halls across the city in the 1790s even as it served as the nation's capital.[77] Leading names in American natural sciences could generally be traced back to Philadelphia. Benjamin Franklin and David Rittenhouse certainly took top billing, but the Bartrams, whose botanical gardens supplied botanists and naturalists across the nation and the Atlantic were also well-known residents.[78]

Scientific headliners across the young nation claimed membership in the American Philosophical Society. As American science took on a more professional caste in the nineteenth century, leaders of American science often trained first in Philadelphia. Benjamin Silliman, for example, who would become one of America's leading scientific minds in the early republic and the editor of the *American Journal of Science and the Arts*, began his training to become professor of chemistry at Yale in 1802. Yale sent him first and foremost to Philadelphia (not Boston or New York) for his training. When he returned there the following summer, he modeled his new laboratory and classroom upon those he had seen in Philadelphia and at Princeton (before leaving for further study and to purchase supplies in Britain).[79]

With its long history of scientific institutions, Philadelphia not only took the lead in promoting the natural sciences but also was a city to be emulated. In October of 1821, law student and native Tennessean John W. Brown reflected on the progress of his current residence, Louisville, Kentucky. "This town is quite a flourishing place and I think bids fair for a city equal to any in the U.S.A. at some future day." But it was not with just any American city Brown sought comparison. "Why not rival Philadelphia itself?" he wrote in his diary. "One thing however is at present to be regretted. The neglect of institutions of learning which are so necessary to every city, town, and society."[80] Meanwhile, Daniel Drake of Cincinnati, Ohio, argued that his efforts to open a medical school would make his city more competitive. "Upon the whole, I am convinced that Cincinnati is to be the Philadelphia of the West as to medical instruction." To ensure Cincinnati's success, Drake recommended that the school hire professors from Philadelphia.[81]

Philadelphia was a destination for those seeking intellectual and social affluence. With such ideas in mind, young Samuel Beall made a trip from Kentucky to Philadelphia in 1814. During his visit, Beall made a point to visit "Museum, Wax Works & Launch."[82] William Staughton often hosted "sons of his particular friends at a distance, who came to Philadelphia to attend

the Medical Lectures" and other educational opportunities.[83] One example is that of John Temple, who was "persuaded that to let Peter come to Philad. would be much to his honour and comfort in the whole of his subsequent life." Thus, Peter Temple headed to Philadelphia in search of scientific learning under the roof of a Baptist minister in 1827.[84]

Ministers, museum proprietors, and physicians played a significant role bringing the book of nature to lay audiences of Philadelphia and, by extension of Philadelphia's influence, other urban centers. Despite disparate backgrounds, circumstances, and even religious or political agendas, they shared a common ideological lens that argued for educated and religious citizens as the key to a strong and lasting republic. For all of these men the natural sciences (not just applied or mechanical sciences) were essential to maintaining the moral and civic virtue required for a successful republic. Using public venues like museums and lecture halls, famous men of science, like Charles Willson Peale, religious leaders like William Staughton, and lesser-known amateur naturalists/physicians like Wilmer Worthington promoted science for a virtuous citizenry.

The morality of textbook writers echoed the civic and Christian virtue presented by public lecturers and museum proprietors in the early republic to a growing audience beyond the city limits. Rather than encourage the feared disbelief of "French philosophers," American scholars couched the natural sciences in terms of explaining *God's* book of nature. As Americans gained greater access to education, they increasingly turned to the study of the natural sciences, encouraged by the moral and civic lessons they were supposed to impart. As the popularizers of the natural sciences in early national Philadelphia would argue, a useful education in the natural sciences went hand in hand with a Christian education. In fact, it could foster morality and a closer relationship with God. Because such an education created both a virtuous and useful citizenry, the natural sciences were central to the education of virtuous citizens in the early republic. As Benjamin Tucker—a public lecturer himself—reminded textbook readers in his preface to *A Grammar of Chemistry*, an unfamiliarity with the book of nature would be "a mortifying ignorance."[85]

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