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Abstract

Science formed an important element of Anglo-American life throughout the eighteenth century, and not only for the colonial elite. In both private and public realms, in commercial as well as social settings, eighteenth-century science amused, educated, provided prestige, and afforded entrée to empire to an extensive range of people. By the middle of the century, and despite the many challenges endemic to colonial life, a widespread interest in natural phenomena had emerged in America. Although this scientific curiosity began as an adjunct to the metropolitan culture of Great Britain, in the decades leading up to 1800, interest in science came to be identified with an independent and indigenous American culture, and was trumpeted as a sign of a developing American nationalism.

Chapter One. Science Beyond Franklin

The study of eighteenth-century American science needs to move beyond the long shadow of Benjamin Franklin. Science, sometimes aimless, often casual, almost always episodic, formed an important element of American life – at home and in public, in commerce and society both – and not just for Franklin. In eighteenth-century America, science amused, educated, and provided prestige and entrée to empire, not only in its requirements of learning and instrumentation but also in its outcomes. In the Anglo-American world, taking part in experimental enterprises enlightened, entertained, and conferred sheen. It also altered outlooks: working with the mental and physical tools of science, regardless of the results, was a transformative experience. Participation in scientific activities provided new things to think about, and also a new way to think. The very values that led to the proliferation of science also helped Americans refashion their outlooks, their ambitions, and their society. An examination of science beyond Franklin reveals that a widespread interest in natural phenomena had emerged in America by the mid eighteenth century. Although this scientific curiosity began as a provincial adjunct to the metropolitan culture of Great Britain, in the decades leading up to 1800, interest in science came to be identified with an independent and indigenous American culture, and could be trumpeted as a sign of a developing American nationalism.

To be sure, no study of American science in the eighteenth century can reasonably omit mention of Franklin, whose life spanned nearly the whole of the century and whose words and work permeated the era. Honored in his own lifetime as the paramount American man of science, Franklin's hold on that title has only strengthened over the centuries. He remains a towering presence in the narrative of early American science.[1] Yet while no examination of American science should discount Franklin, the heavy focus on him comes at the expense of a better understanding of his less-renowned contemporaries and their society. It is not only that Franklin and science are inextricably linked in our imaginings and in our histories, but that to think on the beginnings of American science is to bring Franklin immediately to mind. The tercentenary of Franklin's birth has produced a rich crop of wide-ranging appraisals of his work and influence both within and outside of his scientific accomplishments; reappraisals of American science, meanwhile, have been sparser.[2] Such unbalanced consideration

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[1] See Joyce Chaplin, *The First Scientific American: Benjamin Franklin and the Pursuit of Genius* (New York: Basic Books, 2006); I. Bernard Cohen, *Science and the Founding Fathers: Science in the Political Thought of Jefferson, Franklin, Adams and Madison* (New York: W.W. Norton), 1995; I. Bernard Cohen, *Benjamin Franklin's Science* (Cambridge, Mass.: Harvard University Press, 1990); I. Bernard Cohen, *Benjamin Franklin, Scientist and Statesman* (New York: Charles Scribners' Sons, 1975); Philip Dray, *Stealing God's Thunder: Benjamin Franklin's Lightning Rod and the Invention of America* (New York: Random House, 2005); Stanley Finger, *Dr. Franklin's Medicine* (Philadelphia: University of Pennsylvania Press, 2006); Michael B. Schiffer, et al., *Draw the Lightning Down: Benjamin Franklin and Electrical Technology in the Age of Enlightenment* (Berkeley: University of California, 2003).

For further investigation of Franklin's extended hold on the national imagination, see Carla Mulford, "Figuring Benjamin Franklin in American Cultural Memory," *New England Quarterly* 72, no. 3 (September 1999): 415 – 443.

[2] The literature on Franklin is large and grows larger. Recent works include Alan Craig Houston, *Benjamin Franklin and the Politics of Improvement* (New Haven, Conn: Yale University Press, 2008); J.A. Leo Lemay, *The Life of Benjamin Franklin* 3 vols. (Philadelphia: University of Pennsylvania Press, 2006 – 2009); Edmund S. Morgan, *Benjamin Franklin* (New Haven, Conn.: Yale University Press, 2002); Carla Mulford, ed., *The Cambridge Companion to Benjamin Franklin* (New York: Cambridge University Press, 2008); David Waldstreicher, *Runaway America: Benjamin Franklin, Slavery, and the American Revolution* (New York: Hill and Wang, 2004); Gordon Wood, *The Americanization of Benjamin Franklin* (New York: Penguin Press, 2004).

Recent works that consider American science without Franklin at their center include Silvio Bedini, *Jefferson and Science* (Chapel Hill: University of North Carolina Press, 2002); James Delbourgo, *A Most Amazing Scene of Wonders: Electricity and Enlightenment in Early America* (Cambridge, Mass.: Harvard University Press, 2006); James Delbourgo and Nicholas Dew, eds., *Science and Empire in the Atlantic World* (New York: Routledge, 2008); Sara Stidstone Gronim, *Everyday Nature: Knowledge of the Natural World in Colonial New York* (New Brunswick, N.J.: Rutgers University Press, 2007); Christoph Irmscher, *The Poetics of Natural History: From John Bartram to William James* (New Brunswick, N.J.: Rutgers University Press, 1999); Amy R. W. Meyers and Margaret Beck Pritchard, eds., *Empire's Nature: Mark Catesby's New World Vision* (Chapel Hill: University of North Carolina Press, offers only the most meager recognition of, or appreciation for, the actual breadth of the American scientific scene before and after Franklin, one that traversed a wider geographic spectrum than the environs of mid-eighteenth-century Philadelphia.

None of which is meant to deny Franklin his due. Franklin's foray into the world of experimental physics was thrilling in its boldness, its theorizing, and its results. Less than a decade after he began his "Philosophical Studies" in earnest, the letters detailing his groundbreaking experiments – advancing his unifying theory of electrical action and proposing the use of lightning rods as an effective way to protect against lightning strikes – were published in London and soon after translated into French to remarkable acclaim.[3] Franklin was lionized by his contemporaries in America. He achieved fame in the royal courts and the scientific societies of Europe.[4] In one fell swoop, Franklin gained entrance to transnational intellectual communities and the republic of letters, permanently altering the trajectory of his life and career. The prodigy fêted in his own

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1998); Susan Scott Parrish, *American Curiosity: Cultures of Natural History in the Colonial British Atlantic World* (Chapel Hill: University of North Carolina Press, 2006); Eric W. Sanderson, *Mannhatta: A Natural History of New York City* (New York: Abrams, 2009); Londa L. Schiebinger and Claudia Swan, eds., *Colonial Botany: Science, Commerce, and Politics in the Early Modern World* (Philadelphia: University of Pennsylvania, 2005); Gregory D. Smithers, *Science, Sexuality, and Race in the United States and Australia, 1780s – 1890s* (New York: Routledge, 2009).

[3] Franklin, "Autobiography" in *Writings*, comp. J. A. Leo Lemay, Library of America Series (New York: Literary Classics of the United States, Inc., 1987), 1420. Benjamin Franklin, *Experiments and observations on electricity, made at Philadelphia in America, by Mr. Benjamin Franklin and communicated in several letters to Mr. P. Collinson of London, F.R.S* (London, E. Cave: 1751); Abbé Nollet, *Lettres sur l'Electricité...* (Paris: Chez H.L. Guerin & L.F. Delatour, 1753).

[4] Franklin received honorary Master's degrees from Harvard and Yale in 1753, and from William and Mary College in 1756. He was awarded an honorary doctorate of laws in 1759 from the University of St. Andrews, and was forever after referred to as "Dr. Franklin." In 1753 Franklin also received the Royal Society of London's Copley Medal, given annually for "outstanding achievements in research." He was unanimously elected to membership in the Royal Society in 1756. In 1772, he was made a foreign associate of the French Royal Academy of Sciences, a signal honor. See Lemay, *The Life of Benjamin Franklin*, 3:112; Brooke Hindle, *The Pursuit of Science in Revolutionary America, 1735 – 1789* (Chapel Hill: University of North Carolina Press, 1956), 77 – 79.

time as America's intellectual exemplar is now well into his third century as the epitome of eighteenth-century American science.

Franklin does in fact epitomize the American experience, but in more ways than one. His experiences serve as examples both of the possibilities as well as the limits of American engagement with science. Franklin thus perfectly illustrates the fertile conditions under which American science flourished, after a fashion, as well as the obstacles and outright resistance that were equally part of the scene.[5] Franklin's interactions with science afforded him pleasure as well as intellectual stimulation; the opportunity to employ and appreciate well-crafted apparatus; the company of like-minded contemporaries both near and far, male and female; entrée to fashionable assemblies, scientific societies, diplomatic circles, and a world of ideas, sensibilities, elegance, and refinement; and a way to manage to his advantage the increasingly fluid class structures of the age.

Franklin's masterful negotiation of the opportunities he encountered was unequaled and he enjoyed outcomes beyond what could reasonably be expected. Nevertheless, many of the revolutionary and transformative opportunities so central to his personal story were not unique to him and instead were widely shared. The history of Franklin's interest in electricity captures the ways in which a variety of information from multiple sources about a host of topics circulated and came together in America –

[5] Notwithstanding the honors they eventually bestowed upon him, the Royal Society did not at first see much value to Franklin's work, and refused to print his letters to Peter Collinson in their journal, the *Philosophical Transactions*. At least one correspondent informed Franklin that the members of the Society had laughed when his theory that electricity and thunder were the same was read aloud. Not until the *Experiments and Observations* were translated into French and Franklin's lightning hypothesis confirmed through the sentry box experiment was he vindicated. Lemay, *The Life of Benjamin Franklin*, 99 – 100.

not only for Franklin but for a fairly wide cross-section of people, chiefly in the cities and towns along the eastern seaboard in New England and the mid-Atlantic region. Franklin found himself first inspired by the demonstrations of an itinerant lecturer in the natural philosophy then in vogue. His interest was further stimulated and nurtured by tools sent from Europe, and also texts. Most influential among those imports was an article penned by the Swiss physiologist Albrecht von Haller, written first in French and published in the Dutch Republic, quickly translated into English and printed both in England and America. Haller was himself reporting on the work of a varied cast of German and British investigators. Even at the fringes of the British Empire, Franklin managed to participate in a trans-global, international circulation of scientific goods, ideas, and practices. Other Americans did as well.

Historians have looked for, and lamented, the lack of supposedly true and pure scientists in early America, all the while deprecating or entirely overlooking the participation of more commonplace practitioners. We need to conceive anew what it meant to be involved in the sciences in eighteenth-century America. Without denying the crucial contributions made by a small cadre of elite, university-educated natural historians and philosophers, nor minimizing the difficulties that attended any natural inquiry in early America, we must judge the practice of science in the eighteenth century along a fluctuating continuum.

Franklin himself is partly responsible for this focus on a narrow band of elite practitioners. His 1743 “Proposal for Promoting Useful Knowledge” has long been regarded as a call to elite American gentlemen to take upon themselves the challenge of improving colonial life through intellectual, scientific labor.[6] Franklin argued that the material and intellectual conditions were such that Anglo-Americans could turn their attention from the "mere Necessities" required to establish colonial life towards the improvement of the "common Stock of Knowledge." Franklin's tract proclaimed that there were "many in every Province in Circumstances that set them at Ease, and afford Leisure to cultivate the finer Arts," and he aimed to bring those "Men of Speculation" into a "Society … of Virtuosi or ingenious Men … who [were] to maintain a constant Correspondence." He sought to institute an inter-colonial web of natural philosophers who, too "widely separated" to have many occasions or opportunities to meet and share their findings in person, could nonetheless create and participate in a continental, indeed international, scientific community. Franklin called for the society to be based in Philadelphia, the largest colonial city (and conveniently his home), and recommended that it include "a Physician, a Botanist, a Mathematician, a Chemist, a Mechanician, a Geographer, and a general Natural Philosopher." Franklin's suggestion as to the composition of the permanent society gives us insight into the various disciplines that he imagined were central to group's aims, but also conflates such men of science with those "ingenious Men" in circumstances of "Ease and … Leisure."[7]

We should not take Franklin entirely at his word, however. That network of communication, experimentation, and improvement that he envisioned has frequently been the focus of our histories, yet it is but one side of the actual sets of connections

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[6] Benjamin Franklin, 17 May 1743, "A Proposal for Promoting Useful Knowledge Among the British Plantations in America" in *Writings*, comp. J.A. Leo Lemay (New York: Library of America, 1987), 295 – 297.

[7] Franklin, "Proposal for Promoting Useful Knowledge," in *Writings*, 295.

emerging in the mainland colonies, and in which a variety of people were participating. Benjamin Franklin, certainly well-off and ingenious, no doubt had himself in mind as one of the members of his new society. However, in 1743, Franklin was still five years away from his retirement from the printing business. Franklin anticipated that his proposed society, ultimately the American Philosophical Society, would include such experts – the "Virtuosi" – as existed in Philadelphia and the other colonies. Yet, just as with the Junto, a tradesman's club Franklin assembled nearly two decades earlier, the active membership in the early years of the American Philosophical Society was composed largely of ordinary men. The recent publication of the first of several volumes of biographical sketches of the members of the American Philosophical Society makes clear the modest beginnings and vocations among its founding members, the "great majority" of whom were "merchants, shopkeepers, mechanics, artisans, and small farmers," with only "a leaven of physicians, lawyers, and clergymen" among them.[8] Franklin's Junto had few members with formal academic training; indeed its founding membership was the archetype of the self-improved, and included two surveyors who

[8] See Whitfield J. Bell, Jr., *Patriot-Improvers: Biographical Sketches of Members of the American Philosophical Society, 1743 – 1768*, vol. 1 (Philadelphia: American Philosophical Society, 1997), xiii. For the history of the founding of the American Philosophical Society, see Hindle, *Pursuit of Science*, 68 – 75.

The Junto, organized "for mutual Improvement," included a glazier, a shoemaker, a clerk, a plumber, a mechanic, and only one "Gentleman of some Fortune" among them. See Franklin, "Autobiography" in *Writings*, 1361 – 1362. The "Young Junto," organized in about 1750 and patterned on Franklin's Junto, had a similar membership. It and the Philosophical Society revived during the imperial crisis of the 1760s and ultimately merged into the modern American Philosophical Society. See Bell, *Patriot-Improvers*, 3 – 8 and 175 – 179.

learned their craft on their own, a shoemaker who trained himself in mathematics, and a plumber, self-taught not only in mathematics but in astronomy and Latin as well.[9]

If we do not rely exclusively on Franklin, we begin to see that American science extended much further, and was more contradictory and expansive, either than he envisioned in 1743 or historians have appreciated since. From gentlemen's cabinets to displays in shop windows, via traveling curiosity shows and public lectures, self-organizing and sociable self-improvement associations and philosophical societies, almanacs, newspapers, books and other print ephemera, many people gained access to the new sciences. The cultures of science reached well beyond Franklin's imagined comfortable, leisured elite, and radiated outward to more popular patrons. To argue otherwise is to depend upon a rarified notion of science that not only limits it to a remarkably narrow range of practitioners, but also removes it from its material and social contexts.

Science ought not be detached from our investigations into civil society, and we need to understand the relationships between engagement with science and social forms of civil society.[10] The technology of experimental science – both as a body of knowledge and as the artifacts and tools of newly emerging disciplines – circulated widely in the eighteenth-century Atlantic world. The enhanced production of scientific instruments and printed material, expansion of peripatetic lecturers, and increased numbers of voluntary societies helped put science and its customs within the reach of those eager for knowledge and polish, yet barred from more formal avenues of learning

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[9] Silvio Bedini, *Tinkers and Thinkers: Early American Men of Science* (New York: Charles Scribner's Sons, 1975), 180.

[10] See Lynn K. Nyhart and Thomas H. Broman, eds., *Science and Civil Society, Osiris* 2nd series, 17 (2002).

by class, economics, or sex. By its very accessibility, science fostered gentility and democratization both, and helped Americans mediate between the inherently incompatible demands of social exclusivity and social mobility. Exploring the sciences that were most popular and most germane to the American experience – astronomy, botany, and geography chief among them – illustrates the exchanges, the social and intellectual intercourse that science afforded to the wealthy, the curious, and the unabashedly popular. We thereby gain insight into the reciprocating influences of science, society, and culture.

To the extent that historians have considered the emerging sciences of early America, they have duplicated certain categories that Franklin himself set forth in his 1743 proposal for an intercolonial and international society devoted to the advancement of "Useful Knowledge Among the British Plantations in America."[11] Franklin and those who followed him have focused almost exclusively on a small group of men endowed with education, wealth, and leisure. The study of American science in the eighteenth century has long been delimited by several early, seminal texts as well as an unfortunate and short-sighted consensus that there was in fact little 'real' work done in that era. Brooke Hindle, Dirk Struik, Raymond Stearns, and John Greene all produced works that were deeply researched, quasi-encyclopedic surveys that focused on the usual cast of characters, only to bemoan how the ideas and work of the American "colonists lagged behind their European fellows."[12] These historians too often appraised those colonials

[11] Franklin, "Proposal for Promoting Useful Knowledge," in *Writings*, 295 – 297.

[12] Raymond Phineas Stearns, *Science in the British Colonies of America* (Urbana: University of Illinois Press, 1970), 4. Hindle, *Pursuit of Science*; Dirk Struik, *The Origins of American Science (New England)* 2nd ed. (New York: Cameron Associates, 1957); John C. Greene, *American Science in the Age of Jefferson* (Ames: The Iowa State University Press, 1984).

who participated in the work of that age of discovery as nothing more than "minor contributors of information, feeding American scientific data" to their English and European "patrons." Stearns' rather dry assessment of science as a "process of synthesis and organization" – one that depended on "*ideas*" to be real – makes clear that the narrow standards of mid-twentieth-century historians of science denied early Americans their proper due as authentic participants in a vibrant scientific culture. Hindle recognized that an "enthusiasm for scientific attainment" existed in the American colonies but he could not imagine where "the men … to fulfill the scientific ideals of the Enlightenment" were to be found, since there were only a few Harvard professors at hand.[13]

In many ways, Hindle's notion that scientific work came only from the intellectual training obtained in universities was entirely too accepting of the validity of academic theories as well as too dependent on the hoary disregard for utilitarian developments. That divide between respect for the pure or theoretical sciences and disdain for the applied or technological sciences is as venerated as it is old. Silvio Bedini's understanding that the "'little men of science' … were indeed participating members of a diverse scientific community" comes closer to the broad and holistic sweep that a full appraisal of early American science requires.[14] These historians made certain to emphasize what they regarded as the relative poverty of the American science

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[13] Hindle, *Pursuit of Science,* 5.

[14] Silvio Bedini, *Thinkers and Tinkers: Early American Men of Science* (New York: Charles Scribner's Sons, 1975), xvii.

See as well Clifford D. Conner, *A People's History of Science: Miners, Midwives, and "Low Mechanicks,"* (New York: Nation Books, 2005) for a sweeping look at the "people's" science since pre-history.

scene – which enjoyed a material distinction only by dint of its natural flora and fauna – both because of the genuine absence of institutions, patrons, or trained theorists in colonial America, and because they regarded science in its narrowest form of pure inquiry.

Although the study of science in early America has enjoyed a resurgence of late, it is one largely focused on natural history, not natural philosophy, an interest that reinforces the tendency to miss the concern with science prevalent in early America.[15]

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[15] Though experiencing a minor renaissance, the literature on science in the eighteenth century is still sparse and much more heavily focused on Britain and the Continent than America. See Whitfield J. Bell, *Patriot-Improvers: Biographical Sketches of Members of the American Philosophical Society* (Philadelphia: The American Philosophical Society, 1997); James Delbourgo, *A Most Amazing Scene of Wonders: Electricity and Enlightenment in Early America* (Cambridge, Mass.: Harvard University Press, 2006); Frank R. Freemon, "American Colonial Scientists who Published in the 'Philosophical Transactions' of the Royal Society," in *Notes and Records of the Royal Society of London* 39, no. 2 (1985), 191 - 206; Anne Goldgar, *Impolite Learning: Conduct and Community in the Republic of Letters, 1680 –* 1750 (New Haven, Conn.: Yale University Press, 1995); John C. Greene, *American Science in the Age of Jefferson* (Ames: Iowa State University Press, 1984); Dena Goodman, *The Republic of Letters: A Cultural History of the French Enlightenment*, (Ithaca, NY: Cornell University Press, 1994); Paula Findlen, *Possessing Nature: Museums, Collecting, and Scientific Culture in Early Modern Italy* (Los Angeles: University of California Press, 1994); Daniel R. Headrick, *When Information Came of Age: Technologies of Knowledge in the Age of Reason and Revolution, 1700 – 1850* (New York: Oxford University Press, 2000); Brooke Hindle, *The Pursuit of Science in Revolutionary America, 1735 – 1789* (Chapel Hill: University of North Carolina Press, 1956); Margaret C. Jacob, *The Cultural Meaning of the Scientific* Revolutions (Philadelphia: Temple University Press, 1988); Svante Lindkvist, "The Spectacle of Science: An Experiment in 1744…," *Configurations* 1, no. 1 (1993): 57 – 94; Michael R. Lynn, "Enlightenment in the Public Sphere: The Musée de Monsieur and Scientific Culture in Late Eighteenth-Century Paris," *Eighteenth-Century Studies* 32, no. 4 (1999): 463 – 476; Alan Q. Morton and Jane A. Wess, "Science as polite culture: Early scientific lectures in London, 1700 – 45," in *Public and Private Science: The King George III Collection* (New York: Oxford University Press, 1993); Susan Scott Parrish, *American Curiosity: Cultures of Natural History in the British Colonial Atlantic World* (Chapel Hill: University of North Carolina Press, 2006); Simon Schaffer, "The Consuming Flame: Electrical Showmen and Tory Mystics in the World of Goods," in John Brewer and Roy Porter, eds., *Consumption and the World of Goods* (New York: Routledge, 1993); Steven Shapin, *A Social History of Truth: Civility and Science in Seventeenth-Century England (* Chicago: University of Chicago Press, 1994); Steven Shapin, *The Scientific Revolution* (Chicago: University of Chicago Press, 1996); Richard Sorrenson, "The State's demand for accurate astronomical and navigational instruments in eighteenth-century Britain," in Ann Bermingham and John Brewer, eds., *The Consumption of Culture, 1600 – 1800: Image, Object, Text* (New York: Routledge, 1994); Barbara Maria Stafford, *Artful Science: Enlightenment Entertainment and the Eclipse of Visual Education* (Cambridge, Mass.: Harvard University Press, 1994); Raymond P. Stearns, *Science in the British Colonies of America* (Urbana: University of Illinois Press, 1970); Dirk J. Struik, *Yankee Science in the Making: Science and Engineering in New England from Colonial Times to the Civil War* (New York: Dover Publications, 1991); Alice N. Walters, "Conversation Pieces: Science and Politeness in Eighteenth-Century England," in *History of Science* 35, no. 2 (1997), 121 – 154.

This historiographical renaissance, though much broader in outlook than canonical historical treatments of the pursuit of science in early America (which focused too restrictively on the processes and merits of the scientific enterprise itself), has by and large not covered natural philosophy. This is entirely understandable. Looking as it did at the properties of natural things, and the origins of the effects observed in nature, natural philosophy left artifacts of a different and less-tangible kind than did the ornithology, botany, and zoology of natural history. Our investigations are made intractably more difficult by the very character of the subject studied. Natural history, concerning itself as it did with the discovery, categorization and organization of biological objects, had an ample physicality that was almost entirely absent from the philosophical sciences. The traces of natural philosophy on the thinking, behavior, or culture of the colonists are infinitely more difficult to chart, inasmuch as natural philosophy deals with the realm of the abstract. Many fewer images, or instruments, or other types of physical remains exist to guide the historian, leaving those of us interested in colonial engagement with these far more conceptual subjects with only crumbs of evidence. Yet Anglo-American engagement with science in the eighteenth century extended to theoretical practices as well as material studies.

For colonial natural history specifically, some recent works include Sara Stidstone Gronim, *Everyday Nature: Knowledge of the Natural World in Colonial New York* (New Brunswick, N.J.: Rutgers University Press, 2007); Walter Kingsely and Elaine M. Norman, *André Michaux in Florida: An Eighteenth-Century Botanical Journey* (Gainesville: University of Florida Press, 2002); Andrew John Lewis, "The Curious and the Learned: Natural History in the Early American Republic" (Ph.D. diss., Yale University, 2001); Amy R. W. Meyers, ed., *Art and Science in America: Issues of Representation* (San Marino, Ca.: Henry E. Huntington Library and Art Gallery; 1998); Pamela Regis, *Describing Early America: Bartram, Jefferson, Crèvecoeur and the Influence of Natural History* (Philadelphia: University of Pennsylvania Press, 1992).

The latest scholarship looks to complicate the earlier historiography that imagined New World science to be the child of Europe and its men, as well as the intermediate scholarship that permitted the colonials a minor role in the science of empire.[16] Though the "Atlantic world" is emerging as a broader analytic category, and includes Africa and the other America as well, in general the scholarship remains rooted in the topography of the land and its flora and fauna.[17] These new works consider colonial Spanish America, the colonial Caribbean, as well as the British mainland colonies, and contribute to our expanding knowledge of the scientific ties between the New World periphery and the European metropole.[18] Nevertheless, they remain heavily focused on natural history and ignore the broader appeal of science writ large. Some historians, however, are moving beyond those limits. James Delbourgo's work on the electrical Enlightenment of America is a notable exception, a cultural study of both

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[16] See I. Bernard Cohen, *Franklin and Newton: An Inquiry into Speculative Newtonian Experimental Science and Franklin's Work on Electricity as an Example Thereof* (Philadelphia: American Philosophical Society, 1956); Hindle, *Pursuit of Science*; Stearns, *Science in the British Colonies;* Lucile H. Brockway, *Science and Colonial Expansion: The Role of the British Royal Botanic Gardens* (New York: Academic Press, 1979); Patricia Fara, *Sex, Botany and Empire: The Story of Carl Linnaeus and Joseph Banks* (New York: Columbia University Press, 2003) ; John Gascoigne, *Science in the Service of Empire: Joseph Banks, the British State and the Uses of Science in the Age of Revolution* (New York: Cambridge University Press, 1998); David Mackay, *In the Wake of Cook: Exploration, Science, and Empire, 1780 – 1801* (New York: St. Martin's Press, 1985).

[17] James Delbourgo and Nicholas Dew, *Science and Empire in the Atlantic World* (New York: Routledge, 2008); Susan Manning and Francis D. Cogliano, eds. *The Atlantic Enlightenment* (Aldershot, England: Ashgate, 2008).

[18] See Daniela Bleichmar, *Science in the Spanish and Portuguese Empires, 1500 – 1800* (Stanford, Calif.: Stanford University Press, 2009); Ralph Bauer, *The Cultural Geography of Colonial American Literatures: Empire, Travel, Modernity* (New York: Cambridge University Press, 2003); Sara Stidstone Gronim, *Everyday Nature: Knowledge of the Natural World in Colonial New York* (New Brunswick, N.J.: Rutgers University Press, 2007); Susan Scott Parrish, *American Curiosity: Cultures of Natural History in the Colonial British Atlantic World* (Chapel Hill: University of North Carolina Press, 2006; Londa L. Schiebinger, *Plants and Empire: Colonial Bioprospecting in the Atlantic World* (Cambridge, Mass.: Harvard University Press, 2004).

science and enlightenment in America.[19] So too is Martin Brückner's literary and cultural approach to the geography and geographical knowledge in early America.[20]

Even Franklin, despite his own humble beginnings, had a 'great man' focus on science. He approached not his fellow Philadelphians, but instead John Winthrop of Massachusetts, when transmitting the desires of Nevil Maskelyne, the British Astronomer Royal, that some astronomic observations be made at Lake Superior during the 1769 Transit of Venus across the Sun. Franklin explained his choice by claiming that he knew of "no one ... likely to have a spirit for such an undertaking unless it be the Massachusetts" government. Franklin not only privileged the scientific spirit to be found in Massachusetts; on a practical yet more pessimistic note, Franklin claimed he did not believe any of the other American provinces had any "person & instruments sutable [*sic*] to the task."[21]

Franklin was mistaken, although there was a limit to the number of observers with the skill to take the kinds of astronomical observations hoped for by the Royal Society. But though we know more than Franklin did about the state of natural philosophy in America, too many historians agree with Franklin's implicit assumption that only the grand efforts and the efforts of the grand are worth remarking. The few canonical works on early American science have also stressed, and lamented, the scarcity of 'suitable' persons and the sparsity of necessary instruments. The serious

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[19] James Delbourgo, *A Most Amazing Scene of Wonders: Electricity and Enlightenment in Early America* (Cambridge, Mass.: Harvard University Press, 2006).

[20] Martin Brückner. *The Geographic Revolution in Early America: Maps, Literacy, and National Identity*. (Chapel Hill: University of North Carolina Press, 2006).

[21] Benjamin Franklin to John Winthrop, quoted in Winthrop to James Bowdoin, 18 January 1769, Bowdoin and Temple Papers, MHS.

colonial efforts at scientific inquiry have received nearly the whole of historians' attention and interpretation, yet even that has mustered but little commendation.[22] Indeed, it is the Transit's role in institution building that historians have emphasized; the focus has been on the reformation of the American Philosophical Society and the acclaim it received for the unanticipated fineness of the observations made under its auspices, printed in the inaugural volume of its learned journal.[23] This institutional maturity surprised both European observers and the colonists themselves.[24] But the popular interest so much in evidence throughout the colonies, explored in detail in Chapter Four, "A School of Fashion and Philosophy," has been dismissed straight away with little more than an acknowledgement, if that much.

We need to conceive of science in the broadest terms possible and evaluate the scientific inquiries and practices that many Americans engaged in by those capacious boundaries, rather than by the unproductive and reductionist search for results. Science, its adherents and its consequences, must be examined in an expansive and also more inclusive way, one that incorporates technology, the consumer revolution, the proliferating and far-reaching print and book culture, emerging voluntary societies, and the ties of the Atlantic world. Science should be understood to comprise concepts and apparatuses, techniques as well as technologies. Science is fundamentally concerned with the search for knowledge as well as its production, not just the proof or the certainty that attends the demonstration of such knowledge. In colonial America, science existed

[22] See Hindle, *Pursuit of Science*; Stearns, *Science in the British Colonies*; Harry Woolf, *The Transits of Venus: A Study of Eighteenth-Century Science* (Princeton, NJ: Princeton University Press, 1959).

[23] *Transactions of the American Philosophical Society* 1 (1769 – 1771), 4 – 116.

[24] Stearns, *Science in the British Colonies*, 674.

not only in the ascertainable principles upon which a discipline was built, but also its technology – both the performable practices that a branch of learning required and generated, as well as its tools. As such, science encompassed not only the varied bodies of knowledge that circulated in the eighteenth century (in particular those grounded in the natural environment and its yield), but also the techniques and practices associated with the hunt for such knowledge. Incorporating science into a study of the conceptually fluid and mobile eighteenth-century Atlantic world thus permits a fuller exploration of the century's remarkable social and cultural transformations. Moreover, and more importantly, when we look at this early science, we must consider the individuals involved in that production of knowledge as genuine participants – scientists, in an age when the word as such did not exist.

This kind of science – theoretical and applied, material as well as cultural – was widespread in early America, and its influence was vital to the concerns that preoccupy us about the eighteenth century. The development of distinctively American institutions, the reconfiguration of class boundaries, the rise of refinement and its concomitant transformations in aesthetics – if not absolutely central to their development, science nonetheless was connected to them all. Science helped Americans integrate more fully into the larger metropolitan world of the British Empire. At the same time, however, science influenced the development of an American consciousness, distinct from, and at times in conflict with, that hard-won identity as Anglo-Americans. Far from the province of an elite few, science extended throughout colonial society to people from all ranks who involved themselves in its customs. While such democratization also took place throughout the Atlantic world, particularly in Britain and France, the popular reach of science in North America gave it added momentum across the permeable nature of colonial society. Against the backdrop of the American Revolution, this democratization of science helped to strengthen the bonds of a nascent national identity.

Curiosity about science, to be considered as an experience apart from persistent avocation, was widespread in eighteenth-century America. Such attention ranged from intensive study to polite interest to popular recreation, belying the Pennsylvania botanist John Bartram's complaint to Cadwallader Colden about the impoverished state of American science before the Revolution. Writing to the New York naturalist in 1745, Bartram deplored what he claimed to be the wretched state of science in America. Dividing the majority of the colonial population into three "Classes," Bartram lamented the first as seekers after wealth, the second as seekers after opulence and extravagance, and the third as seekers of competency. In his estimation, those with time lacked the inclination to pursue science, and those with a penchant for study lacked time and materials. Sadly, Bartram considered the workers "many times the most curious" despite such deficiencies in time and tools.[25] Bartram grieved for these enthusiasts – cut off, as he imagined, from the pursuit of science. But he was too harsh in his review. In fact, all three "Classes" enjoyed many occasions to indulge their curiosity, though perhaps not to the extent that would have satisfied Bartram, a passionate botanist.

Although access to even the casual circulation of scientific information in early America had real limits, literacy and numeracy chief among them, scientific interest reached further than we might think. The recent work of scholars has looked closely the many instances of shared medicinal knowledge between Anglo-American, African and

[25] John Bartram to Cadwallader Colden, 7 April 1745. Quoted in Hindle, *Pursuit of Science*, 5 – 6.

American Indian women.[26] Particularly in botany, several colonial women distinguished themselves as extremely accomplished practitioners, especially the South Carolina planters Martha Daniell Logan – who wrote the first American treatise on horticulture – and Eliza Lucas Pinckney, who developed indigo into a cash crop, as well as the New York botanist, Jane Colden.[27] Recent scholarship with a broader sweep than early Anglo-America has described more fully the contributions of women to the progress of science.[28] Native peoples are almost entirely excluded from the recorded story, except as sources of botanical folklore and *material medica*.[29] For instance, Titan Leed's published an ostensible cure for the "*FEVER and AGUE* … an Epidemick Distemper"

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[26] Ellen G. Gartrell, "Women Healers and Domestic Remedies in Eighteenth-Century America: The Recipe Book of Elizabeth Coates Paschall," *New York State Journal of Medicine* 87, no. 1 (1987): 23 – 29; Susan E. Klepp, "Lost, Hidden, and Repressed: Contraceptive and Abortive Technology in the Early Delaware Valley," pp. 68 – 113 in Judith A. McGaw, ed., *Early American Technology: Making and Doing Things from the Colonial Era to 1850* (Chapel Hill: University of North Carolina Press, 1994).

[27] Marcia Myers Bonta, *Women in the Field: America's Pioneering Women Naturalists* (College Station: Texas A&M University Press, 1991); Martha Daniell Logan, *A Gardener's Kalendar Done by a Colonial Lady*, ed. Alice Logan White, (Charleston: National Society of the Colonial Dames of America in the State of South Carolina, 1976); Emily Bowles, "'You Would Think Me Far Gone in Romance': Eliza Lucas Pinckney and Fictions of Female Identity in the Colonial South," *Southern Quarterly* 41, no. 4 (2004): 35 – 51; Mary Harrison, "Jane Colden: Colonial American Botanist," in *Arnoldia* 55, no. 3 (Summer 1995): 18 – 26; Sara Stidstone Gronim, "What Jane Knew: A Woman Botanist in the Eighteenth Century," *Journal of Women's History* 19, no. 3 (Fall 2007): 33 - 59. See also Marilyn Bailey Ogilvie and Joy Dorothy Harvie, *The Biographical Dictionary of Women in Science*, 2 vols. (New York: Routledge, 2000).

[28] See Margaret Alic, *Hypatia's Heritage: A History of Women in Science from Antiquity through the Nineteenth Century* (Boston: Beacon Press, 1986); Marilyn B. Ogilvie, *Women in Science: Antiquity Through the Nineteenth Century. A Biological Dictionary* (Cambridge, Mass.: The MIT Press, 1986); Susan Scott Parrish, *American Curiosity: Cultures of Natural History in the Colonial British Atlantic World* (Chapel Hill: University of North Carolina Press, 2006); Londa L. Schiebinger, *The Mind Has No Sex? Women in the Origins of Modern Science* (Cambridge, Mass.: Harvard University Press, 1989).

[29] See Susan Scott Parrish, *American Curiosity: Cultures of Natural History in the Colonial British Atlantic World* (Chapel Hill: University of North Carolina Press, 2006) and Londa L. Schiebinger, *Plants and Empire: Colonial Bioprospecting in the Atlantic World* (Cambridge, Mass.: Harvard University Press, 2004) who both detail the ways in which Native Americans, African slaves, and ordinary people provided a wealth of botanical information to elite, trained botanists seeking new plants and their uses. See Gronim, "What Jane Knew," notes 74 and 75, for plant descriptions attributed to natives and unlettered common people in the botanical works of both Cadwallader Colden and Jane Colden.

rampant in the "moist and variable Climate" of the mid-Atlantic region.[30] The 'cure' involved a "purge with *Indian-Physick*," a medicine evidently so well known Leeds offered no further information about it.[31] The treatment continued with other native therapies, including one made from the "Powder of the *Sassafras-Root*, mixt with 20 Grains of the Powder of *Snake-Root*," all mixed together in a "decoction of *Wormwood*."[32] The Pennsylvania botanist John Bartram provided a descriptive piece on "Indian Physick" for Benjamin Franklin's almanac that same year, identifying it as the "true INDIAN PHYSICK mentioned" in Tennent's "valuable little Book."[33] Bartram was at pains to distinguish the Virginia plant from those found in Pennsylvania and Maryland, which he warned were "a violent Medicine." This sketchy record holds true for African slaves, although the few instances inscribed into the written record of such transmissions of knowledge do highlight the active scientific exchanges taking place across racial and class boundaries.[34] The most famous American instance of scientific information taken from Africans, one with medical knowledge at the center, is probably that of the Boston minister Cotton Mather and his slave Onesimus, who described to

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[30] Titan Leeds, *The American Almanack,*1741. NYPL.

[31] This was the purgative *Ipecacuania*, described in John Tennent's *Every Man His Own Doctor, or the Poor Planter's Physician.* 3rd ed., (Philadelphia, 1734), 9. Leed's copied directly from Tennent's book, p. 24.

[32] Leeds, *Almanack*, 1741.

[33] *Poor Richard's Almanac*, 1741.

[34] Susan Scott Parrish explores the expropriation of botanical knowledge commanded by African slaves in "Diasporic African Sources of Enlightenment Knowledge," in *Science and Empire in the Atlantic World*, eds. James Delbourgo and Nicholas Dew (Routledge: New York, 2008), 281 – 310. See also Karol K. Weaver, *Medical Revolutionaries: The Enslaved Healers of Eighteenth-Century Saint Domingue* (Urbana: University of Illinois Press, 2006).

Mather the African practice of inoculation against smallpox.[35] Seemingly more celebrated at the time was the unnamed Virginia slave who gained his freedom with a 'cure' for the bite of a rattlesnake.[36] Benjamin Banneker, a free black from Maryland, was a self-taught mathematician, astronomer, surveyor, and almanac maker.[37] The knowledge and practice of science in early America was far from being limited to the educated cadre of university professors, clergymen, and European-trained doctors; rather a wide array of people had the interest and the opportunity to incorporate science into their lives, if sometimes only in limited ways.

The attorney, judge, and natural philosopher Francis Hopkinson noted precisely this refusal to acknowledge science in unexpected, humble places, a myopia found particularly among the learned. In 1784, Hopkinson was attempting to revive the American Philosophical Society after the disruptions of the Revolutionary War; he informed his good friend Franklin that, with the "steady abilities" of the astronomer David Rittenhouse, he had "industriously applied" himself to "raise from a State of Lethargy, our philosophical Society."[38] Hopkinson wrote – and undoubtedly expected that Franklin shared his views – that he had urged the Philosophical Society members to

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[35] See Stearns, *Science in the British Colonies,* 417 – 418, and Margot Minardi, "The Boston Inoculation Controversy of 1721 – 1722: An Incident in the History of Race," *William and Mary Quarterly* 3[d] Ser., 61, no. 1 (January 2004): 47 – 76.

[36] See Sylvia Frey and Betty Wood, *Come Shouting to Zion: African American Protestantism in the American South and British Caribbean to 1810* (Chapel Hill: University of North Carolina Press, 1998), 56.

[37] See also Silvio Bedini, *The Life of Benjamin Banneker* (New York: Charles Scribner's Sons, 1971) and Charles A. Cerami, *Benjamin Banneker: Surveyor, Astronomer, Publisher, Patriot* (New York: John Wiley & Sons, 2002).

[38] Francis Hopkinson to Benjamin Franklin, 24 May 1784, *Writings* ….. 41:u621. For the talk itself, see Francis Hopkinson, "An Address to the American Philosophical Society," *Miscellaneous Essays and Occasional* Writings, 2 vols. (Philadelphia, 1792), 1: 362.

"to encourage a Pursuit of experimental Philosophy, by removing" the terribly limiting "Idea that none but Men of profound Learning and scholastic Education ought to meddle with pursuits of this kind." Hopkinson rejected that wrong-headed belief, which he considered a "great Obstacle" to the fundamental objective of the Philosophical Society, by "asserting that many of the most important discoveries had been made by Men who had not liberal Educations." Instead, Hopkinson believed that a "careful attention to Facts, and a steady Investigation of the Phenomina of Nature" could lead anyone to the "Discovery of Truth." In Hopkinson's view, the "Book of Nature was the Book of Knowledge," and "it was open to all." In this he suspected that he differed with some of the "learned faculty, who think it impossible to attain wisdom" but through the "whole visionary Fabric of Metaphysics."

Hopkinson's aim was to encourage "those who had not the means of a learned Education to become useful by experimental Enquiries" and he closed his letter to Franklin by reporting that the latest diversion was the "raising of Paper Balloons by Means of burnt Straw to the great Astonishment of the Populace." Yet such seemingly innocuous diversions were intimately linked to the new scheme of education that Hopkinson had recommended to the Philosophical Society the previous winter, for in concert with the English clergyman and natural philosopher Joseph Priestley, Hopkinson acknowledged that "important Phaenomena," like electricity before, "serve for Amusement first."[39] Hopkinson could be confident that Franklin agreed with him since Franklin had made many such recommendations nearly 35 years earlier in his "Hints

[39] Priestley wrote that "Electricity … both furnishes matter of speculation for philosophers, and of entertainment for all persons promiscuously." Joseph Priestley, *The History and Present State of Electricity,* vol. 2 (London, 2nd ed., 1775), 134.

towards forming a Plan" for the establishment of an "Academy" to educate the "Youth" of Pennsylvania.[40]

Hopkinson's admonition to the learned men of the Philosophical Society underscored the protean nature of conflict about learning that periodically roiled American society. Prior to the Revolutionary War, public rhetoric surrounding the acquisition of secular, and specifically scientific, knowledge at times warned about its concomitant social instability. As we shall see in Chapter Three, in the aftermath of the explosion in print media that took place in the colonies at mid-century, any number of public and private disputes turned on the 'fake' learning that some took from books. Concerned that such learning could lead to a leveling of the hierarchical divisions that privileged the few, pre-Revolutionary critics at times challenged the validity of the knowledge transmitted. Conflict about the democratizing tendencies of education continued after the war, as evidenced by Hopkinson's rebuke to those "Men of profound Learning." However, in the new United States, the locus of that battle moved from concern about the challenges to the social status attendant upon birth to the caliber of scientific attainments instead. The new nation required learned citizens, and much oratory on the subject idealized the United States both as an incubator of and a haven to science. By the end of the eighteenth century, however, a generalized notion of science as a republican good was routinely invoked.

That tendency of some to equate scientific learning only with the educated elite that Hopkinson warned against has too often been at work in modern evaluations of

[40] Benjamin Franklin, "Proposals Relating to the Education of Youth in Pensylvania," in *Writings*, J.A. Leo Lemay, comp., 323 – 344.

American science. Science, however, had a broader appeal. Franklin's abilities were extraordinary, the results he arrived at from his theorizing and experimentation were notable, and the outcome of his engagement with the wider scientific community, especially in Europe, astounding and inimitable. The culture in which all that transpired, however, was not particular to him.

It is time to reexamine the prevailing iconoclastic images of science. Previous studies of early American science have investigated the relationship of science to the federal government and political institutions; more recently, historians have studied the connections between science and religion, magic, medicine, and gender.[41] Even so, the tendency remains to look at American science through the lens of 'great men' and the grand unrolling of the Enlightenment's claim to Reason when we would benefit far more from an examination that is neither exclusively celebratory nor conversely dismissive. Focusing instead on popular as well as elite Anglo-American engagement with the tools, techniques, ideas, and practices of science, employed rationally as well as recreationally, gives us a fuller picture of the reciprocating influences of science and culture across the eighteenth century. Rather than limiting our investigation to the intellectual content of

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[41] See, Silvio Bedini, *Thomas Jefferson: Statesman of Science* (New York: Macmillan, 1990); I. Bernard Cohen, *Science and the Founding Fathers: Science in the Political Thought of Jefferson, Franklin, Adams and Madison* (New York W.W. Norton, 1995); Bernard Jaffe, *Men of Science in America* … Rev. ed. (New York: Simon and Schuster, 1958); David M. Knight and Matthew D. Eddy, eds. *Science and Beliefs: From Natural Philosophy to Natural Science, 1700 – 1900* (Burlington, Vt.: Ashgate, 2005); A. Hunter Dupree, *Science in the Federal Government: A History of Policies and Activities to 1940* (New York: Harper & Row, 1964); John P. Jackson, Jr., *Science, Race, and Ethnicity: Readings from Isis and Osiris* (Chicago: University of Chicago Press, 2002); Lester D. Stevens, *Science, Race, and Religion in the American South: John Bachman and the Charleston Circle of Naturalists, 1815 – 1895* (Chapel Hill: University of North Carolina Press, 1997); Pnina G. Abir-Am and Dorinda Outram, eds., *Uneasy Careers and Intimate Lives: Women and Science, 1789* – 1979 (New Brunswick, N.J.: Rutgers University Press, 1987); Susan Scott Parrish, "Women's Nature: Curiosity, Pastoral, and the New Science in British America," *Early American Literature* 37, no. 2 (2002): 195 – 245; ; Geoffrey V. Sutton, *Science for a Polite Society: Gender, Culture, and the Demonstration of Enlightenment* (Boulder, Colo.: Westview Press, 1995); Ellen Fernandez Sacco, "Spectacular Masculinities: The Museums of Peale, Baker and Bowen in the Early Republic," (Ph.D. diss., UCLA, 1998).

the disciplines, or the development of instrumentation, we instead can explore the many ways science was incorporated into the pastimes, aesthetics, commerce, and political culture of colonial America as it moved from provincial adjunct in the Atlantic world to independent nation with its own imperial ambitions.

As much as we know about Franklin, there are still lacunae. How much more so in the case of the many occasional practitioners of science who peopled Franklin's world. The very richness of the Frankliniana engrosses and can also overwhelm attempts to tease out the fleeting traces and make sense of the scattered hints left by everyone else.

This chapter, Science Beyond Franklin, has argued that the examination of eighteenth-century science in America needs to move beyond the study of a few heroic practitioners, Franklin chief among them. Moreover, not only does our understanding of *who* participated in scientific ventures in early America need to expand, so too does our perception of just *what* constituted science. By conceiving of science and its adherents more inclusively, we rightly place them in their material and social contexts, giving eighteenth-century Americans their due as authentic participants in a vibrant scientific culture.

Chapter Two, "An Account of the Progress of Learning," argues for a broader understanding both of what science meant in the eighteenth century, and whom it encompassed. Although Benjamin Franklin was the most visible practitioner of science in Anglo-America, he was far from alone; a variety of people throughout Anglo-America engaged with science. A proliferation of texts, tools, and teachers began slowly and grew more prevalent, combining by the mid-eighteenth century to create an environment saturated with science – one that invited many people to involve themselves in scientific ventures, at all levels and with varying results, with Franklin's electrical experimentation the most famous instance.

Chapter Three, "To Instruct Mankind in Philosophical Things," explores a multitude of scientific texts that circulated during the eighteenth century. This print media offers us a window from which to monitor the spread of science as well as the extent of that spread across British America in the eighteenth century. However, the very accessibility of these texts, along with the often egalitarian ideals of science that sounded through that proliferating media, opened up contested ground. Discussions that circulated in print both promoted the spread of science and also attempted to regulate that spread.

Chapter Four, "A School of Philosophy and Science," explores the ways in which science provided an avenue through which Anglo-Americans connected to the metropolitan culture of Britain. The exchange of artifacts and observations from Nature brought a variety of colonists into international interactions that grew more frequent and more expansive as the century wore on. The 1769 Transit of Venus across the face of the Sun provided the occasion for Americans to re-imagine their participation in that traditional relationship. Against the backdrop of the looming war for independence, their scientific work helped them stake a claim for intellectual and cultural independence.

Finally, Chapter Five, "Science Sets Her Sons Among the Stars," examines the rhetorical deployment of science in the new nation in the aftermath of the American Revolution. Far from an elite activity, science in America had long been a feature in most people's lives. Over the course of the century, Anglo-Americans' steady engagement with the raw materials, the ideas and the outcomes, and most especially the rhetoric connected to the practice of science all contributed to the making of a national identity. By the cusp of the nineteenth century, Americans would come to speak of science as uniquely suited to their emerging nation, which acted both as its wellspring of science and natural protector.

Chapter Two. "An Account of the Progress of Learning"

The practice of science was always present in America, from the earliest days of colonization to the heady days of nationhood. This chapter explores the extensive range of science in eighteenth-century America, first by detailing the expansive and inclusive nature of the concept of science, then by exploring how the century-long increase in the ranks of instructors and itinerant lecturers promoted and enlarged that understanding. This dual approach to the *scope* of science charts some of the ways in which a variety of people across the mainland engaged with that new knowledge. By mid century, a proliferation of texts, tools, and teachers combined to create an environment ripe with learning, one that invited many more people to participate in the expanding range of science, at all levels and with varying results. The most famous of these citizen encounters with science was Benjamin Franklin's experiments with electricity. Although Franklin was the most visible, and remains the most celebrated instance of colonial science, he was far from alone. This chapter lays out some of the multiple ways science circulated among his contemporaries.

Science sailed to America aboard the earliest English voyages of exploration and colonization, at work not only in the geography and cartography necessary for the investigations of the new world's terrain, but most particularly in the search for its botanicals. The pursuit of new, extraordinary or merely useful plants themselves, and the proper environment for their cultivation, motivated in part the very earliest exploratory voyages of the Europeans into the Western Hemisphere, and certainly played a role in the English exploration and settlement of the American colonies. Sassafras, the native American plant valued for its antiseptic qualities (it was erroneously believed to be a curative for gonorrhea, among other medicinal uses) was greatly prized in England and was featured in the earliest descriptions of the region written by the English explorers. The English promoter Richard Hakluyt highlighted sassafras in his *Discourse concerning western plantings*.[1] So too did Thomas Hariot, a mathematician, surveyor and astronomer in his own right, who included it among the "Merchantable Commodities" of Roanoke in his *Briefe and true report of the new found land of Virginia.*[2] Hariot's account of the plants and animals encountered in the Roanoke settlement certainly took note of flora of interest in the area, but his description of the region's botany focused first and foremost on the cultivatable aspects of the plants and crops he saw or could imagine. Hariot organized the plants, or "Commodities" as he termed them, into three categories – those that were "Merchantable," those good for "Victuals," and those that could be developed into "Building Materials." Botany was a linchpin of natural history in the sixteenth and seventeenth centuries, and it continued so throughout the eighteenth.[3]

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[1] Richard Hakluyt, *A Discourse Concerning Western Plantings,* ed. Charles Deane (Cambridge, Mass.: John Wilson and Son, 1877), 21 – 22.

[2] Thomas Hariot, *Briefe and true report of the new found land of Virginia* (London, 1588), 9.

[3] Although the colonies were not populated only with Englishmen, this is an examination of the cultures of science in the English colonies that would form the United States before the end of the century. Of course, other European powers had similar ambitions for this new world, ones they exploited earlier than the English. Some recent works examining their scientific explorations include: Antonio Barrera-Osorio, *Experiencing Nature: The Spanish American Empire and the Early Scientific Revolution* (Austin: University of Texas Press, 2006); Daniela Bleichmar, *Science in the Spanish and Portuguese Empires, 1500 – 1800* Stanford, Calif.: Stanford University Press, 2009); Jorge Cañizares-Esguerra, *Nature, Empire, and Nation: Explorations of the History of Science in the Iberian World* (Stanford, Calif.: Stanford University Press, 2006); Charlotte de Castelnau-L'Estoile and François Regourd, *Connaissances et Pouvoirs: Les Espaces Impériaux (XVIe – XVIIIe siècles): France, Espagne, Portugal* (Pessac: Presses Universitaires de Bordeaux, 2005); Antonio Lafuente and José Sala Catalá, *Ciencia Colonial en América* (Madrid: Alianza Universidad, 1992); Juan José Saldaña, ed., *Science in Latin America: A History,* Bernabé Madrigal, trans. (Austin: University of Texas Press, 2006).

By the eighteenth century, however, Americans at many levels of society were participating in a variety of scientific disciplines, notwithstanding the physical, intellectual, and material challenges of colonial life that militated against an easy advancement of learned culture and scientific endeavors. Those disadvantages – the great geographic distances that separated a handful of cities, the dearth of trained practitioners, and a lack of institutions among them – usually are blamed for the supposed failure of real scientific work to emerge from colonial America. Far from being absent in the colonies, however, science formed a recurrent part of American life. Science came in many guises and to every locale in early America. Moreover, a wide and diverse array of people had access to and participated in a world of observation and experimentation, well beyond the limited cast of characters usually submitted as the exemplars of American science. Such a scientific world was not exclusive to the educated, wealthy or well-connected. As the legion of the self-taught and the ill-equipped incorporated science into their lives, they took part as well in what would become an intracolonial and transatlantic stream of learning.

If we were to look to early America for the key elements of the modern scientific community – precise disciplines, state patronage, tangible results – we would be disappointed. Moreover, comparing early American scientific practices and experiences with those that could be enjoyed in Britain or on the Continent is equally problematic, as the opportunities in Europe far outstripped anything available in the Americas. Colonists to the new world simply had no way to match the scientific institutions that emerged in Europe in the aftermath of the Copernican and Newtonian revolutions of the sixteenth and seventeenth centuries. Such institutions, particularly the Royal Society of

London, provided an organized, and at times well-funded, foundation for the practice of science through their collegiality, the sharing of research, the sponsorship of prizes and expeditions, and publication of journals, among other advantages.[4] Prior to 1750, Americans largely lacked libraries, museums, and academies. They frequently had little scientific training, less in the way of experimental apparatus, and until the mid-eighteenth century, no skilled artisans who might craft the necessary tools. Moreover, few colonists had entrée to the international network of learning and inquiry then emerging from the private and public institutions of Europe, exemplified by the Royal Society of London, with its learned journal and society of like-minded colleagues and wealthy patrons.[5] Such deficiencies precluded sustained American participation in experimental science, and some colonial researchers made precisely that complaint. Judging by these standards, there is no denying that the American scientific world appeared to be a poor one indeed.

It is therefore easy to disparage the science that emerged from the American colonies in the eighteenth century as derivative or unimaginative – not science at all – and nearly impossible under the prevailing material and intellectual conditions anyway.

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[4] See James E. McLellan, *Science Reorganized: Scientific Societies in the Eighteenth Century* (New York: Columbia University Press, 1985); Stearns, *Science in the British Colonies*, 105.

[5] The Royal Society of London for the Improvement of Natural Knowledge was founded in 1660 to pursue the new and experimental form of "philosophy" encouraged by Francis Bacon, intended to replace the non-experimental, qualitative Aristotelian approach. John Barrow, *Sketches of the Royal Society and Royal Society Club,* (1849; reprint, London: F. Cass, 1971).

The Society has published its journal, the *Philosophical Transactions*, since 1665.

See Francis Bacon, *The New Atlantis* (London, 1627). Bacon argued for a revolution in the study of natural philosophy, his "Great Instauration," where empirical study could produce knowledge of genuine use. See Anthony Grafton with April Shelford and Nancy Siraisi, *New Worlds, Ancient Texts: The Power of Tradition and the Shock of Discovery* (Cambridge, Mass.: Harvard University Press, 1992), especially chapter 5, "A New World of Learning," 195 – 252.

Rather than make unhelpful comparisons with modern conceptions of science or pit the colonies against the metropole, however, we should instead evaluate eighteenth-century science in America on its own merits. Then we would see that far from being a scientific wasteland, the American colonies provided a lush natural laboratory, one ripe with unknown flora, fauna, and terrain, and in the absence of customary pillars of scientific support, the freedom to observe, experiment, and theorize at will.

Science, or rather the study of natural philosophy, carried an expansive meaning in the eighteenth century, one that encompassed a broad theory of knowledge.[6] Thomas Mifflin's written account of the first lecture that he attended in experimental learning began with exactly that wide scope, defining "Philosophy" as "the Knowledge of all Things … that may be found out by the Power of Reason."[7] Our contemporary model of science as a series of distinct branches of learning, divided into clear categories, simply did not exist in the eighteenth century. The word held a much more extensive and more widely applied meaning then, and it was not until the mid-nineteenth century that "science" stood for the theoretical explanation of natural phenomena, or denoted a method of observation, investigation, description, and experimentation. While theorists in the eighteenth century certainly constructed explanations of natural phenomena, and practitioners employed the scientific method, they were engaging in 'philosophy.' Philosophy was the general description for a system from which nature, its laws and effects, were explained. Science stood for *knowledge*, and as such was considered an

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[6] For an overview of the theories underpinning the practice of European science from the sixteenth century on, see Raymond Phineas Stearns, *Science in the British Colonies of America* (Urbana: University of Illinois Press, 1970), 3 – 43.

[7] Thomas Mifflin's Notebook on Logick, 1757. NYPL.

aim of the seven liberal arts. Sometimes called the arts and sciences, the phrase denoted the curriculum codified in the classical age and offering precepts for the canonical approach to the branches of higher learning. It was designed to impart general knowledge and develop a student's intellectual abilities and rationality, all in service to the making of a free man.[8]

What subjects fell under the rubric of science in the eighteenth century was not limited to our current-day definitions, and a list that enumerated them would be long indeed. The phrase "arts and sciences" encompassed a multitude of learning, and particularly of a technological nature. Medicine itself, along with the study of anatomy, surgery, and inoculation, and the botany of its *materia medica*; Newton's optics; hydrostatics; meteorology; paleontology; the civil engineering of road and bridge building, and public works in general; architecture; agriculture, including crop improvement and animal husbandry; the various branches of natural history, from the ichthyology and conchology of zoology to the vegetal life of botany; the earth sciences of mineralogy and geology; chemistry; mining; manufacturing; and textile production and dyeing. All these formed a part of science, and although each involved the study of different subject matter, the examination of each was scientific. When the English naturalist Erasmus Darwin (grandfather of Charles Darwin) wrote to Benjamin Franklin in order to convey some recent scientific news, he imagined that the "philosophy" would

[8] The seven liberal arts comprised the "trivium" – grammar, rhetoric, and logic – and the "quadrivium" – arithmetic, geometry, music, and astronomy. See Anthony Grafton and Lisa Jardine, *From Humanism to the Humanities: Education and the Liberal Arts in Fifteenth- and Sixteenth-Century Europe* (Cambridge, Ma.: Harvard University Press, 1986); David L. Wagner, ed., *The Seven Liberal Arts in the Middle Ages* (Bloomington: Indiana Press University, 1983); Caroline Winterer, *The Culture of Classicism: Ancient Greece and Rome in American Intellectual Life, 1780-1910 (*Baltimore, Md: Johns Hopkins University Press, 2002).

make the "most agreable part" of his letter.[9] And what wide-ranging "philosophical news" he conveyed! Darwin's letter included notice of some new performances in experimental physics, the latest in observational astronomy, and his own contributions to botanical taxonomy. Beginning with a recent account of some electrical experiments performed by "a Curate in [his] neighbourhood," Darwin went on to report the astronomical news, gleaned from a chat with "Mr. Wedgewood," that "Mr. Herschel [the royal astronomer] had "discover'd three Volcanoes in the Moon now burning." As for his own contributions, Darwin recently had "superintended a publication of a translation of the botanical works of Linnaus … with design to propagate the knowlege of Botany." He offered to send 20 sets to Philadelphia for sale there.

Science in the eighteenth century must be conceived in its broadest sense, signifying any body of knowledge itself, or any field of organized knowledge, built on established principles and grounded in demonstration. To be scientific was to use empirical experiences of observation and experimentation in order to demonstrate clear and convincing knowledge. Such science was not limited to the biologic, earth or physical sciences in their more restricted present-day meanings. Nor did the word 'scientist,' representing a practitioner of science, a student of nature, with knowledge of the material world, exist in the eighteenth century. The term *philosophy* encapsulated such learning, and a philosopher was one "deep in knowledge, either natural or moral."[10] Science was a flexible term that described actions, activities, pursuits, and practices inherent in observational as well as experimental work. It was expansive enough to

[9] Erasmus Darwin to Benjamin Franklin, 29 May 1787, in *Papers,* 45:u37.

[10] The phrase is Johnson's, after Richard Hooker. See Samuel Johnson, *A dictionary of the English language* … 2 vols., (London, 1756), 2:160.

include the experimental or observational work that accompanied inquiry into the theoretical abstractions and material phenomena of the universe, such as in the studies of astronomy, physics, and mathematics generally, as well as the classification work of botany. Yet science also contained the technological and artisanal practice of craft derived from the transmission of rules or systems that were built on custom, as in surveying, navigation , and to some degree botany as well.

Of course, science in the eighteenth century did not mean only those disciplines the modern observer admits into the canon; pseudo-sciences abounded as well, from alchemy to astrology.[11] John Adams wrote from France that "All Paris, and indeed all Europe" found itself "amused with a kind of Physical New Light or Witchcraft, called Animal Magnetism."[12] Propounded by a "German Empirick … Name[d] Mesmer," this new science had "turned the Heads of a Multitude of People." Adams reported that the King of France had "thought it necessary" to convene an academic panel to inquire into this "Universal Cure," with Benjamin Franklin "at <u>their Head.</u>" They published a "Masterly Report" denouncing this "Magnetism," showing it could "never be usefull … <u>because it does not exist</u>." The report apparently did little to "annihilate the Enthusiasm," although Adams predicted that the "Phrenzy must evaporate." And yet, despite his skepticism of this "Enthusiasm," when Adams conducted an epistolary debate with Benjamin Waterhouse concerning the source of "<u>Animal Life,</u>" Adams

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[11] See Robert S. Cox, *Body and Soul: A Sympathetic History of American Spiritualism* (Charlottesville: University of Virginia Press, 2003); Robert C. Fuller, *Mesmerism and the American Cure of Souls* (Philadelphia: University of Pennsylvania Press, 1982); David D. Hall, *Worlds of Wonder, Days of Judgment: Popular Religious Belief in Early New England Display* (New York: Knopf, 1989); Thomas A. Horrocks, *Popular Print and Popular Medicine: Almanacs and Health Advice in Early America* (Amherst: University of Massachusetts Press, 2008).

[12] John Adams to Dr. [Benjamin] Waterhouse, 8 September 1784. Adams-Waterhouse Letters. MHS.

argued in favor of "Magnetism."[13] Rejecting Waterhouse's theory that the "Electrick fluid is the Cause of Life," Adams instead suggested that force by "which the Air" was "convey[ed] into our Lungs … when we breathe" was that very "Phrenzy" he had discounted a few years earlier.

Science, as understood in the eighteenth century, was an admittedly slippery concept into which the merest accretion of knowledge could insinuate itself. It is not we who should say what was or was not science in early America. At the same time, however, certain disciplines had a heightened significance in eighteenth-century America: astronomy, botany, electricity, and geography, particularly the systems needed to calculate and negotiate the dimensional relationships of the earth's surface, surveying and navigation. These are by no means the only important sciences worthy of consideration nor, of course, the only subjects to which Americans turned their attentions and their efforts in the eighteenth century, as is evidenced by that extensive yet still-incomplete list above. These particular fields of study, however, are appropriate for more careful analysis as they were highly adaptable to the conditions that obtained in America, and consequently were among the most widely practiced. They were all relatively easy to engage in, requiring little in the way of specialized equipment, and demanding a very small stake in terms of involvement. In some cases, nothing more than observation was required to participate. All permitted the legion of the self-taught. Moreover, as the languages of science grew more systematic (as in the adoption of the

[13] John Adams to Benjamin Waterhouse, 27 February 1791. Adams-Waterhouse Letters. MHS.

Linnaean system of botanic classification), Americans were liberated to pursue scientific ventures without having to rely on European relationships.[14]

Neither should we make an evaluative judgment that divides natural history from natural philosophy. Certainly, there existed pedagogic as well as practical differences between natural historians' work of naming, collecting, and classifying of physical objects, and natural philosophers' speculation and experimentation with phenomena, such as energy, matter, light, and heat.[15] However, natural philosophy was a covering term, capacious enough to include natural history. Although the differences between them, as practices, were well understood in the eighteenth century, none of the branches of learning were organized into such highly specialized disciplines that an impermeable boundary existed between them. The divide between the collecting and categorizing of natural history, and the theorizing and experimentation of natural philosophy indisputably was real, but it was also one easily breached. Natural philosophers, *i.e.* students of the physical sciences, frequently engaged in natural history when observing and describing the natural objects of a place, such as it plants or animals.

Nevertheless, the two branches of learning also overlapped: mathematics is the foundational knowledge for practices elegant as well as prosaic, from the loftiest astronomy to the most commercial surveying. Indeed, when Jedidiah Morse published

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[14] See Pamela Regis, *Describing Early America: Bartram, Jefferson, Crèvecoeur, and the Influence of Natural History* (Philadelphia: University of Pennsylvania Press, 1999), 12 – 13.

[15] For more discussion on the artificial distinctions between natural history and philosophy, as well as some less obvious parallels, see Anita Guerrini, *Natural History and the New World, 1524 – 1770: An Annotated Bibliography of Printed Materials in the Library of the American Philosophical Society* (Philadelphia: American Philosophical Society Library, 1986), 1- 9.

For belles letters as works of science, see Pamela Regis, *Describing Early America: Bartram, Jefferson, Crèvecoeur, and the Influence of Natural History*, (Philadelphia: University of Pennsylvania Press).

the first American geography, he assured his readers that a "Complete knowledge of *Geography*" was impossible to achieve "without some acquaintance with Astronomy."[16] Benjamin Workman went further in describing the mutual dependence between the two sciences, assuring the readers of his geometry textbook that the "Elementary part of geography is so blended with Astronomy, that a proficiency cannot be acquired in the one, without a competent knowledge of the other."[17] When George Adams issued a new edition of his father's "treatise on the globes," he too highlighted the close connections between astronomy and geometry, as well their necessity "to a liberal education." Without them, Adams claimed, no branch of learning could be "fully comprehended."[18] When 12 year old Sally Ripley, in Greenfield, Massachusetts, began her studies of geography in 1799, she first tackled astronomy – affirming, or merely parroting, the view that "complete knowledge of Geography cannot be attained without some acquaintance with Astronomy."[19]

Indeed, the practice of astronomy often worked in tandem with those of natural history. It was a necessity for both navigation and surveying, and often useful in botany. George Adams promised that with the "mathematical science" of astronomy, students could solve problems whose solutions had long "appeared to be above the reach of human art."[20] With the techniques his book taught, and the use of a few inexpensive

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[16] Jedidah Morse, *The American Geography; or, A View of the Present Situation of the United States of America* (Elizabethtown, N.J.: Shepard Kollock, 1789), 1.

[17] Benjamin Workman, A.M., *Elements of Geometry, Designed for Young Students in that Science* (Philadelphia: John McCulloch, 1790), 5.

[18] George Adams, *Astronomical and Geographical Essays*, 2nd ed. (London: R. Hindmarsh, 1790), v.

[19] Tuesday 16 July 1799. Sally Ripley Diary. AAS.

[20] Adams, *Essays*, vi.

instruments, anyone could "find the distance of any inaccessible object, the height of a spire [or] a mountain … learn to plot a field, ascertain the altitude of a cloud, a fire-ball, or any other meteor," judge the distance of a passing ship, and determine the latitude and longitude of any place.[21] Thomas Jefferson perfectly captured the affinity between all these fields when he wrote to Benjamin Smith Barton in 1803. Needing to prepare his secretary, Meriwether Lewis, for a "confidential" exploration of the Missouri "& whatever river … runs into the Western Ocean," Jefferson called on Barton to draft notes that would help Lewis "draw his attention … to the objects most desirable" and deserving of "enquiry and observation."[22] Jefferson enumerated the "compleat science" that he believed requisite to conduct the investigation and these included "botany, natural history, mineralogy & astronomy."

One of the earliest communiqués by the Boston mathematician Isaac Greenwood to the Royal Society, in 1727, concerned his "New Method for composing a natural history" of the "Winds in every Climate" in order to achieve certainty in navigation. Greenwood's system involved a very complicated schedule of daily accounts at Paris and London as well as "by Seamen on ships," among whom he judged there to be "a considerable number …as have a taste for Physical Knowledge."[23] When the celebrated itinerant lecturer Dr. Moyes toured the new United States lecturing on "the philosophy

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[21] Adams, *Essays*, vi – vii.

[22] Thomas Jefferson to Benjamin Smith Barton, 27 February 1803, Benjamin Smith Barton Papers, HSP.

[23] Isaac Greenwood to [James Jurin], 10 May 1727, Cambridge, Mass., "A New Method for composing a natural history of Meteors," *Materials pertaining to the history of American Science, Letters and Communications from Americans, 1662 – 1900*; Reel 2; frames 471–473; Letter Book G.2.8. APS. It is a curiosity that Greenwood several times referred to his system as a natural history of Meteors when he almost certainly meant meteorology.

of chemistry and natural history," his teachings included discussion of the properties of light, heat, colors, air, earthquakes, dirt itself, metals, water and "vegetable substances."[24] Moreover, Moyes advertised the talks as including "no small part of Natural Philosophy" and promised that the audience would receive "in one view … the rise and progress of this useful science," along with its history of the "brilliant discoveries" on which it was built.[25] When, several years later, Moyes composed a new "Course of Lectures on the Natural History of the ... Earth" he spoke of earth sciences but also on gravity, electricity, and meteors, as well as "On the Natural History of the Planets, Comets, and Fixed Stars."[26]

These 'sciences' came together in the eighteenth-century mind as a congeries of linked pursuits. Robert Morden's introductory text, published in 1702, drew exactly these connections between the "so excellent sciences" of astronomy, geography, navigation, and mathematics.[27] So did Christopher Sargeant, who in 1726 began his commonplace-book with his speculations on the "Creation of the Animals" and the "causes of y[e] Deluge," yet also included several "Observations of Mr. Rays Three Discourses" on specific gravity and the density of air, embraced some 'astro-theological' conclusions about "fixt Stars …ye Planets [and] Comets," and worked in "Observations"

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[24] Henry Moyes, M.D., *Heads of a Course of Lectures on the Philosophy of Chemistry and Natural History* (1784).

[25] *American Herald* [Boston], 31 May 1784.

[26] Henry Moyes, M.D., *Heads of a Course of Lectures on the Natural History of the Celestial Bodies ….* (Boston, 1787). AAS.

[27] Robert Morden, *An Introduction to astronomy, geography, navigation, and other mathematical sciences made easie by the description and uses of the cœlestial and terrestrial GLOBES* (London, 1702).

on light and sound as well as the "Existence of God."[28] The store of "Useful Knowledge" that Franklin specified in his plan for a "Society … of Virtuosi" called for permanent posts filled by a "Botanist, a Mathematician, …a Geographer, and a general Natural Philosopher" who would communicate findings in matters botanical, mineralogical, mathematical, chemical, mechanical, agricultural, and geographic.[29] When the Reverend Peres Fobes, professor of Natural and Experimental Philosophy at Rhode-Island College, proposed his "Course of Lectures upon Natural Philosophy and Astronomy" in 1790, he promised to explain the "first Principles of Agriculture and Botany" as well as "Optics, Astronomy, Electricity" as well. This was an obvious amalgamation of natural history and natural philosophy, the whole of which lent itself to illustration "by a Variety of curious and entertaining Experiments."[30]

As difficult as it can be to chart the participation by the ordinary in these new sciences, their activities took root and formed part of a different scientific revolution that emerged not only in Europe but in America as well. The changes that the new sciences brought about were not restricted to the development of the disciplines themselves but brought radical alterations in society as well. Upheaval naturally followed a scientific revolution that discarded the less empirical Aristotelian world view in favor of a universe as described by Copernicus and Galileo, its mysteries explained through Newtonian physics. New systems developed in the aftermath. Unbeknownst to, at times unarticulated by, those who participated in scientific enterprises, new practices and

[28] Christopher Sargeant, Common-place book. MHS. "Mr. Rays Three Discourses" referred to John Ray, *Three physico-theological discourses…*4th ed. (London, 1721).

[29] Franklin, "A Proposal for Promoting Useful Knowledge," in *Writings*, 296.

[30] "A Course of Lectures upon Natural Philosophy," (Providence, 1790). AAS.

traditions led to substantial changes in social mobility and personal status, in the new institutions they created, and the social spaces they inhabited.

In short, the scientific revolution had a dramatic impact on the common systems of thought at the outer edge of the New World and played a vital part in the style of life in America in the eighteenth century.

During the 1740s, three events triggered an explosion in the public interest of science: the lectures of Archibald Spencer – an itinerant practitioner of natural philosophy – the shipment of electrical equipment from England to the Library Company of Philadelphia, and the circulation in print of a pamphlet by Albrecht Von Haller that summarized recent European experimentation on electricity. Together, these three developments created a charged atmosphere of popular science in colonial America that extended far beyond Benjamin Franklin's more famous experiments with electricity. By examining the larger context of this popular science we not only can place Franklin's electrical work in its proper context, but we can also gain a clearer insight into the meaning of science for colonial Americans, both as a field of knowledge and a venue for entertainment.

As Benjamin Franklin tells the story, it was the fortuitous meeting in 1743 with a certain "Dr. Spence, who was lately arrived from Scotland" that sparked his own interest in electricity.[31] The two men found themselves together in Boston at the start of the successful lecture tour in "EXPERIMENTAL PHILOSOPHY"[32] that took Archibald Spencer,

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[31] Benjamin Franklin, "Autobiography," in *Writings*, comp. J.A. Leo Lemay (New York: Library of America, 1987), 1452.

[32] *Boston Evening-Post* and *Boston Post-Boy*, 30 May 1743; also *Boston Evening*-Post, 1 August 1743. See also, *New-York Weekly Journal*, 24 October 1743; *Pennsylvania Gazette*, 26 April 1744.

"Scottish Physician and Man-Midwife,"[33] along the Atlantic seaboard from Boston to Philadelphia.[34] The itinerant lecturer demonstrated "some electric Experiments" that Franklin observed, either at the doctor's public presentations or possibly at a private meeting. In either case, Franklin's retrospective judgment recalled Spencer as "not very expert" and the experiments as only "imperfectly" performed. Perhaps repeated practice helped improve Spencer's performances. In August, he alerted the public that pursuant to "the Desire of several Gentlemen and Ladies" he would begin a new "course of Experimental Philosophy: which will be the last he ever intends to perform in this Town."[35]

Despite the ostensible crudity of the demonstrations Franklin saw, and notwithstanding his unfavorable appraisal, Franklin acknowledged that those displays "equally supriz'd and pleas'd" him, as the experiments were "on a Subject quite new to" him.[36] More importantly, however, Spencer's performance left Franklin well-disposed to make good use of the assorted electrical paraphernalia that would come his way once he returned to Philadelphia. Soon after his Boston encounters with Dr. Spencer, curiosity piqued, Franklin would find that he had at his disposal all the tools he needed

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[33] The phrase is Thomas Cadwalader's, quoted in I. Bernard Cohen "Benjamin Franklin and the Mysterious 'Dr. Spence.' The Date and Source of Franklin's Interest in Electricity," *Journal of the Franklin Institute* 235, no. 1 (1943): 1–25, 16. Cohen's article definitively establishes both the correct date of the meeting (1743 rather than 1746) as well as the identity of the mysterious "Dr. Spence" of Franklin's autobiography, although Cohen mistakes his first name for Adam, rather than Archibald. It is Cohen furthermore who asserted that the meeting between the two men must have been private, as he claims that Spencer did not hold any public lectures in Boston. However, Spencer did in fact hold his Boston lecture series in 1743 – he held several – at which Franklin may well have been present. See J.A.L. Lemay "Franklin's 'Dr. Spence': The Reverend Archibald Spencer (1698? - 1760), M.D.," *Maryland Historical Magazine* 59, no. 2 (1964): 199–216.

[34] See Lemay, "Franklin's 'Dr. Spence,'" *supra*.

[35] *Boston News-Letter,* 4 August 1743.

[36] Franklin, "Autobiography," in *Writings*, 1452–1453.

to embark on his own investigations into experimental physics. To begin with, Dr. Spencer himself came the following spring to Philadelphia to lecture, and Franklin acted as his agent – although whether Franklin continued to attend the lectures remains unknown.[37] Spencer's first course of lectures drew so many interested parties that, as at Boston, he found himself obliged to begin a second course of lectures in order to accommodate demand. "A Greater Number of Gentlemen having subscribed to *Dr. Spencer's* first Course of EXPERIMENTAL PHILOSOPHY, than can be conveniently accommodated at a Time: He begins his … second Course, on Thursday, the tenth day of May."[38]

Franklin left no word about any further lectures of Spencer's that he might have attended but he had many opportunities to do so as Spencer and his lectures formed an important part of the culture of the town throughout that spring and summer.[39] In time, Spencer established a permanent residence in Maryland, where he lived until his death in 1760. Franklin maintained a connection with him in some capacity, as he reported in his autobiography that before his own retirement from the publishing business in 1748, he "purchas'd all Dr Spence's Apparatus … and proceeded in [his] Electrical Experiments with great Alacrity."[40]

However, Franklin did not need Spencer's apparatus to begin his experimental work, and most likely he did not rely on it at first. By April of 1745, the London

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[37] Lemay, "Franklin's 'Dr. Spence,'" 5.

[38] *Philadelphia Gazette*, 26 April 1744.

[39] William Black recorded in his journal making two visits to Dr. Spence's lectures, once in May and once in June, 1744. "Journal of William Black," *Pennsylvania Magazine of History and Biography* 1, no.3 (1877): 233–249, 246 and *PMHB* 1, no. 4 (1877): 404 – 419, 414.

[40] Franklin, "Autobiography," in *Writings*, 1420.

merchant Peter Collinson shipped to the Library Company a "glass tube, with some account of the use of it in making such experiments."[41] Collinson, the English Quaker, cloth merchant, enterprising naturalist, productive intermediary and assiduous correspondent to many colonists, engaged in scientific enquiries, had once before shipped to the Library Company several glass tubes designed for electrical experiments although no records exist indicating that Franklin used this first apparatus, received in 1742.[42] On the other hand, Collinson's 1745 gift to the Library Company of a second glass tube, coming on the heels of Spencer's lectures in experimental philosophy, and accompanied as it was by a well-illustrated pamphlet, unleashed a fury of experimentation and inaugurated a period of public lectures and scientific exhibitions throughout the colonies.[43]

Spencer's demonstrations were no doubt exciting, possibly even useful – notwithstanding Franklin's criticism of his early, inexpert presentations, his lectures appear to have been very popular and generally quite satisfying – but the key component to that flowering of electrical experimentation was the printed pamphlet. Written by the Swiss naturalist and physiologist Albrecht von Haller, and accompanied by copper-plate illustrations, the *Historical account of the wonderful discoveries, made in Germany, &c. concerning Electricity* elegantly detailed the preceding generation's work in electricity

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[41] Franklin, "Autobiography," in *Writings*, 1453. Indeed, Franklin's letter to Peter Collinson's son, Michael, is more explicit about the use Franklin made of Collinson's gift of the tube and accompanying pamphlet. Franklin to Michael Collinson, 8 February 1775, in Benjamin Franklin, *Papers*, eds. Leonard W. Labaree, et al. (New Haven, Ct.: Yale University Press, 1959 –), 17:65.

[42] Norman G. Brett-James, *The Life of Peter Collinson* (London: E.G. Dunstan, 1926); Jean O'Neill and Elizabeth P. McLean *Peter Collinson and the Eighteenth-Century Natural History Exchange* (Philadelphia: American Philosophical Society, 2008).

[43] J.A. Leo Lemay, *The Life of Benjamin Franklin,* vol. 3, *Soldier, Scientist, and Politician, 1748 - 1757* (Philadelphia: University of Pennsylvania Press), 59, 64–65. vol. 2, *Printer and Publisher, 1730 - 1747* 2:115

and provided a current overview of the state of the field, along with an extensive bibliography. Haller had written his summary in French, but it was quickly translated into English and published as a sixpence pamphlet, complete with "copper plate representations."[44] It was a copy of this pamphlet that Collinson shipped to the Library Company.[45]

Once Franklin and "several" others at Philadelphia began "making electrical experiments," Franklin admitted to being entirely "engrossed" in the subject. Although his fellow researchers might not have found themselves quite so absorbed in electrical tests as did Franklin, there was widespread involvement nonetheless. In order to accommodate all the interested practitioners, Franklin arranged for similar glass tubes to be manufactured in nearby New Jersey. With the subject "so much in vogue," he noted that more than one hundred had "been sold" in a four-month period.[46] Not only were the equipment and techniques in widespread use by these various participants, but the experimentation itself was also extensively observed by an even wider public. Franklin reported that his house was mobbed with "Friends and Acquaintances" who came "continually in crouds" in order to observe his work.[47]

Haller's pamphlet reached the Library Company first, but anyone with access to the April 1745 *Gentleman's Magazine* could read the full account there. Giving it yet

[44] *Acta Germanica, No. VI, Vol. II*. An advertisement for this pamphlet appears in the April 1745 issue of *Gentleman's Magazine*; the text of the pamphlet, without the illustrations, is reproduced in that issue as well. An actual copy of the pamphlet has not come to light. See *Gentleman's Magazine*, 15, no. 4 (1745), p. 224 for the advertisement, pp. 193 – 197 for "An historical account."

[45] Lemay, *Life of BF*, 3:59.

[46] Benjamin Franklin to Peter Collinson, 28 March 1747, in *Experiments and Observations on Electricity* (London, 1769), 1–2 ; Benjamin Franklin, *Papers*, eds. Leonard W. Labaree, et al. (New Haven, Ct.: Yale University Press, 1959 –), 3:134.

[47] Franklin, *Experiments and Observations*, 2.

wider circulation well outside of the Philadelphia Library Company and Franklin's circle, the *American Magazine and Historical Chronicle* reproduced the text in full in its December issue.[48] By the next spring, the Newport clockmaker William Claggett had devised his own electrical equipment and public show, which he presented first at Newport, and by mid-1747 at Boston. Promising a "Great Variety of curious Experiments of the most surprising Effects of ELECTRICITY," Claggett gave demonstrations of the "new Method of electerising several Persons at the same Time." His advertisements made no mention of any accompanying lectures or explanations.[49] That omission did not appear to materially affect the public's interest in viewing his experiments. Although Claggett's clock-making business reportedly necessitated his return to Newport, he bequeathed his equipment to the Capt. John Williams, out of whose house he had operated his spectacle, and Williams carried on "vastly to the Satisfaction" of those people with both 10 shillings and "the Curiosity to attend those wonderful Operations."[50] Boston evidently included a surplus of just such residents as the rival showman Daniel King found it worthwhile to establish a competing electrical attraction, promising to perform Claggett's "wonderful and surprising Operations."[51]

It is not clear what King used to display his "surprising Operations" – possibly one of the glass tubes manufactured in New Jersey. However, Williams went to the trouble and expense to advertise that his experiments, and not those of King, featured

[48] *The American Magazine and Chronicle* 2, Dec. (1745): 530–537. This reprint also omitted the copper-plate illustrations.

[49] *Boston Evening*-Post, 24 August 1747; see also *Boston Evening-Post*, 7 September 1747.

[50] *Boston Evening-Post*, 28 September 1747, quoted in William Northrop Morse, "Lectures on Electricity in Colonial Times," *New England Quarterly* 7, no. 2 (1934): 364–374, 365.

[51] Morse, "Lectures on Electricity," 365–366.

Claggett's "machine."[52] Because of Claggett's artisanal skill, his equipment may have displayed greater elegance or a more refined appearance; however, the demonstrations put on by nearly all in the growing cadre of electrical itinerants were the same. Although the advertisement placed by Richard Brickell to announce his New York show of the "most surprising Effects or Phenominas on Electricity" employed some fresh language, his description of those "Effects" repeated Claggett's almost word-for-word.[53] Both promised to demonstrate the wonderful power of electricity to attract, repel, and flame, "particularly the new Method of Electrising several Persons at the same Time, so that Fire shall dart from all Parts of their Bodies," marvels that reproduced exactly that which satisfied and astonished the "Curious in all parts of Europe."

It is in this context of a proliferation of electrical knowledge as entertainment that we need to place Benjamin Franklin. Franklin played with electricity. He entertained with electricity – but he took his experiments several steps further, into the realm of theoretical physics, and hence we recognize what he did as science. Franklin, however, was a unique actor and when we focus on him, his massive presence overwhelms our ability to evaluate the broader scene. Franklin trained his own electric showmen, chief among them Ebenezer Kinnersley, and these were able to offer additional theories and improved experiments to the demonstrations that lent both an American nature and a metropolitan glamour to the undertaking.[54] Kinnersley's lectures certainly drew on the mystique and gloss garnered from their simulacrum of European gatherings. At the

[52] Morse, "Lectures on Electricity," 365–366.

[53] *New-York Weekly Journal*, 9 May 1748.

[54] J.A. Leo Lemay, *Ebenezer Kinnersley, Franklin's Friend* (Philadelphia: University of Pennsylvania Press, 1964), 58–61.

same time, he emphasized their Americanization of the Franklinian electrical theories. His "course of experiments of the newly-discovered Electrical Fire," included not only "the most curious of those … made and published in Europe," but a considerable "Number of new Ones lately made in *Philadelphia.*"[55] Kinnsersley's demonstrations were perhaps priced out of easy reach for all but the comfortably situated, yet James Bowdoin wrote to Franklin from Boston that Kinnersley's "Experiments … exhibited here, have been greatly pleasing to all sorts of people, that have seen them."[56] However, the many individual demonstrations that emerged in the years following indicates that the 'audience' went to look at what was offered when given the opportunity; moreover, enough information circulated to give even those with no connection to Franklin at least a passing competence.

This interest in the science of electricity did not occur in a vacuum. In mid-eighteenth century colonial America, there was widespread interest in science among the genteel, and also among the more ordinary. Franklin wrote of the Transylvanian Samuel "Domien," an electrical showman he helped train, that on his American tour of public talks, "he had lived eight hundred miles upon Electricity, it had been meat, drink, and cloathing to him."[57] When the Scottish doctor Adam Spencer planned his 1743 lecture tour of North America, he likely had nothing more in mind than to extend to the British

[55] Ebenezer Kinnersley, "A Course of Experiments …" (Newport, 1752), AAS.

[56] James Bowdoin to Benjamin Franklin, 21 December 1751 in Bowdoin – Temple Papers, MHS.

Kinnersley's lectures commanded various prices in local currencies, "one Dollar" for two lectures at Philadelphia in 1751; 30 shillings in Newport in 1752; a "*Chequin*" per lecture at St. John's, Antigua, 25 April 1753. *PG* 2 May 1751; Kinnersley, "A Course of Experiments" for Newport and Antigua. James Delbourgo says that Kinnersley "charged five shillings for admission per performance (seven shillings, sixpence for couples), in *Amazing Scene of Wonders,* 94.

[57] Franklin to John Lining, 18 March 1755, in Franklin, *Experiments and Observations on Electricity* (London, 1769), 319 – 328.

colonies his successful series of public demonstrations of the latest scientific theories. Spencer's talks on a variety of scientific subjects – optics, natural philosophy, the circulation of the blood, and electrical fire – had been well and widely received both in the British provinces and in metropolitan Edinburgh and London; what induced him to travel to several North American cities to continue his work we cannot know. Whatever his expectations, he found the state of American curiosity sufficient to make his speculative and risky trip worthwhile.

The intensity of interest in science can be seen in the arguments it spawned. These contests also speak to the ways in which science could be used to validate or deny social position. Spencer was introduced as an occasional member in Dr. Alexander Hamilton's Ancient and Honorable Tuesday Club; Spencer appears in the records as the "Celebrated Dr Rhubarb, a person famous all over America for his great Skill in natural Philosophy."[58] The strength of Spencer's reputation, according to Hamilton, had been earned "in his curious and Learned experimental lectures, held for the entertainment and amusement of the Ladies and Gentlemen ."[59] Spencer's abilities evidently extended beyond "natural Philosophy," as Hamilton promised to elaborate as well on "that Gentleman's profound knowledge in Grammar, Logick," and other club-going tomfoolery.

Unfortunately, Spencer proved to be neither congenial nor as learned as his reputation recommended, at least in Hamilton's account. On one visit to the Tuesday

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[58] For a fuller description of Spence's demonstrations, see I. Bernard Cohen, "Benjamin Franklin and the Mysterious 'Dr. Spence.'" *Journal of The Franklin Institute* 235, no. 1 (1943): 1–25, especially pp. 7 – 10, which is a transcription of William Smith's notes of Spence's lectures.

[59] Alexander Hamilton, *The History of the Ancient and Honorable Tuesday Club*, Robert Micklus, ed., 3 vols. (Chapel Hill: University of North Carolina Press, 1990), 2:157. Also, see 2:163 and 2:178.

Club, Spencer apparently involved himself in "warm disputes on some mathematical Subjects, in which kind of Science" Spencer-as-Rhubarb refused to yield his point. Sadly, his argument confused mathematical and astronomical terms and, as "a man may possibly be a good mathematician and yet a Sorry astronomer," Spencer could not gain his point. Moreover, comity would never be reached, since the two misunderstood one another so profoundly that, in essence, "one Gentleman … talked of Chalk and the other of Cheese." Worst of all in Hamilton's judgment was the very nature of the dispute, which he found to be "not within the Compass of a proper Clubical Conversation." Not because of the topic itself, but rather because "it exceeded the understanding of most there present." The acrimony continued until "the Philosopher was so disgusted with the Club, as a parcell of Ignoramuses, and the Club with the Philosopher, as an ostentatious pedant, that neither chused to converse together, ever since."[60] Hamilton took no obvious sides in the recounting of this fractious debate. However, by accusing Spencer of building his argument on confused and ill-understood technical terms, Hamilton left the doctor's learned reputation open to question, and demonstrated how scientific learning in early America could be contested ground.

Hamilton, born in Edinburgh and trained as a physician at the university there, had very decided views about who was and who was not a fitting philosopher. He rarely hesitated to pass judgment on those whom he felt were encroaching into the world of science and fraudulently claiming its prerogatives. His earlier assessment of Spencer was markedly more neutral when he wrote about their meeting at a Philadelphia coffee house. Hamilton took care to note that he knew the learned philosopher had "held a

[60] Hamilton, *Tuesday Club*, 2:191–192.

course of physicall lectures of the experimental kind" both in Philadelphia and New York, without specifying whether he attended any himself. However, as Hamilton was conveying a letter to Spencer from a doctor friend in Newport, it is likely the two men had met previously, and not that Hamilton was carrying a letter of introduction from his friend Dr. Moffat – whom Spencer likely knew from his earlier lectures in Newport.[61] Whether Spencer genuinely deserved Hamilton's later disdain remains an open question; Hamilton quite frequently accused of incompetence and impertinence against those men whom he regarded as unequal in learning.

Hamilton's travel journal, the *Itinerarium*, is a record of his four-month long trip in 1744 from Annapolis to Maine and back again and included many sharp observations about the learned frauds, poseurs, and fakes – as he thought them – that he encountered along the way. Right at the outset of his trip, he "fell in company with" a "Mr. D__gs, a virtuoso in botany" who also "affected some knowledge in naturall philosophy, but his learning that way was but superficiall."[62] Hamilton was further disappointed in his new acquaintance's botanizing, being unable to learn from him sufficient specific details about the famous "gensing" plant that purportedly grew nearby, and of which his companion had only a "print or figure."

Hamilton's criticisms offer insight into the ways in which he valued authenticated knowledge, using it to mark a bright and somewhat rigid dividing line between classes in the increasingly mobile colonial society he inhabited. Hamilton

[61] Carl Bridenbaugh, ed., *Gentleman's Progress: the Itinerarium of Dr. Alexander Hamilton, 1744* (Chapel Hill: The University of North Carolina, 1948), 189. "Friday, September 14th …. I delivered him a letter from Dr. Moffat att Newport."

[62] Bridenbaugh, *Gentleman's Progress,* 5.

frequently deployed the charge of ignorance or impudence as a way of regulating those people whom he judged to have stepped out of what he regarded as their appointed place. Hamilton criticized precisely such parvenu philosophers when he wrote so witheringly of his New York stay that he "knew here several men of sense, ingenuity and learning…and a greater number of fops…[who] imagined few or none were their equals."[63] Such men, dismissed by the good doctor because "of lowly extraction," had an overly inflated view of themselves. They "never had…the capacity to observe the different ranks of men…or to know what it is that really constitutes that difference of degrees." In this instance, Hamilton considered ignorance the lesser wrong and was instead far more judgmental about an attempt by some to breach what Hamilton regarded as proper divisions among the social classes.

Whether Hamilton liked it or not, interest in science reached those he might not consider gentlemen. In Boston, Hamilton encountered just such an impertinent pup, a "certain pedantick Irishman" who spoke with a "very thick brogue," and whose preaching was "rather a philosophicall lecture than a sermon." Worse still, he "seemed to be one of those conceited priggs who are fond of spreading out to its full extent all that superficial physicall knowledge which they have acquired more by hearsay than by application or study." Such scientific ignorance, in Hamiltion's view, was not only impudent, it bordered on impiety – thus, an affront not only to the niceties of social order but to religious principles as well. The churchman tried to elucidate on "the specific gravity of air and water, the exhalation of vapours, the expansion and condensation of

[63] Bridenbaugh, *Gentleman's Progress*, 185.

clouds, the operation of distillation, and the chemistry of nature," yet Hamilton dismissed it all as "but a very puerile physicall lecture and no sermon att all."[64]

Whatever his intellectual disagreements with those nearer his own class, Hamilton at least accepted them as his equals. He levied no criticisms against the "physicall" learning of his fellow Tuesday Club members in the disputation with Dr. Spencer-as-Rhubarb. He found nothing wrong when, in his estimation, he judged that the majority of the company present did not know enough to follow the contours of the mathematical–astronomical clash between Spencer and the club Secretary; moreover, in portraying the famous Dr. Spencer as an "ostentatious pedant," Hamilton cast his lot with his fellow club-goers who expelled Spencer from the camaraderie of their voluntary society. Pedantry was a serious, yet slippery, indictment. The "pedantick" preacher made too much of his insufficiently understood book learning, but Dr. Spencer was merely overly ostentatious. Deployed with care, such a denunciation made an easy and dismissible mockery of both men, both for their learning and their lack of it.

When convenient, Hamilton indulged in yet another way of censuring the increasingly popular spread of science throughout colonial society, by being obnoxiously high-minded about the mix of spectacle and learning. For all the "Clubical" conviviality he enjoyed, and the marvelous wit he deployed in his writings, Hamilton occasionally claimed not to tolerate the mix of entertainment and science very well. While still in Philadelphia, Hamilton attended a gathering at the "Governour's Club" which included

[64] Bridenbaugh, *Gentleman's Progress*, 110.

The hapless preacher was the Reverend Stephen Roe, a young Irish assistant at King's Chapel, dismissed in 1744 for "bad behaviour." See Henry W. Foote, *Annals of King's Chapel* (Boston, 1881), I:487, 494, 525.

the governor himself, and "severall other gentlemen of note in the place." At last, Hamilton found himself among a congenial fellowship and enjoyed "conversation [that] was agreeable and instructing," until a coarser element "showed a particular fondness for introducing gross, smutty expressions which [he] thought did not altogether become a company of philosophers and men of sense."[65]

Spencer's lectures reached a large, and mixed, audience. One William Black, secretary of the Virginia commission charged with negotiating with the Iroquois about lands west of the Allegheny Mountains, attended at least two lectures by Dr. Spencer, always in the company of rather grand connections. In May, "[b]etween the hours of 3 & 4 the Governor, Commissioners, and the rest of the Company went to hear a Philosophical Lecture on the Eye, &c., by A: Spencer, M:D."[66] On this particular afternoon, Spencer performed the famed Stephen Gray electrical experiment intended to demonstrate how the electrical "Fire is Diffus'd through all space, and may be produced from all Bodies." In that dramatic reenactment, Spencer caused "Sparks of Fire" to emit "from the Face and Hands of a Boy Suspended Horizontally" from the ceiling by silken ropes "by only rubbing a Glass Tube at his feet."[67] The following week, Black, along with "Colonel Beverly and the Gentlemen of the Levee," was "Entertain'd … very Agreeably with several Philosophical Transactions" that elucidated "Sir Isaac Newton's

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[65] Bridenbaugh, *Gentleman's Progress*, 189–190.

[66] William Black, "The Journal of William Black," *Pennsylvania Magazine of History and Biography* 1, no 2, (1877): 117 – 132; no. 3 (1877): 233–249, 246; and no. 4 (1877): 404 – 419, 414.

[67] For the original experiment, see Stephen Gray, "Several Experiments Concerning Electricity," *Philosophical Transactions* 37, (1731 / 1732), 39. For a fuller description of Spence's demonstrations, see I. Bernard Cohen, "Benjamin Franklin and the Mysterious 'Dr. Spence.'" *Journal of The Franklin Institute* 235, no. 1 (1943): 1–25, especially pp. 7 – 10, which is a transcription of William Smith's notes of Spence's lectures.

Theory of Light and Colours.” Spencer also showed “Several Curious Objects” through the “Solar Microscope,” among other mechanized displays, “all which he perform’d very much to the Satisfaction of the Spectators.”[68]

Understandably, the written record leaves corroborating traces mainly of the colonial elite attending his lectures, but such grandees did not make up the entirety of everyone who heard Spencer. The number of times Spencer repeated the lectures would indicate a larger and more varied audience. Moreover, while a newspaper notice holds certain restrictions – to the literate, to those with leisure and the wherewithal to pay the entrance fee – nonetheless, Spencer’s use of the newspaper as a central way to attract an audience gave the lectures an appearance of liberality and egalitarianism. To be sure, Spencer did seek to make his lectures attractive to those who had previously attended, and no doubt developed something of a following. The last of his Philadelphia lectures admitted at half price any “Gentleman” who had completed the previous course. Notwithstanding those repeated appeals in print to gentlemen and their ladies, the audience for such amusements and entertainments, as well as sustained study, was diverse.

We can also see the widening of the public interest in science in the lectures of Isaac Greenwood, the Hollis Professor of Mathematics and Natural Philosophy at Harvard College for the twelve or so years before Spencer arrived, who was likely the first in America to offer public talks in any of the sciences.[69] While a member of the

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[68] Black, “Journal,” *PMHB* 1, no. 4 (1877), 414.

[69] Isaac Greenwood, *An Experimental Course of Mechanical Philosophy* (Boston, 1726). Greenwood made the claim for the novelty of his lectures when he wrote that “*Courses of Experiments* have not as yet been introduced into New-England, howsoever ambitious, & successful this *Country* has hitherto been in following the Politer Nations of *Europe* in other Things .” p.n.n.

college, Greenwood regularly lectured, outside of the college, on several subjects within his purview – mathematics, astronomy, and natural philosophy more generally. His earliest lectures promised to cover the "Principles of Algebra; Sir Isaac Newton's *incomparable Method* of FLUXIONS … *or any part of* Speculative *or* Practical *Mathematicks, usually taught in the* Colleges *or* Schools *in* Europe."[70] Greenwood's 1726 course of "Mechanical Philosophy" promised to impart a "competent Skill in *Natural Knowledge"* through the use of "*Instruments and Machines."* So efficacious was Greenwood's method that, combined with the "useful *Experiments* performed," Greenwood promised a few weeks' effort would make the attendees "better acquainted with the *Principles* of Nature" and the intricacies of the Newtonian universe than a "*Years* Application to *Books* and *Schemes*."[71] Greenwood divided the course matter into 16 lectures, each of which was "of such a Length as to be an Evening's Entertainement."[72] In a separate course of lectures for those who already had some instruction in the "Mathematical Sciences," Greenwood proposed to demonstrate "the Principles *of* Sir Isaac Newton, *together with the Modern Discoveries in* Astronomy *and* Philosophy." Deep expertise was not necessary to attend those daily talks, as Greenwood promised his explanations would be made in an "*easy manner."* In addition to his various lecture programs, Greenwood published his own text in "ARITHMETICK *Vulgar & Decimal"*, which offered a different sort of instruction designed expressly for

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[70] *Boston News-Letter*, 13 July 1727. See also *New England Weekly Journal*, 17 and 24 July 1727 as well, quoted in Bedini, *Thinkers and Tinkers*, 181.

[71] Greenwood, *Experimental Course*, 1.

[72] Greenwood, *Experimental Course*, 9.

use in "*a Variety of Cases in Trade & Commerce*."[73] This "*Treatise,*" a compilation of all the "Rules *as are of any Importance in the Practice of* Trade," was designed to be equally useful to "the Study of Nature;" indeed, its scholarly organization was adapted "*in a particular manner to the Taste of Persons of Curiosity and Education.*"

The interconnection between scientific disciplines and the broad reach to the public can be seen in Greenwood's lectures both before and after he left Harvard. After his dismissal from the college for drunkenness, Greenwood continued his lecture series "*in any Branch of* Natural Philosophy," whenever a large enough audience could be organized." He offered his public lessons on mathematics "Practical or Theoretical" twice daily.[74] Theoretical mathematics covered Euclid and Appollonius, the practical mathematics included everything from basic arithmetic through "Geometry, Trigonometry, Navigation, Surveying, Gauging, Algebra, Fluxions &c."[75] Greenwood made himself available as well for "*private Instructions*" to "*any* Gentlemen, *or* particular Company *of such*" who wished for it. Within a year, Greenwood also invited public encouragement for a "*Course of Philosophical Lectures,*" to be enlivened with a "*great Variety of Experiments*," anyone who left their name in support of such a course could avail themselves of the free outline of the "*Articles* and *Experiments*" Greenwood proposed.[76] These lessons and private instruction available at Boston appear even more remarkable when we consider that algebra had only been part of the Harvard curriculum

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[73] *Boston News-Letter*, 29 May 1729.

[74] *Boston News-Letter*, 2 November 1738. Hindle, *Pursuit of Science*, 454.

[75] *Boston News-Letter*, 30 March 1739. See also *Boston Gazette*, 26 March 1739, and 2 April 1739, quoted in Bedini, *Thinkers and Tinkers*, 181.

[76] *Boston Weekly News-Letter*, 28 June 1739; also 12 and 26 July 1739.

since 1721 and the study of Newtonian “fluxions” (the branch of mathematics that later developed into differential and integral calculus) was not introduced into the college curriculum until 1751, by John Winthrop, chair of mathematics after Greenwood.[77] After his dismissal from Harvard, Greenwood lectured all along the Atlantic seaboard, from Philadelphia in 1740 and later at Charles Town in the winter of 1744/45, helping to spread the culture of public scientific lectures to yet other communities.[78]

When, in 1732, Harvard received from its London benefactor Mr. Hollis “fresh Confirmation of his Generosity and Regard to the *College*, in a very rich *Addition* to the *Philosophical Apparatus*,” Greenwood expanded his public lectures to include that apparatus.[79] The equipment Hollis gifted the college included a “*Microscope,* a large and exquisite *Armillary Sphere*, and a very costly *Orrery*” – a mechanical representation of the solar system – the first of its kind in America. Like Greenwood’s lessons, which moved along a continuum from the “vulgar mathematics” of trade and commerce (*i.e.*, arithmetic and geometry), to the most valuable science of astronomy, all the way to the polite heights of philosophical lectures, so too did that physical apparatus received at Harvard offer the prospect of moving in several worlds. Greenwood composed his lectures on the “Machinery” of astronomy, most particularly the newly-invented “ORRERY,” but promised that the “*Apparatus*” to be employed – absent only a “*Reflecting Telescope”* – would be finer than anything available at “the Rev. Dr.

[77] Thomas H. Johnson in consultation with Harvey Wish, *Oxford Companion to American History* (New York: Oxford University Press, 1966).

[78] Stearns, *Science in British* America, 454 – 455.

[79] *Boston News-Letter*, 7 September 1732. Mr. Hollis was the nephew of the Thomas Hollis, Esq. of London after whom the mathematics chair at Harvard was named.

Desagulier's or Mr. *Haukesbee's* in *London*."[80] Though the topic of the lectures and the stature of the lecturer – Greenwood held the first such academic chair in the colonies – would seem alienating and intimidating, Greenwood promised that both the "*Physical Experiments*" as well as the "*Language* and *Arguments*" were to be "studiously accommodated to the Apprehension of such who are destitute, as yet, of any Skill in this most valuable *Science.*" Moreover, his boast about the fineness of the apparatus lent a cosmopolitan air to the entire enterprise.

The public interest in science can also be seen in how the orrery touched the imagination. Notice of that first orrery imported into America, and destined for Harvard, appeared not only in the Massachusetts papers but other colonial papers as well.[81] Anyone could enjoy its administration of "the Pleasure of Science."[82] Indeed, "[a]ll Persons, never so remotely employed from a Learned Way, might come into the Interests of Knowledge, and taste the Pleasure of it by this intelligible method." As such, the orrery was likened, at least in print, as the gift of a "new Sense." The essayist Richard Steele predicted that such power "should incite any numerous Family of Distinction to have an Orrery as necessarily as they would have a Clock." [83] He expected that from this "new Scene" opened "to their Imaginations" would spring a "pleasing, an obvious, a

[80] *New-England Weekly Journal*, 1 July 1734.

[81] *Boston Weekly News*-Letter, 14 September 1732; *Pennsylvania* Gazette, 4 October 1732. Discussed in Harrold E. Gillingham, "The First Orreries in America," *The Journal of the Franklin Institute* 229, no. 1 (January 1940), 81-99, p. 82. An orrery is a mechanical solar system used to illustrate the relative positions and movements of the earth and major planets in the galaxy. In 1767 David Rittenhouse built the most accurate orrery in the colonies. This magnificent orrery is housed in the Van Pelt Library at the University of Pennsylvania.

[82] *New-England Weekly Journal*, 17 June 1734. This was a reprint of an essay by Sir Richard Steele, first published in *The Englishman* in 1714, *infra.*

[83] Richard Steele, *The Englishman: being the sequel of the Guardian* (James Carson: Dublin, 1714), 83 - 84.

useful, and an elegant Conversation.” An orrery in every home was inconceivable in the colonies and yet its need was indeed so obvious that soon “not only each Province, but each principal Town” would regard having an orrery as much a necessity as a “publick Town Clock.”[84] Although such an expectation proved entirely too ambitious in the years following the orrery’s introduction, colonial Americans were nevertheless incorporating, and being incorporated into, the world of scientific goods then emerging from London. Not before 1743 was there a second orrery to be found in the colonies, this one constructed by Thomas Clap, president of Yale College. But neither high birth nor education was necessary to enjoy the benefits of the orrery.

Thus, when at mid-century, colonial public science lectures in “Experimental Philosophy” promised that the “astronomical Part will be explain’d and illustrated by a curious large ORRERY,” their audiences could include genuine novices. No expertise in astronomy was needed in order to attend these lectures as the “Mathematical Terms, Figures and Proportions, necessary for the Understanding … are explained for the sake of the ladies and Gentlemen unskill’d in the Mathematics.”[85] But one could learn of the orrery even without attending these lectures. The *American Magazine*, touting its “design … to publish an account of the progress of learning,” carried a description of Yale-College’s orrery explicitly to “instruct.”[86] The report described the miniature solar system in detail, and gave information not only about the planets, their orbits and satellites, and the transit of comets, but also about the method of its own construction.

[84] *New-York Gazette*, 8 July 1734.

[85] *Pennsylvania Gazette*, 5 December 1750; *New-York Gazette, Revived in the Weekly Post-Boy*, 29 July 1751.

[86] *American Magazine and Historical Chronicle* 2, no. 1 (1744), 202-203.

The account of this device thus presented two aspects of knowledge – that of the actual solar system and also of its mechanical representation – permitting a reader both to participate in the scientific exchange and educate himself at the same time.

A telling example of the reach of scientific information throughout colonial society came to light in the aftermath of Franklin's prediction in his 1752 almanac of a solar eclipse to take place on "the second Day of *May*, about Two a Clock in the Afternoon…"[87] The almanac predicted the "Beginning of this Eclipse will be at Thirty-eight min. past Twelve." However, several days before the forecast eclipse, Franklin printed a correction in the *Gazette*, amending the timing.[88] The new "Beginning" of the eclipse was now estimated to start at "20 Min. past Twelve." The correction had been provided by one "T. Fox, carpenter," who wrote that he had worked out this amended timing from "*Halley's Tables.*"[89] Evidently Halley's calculations put the "*Moon's* place at this Time … a Degree forwarder than *Brent's Tables,*" and it was from this divergence among the real experts that the error "published in *Poor Richard's* Almanack" stemmed. Fox built an orrery of his own that he used to illustrate the "Construction of this *Eclipse.*" It was put for a time "in the *Mathematical School*, at the *Academy,*" where anyone interested could observe the "Appearance" of the eclipse in "divers Parts of the Earth."[90]

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[87] *Poor Richard's* 1752.

[88] *Pennsylvania Gazette*, 30 April 1752.

[89] J.A. Leo Lemay provides further information in *The Life of BF*, p. 139 – 140.

[90] According to Lemay, no other description of Fox's orrery has come to light, nor have other references to it.

In time, Richard Steele's sentiments about the utility, necessity, and influence of the orrery took root. When David James Dove at mid-century proposed a course at the Library in Philadelphia on "EXPERIMENTAL PHILOSOPHY, consisting of … *Physics, Pneumatics, Hydrostatics, Optics, Geography* and *Astronomy*," he promised to illustrate the astronomical portion of the lectures by "a curious large ORRERY."[91] Although the emphasis of the lectures was on the scientific, the sociability of the entire event was key: a "Subscriber" paid "two Pistoles" and received a "gratis Ticket for one Lady to attend the whole Course." Dove conducted at least this course of lectures, which proved popular enough that a traveling program was devised, beginning with the nearby towns of New York and Newark.[92] Unable to continue the lecture series, Dove permitted his equipment to be used by the cartographer Lewis Evans, who then delivered the lectures. By July, when Evans was promoting this course in New York, it had been extended to 13 lectures covering "Natural Philosophy and Mechanics … treating of the nature of this World and its Parts."[93] By the time Evans delivered his lectures – which he did at New York, Newark, Philadelphia, and Charles Town – he promised to provide all the "Mathematical Terms, Figures and Proportions, necessary for the Understanding of these Lectures" in order to make them comprehensible to any "of the ladies and Gentlemen unskill'd in the Mathematics."

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[91] *Pennsylvania Gazette*, 5 December 1750.

[92] See Papers of the Shippen Family, Volume 1, Correspondence 1701 - 1755, pp. 111, 113, HSP; also *Pennsylvania Gazette*, 11 April 1751, advertising Ebenezer Kinnersley's course on the "newly-Discovered ELECTRICAL FIRE" to be held "in the same Room Mr. *Dove* lately used for his Course of Natural Philosophy."

[93] *New-York Gazette Revived in the Weekly Post-Boy*, 29 July 1751. See also Bedini, *Thinkers and Tinkers*, 165–166. Bedini mistakenly claims that Dove did not deliver the lectures at all.

Whether or not the orrery actually helped explain the workings of the universe to those attending these talks, the machinery itself was integral to the public lecture scene. Dove's orrery was included when Paul Jackson "purchased the use of "Mr. Dove's Apparatus" for his set of 13 lectures in 1755.[94] Those talks, on "EXPERIMENTAL PHILOSOPHY, for the Entertainment of the CURIOUS," covered a wide range of topics, including "Mechanics, … Pneumatics, … Hydrostatics, … Optics … Geography and Astronomy" and used the inclusion of the orrery as a selling point. Jackson designed his lectures to illustrate the "Nature, Use and Importance of each Experiment," and composed them with a "special Regard … to Plainness, Perspicuity and Method" so as to make the material suitable to people of "common Capacities." Indeed, by offering only one lecture per week, Jackson promised that "such young Gentlemen" who desired to "study that most useful Branch of Knowledge," would have enough time to master the material "without much Interruption to their other Business." Jackson promised a bibliography of sorts, pointing the students to the "best Writers on every Subject" and assuring them that they would "be intitled to Assistance in the algebraic and geometrical Demonstrations" they might encounter, and not understand, in their "private Reading." Jackson made a most impressive case for the "Study of Nature" as the "best for a successful Prosecution of any Art liberal or mechanical." More impressive still, Jackson promised it would provide a "spacious and delightful Field of Knowledge equally fruitful of the most pleasing Entertainment for the Imagination, and the noblest Improvement of the Judgment." Jackson further promised that such learning gave "a Man an acknowledged Superiority over the rest of the Species."

[94] *Philadelphia Gazette*, 6 November 1755.

"Whether the Utility of the Amusement of it be considered" did not matter – Jackson provided both. He recognized the dual benefits attendees derived from his lectures. Their "Curiosity" would be engrossed, but they also would learn useful things. Both the merit and the pleasure of such learning came into focus when a "Correspondent at Paris" acquainted the Pennsylvania readership that "many Young Persons of Distinction" there found they preferred to "set up courses of Astronomy, Natural Philosophy, and Geography with suitable Apparatus of Instruments," rather than attend the "Comedy or the Opera."[95]

These traveling lecturers emphasized the elegance as well as the sociability intrinsic to the instruments they used in their demonstrations. One Mr. Baron's "course of Experimental Philosophy" at mid-century had gone so well that he proposed a second in six parts, covering "Physicks, Pneumaticks, Hydrostaticks, Opticks, Geography, and Astronomy."[96] Baron permitted "Ladies" free admission on a "gentleman's ticket," and assured his public that the "astronomical Part" of his lectures would be "explained and illustrated, by a large and curious Orrery." While the orrery remained a rare piece of equipment in British America throughout the eighteenth century, and one experienced in specific settings, always accompanied by supposedly expert instruction, many other kinds of scientific apparatus – microscopes, solar cameras, optical equipment, reflecting telescopes, mathematical instruments – made the rounds and were accessible without special mediation.

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[95] *Pennsylvania Gazette*, 28 January 1755.

[96] *Pennsylvania Gazette*, 29 January 1751.

The ubiquity in port cities of instruments used in seafaring can dampen our understanding of them as instruments of science as well as of fashion. Mahogany and brass telescopes, quadrants/octants, compasses, items for taking astronomical measurements, surveying equipment, microscopes, electrical equipment – these were meant to be used in specific, often prosaic, settings, but would not necessarily have been seen as workaday nor used only in commonplace work. "Donegan and Company … late of Italy," made and repaired "thermometers and Barometers, likewise all kinds of Glasses for philosophical experiments."[97] Joseph Gatty, also from Italy, handcrafted the "Philosophical instruments" he invented.[98] The "Mathematical Instrument Maker" Thomas Biggs offered "elegant … instruments."[99] Robert Leslie "invented and constructed three different methods of attaching and suspending pendulums of clocks … upon entire new principles." These refashioned and improved plumbs kept the clocks to accurate time, unaffected "by the action of the weather upon the movements."[100] Such improvements had very direct links to the practice of science, as when the American Philosophical Society undertook its own observations of the 1769 transit of Mercury: "a new Time-Piece made by Mr. *Duffield* … with an ingenious contrivance of his … to remedy the irregularities arising from heat and cold."[101]

[97] *Philadelphia Gazette,* 6 April 1785.

[98] *Aurora General Advertiser* [Philadelphia], 21 January 1786 and *Federal Gazette* [Philadelphia], 25 June 1796.

[99] *Federal Gazette*, [Philadelphia] 14 September 1792, 15 May, 1793.

[100] *Loudon's New-York Packet*, 18 March 1788.

[101] "Account of the Transit of Mercury over the Sun, on November 9th, 1769, N.S.," *Transactions of the American Philosophical Society* 1 (1771): 82–99.

Science reached into everyday life both through commerce as well as popular attractions. '[A]ll Gentlemen, ladies and others, of Curiosity," were invited to witness "a large moving Mashene or Land and Water Skip representing many things moving nearly imitating Nature."[102] Although "Gentlemen or Ladies" could arrange a private showing on short notice, the skip was accessible to all who had the one shilling admittance price. The public shows all began in the evening, thus better able to accommodate those with other employment by day. This skip, or one similar, had been advertised in Boston in 1740 as "lately arrived from Holland."[103] This "certain Machine" presented beautiful "Prospect[s]" of all sorts and was promoted as a "Curiosity most accurately done." Its "beautiful Manner" was expected to "attract the Minds of the ingenious, and delight the Fancy" at the same time, uniting science and fashion in one experience.

Thomas Jefferson referred to the utility as well as the entertainment of all such instruments when he wrote to his son-in-law that in "revising [his] philosophical apparatus" he discovered he had "some articles to spare" which his grandson, Francis, would "find of use" in his education.[104] Until that time arrived, however, Jefferson thought Eppes could "in the mean time amuse" himself with the "Markins portable air pump & apparatus," as well as "an hydrostatic balance," and a "solar microscope in brass with Wilson's pocket apparatus," all made by the famed British instrument maker, Dollond. Jefferson offered as well "A best barometer" and, for drawing, a "Camera obscura." George Washington did not ascribe much entertainment value to his

[102] *New-York Evening Post*, May 4, 1747.

[103] *Boston Gazette,* 14 July 1740.

[104] Thomas Jefferson to John Wayles Eppes, 4 June 1808. MSS MFilm 00339 Thomas Jefferson & J.W. Eppes, Correspondence, 1790 – 1810. HEH.

surveying equipment, but considered it to be of such utility and value that he sought recompense for its loss, writing to Carter Burwell "to acquaint the Gentlemen of the Committee … with the loss of …a very valuable, and uncommon Theodolite calculated not only for Superficial measure, but for taking Altitudes, and other useful purposes."[105] The Massachusetts' authority saw such value to the "new *Theodolite*" invented by Rowland Houghton that it granted him "sole Privilege for Ten Years" of its manufacture and sale, along with "suitable Instruments thereto adapted."[106]

Indeed, the apparatus itself was central to the experience when in 1748 the former privateer, occasional fishmonger, and budding impresario John Bonnin invited his fellow New Yorkers to "view the famous *Perspectives"* made available through his "PHILOSOPHICAL OPTICAL MACHINE."[107] Although the venture was promoted as a fashionable and polite activity that improved a person's conversation and judgment, Bonnin's show put a technological marvel at the heart of an aesthetic enterprise. The entertainment relied on a combination of elements that included both the natural and the manmade. The machine was constructed in London and imported into the city. As an added inducement to generate traffic, Bonnin from time to time featured physical novelties, such as fossils and live porcupines. Bonnin's "Perspectives" included chateaux and cathedrals, but also landscaped walks and "beautiful Gardens" that brought botanical scenes to life.[108]

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[105] George Washington to Carter Burwell, Esqr, 20 April 1755 in W.W. Abbot, ed. *The Papers of George Washington, Colonial Series 1: 1748 – August 1755* (Charlottesville: University of Virginia Press), 252–253.

[106] *Pennsylvania Gazette*, 15 January 1736.

[107] *New-York Gazette, Revived in the Weekly Post-Boy*, 28 November and 19 December 1748.

[108] *New-York Gazette, Revived in the Weekly Post-Boy*¸18 May 1749.

Public presentations of the trappings of science on occasion were devoted to their entertainment value alone. Their importance as amusements, however, frequently was connected to their inherent elegance as well. Scientific objects were deployed as diversions that promised to convey a combination of fashion, elegance, and refinement as well. The "vast Resort of People" reportedly attending "at Mr. *Bonnin's"* in order to view his "famous *Perspectives* lately arrived from *London"* – seat of all elegance itself – were "mostly of the *best* Fashion."[109] A different kind of "Aoptick" had been available to the public several years prior, but its promotion did not rest so heavily on either scientific novelty or sophistication. This "Aoptick … represented in Perspective, several of the most noted Cities and remarkable Places in Europe and America, with a new Prologue and Epilogue address'd to the Town."[110] It was not, however, a stand-alone entertainment but rather was added to the performance "in Mr. Hole's Long room" of Scaramouche, a "New Pantomime Entertainment in Grotesque Characters." Here was a novel apparatus promoted as pure spectacle, without any reference either to the elegance of the object itself or the vistas it showed, nor to the educational value of the talks surrounding them.

In keeping with the tone of Bonnin's advertisements, an "elegant exhibition of Shades; containing a variety of entertaining scenes" formed part of a 4th of July celebration, held in the "Garden of the ACADEMY in Broad-Street" in Federal New York.[111] The exhibition "concluded with a Ball" and if the weather proved "suitable to

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[109] *New-York Gazette, or Weekly Post-Boy*, 14 November 1748.

[110] *New-York Gazette*, 13 February 1739.

[111] *Loudon's New-York Packet*, 4 July 1785.

the purpose," those attending were promised that there would "also be an Air-Balloon launched in the garden."

The Philadelphia Quaker Ann Head Warder recounted a less salubrious encounter with the new technology of the hot-air balloon. Writing to family in England, Warder recounted that the "Spanish Ambassador arrived in Town with his Bride in great pomp, many carriages & several with Four horses."[112] The young bride, "about fifteen" was believed to have "an utter aversion to her husband," and had been forced to marry him by her family. For his part, the Ambassador "trys to allure her affections by Glittering Toys of this World, making her the most valuable presents & having a Carriage more gaudy than any" that had ever been seen in Philadelphia. As part of the Ambassador's efforts to woo his wife (and possibly impress his neighbors), the balloonist "Blanchard [was] engaged to divert her with his Baloon rising just before their door soon."[113] The objects of science were put into service as "Glittering Toys."

More commonplace attractions such as nautical and mathematical instruments were also widely accessible in colonial America and could be purchased, repaired, or simply admired at the shops of local craftsmen. One Charles Walpole promised to make or mend "all sorts of mathematical instruments." Furthermore, visitors to his shop could view Mr. Walpole's stock on request. That he relocated from London, seat of the finest instrument makers, could only strengthen his reputation as a craftsman at the same time

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[112] No. 2. 4 mo. 2nd. In Ann Head Warder Papers. HSP.

[113] Jean-Pierre Blanchard successfully launched a hydrogen gas balloon in Paris in 1784, several months after the Montgolfier brothers manned the first hot air balloon flight. Blanchard subsequently toured Europe, giving balloon demonstrations. He presented his balloon in Philadelphia on 9 January 1793. See Paul Keen, "The "Balloonomania": Science and Spectacle in 1780s England," *Eighteenth-CenturyStudies* 39, no. 4 (Summer 2006): 507 – 535.

that his wares helped his customers develop their taste.[114] The London born and trained Anthony Lamb did business in “mathematical instruments for sea or land” including the “late invented and most curious instrument called an octant.”[115] Joseph Blancherd advertised his ability to teach the common “Arithmetic,Vulgar, Decimal and Algebrace” as well as “Geometry practical and speculative Trigonomatry … and several other branches of the Mathematic's,” along with “surveying, navigation … astronomy and dialing,” which instruction would be very much helped by “a curious pair of globes, a set of surveying instruments and other curious mathematical instruments.”[116] The globes especially were a rarity and highly useful in this kind of instruction.

When the Philadelphia schoolmaster Andrew Lamb moved to new quarters, he emphasized that instruments were at the heart of his pedagogy. Lamb had considerable practical sailing experience, having served in the Royal Navy as well as in merchant shipping, and he was able to offer extensive training.[117] He advertised at length about the subjects he “carefully taught and diligently attended” to, with “Navigation in all its parts” in particular. As added inducement to his expertise in “both the theory and practice” of all the mathematics and methods required for skillful sailing, Lamb promised his prospective students that “all these are geometrically, logarithmically and instrumentally performed.”

So too did William Gray promote his New York evening school, where he taught mathematics, surveying “both theory and practice,” navigation, architecture and “other

[114] *New-York Evening Post*, 2 June 1746.

[115] *New-York Gazette*, 13 February 1747.

[116] *New-York Evening Post*, 3 May 1747.

[117] *Pennsylvania Gazette*, 2 May 1751.

branches of the Mathematics." Gray promoted his teaching of "several other things in natural philosophy" which he "plainly exhibit[ed]" through the use of "globes and other machinery." He hoped soon after to acquire "proper instruments" such as would enable him also to teach "optics, perspective, conic sections and astronomy."[118] Gray clearly depended on the lure of those instruments to draw a diverse group of students, as he claimed that his experience had taught him how to "adapt instructions to the different capacities of persons, either young or old," suggesting that he anticipated or at least hoped, to acquire students from different walks of life, and of varying ages.

Burgiss Allison, a schoolmaster in Bordentown, near New York, also stressed the role of instruments in his carefully crafted appeal to those "Gentlemen" who wished their children "taught the Latin, Greek and French languages, vulgar arithmetic, mathematick's with arts and sciences in general."[119] Allison assured the public that he had "furnished himself with an apparatus, peculiarly calculated" to instill in his charges "a love for science" – which he supplemented "by a course of experimental philosophy adapted to the capacities of the youngest." Allison clearly thought his apparatus and curriculum had big appeal, as he pitched his school to genteel parents from Philadelphia to New York. The East Hampton Academy, on the other hand, billed itself as the "cheapest place of proper education in America."[120] In keeping with that thrifty approach, the school promised that "particular attention will always be had to the immediate application of the several branches of science … to their practical use."

[118] *New York Packet* 8 January 1784.

[119] *New-York Journal and State Gazette*, 21 October 1784.

[120] *Loudon's New-York Packet*, 14 November 1785.

When the Academy chose to publicize its successes in educating youth, however, it emphasized the elegance of its scholars' "declamations" and touted their "examples of penmanship … rarely exceeded by the most celebrated performers."[121] Even the most practical branches of science required grace and style in their performance.

Although economic success often eluded those early itinerant lecturers and schoolmasters, science produced for public consumption grew in frequency, suggesting a growing popular interest and a broad audience. Between 1749 and 1753, Franklin's Philadelphia friend Ebenezer Kinnersley took his course on electricity from Boston to Charlestown, and ventured as far afield as Antigua.[122] The goldsmith Joseph Hiller constructed his own apparatus and gave electrical demonstrations in Boston in the mid 1750s.[123] Natural historians also developed public lectures, and in 1770, the Philadelphia physician William Shippen offered a course on fossils. The English émigré Christopher Colles first addressed the public on geography, natural philosophy and physics in Philadelphia beginning in 1771.[124] After the war, Colles spoke in New York on "Natural Experimental Philosophy" including "Pneumatics, hydrostatics, hydraulics, mechanics, optics, electricity and the terraqueous globe." Colles lectures were all to be "illustrated by a variety of curious and entertaining experiments with suitable

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[121] *Loudon's New-York Packet*, 2 February 1786.

[122] J.A. Leo Lemay, *Ebenezer Kinnersley: Franklin's Friend* (Philadelphia: University of Pennsylvania Press, 1964), *passim.* See also Delbourgo, *A Most Amazing Scene of Wonders: Electricity and Enlightenment in Early America* (New York: Routledge, 2008), 94 – 97. A copy of Kinnersley's broadside promoting his Antigua demonstration on 25 April 1753 can be found in Douglas C. McMurtrie, *Early Printing on the Island of Antigua* … (Evanston, Ill.: privately printed, 1953).

[123] *Boston Gazette*, 23 February 1756. See also James Delbourgo, *A Most Amazing Scene of Wonders: Electricity and Enlightenment in Early America* (New York: Routledge, 2008), 99.

[124] *Pennsylvania Gazette*, 26 September 1771; 13 February 1772; 5 May 1772.

apparatus."[125] Benjamin Rush, the Philadelphia physician and educator, lectured on chemistry for several years, beginning in 1774. Dr. Abraham Chovet, physician and a founder of the Pennsylvania hospital, presented public lectures on human anatomy and physiology, illustrated by "his elegant Anatomical Wax-Work Figures" in Philadelphia from1774 to 1776.[126]

The widening popularity of such scientific lectures was very much in evidence when Daniel Moyes, an Edinburgh-trained physician and professor of natural philosophy, traveled to the new United States in 1784 to lecture. Mostly reproducing the itinerary of Archibald Spencer's mid-century tour, Moyes enjoyed phenomenal success in cities all along the eastern seaboard, at Boston, New York, Philadelphia, Baltimore, and Charleston, among others.[127] Far from being a dryly academic subject, his course of lectures on the "Philosophy of Chemistry" was expected to "combine pleasure with improvement."[128] Moreover, his course, "deemed a complete introduction to the noble study of nature and her various operations," with its "variety of experiments," promised to illustrate a "full view of all those astonishing discoveries that "distinguish[ed] the

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[125] *Loudon's New-York Packet*, 24 January 1785.

[126] William Northrop Morse, "Lectures on Electricity in Colonial Times," in *New England Quarterly* 7, no. 2 (June 1934): 364 – 374; Hindle, *Pursuit of Science*, 212 – 213; Raymond Phineas Stearns, *Science in the British Colonies of America* (Urbana: University of Illinois Press, 1970), 510 – 511; Thomas G. Morton, Frank Woodbury, *The History of the Pennsylvania Hospital, 1751 – 1895* (Philadelphia: Times Printing House, 1895), 359 – 360.

[127] Brooke Hindle, *The Pursuit of Science in Revolutionary America, 1735* – 1789 (Chapel Hill: University of North Carolina, 1956), 284. For a fuller examination of Moyes' career, see John Anthony Harrison, "Blind Henry Moyes, 'An excellent lecturer in philosophy''' *Annals of Science* 12, no. 2 (1957): 109–125, pp. 111–115.

[128] *American Herald* [Boston], 31 May 1784.

eighteenth century."[129] Indeed, public assessments of his lectures extolled just how "rationally entertained" the audience was by the "blind philosopher."[130]

Couched in such terms of improvement, merely attending Dr. Moyes' lectures provided a flattering self-portrayal and a reason for self-congratulation: "Observe the encouragement which the ladies and gentlemen of this town afford to the sciences," crowed one published notice, extolling the public-spirited support exemplified by the "large and very respectable audience" present.[131]

Like other public lecturers in science, Moyes intended for his course of lectures to be a heterosocial experience; the cost of a woman's ticket was frequently half that of a man's.[132] His audiences were indeed large, and enthusiastic. When Moyes lectured at Philadelphia, Mary Norris wrote that the "town is at this time greatly entertained with a course of lectures … by Doctor MOYES." To be sure, his reputation had preceded him and he proved immensely popular. "People of every description, men and women, flock to the lectures …. My son and daughter Logan are in town. They are come, like the rest of the world, to the lectures."[133]

The convention of offering a half-price ticket to "Ladies" was of long-standing. Dove's lectures on natural philosophy in the 1750s offered ladies a free ticket; Jackson's

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[129] *New-York Journal and State Gazette,* 18 November 1784.

[130] "Extract of a letter from New-York, dated January 2, 1785" in *Independent Gazetteer* [Philadelphia], 15 January 1785. Also, *New-York Morning Post*, 21 January 1785; *United States Chronicle* [Providence, RI], 10 February 1785.

[131] *Massachusetts Centinel*, 15 September 1784.

[132] *Massachusetts Centinel*, 15 October 1785.

[133] Mary Norris to Humphry Marshall, 23 February 1785 in William Darlington, *Memorials of John Bartram and Humphry Marshall* (Philadelphia: Lindsay & Blakiston, 1849), pp. 535–536. Quoted in Brandon Brame Fortune with Deborah J. Warner, *Franklin and His Friends: Portraying the Man of Science in Eighteenth-Century America* (Philadelphia: University of Pennsylvania Press, 1999), p. 9.

lectures likewise included included a gratis ticket for a lady. Noah Webster's 1786 lecture on the English language sold tickets at half price for women, without the stated necessity of accompanying a man.[134] Christopher Colles' lectures in 1785 also sold a woman's ticket at half the cost of a man's. The tickets to I.T. Jones' 1786 "Lectures Chymicall and Philosophical" admitted a "gentleman and a lady."[135]

Other lecture series were offered to those interested in professional improvement, or medical training. These were, if not restricted to men, at least aimed squarely at them. Some courses lasted many months, such as a year-long course at Columbia College on moral philosophy, one six-month series in Pennsylvania on anatomy, and another on "the theory and practice of surgery.[136] These were intended to prepare men for a career, not to entertain or lightly educate a general public.

Those that attended Moyes' lectures left with a new way of engaging the natural world that they carried into a wider world of sociability. "Our ladies are all turned philosophers – the moment ice begins to form in a tumbler, they are examining into the manner of its christalization --- or if the room happens to be smokey, the cause is directly investigated."[137] So too did "Urbanus," in a printed dialogue with his son "Literatus," judge the utility of Moyes' lectures in part on their ability to "improve" the ladies. "No person could before hold any conversation with them, with either satisfaction or improvement, their heads were so stuffed with dress, dancing and other

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[134] *Loudon's New-York Packet*, 3 April 1785.

[135] *Loudon's New-York Packet*, 24 January 1785; 23 January 1786.

[136] *Loudon's New-York Packet* 10 February 1785; 21 November 1785; 3 April 1786; 25 May 1786; 14 October 1788.

[137] *Independent Gazetteer* [Philadelphia], 15 January 1785.

nonsense, but now such vain trifles never enter their heads, they can entertain each other like rational creatures upon every phenomenon of nature."[138] Theirs was a dyspeptic view, however, and although they could agree that Dr. Moyes had "diffused a great deal of instructions throughout" their city, they also agreed that "poor ignorant New York" had been much in need of "some such thing" as he offered. Looking beyond their vapid and clichéd criticism of women as concerned only with fripperies, we can nonetheless infer that the conversations in their social circle had changed due to Moyes' talks.

But the various "Odes" to Moyes – among which Urbanus and Literatus' rhapsodic "Dialogue" must be included – all speak to a delight among many of Moyes' listeners that was less than level-headed rationality. Along with a rational pursuit of education, we must also make room for a less-than-rational giddy pleasure that some spoke of when in the presence of intellectual self-improvement, adorned with beautiful instruments and focused on the perfections of nature. Dr. Hamilton referred to it when he described a "learned discourse about microscopicall experiments" that demonstrated the "order, elegance, and uniformity of Nature in the texture of all bodies."[139]

The beauties of Nature and the gifts of science would be called upon, at least rhetorically, throughout the century. The rhapsodies might change, but the song was ever sung. "*Philosophic* splendors shine, / And *ignorant shades* dispersed fly, / For like the *sun* you *light* supply." So wrote a self-styled "*Female Attendant on the Lectures*."[140] Of course, we can have no way of knowing who wrote the Ode. Certainly, the "female"

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[138] *Loudon's New-York Packet*, 24 January 1785.

[139] Bridenbaugh, *Itinerarium*, 156, 158.

[140] *Loudon's New-York Packet*, 9 December 1784.

audience members were not the only ones to swoon over Moyes. After all, Urbanus and Literatus themselves purported to consider Moyes to be the "first man in the learned world … [and] the wisest." "Hibernicus," writing under a pseudonym "On the celebrated Doctor Moyes," went even further to "sing to great and learned Moyes's praise" as "ordain'd … to extend the knowledge of mankind."[141]

Moyes operated in both the world of science and of fashion, and was himself praised for uniting "with the profound and enlightened philosopher, an elegant person." He was esteemed "a most entertaining companion in a private circle, descending gracefully from the sublimary of a philosopher to indifferent subjects."[142] Nancy Shippen wrote in her journal during his stay in Philadelphia that the "Philosopher D[r.] Moyse drank a sociable dish of Tea with Papa & Myself, after which I went with him to Miss Craigs, where I spent the remainder of the evening agreeably." Moyes made for excellent company with his skill at the "the Piano Forti, on which he play'd delightfully."[143] The "blind Philosopher" made one of the company when the Shippens held a "small party at home" several days later. Although "D[r.] Moyse far from being entertaining" that evening, Nancy nonetheless spent the following day "in writing by D[r.] Moyse to some of my friends in Charleston. I recommend him in the strongest terms to their civility & protection ."

Though Moyes personally traveled mostly in elite circles, neither his audiences, nor those at other public demonstrations of science, were composed exclusively of the

[141] *Loudon's New-York Packet*, 16 December 1784.

[142] "Extract of a letter from New-York," *The Independent Gazetteer*, 15 January 1785.

[143] Ethel Ames, *Nancy Shippen, Her Journal Book: The International Romance of a Young Lady of Fashion of Colonial Philadelphia with Letters to Her and About Her* (J.B. Lippincott Company: Philadelphia, 1935), 242.

wealthy and privileged; anyone who attended, or was entertained or instructed by someone who had attended, could combine the pleasures of learning with those of fashionability. Absalom Aimwell suggested just how frequent a mixed attendance at these kinds of talks was when he wrote the introduction to his "Mechanics Lecture," published in 1789 and aimed at a group of listeners seemingly very different than those entertained by Moyes.[144] Speaking directly to his putative audience of mechanics, whom he looked upon as the "respectable part of the community," Aimwell suggested that the taste for public lectures was perhaps too much in vogue. In making the case for the singularity of *his* lecture, Aimwell listed a series of public talks on a variety of subjects to which even the most modest artisan had already been subjected. Aimwell sympathized that too much "time and money ha[d] already been spent in hearing lectures. Lectures on philosophy …. Lectures on physic, or more learnedly, upon *materia medica*."[145] In Philadelphia, as in New York, Boston, Charlestown and other cities along the Atlantic seaboard, lectures on scientific subjects proliferated.

These public lectures encapsulated some of the most popular expressions of scientific interest current in eighteenth-century British America, and exemplify the wide range of what then constituted science. The spectacle of science in public and private settings alike frequently combined elements from natural history as well as natural philosophy, and sought to provide enjoyment both rational and sensuous whenever

[144] Absalom Aimwell, Esq., *Lecture Containing a Short History of Mechanics, and of Useful Arts and Manufactures* (Catskill, 1795 reprint). Absalom Aimwell was the pseudonym of Andrew Adgate, a Philadelphia singing teacher and tune-book compiler. Although a copy of the original publication of the booklet has not come to hand, it was widely advertised when originally published.

[145] Taken from "The Mechanics Lecture by Absalom Aimwell, Esq." in *Loudon's New-York Packet*, 30 January 1789; see also *American Mercury*, 2 February 1789. See Absalom Aimwell, Esq. [Andrew Adgate], *A Lecture; containing a short history of mechanics, and of useful arts and manufactures…* (Philadelphia, 1795) for the full text.

possible. Lectures were not the only way science was diffused through society but they do provide us with a window onto some of the topics and methods deployed by the popularizers as well as their audiences.

Absalom Aimwell's lecture was, as billed, a paean to the mechanical trades. As a celebration of those trades, it contained little of educational value. However, what Aimwell had to say in his laudatory comments about one class of mechanic – printers – recognized yet another avenue for the transmission of scientific ideas at all levels of society during the eighteenth century. Highlighting perhaps the most famous, yet humblest, American printed product, Aimwell asserted that "Poor Richard's Almanac alone, would be sufficient to immortalize the whole fraternity" of printers.[146] The explosion in printed matter that took place in the colonies from the 1740s on certainly included a host of vehicles that transmitted all levels of scientific learning to many classes of people.[147] Printed sources, from treasured books to the ephemera of magazines, newspapers, and almanacs, conveyed vast amounts of scientific information that circulated in ways both predictable and surprising. In exploring the ways in which science moved through American society, we have to look at how it was represented in print and how different people in different places interacted with those printed sources.

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[146] Aimwell, *A Lecture; containing a short history of mechanics, and of useful arts and manufactures…* (Philadelphia, 1795), 29.

[147] Richard D. Brown, *Knowledge is Power: The Diffusion of Information in Early American, 1700 – 1865* (New York: Oxford University Press, 1989).

Chapter Three. "To Instruct Mankind in Philosophical Things"

Printed materials, particularly for secular subjects, were scarce in America in the early decades of the eighteenth century.[1] Nevertheless, texts that conveyed scientific philosophies, knowledge, and practices did appear in the colonies, and scientific ideas percolated through society via the mediation of print in often-surprising ways. By the middle of the eighteenth century, however, not only did the sheer number of print sources available to Americans expand, so too did the type of printed matter they could choose from. While the subjects treated in print always were diverse, science increasingly grew to be a topic covered in a variety of ways in books, newspapers, magazines, and almanacs. This explosion of print matter increased the mix of ideas and practices available to an ever-widening colonial audience, and had a growing influence on public discourse as well as private lifestyles.

As print matter expanded and developed a more prominent role as an agent of education and change for a wider cross-section of people, some commentators criticized it precisely because they observed – and consequently feared – that it democratized knowledge and thus posed a challenge to the social order. The role of print in transmitting learning, scientific as well as aesthetic, was at times contested ground in British America. So too was the content it conveyed. When the public was solicited to supply a New York newspaper with mathematical calculations relating to astronomical phenomena, one reader responded with a chastisement instead. "Holy writ gives us many Instances of God's illustrating his Omnipotency by showing to Mankind some

[1] See E. Jennifer Monaghan, *Learning to Read and Write in Colonial America* (Amherst: University of Massachusetts Press, 2005), for information about the growth in the stock of print available in the mainland colonies.

extraordinary Token and Sign."[2] The comet New Yorkers had been observing and were invited to comment on was just such an omen, claimed the writer, and its purpose was not to induce further scientific study of astronomy. Rather, it was meant to reclaim the people "from their vicious ways and…to stir them to a firmer adoration and service of Him."

More frequently, however, admiration, even gratitude, for the benefits of progress in science and mathematics often found its way into print. A laudatory article about the "late wonderful discoveries, and improvements of arts and sciences," featured in the *American Magazine*, went on to decry the lamentable condition of the world in the recent past.[3] "It was a *Green-headed* Time; every useful Improvement was hid." Previously, men practiced "*Philosophy* without Experiment; *Mathematics* without Instruments." While warning against an easy exaggeration of the advantages of the current age, the author nevertheless proposed that even a sober assessment would admit that "the World is now daily *increasing in experimental Knowledge"* and that "Perfection of Discovery … serve[d] only to show that nothing's known, to what is yet to know." Thomas Jefferson, in one of his clearest and most definitive statements on education, agreed, observing that it would be "impossible" to "take a survey of what is already known [and] not see what an immensity in every branch of science yet remains to be discovered."[4] Moreover, Jefferson condemned as "cowardly the idea that the human mind is incapable of further advances." This "doctrine" was the work of

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[2] *New-York Weekly Journal*, 14 March 1742; 22 March 1742.

[3] *American Magazine and Historical Chronicle* 1, no. 2 (October 1743), 71-73.

[4] Thomas Jefferson to William Greene Munford, 18 June 1799. Printed in *On Science and Freedom: The Letter to the Student William Greene Munford* (Worcester, Mass.: Achille J. St. Onge, 1799).

"despots" who had some supporters in American society, and who encouraged a "look backwards" instead of "forwards for the improvement of science." Jefferson found comfort in the more prevalent "American mind" which he considered "already too much opened" to fall victim to those "feudal" notions. He professed to have confidence that so long as "the art of printing is left … science can never be retrograde."

Throughout the century, Americans relied on print as a vital means of disseminating information. James Alexander's instructions on how best to observe the mid-century Transit of Mercury made clear the extent to which scientific knowledge was conveyed in America through the mediation of print.[5] Directing those who wished to know "what Apparatus of Instruments should be procured," Alexander advised them to "refer to the Abridgement of the *Philosophical Transactions.*"[6] Alexander provided for his readers the volumes and page numbers where information "as to the Observations of the Transit of *Mercury*, in particular, and Instruments the Observers made use of" were to be found. When Benjamin West, in his 1769 *Account of the Transit of Venus* described the preparations made in Newport, Rhode Island, he was explicit about just how heavily the Americans relied on print sources. They discovered when fitting their new "catadiopric micrometer" that they had no "author by us, from which we could get the use of that curious instrument" and were consequently "obliged to have recourse to experiments."[7] Indeed, Joseph Brown, the "very respectable merchant of Providence"

[5] James Alexander, *Letters Relating to the Transit of Mercury over the Sun, which is to happen May 6, 1753* (Philadelphia: B. Franklin, 1753).

[6] Alexander, *Letters*, 2.

[7] Benjamin West, *An Account of the Observation of Venus Upon the Sun…* (Providence, R.I.: John Carter, 1769), 12.

who purchased the apparatus used by West in Rhode Island, was first inspired to acquire it after "Reading Mr. Winthrop's account of the transit of 1761."[8]

This ready access to learning, and its possible prerogatives, could lead to anxiety. Consider that Paul Jackson's lectures promoted the "Study of Nature" as "undoubtedly the best Preparative for a successful Prosecution of an Art liberal or mechanical."[9] Jackson promised to expose his audience to "a spacious and delightful Field of Knowledge equally fruitful of the most pleasing Entertainment for the Imagination, and the noblest Improvement of the Judgement." Such "Judgment" gave "a Man an acknowledged Superiority over the rest of the Species," or so Jackson assured the public. Alexander Hamilton objected strenuously to precisely this inappropriate "Superiority" when he criticized as pendantic, trite, showy fops some whom he encountered in Anglo-America.[10]

Books were particularly hard to come by in the earliest decades of the century, and Benjamin Franklin noted as much in his *Autobiography*. "At the time I establish'd my self in Pensylvania," he wrote, "there was not a good Bookseller's Shop in any of the Colonies to the Southward of Boston."[11] In the middle colonies, Franklin observed that the "Printers were indeed Stationers, and they sold only Paper, &c. Almanacks, Ballads, and a few common School Books." Lovers of books were "oblig'd to send" to England for them. Describing the lending library he and the other members of the Junto established in 1730, Franklin lamented that "So few were the Readers … in

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[8] West, *Account of the Transit*, 10.

[9] *Pennsylvania Gazette*, 13 November 1755.

[10] Hamilton, *Itinerarium*, 52 – 53.

[11] Franklin, *Autobiography*, 1379 – 1380.

Philadelphia … and so poor" that he was not able to get above "Fifty Persons, mostly young Tradesmen" to agree to contribute to the costs of the library. Notwithstanding that paucity of subscribers, Franklin observed that the library "soon manifested its Utility, was imitated by other Towns," and "Reading became fashionable." Within a few years' time, Franklin reported, foreigners judged Americans to be "better instructed & more intelligent than People of the same Rank" found elsewhere.

While there is little doubt that the "Philadelphia publick Library" was revolutionary and transformative, and that books – expensive and rare – were in short supply in the colonies during the first decades of the eighteenth century, it was possible to obtain some books despite these difficulties. Moreover, by the middle of the eighteenth century, not only did the sheer number of print sources available to Americans expand, but so did the variety of printed matter from which they could choose. Books certainly were the most durable and authoritative printed source for scientific information, but imported literary and scientific journals, British and colonial newspapers, magazines, almanacs, and even private writings also served as vehicles to communicate new systems and ideas.

Although books were a scarce and valued commodity in the first half of the eighteenth century, they and information about them did manage to percolate through society. One Nathan Prince, a tutor at Harvard in the 1720s, began to compile what he termed a "Dictionary" of "all the Authors in those Arts and Sciences which I intend to gain an insight in to."[12] The bibliography grew to include *thousands* of books, organized

[12] Norman S. Fiering, "The Transatlantic Republic of Letters: A Note on the Circulation of Learned Periodicals to Early Eighteenth-Century America," in *The William and Mary Quarterly* 3rd ser., 33, no. 4 (October 1976): 642 – 660; 657.

into thematic groups and covering the gamut from "Languages" to "Mathematics" and "Natural Philosophy." Prince did not have direct access to the many book titles he amassed. However, what he did have was knowledge of those titles that he culled from the literary and scholarly journals to which he did have access. Prince's list is perhaps a better representation of the attenuated contact with texts colonial Americans had than it is a genuine bibliography, representing what was actually available. Nevertheless it provides an important element in our understanding of the ways in which science and knowledge about science passed through colonial society.

Books were a valuable tool not only in the transmission of knowledge, but also as a way for a wide variety of people to train themselves to certain habits of mind and to particular methods of observing and being observed. Thomas Clap, president of Yale College, made just that argument in his 1743 introduction to a reprinted and expanded "Study of Philosophy."[13] Clap promoted a course of instruction to begin with the teaching of "the Mathematicks" because it would prove "very useful to inure [students] to thinking, to possess them of a Habit of close Application, and by that means ripen their Minds to a fixed and strong attention to the Objects about which they are employed."[14] Once students had mentally prepared themselves, they could "proceed to the sublimer Studies of Logic and Natural and Moral Philosophy." The *Museum for Young People*, imported from London only a few years later, made explicit that link

[13] *An Introduction to the Study of Philosophy, Exhibiting a General View of all the Arts and Sciences, for the Use of Pupils, With a Catalogue of some of the most valuable Authors necessary to be read in order to instruct them …. By a Gentleman Educated at Yale-College …. The 2nd edition, the first having been publish'd at London in the* "Republic of Letters" *for May, 173*1…. (New London, 1743).

[14] *Introduction to the Study of Philosophy, Exhibiting a General View of all the Arts and Sciences*, iii. The pamphlet included several pages of books deemed by Clap to be the most worthwhile. Many of the titles also were in Yale's library, the *Catalogue* to which was printed in 1743 as well.

between scientific knowledge and manners. The *Museum* billed itself as a "private Tutor for little Masters and Misses," and promised to educate on "a Variety of useful Subjects." It covered geography, physical as well as cultural, astronomy, and a general "Account of the Arts and Sciences," but it also provided clear "Rules for Behavior."[15]

Another source of bibliographic information revealing the presence at least of some scientific titles were book auctions, which often were accompanied by printed catalogues. A sale early in the century at the "Crown Coffee-House" in Boston advertised its "collection of choice books" as including those "upon most of the arts and sciences."[16] The printer Samuel Gerrish claimed to offer a "good Variety of Excellent Expositions of … Books … Of Philosophy both Natural & Moral" when he held a book sale in Boston in 1723.[17] Notwithstanding that promise, Gerrish's catalogue lists very little in the way of science, and most of Gerrish's stock was heavily tailored to appeal to ministers, lawyers, teachers, and doctors. Even so, among the "Physick," law, history, poetry, and exegeses of scripture, Gerrish listed Bacon's "Natural History," Euclid's "Geometry," Hobbes's "Elements of Philosophy, With Lessons to the Professors of Mathematicks," books "Of Botany," and Curson's "Theory of Sciences." When Thomas Cox published his catalogue of books for sale in 1734, it covered nearly three dozen pages and listed almost 900 titles.[18] In the sciences, the collection included geographies,

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[15] *Pennsylvania Gazette* 15 November 1750.

[16] George L. McKay, *American Book Auction Catalogues, 1713 - 1934: A Union List* (New York: The New York Public Library, 1937), 39.

[17] *Catalogue of Choice and Valuable Books …Lately Imported from London* (Boston: Samuel Gerrish, 1723).

[18] *A Catalogue of Books, In all Arts and Sciences* … (Boston: T. Cox, 1734). See Clarence S. Brigham, "American Booksellers' Catalogues: 1734 – 1800"in Lawrence C. Wroth, honoree, *Essays Honoring Lawrence C. Wroth* (Portland, Me.: Anthoensen Press, 1951). For a more current view of the Boston

herbals, books on distilling as well as a "*Treatise on Liquors*," "*Chymistry*," geometry, "Switzer's *System of Hydrostaticks and Hydraulicks*," trigonometry, a "*Demonstration of Sir Isaac Newton's Philosophy,*" mathematics, anatomy, astronomy, arithmetic "Vulgar" as well as "Decimal," five volumes of the abridged *Philosophical Transactions* of the Royal Society of London, Oldfield's *Essay towards the Improvement of Reason*, algebra, "lectures in pharmacy," Boyle's *Experiments* and *Considerations on the Usefulness of Experimental Natural Philosophy*, Krill's *Introduction to Natural Philosophy* – a truly vast assortment of titles, covering all the important sciences. The books all were "expos'd to Sale for *Three* Months." Two years earlier, the library of John Montgomerie – colonial governor of New York and New Jersey – was sold at auction after his death in June 1732. The manuscript account of the sale is an invaluable resource, as it lists 1,341 volumes by title, the purchase price, and the purchaser.[19] Reading the list of buyers makes clear that these texts were a luxury item for the wealthy and high-borne. Indeed, the revenue realized from the sale of the books alone totaled nearly 13% of the value of the estate. However, the inventory list does support the suggestion that foundational texts in the sciences were available and circulating in the colonies in the early decades of the century. Among the titles sold at the auction were books by Bacon and Locke, as well as "Newton's Chronologie" – the triumvirate upon which Enlightenment science was founded – and several texts on geography and the use

book trade, see Hugh Armory, "The New England Book Trade, 1713 – 1790," in Hugh Armory and David Hall, eds., *A History of the Book in America* (Cambridge: Cambridge University Press, 2000), Chapter 9, 314 – 346.

[19] "Inventory and Account of the Estate of John Montgomerie, Charles Homes, Administrator," NYPL. The sale is advertised in the *New-York Gazette* 8 May 1732. For a full length treatment of the books contained in the library and their influence on the intellectual life of New York, see Kevin J. Hayes, *The Library of John Montgomerie, Colonial Governor of New York and New Jersey* (Newark: University of Delaware Press, 2000).

of the compass. "Vulson's Heroic Science," however, dealt with heraldry – further proof of the elastic and capacious nature of 'science' in the early eighteenth century.[20]

Not every buyer of such books necessarily belonged to the rarified world of elite intellectuals, however. The Maryland physician Alexander Hamilton by chance gave a sketch of one of the more modest men who participated in the auction. The Reverend John Miln attended from Albany and purchased several lots of books.[21] Miln may have been a minister but he did not meet Hamilton's standards and Hamilton's description of Miln in his *Itinerarium* once again shows him adjudicating the boundaries of scientific virtuosi. He wrote of Miln, with whom he happened to share a ferryboat ride up the Hudson River, that he "read a treatise upon microscopes and wanted me to sit and hear him, which I did, tho' with little relish, the piece being trite and vulgar, and tiresome."[22] Moreover, Hamilton believed that his own authentic and authenticating experience validated his opinions, as he had "seen Leewenhoek and some of the best hands upon that subject" of microscopy. Hamilton therefore had little use for a commonplace printed tract. He mocked Miln as easily "surprise[d] att every little trite observation" as well as "an intire stranger to the mathematicks," unable to tell the "difference betwixt a cone and a pyramid, a cylinder and a prism." Was Miln guilty of posing as a "learned man who took an interest in the sciences" but one out of his intellectual depth?[23]

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[20] See Kevin J. Hayes, *The Library of John Montgomerie, Colonial Governor of New York and New Jersey* (Newark: University of Delaware Press, 2000) for a printed copy of the entire book catalogue as well as the sales price and purchaser. Hayes does an excellent job of tracing Montgomerie's books through colonial private libraries.

[21] Hayes, *Montgomerie*, 41- 42.

[22] Hamilton, *Itinerarium*, 52 - 53.

[23] Hayes, *Montgomerie*, 42.

Perhaps. More significant, however, is the image of Miln sharing with his fellow ferryboat passengers the details of the "treatise on microscopes" that he was reading in public.

By the 1740s, book sellers definitely began to move beyond the religious tomes that once had been their major source of revenue. William Bradford, printer of T*he New-York Gazette* in 1739, broadened the stock of his shop to include non-theological texts, including the works of Aristotle and Locke, thereby increasing the mixture of ideas and experiences accessible to the public readership.[24] At least as early as that year, the *Mathematical Elements of Natural History* by the Dutch mathematician William Gravesande's were imported into the colonies.[25] Considering that it was 1743 before the Harvard faculty agreed that this work should "be recited" as part of the formal curriculum, its ready access in the colonies bolsters the suggestion that important scientific texts were available.[26] Isaac Newton's works also circulated freely, and at least in the port cities, Newton's *Principia* moved through colonial hands. "The person who so ingeniously borrowed Sir Isaac Newton's works out of my printing-office is earnestly desired to return them speedily," beseeched the printer John Peter Zenger.[27] Zenger claimed the book did not belong to him, and we have no way of knowing whether he stocked it for sale, had borrowed it himself, or imported it for a bespoke

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[24] Carl Bridenbaugh, *Cities in the Wilderness: The First Century of Urban Life in America, 1625-1742*, (New York: The Ronald Press Company), 461.

[25] Advertised for sale 22 March 1739 *Pennsylvania Gazette*. William Jacob Gravesande, *Mathematical elements of natural philosophy, confirm'd by experiments: or, an introduction to Sir Isaac Newton's philosophy*. J.T. Desaguliers, trans., 2 vols., 5th ed. (London, 1737).

[26] See Clark A. Elliott and Margaret W. Rossiter, eds., *Science at Harvard University: Historical Perspectives* (Bethlehem, Pa.: Lehigh University Press, 1992), 335.

[27] *The New-York Weekly Journal*, June 19, 1749.

purchaser. However, his distressed plea for the book's return is a sign both that the book was available as well as desirable enough to "borrow" without notice. Printing offices and their bookshops may even have functioned as proto-lending libraries for scarce yet valuable texts. William Bradford placed a notice at the back of his *Gazette* searching for an errant text, asking "the person who ha[d] borrowed the second volume of Locke *Upon Human Understanding"* to return it to him.[28] In Philadelphia, the "Gentlemen that bespoke Brooke's Natural History" were sought out via notice in the newspaper.[29] Private libraries were also periodically disposed of piecemeal, as estates were liquidated.[30] Texts circulated in a variety of ways to an interested audience who read them.

By the mid-eighteenth century the number and variety of scientific books for sale increased, suggesting a growing readership. Benjamin Franklin's 1744 book sale also offered books on natural history, geography, fossils, chemistry, mathematics, chemistry, and "Newton's Philosophy." Franklin's sale not only strengthens our understanding of the types of scientific texts printers with an eye for popular tastes considered worth stocking, it also provides a salutary reminder of what would have been considered desirable and *au courant* – the catalogue listed editions of popular English magazines from the previous decade, the *Gentleman's* Magazine for 1731 to 1735, and the *London Magazine* for 1738. Franklin also presented for sale a choice piece of scientific equipment, a "Pair of Globes … having on the Terrestrial Globe all the Discoveries of

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[28] *New-York Gazette*, 20 August 1739. It would be interesting to know more about printers' and booksellers' policies.

[29] *Pennsylvania Gazette*, 19 July 1764.

[30] *New-York Weekly Journal*, 4 February 1745.

the Year 1738; and on the Cœlestial Globes all the Stars in Flamsted's Catalogue, with Bayer's Notes to know them by. *These are the best Globes extant."*[31] By 1766, the sales catalogue listing John Mein's stock ran to more than 1,700 titles, with most books on science grouped under "Books of Entertainment, &c."[32] This category included "Gravesand's *Newtonian Philosophy*," as well as texts on the use of the globes, astronomy, surveying, navigation, and arithmetic, geometry, and trigonometry. Most of these scientific texts were identified as "very cheap." We cannot know with certainty who purchased the books. We know even less about who may have passed through the shops to look at and possibly page through the stock. What is clear, however, is that a range of texts covering a multiplicity of sciences was circulating through colonies.

Titles themselves do not tell the whole story of the spread of scientific print culture. Hidden between the covers of many self-help books was a plethora of scientific material. Thomas Gilbert bought a copy of *The American Instructor* in 1755 and it passed from father to son, and perhaps to other hands, for at least 150 years.[33] Although it was categorized as a "secretary" book, in fact this was an omnibus text and useful to many more than just men employed as clerks. Explicitly designed to teach a variety of subjects, the book compiled lessons on a vast array of subjects, including "Spelling, Reading, Writing, Arithmetick," penmanship, the proper wording for a variety of legal forms used in business, bookkeeping, and several building trades – all "without the Help of a Master." Although the British editions continued to be imported into the colonies,

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[31] *A Catalogue of Choice and Valuable Books … in most Faculties and Sciences …* (Philadelphia: B. Franklin, 1744).

[32] *Catalogue of Curious and Valuable Books* (Boston: J. Mein, 1766).

[33] George Fisher, *The American Instructor; or, Young Man's Best Companion* (Philadelphia: B. Franklin and D. Hall, 1748). This copy is held by the Huntington Library.

and reprinted as well, Benjamin Franklin in 1748 Americanized the 9th edition of Fisher's self-help book. As Franklin explained, the British edition of the book contained "many Things of little or no use in these Parts of the World." Consequently, these he excluded and "in their Room many other Matters inserted, more immediately useful to us Americans."[34] The *American Instructor* was a wide-ranging vade mecum, intending to train the "young Man's Mind for Business." Towards that end, the book laid out a program that began with knowledge of English, taught "to write a good, fair, free, and commendable Hand," and moved on to the "excellent Science of Arithmetick, both Vulgar and Decimal."[35] However, the book also included "A short, but Comprehensive Account of all Arts and Sciences."[36] Beginning with a debunking of "Alchymy," and in later editions, of astrology too, the book covered in brief all the useful sciences of the day, including astronomy, botany, geography, hydraulics, mathematics, navigation, and surveying, among others.[37] The Gilbert family used Franklin's edition as a ready reference, recording births on the front flyleaf as well as the recipe to "make one quarte of ink."[38]

We can also find scientific material in commonplace books, diaries, and other journals with scribbled notes and recorded personal information. The commonplace book kept by the Philadelphia silversmith John Leacock, begun in 1768 after his

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[34] For more on "secretaries" in general, see E. Jennifer Monaghan, *Learning to Read and Write in Colonial America*, (Amherst: University of Massachusetts Press, 2005), 213 – 231.

[35] Franklin was the first American printer to provide illustrations of various scripts. See Fisher, *American Instructor*, 12.

[36] Fisher, *American Instructor*, 296.

[37] Fisher, *American Instructor*, 296 – 302.

[38] Fisher, *American Instructor*. HEH.

retirement from business, also gives witness to the varied scientific interests that took his attention. Misleadingly entitled "Observations, Experiments &c. Extracted from the *Philosophical Transactions* Respecting Farming, Gardening, &c.," Leacock's book contains more than just transcribed articles from the Royal Society's learned journal, although those transcriptions are suggestive of the wider circulation some seemingly scarce texts enjoyed.[39] While the assortment of entries (organized alphabetically) does include some articles copied from printed sources, it also incorporates folklore, cooking recipes and in particular, medicinal instructions, along with a good deal of horticultural information that Leacock would naturally have found useful in tending to his vineyards.

Along similar lines, David Jones, a Baptist minister in Chester County, Pennsylvania, kept a memorandum book where he listed the sacred texts from which he preached his sermons. In it, however, Jones also made a record of his medicinal "receipts, inscribing many details of his botanical experimentation.[40] There, among the scores of pages listing Bible passages he found inspirational, Jones also incorporated his botanical pharmacopoeia. Here, the barks of "Dogwood Roots, of Sassafras Roots, of yallow poplar Roots … of wild Cherry Tree" were made into decoctions, boiled with rye, bruised and added to brandy. Jones even transcribed the method used by the "Indians [to] cure the lues venereal," that is to say, syphilis. The memorandum book tells us little about the method Jones might have used in keeping his scientific accounts – did he record his "receipts" as he heard them while preaching the circuit? Were they the most

[39] John Leacock, Commonplace book, 1768 – 1800. American Philosophical Society.

[40] Rev. David Jones Memorandum Book, HSP. Rev. Jones wrote that the book contained his sermons for 1786, but he apparently kept it for many years longer, as some of the entries date to 1816.

useful of his repertory, and therefore to be kept close at hand? Difficult to remember perhaps, and so better off written down? We do not know. All that is certain is that Jones put his botanical works alongside his spiritual ones, making a permanent record of them and leaving us with further evidence that science in America found its way into unexpected places.

The commonplace book kept by Thomas Robie during several of the years when he published an almanac after his graduation from Harvard in 1708 was quite similar. It contained “extracts from Divers Authors” on historical, biblical, and scientific subjects, but was devoted largely to medical matters and the “medicinal receipts” that might be used to treat such ailments as “dry cough,” “catalypse,” or “convulsions.”[41] However, Robie also included meteorological speculations that he had transcribed from an abridged article by “Dr. Wallis in ye Philosophical Transactions,” as well as his notes on the “difference between Heat and Cold, Summers and Winters.” These depended on evidence from “Galileo’s experiment, in his Systema Mundi diag. 1.” Christopher Sargeant, a college-educated schoolmaster and minister also kept a commonplace book filled with scientific “observations” extracted from books.[42] From “Mr. Neipingtets Religious Phylosophy,” Sargeant transcribed a long discourse “Of Air,” that discussed its “heft” as well as its “elastick or springy faculty.” From “Mr. Rays Three Discourses,” Sargeant copied out “Observations” on gravity, plants, and the “Density of ye air” and its relationship to the refraction of sunlight. The “Astro:Theol:” of “Mr.

[41] Thomas Robie Commonplace book, 1714 – 1717. MHS.

[42] Christopher Sargeant Commonplace-book, 1726. MHS.

Derham" provided remarks on "ye fixt Stars … Planets … Comets," and Sargeant made notes on properties of "Light" and "Sound" as well.

This trend continued in the second half of the eighteenth century. The Massachusetts physician Samuel Adams kept a "short broken account of his Practice of Physick, in the Town of Truro on Cape-Cod" beginning in 1771, one that included "hints regarding the weather."[43] It is certainly not unusual or unexpected to find that a man trained to medicine and surgery would keep a record "designed as an Assistant in his observations and improvements" in his work. Medical practice throughout the eighteenth century still relied heavily on botanical treatments and remedies, and continued interest and investigations into such natural history would be completely unremarkable.[44] What is interesting and significant about the doctor's habit of keeping a record of his professional life is to note how varied those interests that he found worthy of recording actually were.[45] Adams was cognizant of his wide-ranging – yet related – interests inasmuch as he labeled his record a "Miscellaneous Diary." When he began it, Adams wrote that he kept the diary only for "his own Private advantage." Yet several years after he began keeping this diary, Adams wrote encouragingly that the act of writing would be "an enticement … to employ [his] time industriously" so that he could cover himself with "Honor" while he labored for the "good of my fellowmen." It was 1773 when Adams wrote to persuade himself that his record of the weather, the books he read, the products of his kitchen garden, and some descriptions of his medical practice

[43] "Samuel Adams's Private Miscellaneous Diary," Dr. Samuel Adams Papers. NYPL.

[44] For a more thorough survey of the American medical scene in the eighteenth century, see Brooke Hindle, *The Pursuit of Science in Revolutionary America, 1735 1789* (Chapel Hill: University of North Carolina, 1956), particularly chapter 3, "Naturalists and Physicians," 36 – 58.

[45] Adams Diary. NYPL.

would benefit his compatriots – and he was deeply involved in the political struggles of the time. By the following year, Adams was appointed to the local committee of correspondence, and it seems clear that his high-flown ambitions for his written miscellany reflected the temper of the times.[46] By 1778, Adams described his diary – kept at least in part while a surgeon in "his Excellency General Washington's Camp" – as "mostly private" with "many trivial occurrences designed only for a memento."[47] Adams continued to chronicle the weather, as well as other natural observations that struck him as meriting "rememberance," without situating his *corpus* within a larger, national context. We cannot know whether he tempered his ambitions about the experiences he had collected, or to what extent he believed his work might benefit his fellow Americans. But Adams' willingness to write about such goals, about work that he had done before and would continue to do long after he felt it desirable or fitting to couch it in nationalistic terms, helps demonstrate how the twin impulses of personal enjoyment and civic advancement could merge, rhetorically and actually, and give added meaning to abiding interests.

Moreover, it is important to keep in mind that Adams would not have received a university education, nor even a formal course of medical training as there was no real medical school in the colonies until 1765. While we cannot know with precision the kind of instruction Adams received, we do know that he learned his trade directly from a physician in the Connecticut town where he was born. Adams' teacher – Dr. Nathaniel Freeman – had himself been prepared for a medical career under the direct guidance of

[46] Simeon L. Deyo, ed., *History of Barnstable County, Massachusetts: 1620 – 1637, 1686 – 1890* (New York: Blake, 1890), 222, 227.

[47] Adams Diary. NYPL.

an older physician.[48] In some ways, Adams' diary was a continuation of a venerable tradition of pedagogy, an apprenticeship of sorts. Adams learned his occupation first-hand from someone more experienced, who been educated to the craft in the same manner – but as the practice of medicine professionalized towards the end of the eighteenth century, the kind of education that Adam's training represented was largely abandoned. We have no real way of knowing whether Adams intended his notes for his own benefit or those of his countrymen, nor if he used them to help prepare the next generation of medical practioners. They do offer a fuller picture, however, of the ways in which Americans made use of the strands of scientific learning to which they were exposed.

The Kearny family, living near Perth Amboy, New Jersey, also kept a diary in which they collected and transcribed more than 50 years' worth of useful scientific information ranging from the "Method of obtaining Natural Flowers In Winter, fresh blown" (copied out of the London Magazine in 1753) to a "Cure for the Whooping Cough" from 1794.[49] Among all these medicinal treatments, including "Receipt[s]" for colds and cures for "Gout in the Stomack," "Poison," and the "Bite of the Rattlesnake," the diary also contained pages taken from textbooks, some written out by hand. The *Elements of Plane Geometry,* printed in London in 1743, appears in the beginning of the diary, as well as part of an undated *Treatise on ALGEBRA*, along with "Essays on several curious and useful Subjects in Speculative and Mix'd MATHEMATICKS"

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[48] Simeon L. Deyo, ed., *History of Barnstable County, Massachusetts: 1620 – 1637, 1686 – 1890* (New York: Blake, 1890), 227. Henry Crocker Kittredge, *Cape Cod: Its People and Their* History 2nd ed. (Boston: Houghton Mifflin Co., 1968), 120.

[49] For biographical information about some members of the Kearny family, see William Northey Jones, *The History of St. Peter's Church in Perth Amboy New Jersey* (New York: Patterson Press, 1924).

designed to introduce and explain the key elements of Newton's *Principia*. An incomplete text from 1748, covering "Trigonometry, Plane and Spherical" was bound in with blank pages, where a diary was kept for 1778.[50]

Keeping a written record of printed scientific treatises may not have been a common occurrence, but neither was it rare. Often these books were not much more than indexes or memory aids, directing the reader to the source where the information originally appeared. Sometimes, the line of reasoning in the original article was laid out in brief, and in the case of medical treatments, the formulae and instructions usually were specified. A scientific copybook from the end of the eighteenth century is a model for this kind of homemade record. The entries are indexed alphabetically under the umbrella term "Nat.[l] Philosophy . Botany" and point to descriptions that range from "astronomical discoveries & conjectures" to how to make a "Toddy Arrack."[51] When Benjamin Smith Barton sent an inquiry to Thomas Jefferson about the views held by the chemist Joseph Priestley, Jefferson wrote back that Priestley had not written to him on the subject, but that when Jefferson pressed him to tackle it, Priestley was able to confirm that "his commonplace book would refer him readily to the materials."[52]

Especially in the absence of a population well-trained to the practice of the sciences, books were a prime way to transmit scientific knowledge among novices as

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[50] Diary of Ravaud Kearny, NYPL. It is an open question how complete the printed works were when the diary was in its original form, since some of the pages are torn and missing. All three of these textbooks were authored by Thomas Simpson, a self-taught mathematician and member of the workingman's Mathematical Society in Spitalfields, London. *Elements of plane geometry....*; *A treatise on algebra wherein the principles are demonstrated... ;* and *Trigonometry, plane and spherical….*

[51] Anonymous scientific copybook. APS. This particular copybook records excerpts from British scientific journals, and may not be an American production.

[52] Thomas Jefferson to Benjamin Smith Barton, 14 February 1805, Benjamin Smith Barton Papers, 1778 – 1813. HSP.

well as those more expert. When Cadwallader Colden wanted to expand the library of botanical books available to his daughter, Jane, he wrote to Peter Collinson with a request for specific titles. In Colden's view, "the best cuts of pictures" would serve as the "next best" thing to having direct access to plants in a "Botanical Garden," an impossibility for Jane Colden.[53] Cadwallader Colden explicitly requested certain texts, chief among them Tournefort's *History of Plants.*[54] Collinson replied that he had "at last been So luckky" as to acquire some "fine" books in "excellent preservation."[55] The Pennsylvania minister and avid horticulturalist Henry Muhlenberg had an even greater reverence for the value of a good book. Muhlenberg maintained a steady friendship with Benjamin Smith Barton, the university-trained naturalist and professor of botany and *material medica*, and author of the first botanical textbook printed in the United States. Barton and Muhlenberg exchanged plants, seeds, opinions about them, and of course books. In 1791, Barton wrote to Muhlenberg to thank him for the loan several books, and to hint at borrowing "Walter's *Polygal Flora.*"[56] Muhlenberg was himself also impressed with Barton's library and had inquired as to the source of Barton's "English books." These Barton received from his "correspondents in England," which was also how Muhlenberg expanded his library – thereby quashing Muhlenberg's hope that he would discover a nearer source for books.

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[53] Cadwallader Colden to Peter Collinson, in *Letters and Papers of Cadwallader Colden*, 9 vols. (New York: New York Historical Society, 1918 – 1937), 5:37.

[54] Joseph Pitton de Tournefort's *Elemens de Botanique* which were translated by John Martyn and published as *Tournefort's History of Plants Growing About Paris* (London, 1732).

[55] Peter Collinson to Cadwallader Colden, 6 April 1757, in *"Forget not Mee & My Garden …" Selected Letters, 1725 – 1768, of Peter Collinson, F.R.S.*, Alan W. Armstrong, ed. (Philadelphia: American Philosophical Society, 2002), 204.

[56] Benjamin Smith Barton to Henry Muhlenberg, 15 November 1781. Henry Muhlenberg Papers, HSP.

These examples suggest that some of the material collected in books, as well as journals, was intended to pass scientific knowledge from one generation to the next. The undated catalogue of books from the estate of Archibald Laidlie, minister in the Dutch Reformed Church in New York, is suggestive about the books and methods used to educate both children and adults in natural sciences as well as manners.[57] Among the theology and philosophy to be expected in a minister's library, Laidlie also held a copy of the "Gentlemens & Ladies Astronomy," seven "volumes" of "Nature displayed," and eight volumes of the London magazine *The Spectator*.[58] The *Display of Nature* presented the material as a series of dialogues between a pupil and a tutor, and covered astronomy, meteorology, geology, and all parts of natural history, among other subjects. However, the book was not a multi-volume work, and it is likely these volumes were additional copies of the same text. The astronomy book was almost certainly by James Ferguson.[59] One highly desirable feature of Ferguson's text was that it promised to teach astronomy "without any previous knowledge of Geometry or Mathematics." This it did through the mechanism of dialogues between a brother and a sister, Neander and Eudosia, copying the pedagogical trick of the *General Magazine*, first published in 1755,

[57] The catalogue is likely from 1779, when Laidlie died in Red Hook, New York. In Miscellaneous Papers of Jared Lane, of Rhinebeck NY. NYPL

[58] "Nature displayed" was likely J.F. Martinet's *A Display of Nature; In Dialogues ...*" Which edition is unknown though undoubtedly an English version as Laidlie was the first minister of the Dutch Reformed Church in New York to preach in English. See *Appleton's Cyclopedia of American Biography*.

[59] James Ferguson, *An Easy Introduction to Astronomy, for Young Gentlemen and Ladies* …2nd ed. (London, 1769).

where Cleonicus taught his sister Euphrosine through a series of dialogues entitled "The Young Gentleman and Lady's Philosophy".[60]

Silas Felton's handwritten "Life or Biography" details the ways in which one determined boy managed to educate himself through dint of persistent application, and the help of books.[61] Born in Marlborough, Massachusetts in 1776 and kept at work on the family farm, he attended school only sporadically. Felton reported that by "the age of 9 and 10, I was very fond of reading … and borrowed all the story books within my reach; these I perused evenings, and Stormy Days." In 1790 "a law passed doubling our schooling." Silas, however, was "kept at work, so that I had only a common chance like other boys in the neighborhood. Strictly following my old practice of reading, I used generally to have some book or newspaper every evening and Stormy Day ." For the five years following that change to the law, Felton attended school only "a part of the time they kept; but practiced carrying my book home on the evening, to study, because I was generally ambitious to excell in learning. …accordingly, when I arrived to the age of 19, I got through the large part of Pike's large Arithmetick; would rite a middling hand, and could read as well as most ." Felton was appointed to a schoolmaster's position, making a life for himself off the farm, an ambition previously unattainable if not unimaginable, working with ideas that had occupied his attention since childhood.

Newspapers, far more widely available than books, were also helpful in the transmission of scientific knowledge, and they played an especially important role in

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[60] *General Magazine*, 1755. The frontispiece to the original magazine is copperplate illustration by W. Owen, called "The Young Gentleman and Lady's Philosophy." It shows the siblings as sumptuously garbed in a gilt hall with exquisite brass instruments and wooden globes, making clear the connections between gentility and the sciences.

[61] "Life or Biography of Silas Felton written by himself". NYPL.

keeping a geographically isolated and dispersed group informed. Printers regularly included dispatches that detailed natural phenomena, from routine rains and thunderclaps to rare celestial occurrences. The *Pennsylvania Gazette* in 1737 reprinted an item from the London papers that gave an account of a “Comet” then appearing in the British Isles.[62] The writer felt that since it had been “so little observed, as yet, by Astronomers,” a printed account of his observations would “do an acceptable Piece of Service to the Learned World .” Whether that account did advance astronomical learning is uncertain; however, it added to the general public conversations and conjecture about astronomy. Moreover, since this comet had been observed in the western hemisphere, and the Royal Society received news of it from Kingston, Jamaica, as well as Philadelphia, this printed account taken from a London paper about a phenomenon observed and discussed in American society could only contribute to a feeling of collective study.[63] That same year, a report from “Rhode-Island” detailing the “*Aurora Borealis*” – the display of natural lights in the sky that result when solar winds encounter the Earth’s magnetosphere – appeared in the colonial papers.[64] A phenomenon that had in previous years been communicated to the Royal Society of London by correspondents throughout

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[62] *Pennsylvania Gazette*, 26 May 1737.

[63] “Letter from Rose Fuller … from Jamaica,” 1 March 1736, Materials Pertaining to the History of American Science, Letters and Communications from Americans, 1662 – 1900; Reel 2; frames 465 – 466; Letter Book G. 2. 7. APS. “Observations of the late Comet, and the Solar Eclipse …Reresby to Peter Collinson,” 18 February 1736/7, Materials Pertaining to the History of American Science, Letters and Communications from Americans, 1662 – 1900; Reel 7; Frame 3626. Letter Book C. 23. 307 – 309. APS.

[64] *Pennsylvania Gazette*, 18 August 1737.

New England and the middle colonies now also generated intracolonial attention and notice.[65]

Newspapers thus served a vital function in connecting British North America with the larger trans-Atlantic world of science. Moreover, the reach of that information was incalculably larger than the print runs for these weeklies would suggest. J. Hector St. John de Crèveoeur described the practice of going to hear the newspapers read in the countryside, writing that "Some of the most Learned procured the News Papers, & it was generally of a Saturday" that even simple country folk "went to hear the best Scholar read the great news from abroad."[66] As early as 1739, the *New-York Gazette* included the following feature as a mere bagatelle, simply printing the notice. "They write from Bordeaux, that the Royal Academy of Belles Letters, Arts and Sciences established there, proposes to all the learned in Europe a prize."[67] The *Weekly-Journal*, on the other hand, devoted considerable space to a full description of the annuity prize as well as the questions to be solved. One prize was to be awarded "for the best Piece on the Question, *Whether the Air we take in by Respiration passes unto the Blood*; the other to that which explain, with the gratest Probability, *the Cause of the Heat and Coldness of Mineral*

[65] "A short account of the Aurora Borealis 27th March 1726 at Roxbury by Paul Dudley," Materials Pertaining to the History of American Science, Letters and Communications from Americans, 1662 – 1900; Reel 1; Frames 428 – 432. Letter Book D. 1. 91. APS. Richard Lewis to Peter Collinson 10 December 1730 "Account of an Aurora borealis on October 22, 1730," Materials Pertaining to the History of American Science, Letters and Communications from Americans, 1662 – 1900; Reel 2; frame 10 -12. Classified papers, IV (2) 4. APS. "Account of an Aurora Borealis Seen in New England on 22 Ocrtober 1730 by Isaac Greenwood," Materials Pertaining to the History of American Science, Letters and Communications from Americans, 1662 – 1900; Reel 2; frames 491 – 500. Letter Book G. 2. 10. APS.

[66] In Dennis D. Moore, *More Letters from the American Farmer: An Edition of the Essays in English Left Unpublished by Crèvecoeur* (Athens, Ga.: University of Georgia Press, 1995), 14.

[67] *New-York Gazette*, 29 January 1738/9.

Waters.”[68] Further, the editor saw fit to include the address of the Academy, as an aid to those natural philosophers interested in undertaking a response. Even if the logistics of time and distance were to forestall any genuine colonial effort to win the prize, the inclusion of all the particulars of the questions points to respect for the interests and abilities of the paper’s readership. Moreover, the explanation given for the repeat of a previous year’s question on the “*Cause of Fertility of Lands*” emphasized that none of the “Dissertations” submitted could be “adjudged …for want of Experiments and Observations absolutely necessary for explaining a Work of this Nature...,” further bolstering the premium placed on the scientific method.

The science in colonial American newspapers should not be seen simply as derivative; it reflected real interest and engagement that formed the basis of a distinctly American understanding of science. It is easy to denigrate and dismiss the substance of early American newspapers either as wholesale reproductions of English content or as overly focused on immediate and local concerns.[69] That view does a disservice to the welcome freshness either category of writing held for Americans. Local printers worked to keep readers apprised of the happenings reported in the European journals but also took care to reprint news of interest from across the colonies. While it is true that the reports from overseas might take months to appear in the American newspapers, the news would be fresh when it was received. Serving as repositories of information about everything from war and politics to freakish acts of nature, newspapers kept Americans

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[68] *New-York Weekly Journal*, 15 January 1738/9.

[69] See Frank Shuffelton, “A Continental Poetics: Scientific Publishing and Scientific Society in Eighteenth-Century America,” in Carla Mulford and David Shields, eds., *Finding Colonial Americas: Essays Honoring J.A. Leo Lemay* (Newark: University of Delaware Press, 2001), 277 – 291.

informed and entertained.[70] Writing in 1725, the Swiss traveler César de Saussure noted the incredible diversity and influence of newspapers, marveling that a "husband will warn the public not to lend or sell his wife anything on credit … A quack will advertise that he will cure all ailments. A person who has been robbed promises a reward to whoever will help him to recover his stolen property."[71] Saussure noted that the newspapers also conveyed all that was fashionable: "Entertainments and spectacles are advertised; also offers of houses, domains, furniture, carriages, horses for sale or hire, books, pamphlets, etc." To know "of all the gossip and of everything that has been said or done in this big town" required only that one read the newspapers.

De Saussure referred to the newspapers of London. However, even the most casual reading of colonial newspapers would confirm that the phenomenon de Saussure remarked in Britain obtained in Anglo-America as well. While perhaps differing in quantity, there was little qualitative difference between the metropolitan and colonial papers as vehicles of information and change.

Moreover, by overlooking the content of the bread-and-butter business of American newspapers – the public notices, announcements, and commercial advertisements of the back pages – valuable information about the daily concerns of Americans can be lost. It is true that newspapers were less frequently the vehicle by which substantial scientific information passed through American society, since many

[70] The standard, if now dated, work on early American newspapers is Frank Luther Mott, *American Journalism: A History of Newspapers in the United States through 260 Years, 1690 – 1950*, rev. ed. (New York: The Macmillan Company, 1950). A more recent work is William David Sloan and Julie Hedgepath Williams, *The Early American Press, 1690 – 1783*, The History of American Journalism, eds. James D. Startt and William David Sloan (Westport, Ct.: Greenwood Press, 1994).

[71] César de Saussure, *A Foreign View of England in 1725 – 29* (London, 1902), quoted in Roy Porter, *The Creation of the Modern World: The Untold Story of the British Englightenment* (New York: W.W. Norton & Company, 2000), 78 – 79.

columns were devoted to military dispatches and political happenings, and the back pages were given over to advertisements. However, the advertisements themselves carried a wealth of information about books, lectures, and instruments available to the colonists, and would have generated and sustained conversations about the meaning and influence of science.

At times, newspapers did circulate information about scientific happenings, which were broadcast throughout society by means of an informal network of newspaper print relays. We can see the extensive reach of this system when John Coppock in 1734 recorded in his commonplace book "A Receipe, being an Effectual Cure for all Distempers arising from an inveterate Scurvey …"[72] The story was especially interesting not only for the "cure," which Coppock did record fully, but also for the surprising news that it was "the discovery whereof a Negro Man in Virginia…" This unnamed slave was "freed by the Government, and had a pansion of Thirty Pounds Starling Settled on him during Life." The entire story, including the remedy's formula, Coppock "writ out of a Newspaper."

Perhaps because publishers knew their newspapers would be read in other communities, information, description, discussion, and debate over astronomical events were frequently the subjects of transcolonial newspaper accounts. Those reports of celestial wonders provide a clear case of the way in which newspapers reported scientific information, indicating widespread public interest and curiosity. Newspaper notices

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[72] Commonplace books, John Coppock and others, 1733 – 1782. NYPL.

We also know about a South Carolina slave who similarly was manumitted and received a government pension for passing along his cure for the rattlesnake bite. Sylvia Frey and Betty Wood, *Come Shouting to Zion: African American Protestantism in the American South and British Caribbean to 1810* (Chapel Hill: University of North Carolina Press, 1998), 56.

covered not only local sightings, but gave detailed accounts of cosmological happenings in other, faraway locales, imparting a new universality to ways in which people regarded the cosmos. The 1737 northern lights in Rhode Island produced the "Usual Variations and Appearances." They also generated a beautiful, and rare, nighttime rainbow, with a "most amusing Appearance," and notice of this unusual, and entertaining, event appeared not only in local newspapers, but as far away as Philadelphia just a week later.[73] Even events in London made colonial papers and provided new readings for shared experiences. Asserting that publishers would do "an acceptable Piece of Service to the Learned World" by including this "Letter and account" of a little-observed comet then in visible orbit, "Mr. James Mann, an Optical Instrument Maker at Sir Isaac Newton's head" provided not just notice of it but also the opportunity to see it. He had outfitted the top of his house with "an Observatory, and furnish'd [it] with Telescopes…" so that any "such Gentlemen as are curious may have an Opportunity of viewing this uncommon Sight, any Evening when it is clear ."[74] "From Boston" came news in 1744 of "a Comet … near Pisces…" smaller than once seen two years previously, but closer.[75] The Boston papers subsequently printed "the account from an ingenious Gentlemen [sic], who has observed the Comet every Evening since it first appeared," and who provided a full description of its orbit. This account appeared in the Philadelphia papers within two weeks.[76] When the 1742 comet had blazed across the

[73] *Philadelphia Gazette*, 18 August 1737.

[74] "From London," *Pennsylvania Gazette*, 26 May 1737.

[75] *Pennsylvania Gazette*, 19 January 1744.

[76] The same dispatch appeared also in *The American Weekly Mercury* [Philadelphia], 12 January 1744.

sky, the *Pennsylvania Gazette* devoted considerable space to describing its orbit.[77] The column included information gleaned from the "modern Astronomers" about the physical composition of the comets, very much grounded in Newtonian science, and quoted "Dr. Keill in his "Astronomical Lectures" to defuse some of the speculations about its portents, which, it was claimed, were based largely on superstition and speculation.[78] Indeed, when that comet appeared above New York late in the winter of 1742, a lively public discussion ensued. Its appearance generated months of scientific analysis, explication and discussion. Correcting the observations that were carried in the previous week's newspaper, an amateur astronomer wrote in to "send you two observations taken with a thread" that he promised would improve on those of the last week, and help "point out the path and place of the comet."[79] Other readers continued tracking the comet and submitted observations to the public scientific dialogue. As noted earlier, only one reader responded to the printer's request for the results of study with a backwards glance. The comet New Yorkers had been observing was a sign from the Almighty, claimed the writer. Its purpose was to reclaim them "from their vicious ways and…to stir them to a firmer adoration and service of Him."[80]

Newspaper discussions of natural phenomena not only connected different parts of British North America, but also connected colonial Americans to a larger world of science. The outpouring of commentary carried by the colonial newspapers during the

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[77] *Pennsylvania Gazette*, 3 March 1742.

[78] John Keill was the Savilian Professor of Astronomy at Oxford and wrote the first astronomy textbook based on Newtonian science, *An Introduction to the True Astronomy: or, Astronomical Lectures, read in the Astronomical School of the University of Oxford* (London, 1721).

[79] *New-York Weekly Journal*, 14 March 1742.

[80] *New-York Weekly Journal*, 22 march 1742
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advent of the celebrated "Great Comet" of 1744 is illustrative of the ways in which humble newspapers played an important role in that transmission of scientific information. Almost certainly the comet reported near Boston in 1744 was the same observed throughout the northern hemisphere in the winter of 1743/44: Chésaux's comet is one of the noblest comets in recorded history, with a six fan tail, and so bright it was visible not only with the naked eye, but by daylight.[81] "The Comet appeared; and, in the brightest Sun-shine, was very visible at Noon," reported one Boston paper.[82] News about comets filled the newspapers while the great comet remained in celestial orbit above the colonies. In Boston, Mather Byles published "The COMET," an original poem written in its honor, and "adorned with a Cutt."[83] The cover illustration showed the comet streaming across the night sky, and a mixed group of men and women gathered at a large telescope, viewing it both through the instrument itself as well as with the naked eye. The great minister and colonial man of science Cotton Mather also printed a pamphlet on the comet.[84] In just a few pages, Mather's essay introduced and synopsized the theories and conjectures of astronomy's pantheon, from Isaac Newton, Cassini, and Bernoulli, to Brahe, Kepler, and Halley.[85] Possibly more comprehensible,

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[81] David A. Seargent, *The Greatest Comets in History: Broom Stars and Celestial Scimitars* (New York: Springer, 2009), 116 – 121. This comet is widely considered the most spectacular of the eighteenth century.

[82] *Boston Post-Boy*, 20 February 1744.

[83] [Mather Byles], *The Comet: A Poem* (Boston, 1744). Advertised in *Boston Weekly News-Letter,* 16 February 1744.

[84] Cotton Mather, *An Essay on Comets, their Nature, the Laws of their Motions, the Cause and Magnitude of their Atmosphere, and Tails, with a Conjecture of their Use and Design,* (Boston, 1744).

[85] Italian mathematician and natural philosopher, Giovanni Cassini; Daniel Bernoulli, a Dutch-Swiss mathematician; Tycho Brahe, a Danish astronomer; Johannes Kepler, an Austrian mathematician; and Edmund Halley, the English astronomer.

the *American Magazine* published an "Account of Comets in general, from the Rev. Mr. Rowning's Compendious System of Natural Philosophy."[86] It was almost immediately reprinted as the lead story in the New York newspaper, reaching even further into popular culture.[87]

While newspapers played a useful role in the rapid transmission of information across the colonies, some regarded the medium as inherently déclassé and thus incompatible with, even detrimental to, the value of the scientific news conveyed. The New Yorker Cadwallader Colden read about Benjamin Franklin's 1752 kite experiment in his local newspaper. The *Pennsylvania Gazette* featured the item on the 19th of October and it was reprinted in the *New-York Evening Post* the next week, appearing on the 23rd. Colden immediately wrote to Franklin expressing the hope that "a more perfect and particular account" of it would be "published in a manner to preserve it better and give it more Credit than it can obtain from a common News paper."[88] That Franklin did not do so suggests that he was satisfied the reports of the experiment published in the colonial papers sufficed.[89]

At mid-century, a new type of publication, the magazine, joined the crop of print options available to the wider reading public, offering some scientific information to the public. Not nearly so plentiful as newspapers, nor as successful, magazines nevertheless also provided a wide range of scientific information that circulated to a general audience.

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[86] n.t. *The American Magazine and Historical Chronicle* 2, no. 1 (January 1744): 207 – 210.

[87] *The New-York Weekly Journal*, 13 February 1743.

[88] Cadwallader Colden to Benjamin Franklin, 24 October 1752 in *Writings*, 4:373. For more on intracolonial scientific correspondence, see Edwin Wolf, 2d, *The Library of James Logan of Philadelphia, 1674 – 1751* (Philadelphia: The Library Company of Philadelphia, 1974).

[89] Lemay, *The Life of Benjamin Franklin*, 3:109.

Four magazines appeared in quick succession in the 1740s, although not all three met with success.[90] The *Boston Weekly Magazine* aspired to a diversity of quality material, such as would satisfy the needs of those they identified as well read and cultured. "It has often been wished by Gentlemen of Ingenuity and learning, that a Weekly Paper were published among us, something different in its Nature and manner from those which already entertain us."[91] The publishers of this new weekly emphasized the permanence of their product, so different from the others then available. They derided the usual content of the "Common News papers … which though they may be of present Curiousity and Advantage, yet are soon flung aside, as of small Use a few Days after their first publication." Aiming high, the *Boston Weekly* proposed itself as a "Piece of valuable Furniture in the Library of a Gentleman."[92] By its third, and penultimate issue, however, the editors excoriated "the foolish custom of continual reading." Such "poring over Books" transformed "Thousands" into "Coxcombs by what is falsely called, Science, Learning, and Reading" and interfered with their development into "useful Members of the Commonwealth."[93] The publishers of the *Boston Weekly* appeared to distinguish between 'false' and 'useful' learning. In fact, their financial success – ultimately elusive – depended on stimulating and meeting the interests of a general reading public.

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[90] *The American Magazine, or a Monthly View of the Political State of the British Colonies*, 1741; *The General Magazine and Historical Chronicle, for all the British Plantations*, 1741, *The Boston Weekly Magazine*, 1743, and *American Magazine and Historical Chronicle*, 1743. See Frank Luther Mott, *A History of American Magazines, 1741 – 1850* (New York: D. Appleton and Company).

[91] *The Boston Weekly-Magazine* 1, no. 1 (March 2, 1743), 1.

[92] *The Boston Weekly-Magazine* 2 March 1743, 1.

[93] *The Boston Weekly-Magazine* 16 March 1743.

Thus, the subject matter of the periodicals reveals more about the editors' assessment of popular tastes than did those fulminations against coxcombs. The magazines' contents could not be described as anything but eclectic. The introduction to the *American Magazine* – the first really important, though only modestly successful, colonial magazine – promised as much. "It is allowed on all hands, that the writings of a miscellaneous kind have something in their nature peculiarly engaging. A variety of subjects [have] a certain quality of unbending and entertaining the mind."[94] Religious treatises, light verse, essays, informative articles – the contents frequently were at intellectual odds with each other, but nevertheless were presented without any apparent awkwardness. The *American Magazine* did not hesitate to publish, and advertise on the strength of it, "*The Case of Satan's Fiery Darts in Blasphemous Suggestions and Hellish Annoyances*" as well as "*An Essay on Comets, Their Nature, the Laws of their Motions, the Cause and Magnitude of their Atmosphere; with Conjecture of the Use and Design.*"[95]

Basing this American print production on a metropolitan example, the publishers of the *American Magazine* assured the reading public that "Compositions of this Nature" had received "encouragement … in Great-Britain from People of all ranks, and of different sentiments."[96] The editors expressed the hope that that their magazine would prove its intellectual worth to American readers and become a "treasury of knowledge and learning of the *serious* and *pleasant*." Styled as more than amusement, the

[94] *American Magazine and Historical Chronicle* 1, no. 1 (September 1743), i-ii. It had a publishing run of three years, far longer than any other magazine to date. It was printed and sold in Boston, as well as by James Parker in New York. It was sold also in Philadelphia, New Haven, and Newport.

[95] *American Magazine and Historical Chronicle* 1, no. 4 (December 1743), 177.

[96] *American Magazine and Historical Chronicle* 1, no. 1 (September 1743), ii-iv.

magazine aimed to instruct, and to instruct all. "Hence we presume that no reader of whatever taste or turn he be, will fail of being either edified or pleased." Lastly, because the publishers claimed to seek a reading public of all ranks, they held that "every man or party of men have a natural right to be heard; let their opinions be what they will."

Via the mediation of print, then, readers could join a coterie of learning and urbanity, often with science at its center. An ostensible "Design" of the *American Magazine*'s purpose was "to publish an Account of the Progress of Learning." [97] It referred to that brief when it carried a description of "an Orrery or Planetarium in the Library of Yale-Colledge" explicitly to instruct. This miniature solar system was made at Yale "in some Measure" to mimic "those large and costly Orreries" heard about in Europe. The account of Yale's orrery was quite extensive. Beginning with the Zodiac – the apparent line that the Sun traces across the sky during the course of a year and with which everyone in America would have been familiar – the description of the orrery provided a complete explanation of the known universe. The report gave data not only about the planets, their orbits and satellites, and the transit of comets, but in so doing it also provided information about the mechanical construction of the "Machine." The account of this device thus presented two aspects of knowledge – that of the actual solar system and also of its mechanical representation – permitting a reader both to participate in the scientific exchange and educate himself at the same time. These essays on "entertaining and useful subjects," read properly, could be an education in themselves.

Some of these magazines were conceived as a print vehicle that could "speak to and for a larger intercolonial audience" in a way that newspapers – because of their local

[97] *American Magazine and Historical Chronicle* 1, no. 5, (January 1744), 202-203.

ties – could not.[98] This "intercolonial audience" would be interested in a wide array of subjects, including science broadly conceived. William Smith, publisher of the *American Magazine*, made just that claim in 1757 in support of his nascent venture. Because magazines could cover a wider range of topics, and would reach a broader audience than either newspapers or private correspondence, such intermediate print productions could better represent "the important concerns of these *Colonies*." Smith went on to claim that many were disheartened by the "difficulty of acquiring any tolerable notion of *American* affairs."

However, Smith did not have an American audience in mind for his magazine. He expressed much more concern with providing "persons at a distance a just idea … of these *American* colonies.[99] Smith designed his magazine as a way to craft a larger place for the colonies within the imperial imagination.[100] However useful, or successful that project, Smith's imperial focus made for uneven content. The magazine published some accounts of "European Affairs" and the "North-American Indians," to be sure, and presented a "Philosophical Miscellany" as well. Smith promised that the philosophical pages of the magazine would contain "the newest discoveries and improvements in any of the branches of philosophy, natural history, agriculture, mathematics or the mechanic arts."[101] Unfortunately, the miscellany included items both scientific and fantastical, covering the "philosophy of earthquakes" and a "new solution" to the northern lights, as

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[98] Frank Shuffelton, "A Continental Poetics: Scientific Publishing and Scientific Society in Eighteenth-Century America," in Carla Mulford and David Shields, eds., *Finding Colonial Americas: Essays Honoring J.A. Leo Lemay* (Newark: University of Delaware Press, 2001), 277 – 291; 279.

[99] *American Magazine, and monthly chronicle for the British Chronicles…* 1 (October 1757), 4.

[100] *American Magazine, and monthly chronicle for the British Chronicles…* 1 (October 1757), 3.

[101] *American Magazine, and monthly chronicle for the British Chronicles…* 1 (October 1757), 6.

well as an account of the "mer-man and mer-maid" and other tales of the supernatural.[102] Regardless of the publishers' intentions, of course, the magazines circulated in American society, adding to the many scientific exchanges occurring through the use of print.

Almancs, likely the most common print source for scientific information at all levels of society throughout the century, were ubiquitous in eighteenth-century America. As the almanac maker Isaac Briggs remarked in the preface to his 1798 issue, "few productions of Human Science are as capable of being made of more general and important use to mankind than an ALMANAC."[103] Briggs noted that their "cheapness" made it possible for the "poorest citizen to possess one." As a result, Briggs estimated that almanacs were "more extensively circulated throughout the country than perhaps any other publication, (the Holy Scripture excepted)." Their ubiquity made them the "most proper vehicle … for the diffusion of … natural science, and for exciting a spirit of scientific enquiry amongst our youth."

Indeed, almanacs covered an assortment of topics beyond science, including literature, art, ancient history and current events, but they also encompassed every field of science then acknowledged. An incomplete list of the sciences that almanacs covered would include astronomy and the Copernican universe, Newtonian physics, meteorology, botany, animal husbandry, chemistry and kitchen arts from cookery to distilling, mathematics, and *material medica* and homeopathic remedies.[104] The earliest American

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[102] *American Magazine, and monthly chronicle for the British Chronicles* 1 (October 1757), n.p.

[103] *Briggs's Maryland, Pennsylvania & Virginia* Almanac, *1798*.

[104] To be sure, almanacs also included tables for currency conversion, ways of calculating interest, geodesy, all the earth sciences, geology, meteorology, management of the home, gardens and livestock, &c. See Marion Barber Stowell, *Early American Almanacs: The Colonial Weekday Bible* (New York: Burt Franklin & Co., Inc., 1977), xiv – xv.

almanacs included an element of scientific systems. Samuel Atkins, a self-professed "Student of Mathematicks and Astrology," claimed that he published his *Kalendarium Pennsilvaniense* in 1686 because of his acquaintance with "Ingenious Persons" who were "Lovers of the Mathematical Arts, some of which have wanted an Ephemeris to Practice thereon."

Disposable though almanacs were, those that were regarded as repositories of practical information often were kept long after their use as a daily calendar had been spent. Moses and Graham Parsons, of Newburyport and Byfield, Massachusetts kept a handwritten diary for 10 years into which they interleaved items of scientific interest taken from various printed almanacs.[105] In 1775, "A Geometrical Construction of a Lunar Eclipse," with an illustration, was added to the diary.[106] In 1778, the illustration of the entire solar system, depicting stars in the outer rings, along with a description of the Comet of 1680 was interleaved into the diary.[107] Similarly, an anonymous commonplace book from the last quarter of the eighteenth century was used to record "Notes and References to Books" as well as "Casual Observations" about the natural and political history of America.[108] The anonymous compiler of the book kept a log of almanacs where information he or she deemed useful could be found, from a "Description of America" to the "Cure for the Distemper." The "Notes and References" began with a transcription from the "Annual Register" for 1776 that dealt with the "Treatment of the Consumption" and other medical therapies. Moreover, the writer

[105] Moses Parsons' Diary, 1773 – 1783. HEH.

[106] William Slygood, *The North-American's Almanack*, 1775.

[107] Daniel George, *George's Cambridge Almanack*, 1778.

[108] Commonplace book, 1776 – 1825. HEH

included a categorized record of magazines, noting when and where articles of interest had appeared.

Some almanac makers began quite early to emphasize the scientific precision that they brought to the calculations contained in their books, both in the latitudes that they used to calculate their forecasts of celestial phenomena and meteorology, and in the forecasts themselves. Reliable information was linked to localized knowledge, so that *Americanizing* the almanacs added to their value and their utility. The "Lover of *Astronomy"* who issued the *New-England Kalendar* in 1703 promoted the authenticity of his calculations to his readers. He alerted them to the fact that in recent years, some had "pretended to make Almanacks" by taking the "Eclipses, the Planets places, and Aspects, and the Lunations, out of Ephemeride," or published astronomical tables rather than rely on their own tabulations.[109] Individual observation alone exposed those frauds, as there was frequently little correspondence between such manufactured predictions and actual events. However, as he claimed that most of those published star tables ended their predictions in 1701, the almanacs published the previous year by those makers who could not perform their own calculations had "not Inserted" key information, such as the "Places and Aspects of Saturn, Jupiter, Mars, Venus & Mercury." Those omissions reduced the worth and utility of the almanacs, but worse still was the use in a colonial almanac of data calculated for London. The anonymous Philomath who worked the New England Kalendar marveled "that any man who pretends to be so much an Astronomer, as to make an Almanack, shou'd think, that Solar Eclipses Calculated for London would serve for New England." He pledged to his readers that he had

[109] *New-England Kalendar* … 1703.

"Calculated" himself all the work he presented, and had made it correspond to "the meridian of Boston," given with a precise "latitude [of] 42. g 25 m. north." The following year, his *Kalendar* included "a true Account of the Eclipses, and the *Geocentrick* places" of the known planets, and he alerted his readers that a competitor's almanac did not.[110] That other production was filled with astronomical errors, from the straightforward "*Places of the* Planets" to the more difficult to calculate "*Solar Eclipse* in November." The almanac maker Samuel Clough – very likely the target of those libels – responded to the criticisms by announcing to his readers that a "bold and ignorant pretender to Arts and Sciences," a man who was nothing but an "aspiring *Pedant*," had been abusing him and them.[111] By contrast to the precise latitudes and meridians asserted on the New England Kalendar, which offered exactness at "42. deg. 75 min" for use in "any part of "New-England," Daniel Leeds' "American Almanack" for 1705 was fitted for the general latitude of "40" and offered for use from "New-found-Land to Carolina." Joseph Taylor similarly made claims to geographically focused precision with his 1706 "*Mathematical Almanack* … exactly Calculated according to the Precepts of the Ablest Astronomers, and the most rational grounds of Art. For the Vertex of Philadelphia."[112]

Notwithstanding the geodetic exactitude that the almanac-makers purported to bring to their calculations, almanacs were a venue where both the science of astronomy and the pseudo-science of astrology appeared. No almanac was complete without its

[110] *New-England Kalendar* … 1704. Samuel Clough was probably one of the almanac makers criticized in the prefaces. See Marion Barber Sowell, "American Almanacs and Feuds," in *Early American Literature* 9, no. 3 (Winter 1975): 276 – 285.

[111] *Kalendarium Nov-Anglicanum* … 1705.

[112] *Ephemeris Sideralis, A Mathematical Almanack*…1706.

zodiac man, an illustration of a nude man that showed how the twelve constellations reigned over his anatomy. Yet as early as 1710, Thomas Robie's Boston almanac included a woodcut illustrating a "Type" solar eclipse. Robie predicted an eclipse would take place on February 17th and in order to make it more comprehensible to his readers, he provided the image of generic eclipse, demonstrating the relative positions of the Earth, Moon, and Sun during the event.[113] The 1723 *Astronomical Diary* by "B.A., Philo-Astro" offered readers "an Hypothesis of the Motion of the Earth and Planets, which it is probable may be met with some Objections and Censures from some unthinking Readers, who are apt to condemn every Thing that squares not with their common Notions."[114] Philo-Astro used his preface to debunk the Ptolomeic system of an Earth-centered universe, which improved knowledge was due in part to the apparatus of science, the "Invention of the Tellescope." Though the writer claimed to be a "star lover," he did not promise much expertise in astronomy, since he did not "publish these Speculations for the Information of Learned Astronomers," under whom he offered to "willingly become a Schollar." No, Philo-Astro "collected and published them for the Information of the unlearned, that they may know the general received Opinion of the Learned World concerning the Motion of the Earth and Planets or Globes that Revolve around the Sun, the Center of Gravity for this System."

Several other almanac writers were providing information about the Copernican universe, often with illustrations, at the same time as Philo-Astro without going so far as to call their readers "unlearned." Nathaniel Bowen's almanacs in the early 1720s not

[113] *An Ephemeris of the Cœlestial Motions* … 1710.

[114] *Astronomical Diary, or An Almanac*… 1723.

only provided solid astronomical information for the upcoming year, it made great claims for his city. His 1722 almanac was "Apply'd to the horizon of Boston the metropolis of N. England."[115] The following year, Bowen's calendar was for the "Famous Town of Boston ." Both carried illustrations demonstrating exactly the mechanism by which solar and lunar eclipses occurred, mimicking the action of those celestial bodies during the events. Bowen's 1722 *diary* also offered several pages presenting a very comprehensive account of that year's eclipses.

Nevertheless, the blending, or at least the coexistence, of astronomy and astrology continued apace and reflected popular interest in science. While the astrological claims can seem scarcely credible to modern readers, in the eighteenth century astrology fit quite comfortably into a seemingly scientific, *i.e.*, rational, explanation of the world. Nathaniel Ames' first almanac carried his signature as a "Student of Physick and Astronomy," and provided a careful description of the annual eclipses and of their timing.[116] His 1728 diary, however, was more expansive and offered a mathematical explanation for the zodiac, along with the iconographic sign for each. He also described the planets' "Motions through the Zodiack" along with their "Radiations and Aspects." Ames recalled for his readers that he had attempted in the previous year to provide a "a brief hint of the Motions & Diameter of the Planets & their distance from the Sun."[117] This year he hoped to explain the "region of the Fixed Stars" that existed "above or beyond these Planetary Globes," and thus to communicate to his

[115] *New-England diary* … 1722, 1723.

[116] *Astronomical Diary, or Almanack*… 1726.

[117] No copy exists of Ames' 1727 almanac.

readers the vast scale of the universe. By 1730, however, Ames again combined astronomy with astrology. He wrote about the annual eclipses but also made observation “that according to Authors, the Eclipse of the Moon, which happens in Leo, the 2d Sign of the fiery Triplicity, threatens more Grudgings, Repinings, discord and hatred, murmuring, complaints of the common People .” In 1731, he included an acknowledgement of the “prodigious Effects of Nature of late Years” including “Thunder & Lightning, violent Storms, tremendous Earthquakes, great Eclipses of the Luminaries … and strange Phenomena in the Heavens: The Aurora Borealis.”[118] Ames tried to account for them, and attributed the source to a “concatination of Causes” from “hot and Moist Vapours” and the “Agitation” of the air to the mighty powers of God and the “malign Effects” of the planets. Whether “these *Phaenomena* forbode Good or Ill” Ames declined to predict. However, his attempt to explain the phenomenon rationally did rely on the validity of the scientific method. The 1732 “Virginia and Maryland Almanack” by John Warner “Philomath” devoted four pages to the eclipses that year and made no apology for interpreting them as harbingers of “Famine, great Sickness, pestilent Diseases, &c. … Shipwrecks, &., [and] Schisms &c. in Religion” At the same time, he provided a completely rational, physical explanation for the solar and lunar eclipses by asking and answering of both “What it is? And when it happeneth.”

Thomas Godfrey’s 1733 Pennsylvania almanac combined the fantastical along with the rational, noting the eclipses for that year as well as describing their “Effects” which he claimed “no Rational Man will deny.”[119] At the same time, his almanac

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[118] Ames, *Astronomical Diary*… 1731.

[119] Thomas Godfrey, *Almanac* 1733.

carried a letter "On the Cause of Plums untimely falling off the Trees," along with a recommendation for a cure. Both the explanation of the cause and the therapy promoted were grounded in observation and experimentation – the scientific method. Benjamin Franklin's first *Poor Richard's Almanac* in 1733 did no more than make mention of the eclipses that year, although of course it included the man's zodiac. In 1736, however, Franklin observed "that whoever studies the Eclipses of former Ages, and compares them with the great Events in the History of the Times and Years in which they happened (as every true Astrologer ought to do)" would find that the fall of every empire was preceded by an eclipse. Since eclipses are an annual event, it is not clear just how seriously Franklin's readers were to take that warning! In time, *Poor Richard* occasionally illustrated the eclipses with drawings to make the geometry of the phenomena obvious and more comprehensible.[120]

Almanacs often highlighted eclipses since they were frequent phenomena of which every reader would be aware and the ability to predict them demonstrated the almanac maker's power of mathematics and science – and hence the almanac's overall reliability. When Titan Leeds in 1740 listed the six eclipses that he foretold for the year, he refused to make a determination "as to their Effects," whether good or ill.[121] The following year, Leeds took the same impartial tone when describing "a Conjunction of *Saturn* and *Jupiter* … in the fiery Sign of *Leo*." According to Leeds, although both clerics and astrologers "ascribed wonderful Effects to this Conjunction," he nonetheless

[120] Franklin, *Poor Richard's…*1752 and 1753.

[121] Titan Leeds, *The American Almanack for the Year of Christian Account 1740*. NYPL.

advocated an indifferent approach to the celestial marvels.[122] The following year, Leeds was much more inclined to forewarn of "much evil to Mankind" which he attributed to a "great Eclipse."[123]

Thomas More's almanac for 1748, however, took a more tempered and inoffensive approach in describing that year's expected eclipses, observing only that the lunar eclipse that year "Prognosticate[d] Prosperity to the Godly, and Adversity to the Wicked."[124] More's approach to his readership seemed contradictory in that he adopted the mien of a country bumpkin, yet provided highly sophisticated information and interpretations of astronomical events. He promised to omit "nothing" from his almanacs that would be useful to his "Country Friend." He offered a poetical panegyric to the innocence and freedom enjoyed by those who lived in humble circumstances, "far from Cities."[125] At the same time, he made an argument for the observation of celestial phenomena as something more than the indulgence of idle curiosity or uninformed, trembling awe. Instead, More integrated even so modest an act as the observation of the eclipses into the gravest, most scientific concerns of the day. According to More, who pretended to pass along the "generally approved" views of most, the "Observations" of eclipses formed the basis of proof from which "the whole Body of Astronomy" could be "confirmed and demonstrated."

By mid-century, however, several almanac makers would provide a genuine education in astronomy, attesting to the popular interest in science as well as the

[122] Leeds, *American Almanack*, 1742. NYPL.

[123] Leeds, *American Almanack*,. 1743. NYPL.

[124] Thomas More, *The American Almanack* … 1748. NYPL.

[125] Thomas More, *The American Country Almanack* … 1750. NYPL.

extensive instruction in science available through unconventional or alternative means. Roger Sherman's "astronomical" almanac for 1752 included a poetic geography of the course of the solar eclipse that year.[126] A mathematical enthusiast, who for his "own Amusement spent … leisure Hours" on its study, Sherman with great verve brought solid astronomical information to a wide public.[127] His description of the noble solar eclipse of 1752 reads nothing like the usual dry and straightforward notices of such phenomena. It is a gorgeous account, filled with romance and poetry, and though perhaps not intentionally, a real call to learning.

> The Center of the *Penumbra*, first touches this *Terraqueous* Globe in the *Pacific Ocean* … and passing over the South Sea; it first touches Land near *Almacing Isles*, on the Coasts of *Mexico*, then passing over the Continent by the City of *Puebla de Los Angeles*, it enters the *Bay of Mexico* a little South of the Mouth of *St. Peter's River*, and the Sun will be totally and centrally Eclipsed at Noon … from *Negrillos*, then passing along Northward of *Cuba*, over the South Part of the *Gulph of Florida*, and over the *Bahama Islands* into the *Atlantic* Sea, it passes over to the Coast of *Guinea*, South of the Isles of *St. Jago* and *Fuego*, near the Continent of *Africa* a little South-West of the Mouth of the *Senegal* River.[128]

Benjamin Franklin called such improvement in the understanding of geography, and instruction in astronomical learning, "the common concern of all polite Nations."[129] When Franklin at mid-century offered his ideas on establishing an "Academy" in

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[126] Roger Sherman, *An Astronomical Diary* …. 1752. NYPL.

[127] Sherman, *Astronomical Diary, … 1750*. NYPL. See also Lewis H. Boutell, *The Life of Roger Sherman* (Chicago, 1896): 18 – 41.

[128] Sherman, *Astronomical Diary,* … 1752. NYPL.

[129] Benjamin Franklin to James Bowdoin, 28 February 1743, *Papers*, 4:446a.

Pennsylvania, to provide "the Accomplishments of a regular Education," he emphasized the teaching of "some of the first Principles of *Geometry* and *Astronomy*."[130]

Sherman added other embellishments to his almanac that year. The verses that that headed each month's entry all were devoted to science, and encapsulated scientific lessons in their stanzas – extolling the heliocentric universe of Copernicus in January, describing Newton's laws in February, and so forth. The final months of the year were devoted to an explanation of the change from the Julian to the Gregorian calendar. Even Sherman's "Explanation of Old and New Stile," however, included a lengthy description of the annual revolution of the Earth around the Sun and the cause for the need to adjust the date.

Benjamin Franklin, however, must be credited with providing colonial Americans with a masterpiece of astronomical learning in his *Poor Richard's* of 1753 and 1754. *Poor Richard* in 1753 gave a minute by minute schedule by which observers could track that year's transit of Mercury across the sun. "On *Sunday*, the 6th Day of *May*, in the Morning, the Planet *Mercury* may be seen to make a black Spot in the Sun's body, according to the following calculations." Franklin advised his readers that if they would "get up betimes, and put on … Spectacles," they would be rewarded with the sight of "*Mercury* ris[ing] in the *Sun .*" Hoping perhaps to temper expectations about what that would look like, Franklin advised his readers that Mercury would "appear like a small black Patch on a Lady's Face."[131]

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[130] Franklin, "Proposals Relating to the Education of the Youth in Pensilvania," 1749, in *Writings*, 323 – 344, 330.

[131] For a discussion about Franklin's increasing insertions of scientific materials into the *Pennsylvania Gazette* and *Poor Richard's Almanac*, see Chaplin, *Scientific American*, 61 – 63.

The real majesty of that year's almanac, and of the following as well, was the comprehensive instruction in the then-current state of astronomy that Franklin provided. Franklin admitted appreciation for the "Power … of Creation" that a consideration of solar system, what he called "the Great Works … of Nature," afforded. The invention of the telescope, however, as well as the "sagacity of the Astronomers of later Ages," made it possible to study more than that which was plainly visible to the eye, the Sun or the Moon. Franklin expected that his almanac was likely to "fall into the Hands of some, who have not Leisure or Opportunities of reading Books of Astronomy," and he therefore devoted almost the entirety of two years of almanacs to distilling such knowledge into his modest pocket books for the benefit of those ordinary people. Beginning with the "Magnitudes, Distances, Orbits … determined by what Astronomers call their parallaxes, and by their Elongations from the Sun, and … other … Methods which would take up by far too much Time to explain," Franklin provided his readers with the distances of the Moon and the Sun from Earth, along with a modest explanation in how such distances were calculated. In explaining those distances, Franklin mentioned the upcoming 1761 Transit of Venus which astronomers of the day hoped would help calculate the exact distances, and so give an accurate measure of the entire universe.

In an astronomic tour-de-force, Franklin described the Earth's orbit; explained what sun spots were; gave a picture of the solar system in general; listed each known planet, its axis, and orbit, and speculated on their atmosphere; and also on the perspective towards the solar system one would have from standing on the surface of each of those planets. Franklin explained Newton's "Doctrine of the Motion of the Earth and other Planets, and the Comets round the Sun, and the secondary Planets or Satellites round their Primaries," so that there was no room to "hesitate about it." He explained the seasons, the rising and the setting of the sun, and provided information about the construction of a crude, homemade orrery in order that anyone could physically reproduce the effects of an eclipse. By using an apple and a candle, and Franklin's explanation, "it will be easy to understand how the Earth's Turning once round upon her own Axis, makes a Day and a Night; … and the length of days and nights and eclipses." Franklin further discussed the moon's surface and environment, its waxing and waning, its orbit, and finally the role of the Moon on the Earth's tides.

The following year, Franklin moved to the outer planets, beginning with Mars, then Jupiter and its Moons and eclipses. He dealt with the speed of light, and explained Saturn, its climate, orbit, axis, and its ring. He provided an account of comets, meteors, and their orbits, and used them to discuss Newton's laws of motion. Franklin delved into the outer reaches of the universe, discussing Orion's Belt and the Milky Way – and proposed that "each of those innumerable Millions and Myriads of Luminaries" was a "glorious Sun, a stupendous World of Light and Heat, with its System of Planets, Moons and Comets going round it." Altogether, Franklin endowed any willing reader of his almanac with as extensive an education in astronomy as possible.

While no other almanac could hope to equal the masterpiece in astronomical education of the mid-century *Poor Richard's,* almanac makers continued to provide instruction and edification in the sciences. Roger Sherman's1754 *Diary* offered an explanation of the ecliptics of each planet and delved into Newtonian physics as well, giving tutorials on hydrostatics and hydraulics.[132]

Particularly as the world began to anticipate the return of the comet that Edmund Halley had predicted would arrive in 1758, almanacs began once again to provide abbreviated treatises on comets.[133] Nathaniel Ames' 1759 almanac went to press before the arrival of Halley's comet was confirmed, but used its predicted arrival as the launching point for a straightforward explanation of the solar system and the basics of astronomy. *Copernicus* Weather-Guesser included a fundamental lesson on astronomy in his 1768 almanac.[134] Eleven pages long, and written as a conversation between Copernicus and a "young lady," it detailed not a romantic rendezvous but rather a scientific lesson from the great man. Faced with his companion's religious objections to his concept of a heliocentric world, Copernicus claimed to be "under no doubt about answering all her Objections … against the diurnal Motion of the Earth." Copernicus assuaged they young lady's concerns by assuring her that "since the Design of the holy writings, is not to instruct Mankind in Philosophical Things, but in divine Matters, therefore it is not necessary to restrain the Sense of Those Texts, to the strict Propriety of the Words ." The Bible, after all, did not pretend to teach astronomy.

Almanacs were filled with useful information as well as what might best be termed folklore. However, it is immaterial whether these prognostications, receipts and cures were useful. Rather, it is important to recognize that they often centered around

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[132] Sherman, *An Astronomical Diary* … 1754. NYPL.

[133] Roger More, *The American Country Almanack*…1758. NYPL.

[134] *The New Jersey Almanac*… 1768. Quoted in Sowell, *Almanacs*, 210 – 211.

science, and were pervasive, widely accepted, and deeply entrenched in American culture.

When Cadwallader Colden wrote to Benjamin Franklin urging him to publish the news of his electrical experiments in a more authoritative *printed* account than the newspaper offered, Colden believed such material weightiness would lend those discoveries permanence and respectful recognition. Yet the role of print in transmitting knowledge was contested ground in colonial America, and frequently the content so conveyed was as well. Alexander Pope gave critics of widespread learning the language and the logic for their attacks, and these condemnations rose in tandem with the expansion of print sources that made just such learning more accessible. “Most have the seeds of Judgment in their Mind,” wrote Pope.[135] But their natural “good sense” was mutilated by what he called “false learning.” Pope laid the blame for such confusion squarely on education. “Some are bewilder’d in the maze of schools, And some made coxcombs Nature meant but fools.”

Echoes of Pope were evident throughout the colonial debate over the proliferation of scientific learning, intellectual advancement, and the spread of education more generally. As with Dr. Alexander Hamilton and his disdain for the New York fops, such clashes offer us insight into the ways in which printed avenues to learning and self-improvement discomfited some who would use these self-same organs to rail against that very development. Moreover, as Benjamin Franklin astutely noted through his literary alter-ego, “Philosophy as well as Foppery often changes Fashion.”[136]

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[135] Alexander Pope, *Essay on Criticism* (London, 1713), 2.

[136] *Poor Richard*, 1753.

Learning itself, to say nothing of the subjects under review, was a source of conflict, as colonials negotiated an identity as Americans. The learned coxcomb became a persistent foil in colonial commentary. An essay "From a late Paper" that appeared at mid-century in several colonial newspapers lectured on "the Esteem due to learned Men."[137] Though the "Learned" were "accus'd of Pride and Haughtiness" the essayist found such criticism unjustified. Moreover, he condemned mindless attention to hierarchy and the habit of holding the well-borne in high esteem, often for no other reason than their having had notable ancestors. "Study is the only true Way of knowing the World …It is a Means that is offer'd to a Citizen as well as to a Nobleman."

A different essayist wrote just the opposite in his letter a decade later. The lover of science "Philo Physicus" claimed that the "Pride and Arrogance" displayed by "Men of Learning" was to blame for the contempt and ridicule of the world. "They fancy the Modes of Education is the only Criterion for Knowledge." These scholars were nothing but "Pedant[s]", burdened with book learning yet lacking in sense. Physicus reprimanded the educated and assured them that their theories needed to be grounded in "Practice" and their "Knowledge" turned to service in the "Purposes of Life." What those purposes might be, Philo Physicus left unsaid.[138]

Another series of purported letters to the editor appeared in the *New-York Weekly Journal* arguing about just what sort of "Knowledge, and good literature … distinguishe[d] the true Gentleman from a trifling and affected Coxcomb."[139] The writer

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[137] *New-York Weekly Journal*, 22 October 1750; *Boston Post Boy* 3 December 1750.

[138] *New York Mercury*, 21 September 1761.

[139] *New-York Weekly Journal*, 13 February 1749.

was railing against "the various companies of Men, that collect themselves in to Weekly clubs, and Societies, in several parts of [the] City," and who by dint of their impertinent conversation, he deemed fools. A public letter addressed "To the Sage Philosophers, that have collected themselves into a Weekly Society, for the Promotion of usefull Knowledge, at the House of Mr. Cook, Tavern-Keeper," that appeared the following week may or may not have been intended for those self-same gentlemen.[140] Though the ostensible reason for the ridicule he heaped upon them was due to the writer's claim that the "Philosophers" eschewed "Religion and Superstition," it was also likely due to his conviction that they suffered from a "Want of Education." The writer left unstated in what particulars the "gentlemen" were wanting – humility, place, actual knowledge? – but like Alexander Hamilton, he mocked the club-going men both for their learning as well as their lack of it.

This conflict about the role of learning in creating either pedantic coxcombs or cultured people continued throughout the century. When the attorney William Paterson wrote in 1770 to his fellow Princetonian John Macpherson, Jr., Paterson gave some approval to the coxcomb, who could "trifle agreeably," an ability that Paterson declared would elude the "man of genius." Paterson admitted that the "school of … philosophy and science" was not where the coxcomb shone, but acknowledged his genius nonetheless. According to Paterson, a successful fop excelled in the world "of fashion and of folly," which required some "genius," just not of the scientific sort.[141] On the

[140] *New-York Weekly Journal*, 27 February, 1748/9.

[141] William Paterson to John Macpherson, Jr., 1 May 1770, quoted in W. Jay Mills, ed., *Glimpses of Colonial Society and the Life at Princeton College, 1766 – 1773* (Philadelphia: J.B. Lippincott Company, 1903), 75.

other hand, the attorney William Sullivan wrote in 1799 to a young friend and presented some hints towards attaining the manners of such a man.[142] Offering his opinions on the conduct of an educated gentleman, Sullivan urged his future charge to “learn many things to make you more useful and more agreeable.” The “kind of character” Sullivan urged Curtis to develop would be a pleasing blend of abilities and charm. Admittedly, Sullivan was offering advice to succeed in the business world, not the world of science. Nevertheless, his recommendation to combine learning with pleasing manners reflected one strain of thought that had been at work throughout the eighteenth century on the reciprocating relationship between the sciences and sociability, accomplishments in learning and in politeness.

The Belles Lettres Club of Federal New York was founded to promote precisely those principles and secure for its members the benefits of “social intercourse.”[143] Nonetheless, they soon found themselves nonplussed by such seemingly democratic impulses. One Saturday, the club debated whether “Females” should receive instruction in the “Sciences?”[144] Unfortunately, the recording secretary did not begin to list the “heads of argument” until the following year so we have no record of the points each side put forth. What is recorded is that the question was decided in the negative; even “Riker,” who had the charge of debating the point in the affirmative, voted against science education for women. Erasmus Darwin’s 1798 plan for “Female Education” skirted the issue somewhat by including “Arithmetic” with “Card Playing,” and inserting

[142] William Sullivan to Charles Curtis, 2 January 1799. Sullivan Collection. HEH.

[143] Minutes of the Belles Lettres Club. NYPL

[144] Saturday 10 August 1799, Minutes of the Belles Lettres Club, p. 77.

"Geography," and "Natural History" in the early stages of the curriculum, before moving on to the "Rudiments of Taste. Beauty. Grace."[145] However, in his section on "Arts and Sciences," Darwin recommended the study of "other sciences." These could serve as a source of "amusement," but also provide the foundation on which women would expand "their sphere of taste and knowledge." Darwin advocated for at least moderate female accomplishment in several sciences, including botany and chemistry, and recommended "attending lectures in experimental philosophy" in order to become familiar with "astronomy, mechanics, hydrostatics, and optics, with the curious addition of electricity and magnetism." In Darwin's view, such study would enable women to hold more appealing conversations, which in turn would make them more interesting to men. Why, then, would the sociably clubbable belletrists deny themselves the pleasure of better-informed conversationalists? A discussion the Club held few months later may give some insight: debating whether "natural abilities [were] more useful to the possessor than acquired knowledge?" the question "Carried in the Negative by a majority of two."[146] Acquired knowledge had utility and power, and by those very qualities sometimes generated conflict and drew complaints, especially when people grew concerned about who would deploy such learning and its attendant authority.

An education in the sciences thus improved more than a person's conversation; it also changed one's standing with the world. The listings in the New-York Directory, published in 1787, offer a glimpse of the challenge to the social order that proficiency in the sciences could pose, leading to conflicts between men and women, and among social

[145] Erasmus Darwin, *A Plan for the Conduct of Female Education in Boarding Schools, Private Families, and Public Seminaries* (Philadelphia, 1798), p.n.n. Section XV.

[146] 9 November 1799, Belles Lettres, p. 85. NYPL.

classes, especially artisans and gentlemen. The "New-York Society, for promoting useful Knowledge" was among the groups deemed worthy of inclusion in the Directory.[147] Its officers, listed in the Directory, were all elite men. The presidency, possibly an honorary position, was held by the governor, "His Excellency George Clinton, Esq.," but none of the other officers were drawn from the artisanal class, nor were they in any way employed in fields that entailed "useful Knowledge."[148] The Society was intended primarily as an institution for men of education to pursue their goals of advancing manufacturing and agriculture, without necessarily incorporating those orders of men who presumably would implement their plans. The group nevertheless notified the public of their meetings. We do not know whether the Society's meeting "at the Coffee-House, at six o'clock," and to which "every member [wa]s requested to attend" enjoyed a broad and general attendance.[149] However, the Society's public appeal at the same time that it limited its membership to an educated, elite cadre perpetuated conflict between artisans and gentlemen. Science, and its role in establishing the parameters of "useful Knowledge," remained contested ground.

As "Father Abraham Hutchins, Mathematician" observed in his almanac, "Men of noble birth are noted to be envious to new men when they rise: for the distance is altered; and it is like a deceit of the eye, that then others come on, they think themselves

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[147] New-York Directory by David C. Franks, (New York, 1787), 54. See also *Loudon's New-York Packet*, 13 July 1787.

[148] See Joseph F. Kett, *The Pursuit of Knowledge Under Difficulties: From Self-Improvement to Adult Education in American, 1750 – 1990* (Stanford, Calif.: Stanford University Press, 1994), 104 – 107 for a discussion of the elite intentions of the founders of this and other such societies.

[149] *Loudon's New-York Packet* 10 March 1789 and 9 June 1789 (the meeting began at 7:00 this night). Bradford's Coffee House was in the East Ward, on the southeast corner of Wall and Water Streets. See Thomas E.V. Smith, *The City of New York in the Year of Washington's Inauguration, 1789* (New York: Anson D.F. Randolph & Co., 1889), 200.

go back."[150] Through print media ranging from books, to newspapers, magazines, and especially almanacs, scientific instruction reached a broadening audience in the second half of the eighteenth century. Learned societies might grapple with the impulses of "Improvement" and the outward spread of the benefits of learning, but they did so without challenging the notion that education and improvement were, at bottom, elegant, gentlemanly pursuits. It follows that those who engaged in them would be, if not absolutely altered, amenable to the idea that they had been transformed by them.

[150] *Father Hutchins Revived; Being an Almanac … for the Year 1790*. NYPL

Chapter Four. "A School of Fashion and Philosophy"

Science was a perennial way for Americans to connect to the metropolitan culture of Britain. The circulation of things scientific – artifacts and observations from nature, apparatuses, technologies, and ideas – brought Americans at many levels of society into international scientific exchanges. These grew more frequent and more expansive as the eighteenth century wore on. At first, much of this interest reflected a provincial culture's dependence on the metropolitan centers of Europe; participating in scientific practices helped give Anglo-Americans assurance and poise, and promoted a self-conscious identity as Britons. However, from those efforts to join the international scene, Americans began to develop their own metropolitan culture. This involved intracolonial and international networks of communication, the examination as well as the exploitation of the natural world, and sociable intercourse designed in part to educate and amuse as well as to refine manners. Over the course of the century, the colonists increasingly deployed science not just to reinforce their cosmopolitan, British bonds but also to confirm and substantiate a distinct national status as Americans. In their greatest attempt to use science as a springboard into cosmopolitan and scientific maturity – examining the 1769 Transit of Venus across the face of the Sun – the colonists drew upon a century of this mixed scientific engagement. Since the Transit compelled them to observe, collect, and interpret data all at once, the colonists were able to move beyond the subservience that historically attended the less prestigious collection of raw material.

In their most ambitious effort to use science as a way to assimilate as Britons, they unwittingly launched themselves as Americans.[1]

The 1769 Transit of Venus capped an era of scientific involvement that Anglo-Americans had engaged with for decades in ways sporadic as well as purposeful.[2] From the earliest days of settlement, however, the colonists had used the natural bounty of the land around them, along with the perspective they enjoyed as inhabitants of the western hemisphere, to participate in transnational scientific ventures, to form associations with Britons and others on the Continent, and to insinuate themselves into the widening Republic of Letters emerging from the urban centers of Europe. Indeed, as early as 1680, an anonymous correspondent communicated to the Royal Society observations made "of naked eyes" at Boston as well as some made "with a brasse quadrant & telescope."[3]

American preparations for the observation of the 1769 Transit represented both the culmination of the colonies' century-long participation in an international scientific exchange, and the beginning of a new sense of identity reflecting the ideals of a more egalitarian culture. Science was a central component in that transformation. Observing the Transit, however, represented more than pure science, and it involved many people

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[1] The inherent tensions between those on the periphery doing the work of gathering and collecting and those in the metropolitan center doing the scientific, 'philosophical,' work of examination and explanation is treated in Ralph Bauer, *The Cultural Geography of Colonial American Literatures: Empire, Travel, Modernity* (New York: Cambridge University Press, 2003), esp. 15 – 29, 184 – 189. See also Raymond Phineas Stearns, *Science in the British Colonies of America* (Urbana: University of Illinois Press, 1970), 415, n. 52, for the disdain with which the Royal Society of London received colonial communications.

[2] Particularly in the realm of astronomy, the mid century was rife with remarkable phenomena that occupied American as well as European attention: the Great Comet of 1744, the return in 1758 - 1759 of the comet predicted by Edmund Halley, and the transits of Mercury across the face of the Sun in 1744 and 1753, and those of Venus in 1761 and 1769.

[3] "Observations of a Comet Made at Boston in New England, 27 December 1680." Materials Pertaining to the History of American Science; Letters and Communications from Americans, 1662 - 1900. Reel 1; frames 72 – 74. Classified Papers VIII (1) 33. APS.

from different levels of society, each with differing expectations, reflecting an ongoing tradition of American science that had always included a diverse group with equally diverse ambitions.

We can look at the correspondence of several colonials to see how provincial Americans had long sought to join the cosmopolitan world of science by offering eyewitness testament of natural phenomena. Thomas Banister wrote to the Royal Society of London early in the century about a "very remarkable appearance in the Skie" that had come into sight the previous summer.[4] This letter shows how some colonials employed the rhetoric of utility and advancement of knowledge to join the international world of scientific exchange. Writing from Boston, Banister forwarded to the Royal Society information of a marvelous "Ball of fire" observed the previous summer from Albany to New Haven, the particulars of which could only have come from multiple accounts pieced together carefully. The "Ball of fire" first rose "westward of Albany" and passed from "Horizon to Horizon" in the space of two minutes. It next was reported as appearing to the "people of New Haven and the Sea Shore" but was soon "lost in the Ocean." From its first appearance at Albany to the time it dipped below the horizon east of New Haven, "was but a few minutes … but above 150 miles." This happened at "the Dusk of Evening," but in the morning "glistening particles of the Sand" were discovered in the "Streets and roads, and Pines" where the orb had passed. Whether or not one had been an eyewitness, the description and its physical traces connected everyone with its evidence. When a "Streak or Ball of Fire" was seen and "a terrible Noise heard in the

[4] Thomas Banister to John Chamberlayne, 1 January 1711. Materials Pertaining to the History of American Science; Letters and Communications from Americans, 1662 – 1900; Reel 1; frames 291 – 293. Letter Book B. 2. 65. APS.

Air" along a 100-mile swath of Connecticut, printed accounts of the "extraordinary phaenomenon" asked that anyone with information about its "appearance in other parts" communicate it to the "Publick" via the newspapers[5]

Thomas Robie's commonplace book carries a copy of a letter underscoring the international nature of the cooperation sometimes needed to collect and transmit such eyewitness reports.[6] Matthew Wright, of Cheshire, offered himself in 1713 or 1714 as intermediary between Robie (who was by then a tutor at Harvard) and Mr. Derham, "one of ye oldest Members of Our Royal Society." Wright sent Robie observations of "two Eclipses" and encouraged him to reciprocate with "good Observations" he had made, safe in the knowledge that they would be "carefully communicated to ye Royal Society." By the time Robie's communications were actually read to the Royal Society, no mention was made of whether he was still employing an intermediary to communicate with them.[7]

Many colonists who corresponded with the Royal Society made use of a motley crew of witnesses. Paul Dudley's account to the Royal Society of the aurora borealis lamented that his "Informers (not being Curious Persons) were uncertain as to the number" of streams of light emitted, but fortunately an "ingenious Country man … who got up at the first appearance of this light supposing it to be day" was able to supply him

[5] *The New-York Weekly Journal*, 27 December 1742.

[6] Thomas Robie, Commonplace Book 1714 -1 717, Massachusetts Historical Society, Boston.

[7] Thomas Robie, "Observations of the Eclipse of the Moon on January 28, 1731/2." Materials Pertaining to the History of American Science; Letters and Communications from Americans, 1662 – 1900; Reel 6; frame 3376. Register Book C. 16. 181 – 2. APS.

with more accurate information.[8] The aurora borealis must surely have been a topic of conversation among all sorts of people, and one not necessarily regarded only as a link to the burgeoning scientific community. When an *“Aurora Borealis* which lasted the greater part of the Night” appeared over Rhode Island, distinguished by a “most Beautiful Bow … about the colour of a Rainbow of the Moon,” the printed account was published immediately in other colonies.[9] But with Dudley’s account, and Richard Lewis’s as well, we begin to get a sense of the flow of conversation and information intrinsic to these events. Lewis reported to the Royal Society that the people of Annapolis were, “Entertained with a Phenomenon … as was never observed before .” As Lewis reported that they found the aurora borealis very “surprising,” it follows that conversations about it must have been general.[10] Isaac Greenwood gave an account of the same aurora borealis to the Society, observing that its beauty was such that “the generality” of people would remember it.[11] Lewis further communicated to his London scientific correspondents about other astronomical occurrences that seemed worthy of note, recounting the observations of “Doctor Sam’l Chew att Maidstone,” who shared

[8] Paul Dudley, “A Short Account of the Aurora Borealis 27th March 1726 at Roxbury in New England.” Materials Pertaining to the History of American Science; Letters and Communications from Americans, 1662 - 1900. Reel 1; frames 428 – 432. Letter Book, D. 1. 91. APS.

[9] *Pennsylvania Gazette*, 18 August 1737. The account had appeared in a “Rhode-Island” paper the previous week.

[10] Richard Lewis to Peter Collinson, 10 December 1730, “Account of an Aurora Borealis on October 22, 1730.” Materials Pertaining to the History of American Science; Letters and Communications from Americans, 1662 - 1900. Reel 1; frames 10 – 12. Classified Papers, IV (2) 4. APS. Read March 4, 1730/1. Printed in *Phil. Trans*. 37, (1731-1732): 69 – 70.

[11] Isaac Greenwood, “Account of an Aurora Borealis seen in New England on 22 October 1730.” Materials Pertaining to the History of American Science; Letters and Communications from Americans, 1662 - 1900. Reel 2; frames 481 – 500. Letter Book G. 2. 10. APS. Printed in *Phil. Trans.* 37, (1731-1732), 55 – 69.

the news of "several Spots in the Sun" he had observed for "some Days past at Morning and Evening … with his Naked Eye."

Such daily interactions of the like-mind leave few traces yet we occasionally catch glimpses of those generally unrecorded conversations and contributions. Peter Collinson wrote to the Philadelphia doctor John Kearsley, and enclosed the *Philosophical Transactions* (the publication of the Royal Society) for July and August of 1738. Kearsley promised to deliver them "(as advised) to the Person from whom I had the conversations made on the Eclipse of the Sun, and on the Comet which appeared here in March 1736/7." Both Kearsley and "the Gentleman" (whose identity is not disclosed either in this letter or the report in the *Transactions*) took "no small satisfaction" from its publication," which gratified their "desires … of pleasuring some curious Gentlemen."[12] But the conversation and the publication of their efforts to transcribe that which they had seen did more than pleasure the fellows of the Royal Society – they also "advanced" the "curious study of Comets" and helped bring about "some Certainty" on meaning and impact on the "Solar System."[13]

Though it would be a stretch to say that everyone in colonial America could or would contribute their observations to the discussions of the Royal Society, many people did take the opportunity to report on their natural surroundings. Indeed, the Society received correspondence from both 'commissioned' agents, such as Robie and Dudley,

[12] "Observations upon the Comet seen in January and February 1736-7, and of an Eclipse of the Sun. Feb. 18 1736-7. made at Philadelphia in Pensylvania, inclosed in a Letter from Dr. Kearsly to Mr. Peter Collinson, F.R.S.," in "A Collection of Observations …" in *Philosophical Transactions* XL. no. 446, (1737 – 1739): 111 – 123; 119-120.

[13] John Kearsley to Peter Collinson, 16 July 1739, "A Letter … concerning the Virginian Rattle Snake Root & American Ginseng, with notice of the appearance of a late Comet." Materials Pertaining to the History of American Science; Letters and Communications from Americans, 1662 – 1900. Reel 7; frame 3699. Letter Books. 26. 393-8. APS.

as well as others with no evident connections to the Royal Society. Friends and strangers alike conveyed their sightings of astronomical oddities, either for inclusion in the *Philosophical Transactions* or just to be read at the Society's meetings.

By no means were these communiqués always intended to be instructive, though many were. (And, of course, not all concerned astronomy.) Isaac Greenwood, professor of mathematics at Harvard, was enough inspired by the Royal Society's "generous Principle of promoting Natural Knowledge" he took to be at the heart of their mission that he dared to send along "some few imperfect Thoughts," flattering himself that they might be "new and uncommon." He left it up to James Jurin, secretary of the Society, to decide whether they would be of any help to the "Promotion of Physical Knowledge," and if he found them so, Greenwood was confident Jurin would "improve them in such a manner as that they may become most useful." It was that very hope of having his work improved by Jurin – in other words, by collaborative effort – that persuaded Greenwood to write to him and not "any other of my Friends in London."[14]

Some correspondents, such as Yale College president Thomas Clap (designer of the first American orrery), suffered keen pangs of provincial self-consciousness about the colonists' inability to equal the British "in making Observations of the heavenly Bodies."[15] At least so he claimed. Although Clap employed a discourse of inequality, he did so while communicating his own astronomical observations and what he termed

[14] Isaac Greenwood to [James Jurin], 10 May 1727. Materials Pertaining to the History of American Science; Letters and Communications from Americans, 1662 – 1900. Reel 2; frame 471 – 473. Letter Book G, 2.8. APS.

[15] Thomas Clap to C. Mortimer, rec'd 4 April, 1744. Materials Pertaining to the History of American Science; Letters and Communications from Americans, 1662 – 1900. Reel 3; frames 1066 – 1067. Letters and Papers I. 7. 296. APS.

some "imperfect Accounts from an Infant-College" in imitation of the "Example of our Mother Country." Clap certainly was concerned with the difficulties under which his "Infant College" labored, having "no kind of Instrument adapted" to the needs of genuine astronomy.[16] "Yet even "under these Disadvantages," Clap "tho't it Convenient to make the best Attempt that he could" of observing "Heavenly Bodies." Using the common instruments he had at hand, he made his observations and sent them to London.

While Clap presented himself, and his circumstances, in an inferior light – asking Mortimer's indulgence if Clap had mistaken his title as secretary to the Royal Society, expressing doubts that he would receive the "Favour of an Answer" – Clap was also keen to make his own metropolitan connections clear. *Should* Mortimer choose to write to him, the letter could be left with the "Rev. Dr. Watts," author of a well-known astronomical text, and a reputedly a regular correspondent of Claps's.[17]

Martha Gerrisk, on the other hand, a well-born Massachusetts woman and the sister of Governor Jonathan Belcher, admitted to no such embarrassment when venturing to make her own astronomical observations. She sent not one but two drawings of a "Parhelia" to her brother, as she judged the first to be "Imperfect." Though she did not outright request that Belcher forward her illustrations to the Royal Society, she hinted at the appropriateness of the Society receiving this second, perfected copy. Gerrisk "Flatter[ed her]self that this is as Exact a Draught as can be taken." She could have that

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[16] Thomas Clap to C. Mortimer, 1 April 1744. Materials Pertaining to the History of American Science; Letters and Communications from Americans, 1662 – 1900. Reel 3; frames 1069 – 1072. Letters and Papers I. 7. 308. APS.

[17] Isaac Watts, D.D., *The Knowledge of the Heavens and the Earth made easy: or, The First Principles of Astronomy and Geography Explain'd by the Use of Globes and Maps; with a Solution to the common Problems by a plain Scale and Compasses as well as by the Globe* (London, 3rd ed., 1736).

confidence because she claimed to be comparing her own illustration to one in her possession "drawn by a person skilled in Astronomy." Indeed, she was hurrying to send hers to Belcher rather than run the risk of being "forestall[ed]" by someone else. Gerrisk, suffering from none of the insecurities that seemed to plague Thomas Clap, assured her brother that had her illustrations come "from a Masculine hand," she was convinced they "would be an acceptable Present to the Royal Society."[18] Belcher did send the drawings and they were duly entered in the Society's letter book, though not without a persnickety inquiry by one Henry Newman as to their fitness for "cognaisance" by the Society, the parhelion being "a Phaenomenon less seen in England than there."[19] Newman quibbled with several points made by Gerrisk, including the parhelion's "Square" representation. He added as well his own "wonder at its appearance in the Morning" rather than the time he had seen one during his stay at New England, "in the Afternoon about 3 or 4 o'clock." Rarity usually lent a premium to colonial communications, and in fact the letter and illustrations were shared with the Society on 30 March 1734, despite their feminine provenance.

An interest in astronomy was shared as well by ordinary people who found ways of recording their impressions of celestial incidents. John Coppock documented in his commonplace book a report from the fort near "Annapolis Royal" detailing a "Darkness which visibly increased as the Sun approached over the Meridian" such that "they were

[18] Martha Gerrisk to Governour Belcher, 24 December 1734. Materials Pertaining to the History of American Science; Letters and Communications from Americans, 1662 – 1900. Reel 2; frames 501 – 504. Letter Book G. 2. 37. APS. A parhelion is an optical illusion produced by sunlight passing through ice crystals in the upper atmosphere, suggesting a double sun.

[19] Henry Newman to Cromwell Mortimer, 19 March 1734/5, in Martha Gerrisk to Governour Belcher, 24 December 1734. Materials Pertaining to the History of American Science; Letters and Communications from Americans, 1662 – 1900. Reel 2; frames 501 – 507. Letter Book G. 2. 37, APS.

obliged to Light Candles all over the Fort[;] as there was no possibility of an Eclipse at that Time, Some of them believed it was the LAST DAY."[20] Though the superstitious people were roundly "Ridicule[d]" for their credulity, near a fortnight later not even the "greatest Libertine" among them was reassured that the end of days had not arrived. That people from many different stations in life believed astronomical phenomena unusual and interesting, suitable topics of conversation, and objects of enjoyment and education seems clear. How they were to be interpreted remained an open question.

Astronomy in particular presented expansive opportunities to any who chose to explore its mysteries. Long linked to various types of improvement, civic as well as personal, astronomy connected as well to amusement and refinement. Certainly, it was the most public of the new sciences, and conversations about celestial phenomena circulated in myriad ways: through almanacs, which kept readers informed of expected eclipses, regardless of their visibility in the colonies; in newspapers, which printed news of heavenly apparitions in all the colonies and provided a public forum for recreational astronomers; in printed science books imported in ever-increasing amounts from England; through observation of and practice with newfangled instruments which perhaps by their very scarcity, called forth great public interest; and schools of all types that taught astronomy to any able to pay the tuition.

Astronomy not only had utility in colonial America, it also had cachet. Closely linked to geography, astronomy had long been an arrow in the gentlemanly quiver of skills. Writing on the "Principles of Geography and Astronomy," Lieutenant Colonel

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[20] Entry dated 17 October 1733. John Coppock and others, Commonplace books. NYPL. Although there was an Annapolis Royal in Nova Scotia, this fort was more likely in Maryland.

Edward Antill addressed himself to a companion with a "studious Turn" and a "Laudable thirst, after mathematical Knowledge," a prerequisite to astronomical learning. Antill, making use of his time while held a prisoner of war in New York, made no "Panegyric" to mathematics, its "Excellency, & Usefullness" having already been "Ellegantly Describ'd." But, as he assured his correspondent, "[e]ven a moderate investigation … very Richly pays, the pains to Acquire it: It Harmonizes the Ideas, strengthens the Reason … and Corrects the Manners."[21]

Anthony Lamb's 1755 engraved broadsheet advertising his shop "at S^{r}. ISAAC NEWTON'S HEAD" is an instance of the ways in which the material objects of scientific pursuits circulated in appearance as well as reality, and how that transmission worked in tandem with the ideals of high intellectual pursuits and elegant fashion.[22] Lamb was a skilled engraver, trained in London, and had a highly specialized, and quite rare, set of skills as one of the only makers of mathematical instruments in America at the time.[23] Lamb's broadsheet listed all his wares, from the latest Godfrey's Quadrant to "all sorts of Mathematical Instruments, for Sea and Land, in Silver, Brass, Ivory or Wood." Not only were Lamb's instruments of the highest quality, particularly those made of brass or silver – exceedingly rare metals in the colonies – so too was the broadside Lamb devised. American tradesmen, like their British counterparts, regularly used trade cards as a means of advertising, and these often included distinguishing and identifying symbols or

[21] "Principles of Geography and Astronomy," 1780, Edward Antill Papers. HSP.

[22] Only one copy of Lamb's broadside is known to exist, in the collections of the New-York Historical Society. It is reproduced in Early American Imprints, Series 1, no. 40759, and also in Bedini, *infra*.

[23] Silvio Bedini, "At the Sign of the Compass and Quadrant: The Life and Times of Anthony Lamb," *Transactions of the American Philosophical Society* 74, no. 1 (1984): 1–84. Lamb had been transported to Maryland as a result of criminal behavior in London. He settled in New York once his term of indenture ended.

illustrations. Lamb's broadside, however, is exceptionally ornate. Done in the highest Chippendale manner, featuring elaborate rococo scrolls and borders, adorned with acanthus leaves and floral arrangements, it provided not only advertising for Lamb, but another way for his instruments to circulate in elegant fashion.

The way in which Lamb identified his shop over the years tells a bit of that story. His earliest shop was distinguished with a "Compass and Quadrant." When Lamb moved in 1745, he advertised that his instruments were for sale "At the Sign of the Quadrant and Surveying Compass," making clear that he offered computational instruments for land as well as sea. By 1750, however, although Lamb did not change the location of his shop, he did change his sign. From then on, Lamb's shop, as well as his broadside, featured an elegant bust of "Sir Isaac Newton's Head."[24] Charles Walpole, Lamb's first competitor in New York, who promised to manufacture or mend "All sorts of Mathematical Instruments, either in Silver or Brass," made sure to announce he also was a "Citizen of London," where he presumably had trained.[25] The imprimatur of the London connection provided an implicit endorsement of the quality of Walpole's work, but his shop – "at the corner of Wall-Street" – did not enjoy the prestige that came from association with the foremost mathematician of his age and one of the greatest scientific minds of all time.

Theophilus Grew, a Philadelphia mathematician, emphasized just such advantages as those stated outright by Antill and implied by Lamb, when he promoted his own services. "Mathematical Learning," he assured readers of the *Pennsylvania*

[24] Bedini, "At the Sign of the Compass and Quadrant," 34.

[25] *New-York Evening Post*, 2 June 1746.

Gazette, was "generally pursued by the Gentry and those of the first Rank, as a necessary Qualification."[26] With the aid of his "Globes … and other Instruments for the Mathematical Service," he held classes during the "Winter Season," teaching "*Gentlemen*" those subjects best suited to polite learning. Charles Fortescue emphasized exactly this advantage to taking lessons from him, inasmuch as he taught "the Gentleman's astronomy."[27] Mr. Alison made no pretense of teaching only gentry, although his lessons certainly were imbued with gentility: at his "Free-School … all Persons [might] be instructed in the … Parts of Polite Learning" at no cost.[28] More and more colonists could pursue a cosmopolitan education. Encompassing more than science but relying on its assumptions, it combined the rigors of mathematics and science with the niceties of languages and literature to yield judgment, taste, and discernment.

The growth of print media beginning in the 1740s opened up an avenue for scientific discussion to a broader audience beyond the limited world of private correspondence with the Royal Society. Almanacs, newspapers and magazines also provided vehicles from which to circulate information and intelligence of celestial happenings everywhere. Colonial papers regularly carried on a readers' science correspondence, and frequently featured news and commentary about comets, which always engrossed colonists' attention. Via the mediation of print, readers could join the coterie of learning and debate surrounding the new sciences; astronomy above all other

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[26] *Pennsylvania Gazette,* 26 October 1738 and 20 September 1744.

[27] *Pennsylvania Gazette,*6 December 1743

[28] *Pennsylvania Gazette*, 24 November 1743.

disciplines appealed to men of varied interests.[29] Astronomy, and the mathematics on which its knowledge was built, was a suitable pastime for an educated cadre, but it also drew adherents from other, more crassly commercial spheres. Just as much as the development of pristine science, global trade and expanding commercialization depended on knowledge. When the dispatches from London brought news of a "Cadaioptrical" telescope, invented by the Reverend Mr. Hardy, and "sufficient to render the eclipses, occultations, etc. of Jupiter's satellites visible," the short telescope was immediately seen as a good fit for shipboard use and its invention a "solution of that grand problem, to determine the longitude.…"[30] The need for science to be applied concretely could not have been more clear. Such uses brought science into worldly discussion and consideration for practical, commercial applications.

The interest in science went beyond astronomy as well. Indeed, the curious could be found at all levels of society, concerned with the improvements possible from a variety of scientific subjects. Writing at mid-century to the Connecticut physician, clergyman, and agronomist Jared Eliot upon the receipt of 12 essays on husbandry, Benjamin Franklin detailed a varied cast of characters whom he counted among the "curious," a group more expansive than most observers of the early American scientific scene ordinarily acknowledge.[31] Brooke Hindle, the canonical historian of American science, judged American agriculture to be "in dire need of improvement," and asserted

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[29] I use 'men' advisedly and I am very keen to learn more about the Miss Polly Norris whose "large refracting telescope" was borrowed by the APS in order to outfit "Dr. Williamson" for the 1769 transit. 20 May and 16 June, 1769, *Early Proceedings of the American Philosophical Society… from the Manuscript Minutes of its Meetings from 1744 to 1838* (Philadelphia: McDalla & Stavely, 1885).

[30] *The New-York Gazette, Revived in the Weekly-Post Boy*, November 16, 1747.

[31] Benjamin Franklin to Jared Eliot, 12 September 1751, *Papers* 4:192a.

that as late as 1775, the only agricultural "experimentation was done by enlightened individuals," chief among them Thomas Jefferson.[32] Certainly, Eliot himself has long been regarded as among the best of the few "gentlemen farmers" on the American scene, and he was one of the very few actually to publish his views on agricultural improvement prior to the American Revolution.[33] His works on soil management and crop production (among other essays on agronomy) were hugely popular and the best-known of any treatises on agriculture published in the American colonies.[34]

Franklin's letter shows that the universe of "enlightened individuals" comprised more than the predictable luminaries listed by Hindle. Recommending the English naturalist Peter Collinson to Eliot, Franklin praised his English friend as "very curious in Botany and other Branches of Natural History, and fond of Improvements in Agriculture, &c." Franklin reassured Eliot that Collinson would be "pleas'd with your Acquaintance." To see Collinson called out for his interests in the natural sciences was only to be expected. However, Franklin also included among the "curious" his "Ingenious Acquaintance … Mr. Hugh Roberts, one of our most curious Farmers." In Hindle's view, Roberts, although politically influential, had no more than "a passing acquaintance with science."[35] Franklin held a different a view. Franklin wrote that he was "persuading" Roberts to send Eliot "such Hints as … may give you farther Insight into that Matter." Although Roberts "greatly esteemed" Eliot's writing, the "curious

[32] Brooke Hindle, *The Pursuit of Science in Revolutionary America, 1735 – 1789* (Chapel Hill: The University of North Carolina Press, 1956), 194 – 195.

[33] Hindle, *Pursuit of Science*, 33.

[34] Jared Eliot, *Essays upon field-husbandry in New-England, as it is or may be ordered* (Boston, 1760).

[35] Hindle, *Pursuit of Science*, 130.

Farmer” in him found some of Eliot’s methods of land reclamation to be embryonic. Notwithstanding Eliot’s supposed need for schooling in the “Improvement of Swamps and Meadows,” Franklin assured Eliot that “in other Respects,” Roberts held Eliot’s work in high regard, and far “preferable to any thing of late Years publish’d on that Subject in England.” According to Roberts, the English only imitated, rarely offering anything “new or useful,” whereas Eliot grounded his work in experimental science: he “collected Experiences, and Facts,” and so his “Propositions” were both “reasonable and serviceable.”[36]

Botany was thus as instrumental as astronomy in connecting the colonies to the metropole.[37] As early as the middle of the sixteenth century, the London Company had begun to urge the Virginia colonists to analyze “divers trees, whose virtues wee are yet ignorant” for “Medicinall liquor and Balsomes .”[38] And when, nearly 100 years later, the English naturalist Mark Catesby included a description of the sassafras tree in his *Natural history of Carolina*, he assured his readers that its “virtue” was so “well known, as a sweetener of the blood” that he thought only to add a notice about its use by

[36] Benjamin Franklin to Jared Eliot, 12 September 1751, *Papers* 4:192a.

[37] Indeed, the majority of the scientific work done in the Americas pertained to the natural history of its flora and fauna. See Raymond Phineas Stearns, *Science in the British Colonies*, 75 and *passim.* A trinity of Spanish authors – Oviedo, Mondardes, and Acosta – treated the natural history of the New World. These three were immensely influential in their own day and still serve as foundation to the literature of the New World’s natural history. Gonzalo Fernández de Oviedo y Valdés, *The Natural History of the West Indies*, trans. Sterling A. Stoudemire (Chapel Hill: University of North Carolina Press, 1959; Nicolás Monardes, *Joyfull Newes out of the Newe Founde Worlde* …, ed. Stephen Gaselee (New York: A.A. Knopf, 1925). José de Acosta *The Natural and Moral History of the Indies* …, ed. Clements R. Markham, 2 vols. (New York: Burt Franklin, 1964).

[38] Edward Williams, *Virgo Triumphans: Or, Virginia richly and truly Valued* … (London, 1650), quoted in Stearns, *Science in the British Colonies*,76.

Virginians as an effective antipyretic.[39] Catesby took care to include his opinion on its fitness for cultivation in England, some specimens having survived the "cold of several winters" at "Mr. Collinson's at Peckham." In his work on the flora of the Carolinas, the New Jersey landowner and politician Daniel Coxe emphasized the region's agricultural plants more than did Catesby, with a chapter devoted expressly to "the useful Animals, Vegetables, Metals, Minerals, and other rich and valuable Commodities," including grapes and maize.[40] Though couched largely in therapeutic terms, these sorts of encouragements were nonetheless meant to advance commercial, as well as scientific, interests. Too often, the modern observer – burdened with notions about the ostensible purity of science – disdains such mixed intentions.[41]

Knowledge about nature, received from whatever source, was regarded as worthy of transmission to the Royal Society. A correspondent writing from Jamaica sent in a requested report on the "Soap berry" but since he had not "yet got any tolerable Satisfaction," he included news about other, as yet-unexplained, local plants. In particular, this Mr. Traill wrote about "another thing in this Country, which is of the Vine kind, called Clap and Cure" by some but "Chaw Stock" by others, and which he believed might have had properties much like the sought-after soap berry. This plant had multiple applications, as the "Negroes" used it to "clean their Teeth with, and frequently to cure a simple case of Gonorrhea." When "bruised and beat up in warm

[39] Mark Catesby, *The natural history of Carolina, Florida, and the Bahama Islands: containing the figures of birds, beasts, fishes, serpents, insects, and plants…*, 2 vols. (London, 1731 - 1743), 1:55.

[40] Daniel Coxe, *A Description of the English Province of Carolana* [sic] (London: Olive Payne, 1741).

[41] In fact, Stearns makes precisely that point in *ibid.* n. 60, p. 76, writing about one tract that it was "a promotion pamphlet with purple passages. The company's interest was clearly commercial, only incidentally scientific."

water," this plant lathered well enough to shave with. Since the plant gave no evidence that it bore a berry, it might not be the elusive "Soap berry" the Royal Society wanted to learn about. Nonetheless, this correspondent promised to continue his research into the plant .[42]

Eleazer Phillips wrote unprompted to the Royal Society from South Carolina, informing them that there were "Drugs groing" near Charleston that far exceeded some standard remedies to cure "all agues & feavors & other Distempers … much Better with Safety." So important did Phillips consider this news that had already written to the Georgia Trustees, asking them to share the word with the Royal Society and the College of Physicians in London. Since Phillips had never before corresponded with the Royal Society, and was not personally acquainted with any of its members, he believed "Brigadier Generall Ogelthorp & Capt. Thomas Coram" would be able to give his bona fides.[43] The Society clearly felt this news had merit, as Phillips' letter was read to the Fellows.

William Sherard submitted to the Royal Society his hearsay account of a poison tree, having learned of it "from Mr. More – which probably he had from Mr. Dudley ."[44] Paul Dudley wrote a similar account to the Royal Society about that "Poyson Wood

[42] James Traill to Phillip Miller, 1 July 1737, "A Letter from Mr. Traill to Mr. Phillip Miller, concerning the Soap berry … and other Jamaican Plants." Materials Pertaining to the History of American Science; Letters and Communications from Americans, 1662 – 1900. Reel 7; frame 3631. Letter Books. 24. 25-7. APS.

[43] Eleazer Phillips, 8 May 1745, "Of drugs growing near Charleston, S.C. better than Jesuits' bark." Materials Pertaining to the History of American Science; Letters and Communications from Americans, 1662 – 1900. Reel 3; frames 1096-1099. Letters and Papers I.9.418. APS.

[44] "A Farther account of the same Tree by William Sherard," no date. Materials Pertaining to the History of American Science; Letters and Communications from Americans, 1662 – 1900. Reel 6; frame 3363; Register Book 11. 129 – 130. APS.

Tree" and his report – with only a descriptive account and missing all of the botanical classification found in Sherard's report – not only was read to the Society, but published in the *Transactions* as well.[45] Dudley, elected a Fellow of the Royal Society in 1721, made no claims to any botanical knowledge, yet his reports to the Royal Society often incorporated extremely useful horticultural information, especially ways in which the natural products of the region could be turned to commercial profit.[46]

The Boston surgeon Zabdiel Boylston had his opinion solicited by the Royal Society, on the supposed curative powers of that rattlesnake root. Unfortunately, Boylston was unable to send "any tolerable account of the Antidote or Cure" as he claimed that the twin pressures of business and ill-health had prevented him from making "but few Experiments that way."[47] The Germantown physician Christopher Witt also found himself brought into the London conversations about the alleged healing powers of the rattlesnake root. Peter Collinson requested some of Witt's "instances of [his] own knowledge" of the curative powers of the root, for the benefit of those skeptical "London Physicians" who expressed "doubt if ever the Bite of a Rattlesnake

[45] Paul Dudley, "On the Poyson-Wood tree in New England, Boston." Materials Pertaining to the History of American Science; Letters and Communications from Americans, 1662 – 1900. Reel 1; frames 131 – 133; Classified Papers 10 (1) 45. Read 16 March 1720/21. APS. Paul Dudley, John Chamberlain, "An Account of the Poyson Wood Tree in New-England …," *Phil. Trans.* 31, no. 367 (1720 – 1721), 145 – 146.

[46] Paul Dudley, "Description of evergreens." Materials Pertaining to the History of American Science; Letters and Communications from Americans, 1662 – 1900. Reel 7; frame 3400. Register Book 19. 370-85. APS. Frederick E. Brasch, "The Royal Society of London and its Influence upon Scientific Though in the American Colonies," *The Scientific Monthly* 33 (October - November, 1931): 336-355, 448-469.

[47] Zabdiel Boylston to Cromwell Mortimer, 17 December 1737, "A Letter … accompanying a Specimen of the Cedar Balsam ." Materials Pertaining to the History of American Science; Letters and Communications from Americans, 1662 – 1900. Reel 7; frame 3636. Letter Books. 27. 180-81. APS.

can be cured."[48] Witt provided instances of two successful cases taken from his own thirty years' experience with the plant. So too was the Philadelphia doctor John Kearsley invited by Peter Collinson to venture his opinions on the "virtue & good effect" of the rattlesnake root. Kearsley had never seen the root in his "Province," and he made clear that there existed no consensus about it. "Persons of seeming Judgment speak differently of its use, particularly Men of our Profession."[49]

The Royal Society was always eager to receive exceptional natural specimens from abroad. The Earl of Dartmouth, British Secretary of State for the Colonies from 1772 to 1775, received a request from the Royal Society early in his tenure to "procure for their use the more uncommon natural Productions of his Majesty's Dominions in America." These were highly valued throughout Europe. Several years later, Dartmouth was asked to secure the King's permission for the Royal Society to send "a collection of natural Productions of North America …to the King of Spain."[50]

Jane Colden, Cadwallader Colden's daughter and an expert botanist in her own right, similarly situated herself at the center of collective scientific practices when she recorded the botanical habits of both the common people as well as the Native

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[48] Christopher Witt to Peter Collinson, 24 March 1738/9, "A Letter … concerning the virtues of the Rattlesnake Root ." Materials Pertaining to the History of American Science; Letters and Communications from Americans, 1662 – 1900. Reel 7; frame 3692. Letter Books. 26. 378-81. APS.

[49] John Kearsley to Peter Collinson, 16 July 1739, "A Letter … concerning the Virginian Rattle Snake Root & American Ginseng, with notice of the appearance of a late Comet." Materials Pertaining to the History of American Science; Letters and Communications from Americans, 1662 – 1900. Reel 7; frame 3699. Letter Books. 26. 393-8. APS.

[50] 12 December 1772, Earl of Dartmouth to R.S. Materials Pertaining to the History of American Science; Letters and Communications from Americans, 1662 – 1900. Reel 7; frame 3000. Miscellaneous Manuscripts. 3.73. APS. 1 March 1774, Dartmouth to [Royal Society]. Materials Pertaining to the History of American Science; Letters and Communications from Americans, 1662 – 1900. Reel 7; frame 3003. Miscellaneous Manuscripts. 3.74. APS.

Americans in her region. Jane Colden learned from her father how to classify and describe plants according to the Linnaean system, and she went on to catalogue more than 300 species of plants in and around her family's holdings in the Hudson Valley of New York.[51] For that catalogue, however, Jane Colden consulted not only books and botanically experienced visitors to her family's farm, but also discussed local flora with the local "Country People" and the indigenous peoples as well.[52] She wrote of the "Mountain Mint" that the "Country People here make a Tea of the Leaves and use it for pain or sickness at their stomach." When describing "Gold Thread," Colden attributed her knowledge of it to "their" frequent use of a "Decoction" made from the "Leaves & Roots," and used as a cure for "Sore Throate" and also "the Canker." The "Indians" made a "Decoction of the Bark of the [Prickly Ash] & use it for long continued Coughs, & likewise the Dropsy." The "Spicewood … Bark, Leaves & Berries" were all utilized by the "Country People in the Stead of spice in Cookery."

Sarah Callister, an educator in Maryland, also kept a record of the botanicals useful in medical treatment. In some instances, however, the information was received at second-hand, as in the "decoction" of the "Beach Tree" nut, useful for an "expeditious cure for wounds … for burning or scalding; as well as a restorative" for frostbite."[53]

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[51] Jane Colden, *Botanic Manuscript of Jane Colden, 1724 – 1766, (*New York: The Garden Club of Orange and Dutchess Counties, 1963). This is a reproduction of 57 illustrations and descriptions taken from the original manuscript, which is held by the Botany Library at the Natural History Museum in London. See also Sara Stidstone Gronim, "What Jane Knew: A Woman Botanist in the Eighteenth Century," *Journal of Women's History* 19, no. 3 (Fall 2007): 33 – 59 and Mary Harrison, "Jane Colden: Colonial American Botanist," *Arnoldia* 55, no. 2 (Spring 1995): 18 – 26.

[52] Colden, *Botanic Manuscript*, 20. See Gronim, "What Jane Knew," notes 74 and 75, for a full list of plant descriptions attributed to natives and unlettered common people in the botanical works of both Cadwallader Colden and Jane Colden.

[53] Correspondence of Sarah and Henry Callister, 1741 – 1780. Callister Papers from Maryland Diocesan Library Collection,Volume IV, pp. 655 – 869: p. 854. NYPL.

This knowledge was attributed to "G. Carver, account from the Indians." The utility of the "Yellow Ash … in dying yellow" and the "fiery taste like pepper" of the berry of the "Prickly Ash" also were said to be "highly esteemed by the natives." Mrs. Callister made a note that she had already "mentioned one instance of its efficacy" in treating "a Veneral disorder."

Native botanical knowledge had of course long been at the heart of transatlantic communications from the Americas.[54] When the Maryland doctor Richard Hill wrote to the Royal Society secretary, "doctor Mortimer," with a description of the "medicinal qualities of the Jerusalem Oak and Throatwort," Hill made sure to identify the Throatwort as "an Indian Remedy, & by them used almost universally."[55] Peter Collinson wrote to the New York naturalist Cadwallader Colden that "Mr Girle a very Eminent Surgeon has read in the History of N. England perhaps by Cotton Mather to the Royal Society than an Herb by the Indians Nam'd Tautrittipang was a Sovereign

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[54] See Londa L. Schiebinger and Claudia Swan, eds., *Colonial Botany: Science, Commerce, and Politics in the Early Modern World* (Philadelphia: University of Pennsylvania Press, 2005). Also, Daniela Bleichmar, "Atlantic Competitions: Botany in the Eighteenth-Century Spanish Empire," in James Delbourgo and Nicholas Dew, eds., *Science and Empire in the Atlantic World* (New York: Routledge, 2008): 225 – 252; Daniela Bleichmar, "Exploration in Print: Books and Botanical Travel from Spain to the Americas in the Late Eighteenth Century," *Huntington Library Quarterly* 70, no. 1 (2007): 129 – 151; Roy Macleod, ed., *Nature and Empire: Science and the Colonial Enterprise, Osiris*, 2nd series, 15 (2000); Elaine M. Norman, *André Michaux in Florida: An Eighteenth-Century Botanical Journey* (Gainesville: University Press of Florida, 2002); Londa Schiebinger, *Plants and Empire: Colonial Bioprospecting in the Atlantic World* (Cambridge, Mass.: Harvard University Press, 2004).

[55] Richard Hill to [Cromwell] Mortimer, 8 March 1735/6, "A Letter from Doctor Richard Hill to Doctor Mortimer, concerning the medicinal qualities of the Jerusalem Oak and Throatwort." Materials Pertaining to the History of American Science; Letters and Communications from Americans, 1662 – 1900. APS.

Remedy for the French Disease. Desires some Intelligence about It."[56] Things scientific were useful tools in the cosmopolitan as well as commercial worlds.

David Hosack articulated well how the "agreeable exercise" of botany could unite the aesthetic with the intellectual.[57] A physician, educator, and avid botanist, Hosack, who founded the Elgin Botanical Gardens in New York City, the first public botanic garden in the United States, was perhaps motivated by his own passion for the subject when he wrote to Amos Eaton, an eminent naturalist from New York, preparing to deliver a popular course of lectures on botany in the "Botanical Institution at Catskill." Despite, or because of, his passion, Hosack delivered in a few sentences the essence of the beauty and the benefit attributed to the study of botany. Hosack – again, not a neutral observer – shared with Eaton his own view that there was "no subject so well calculated to occupy the mind as the study of Natural History." In Hosack's view, such study both trained the memory and taught the student how to make close observations of "those objects which otherwise we pass by with careless indifferent." To all of its other advantages, the study of natural history also gave the student "very different eyes" with which to survey anything, "whether it be the production of Nature or art."

The systematic study of nature, however, not only improved the senses, and the memory, but also the "faculties of Judgement and of Reason" as well. Moreover, and perhaps more importantly, Hosack argued that this kind of learning improved the

[56] Peter Collinson to Cadwallader Colden, 6 April 1757, in *"Forget not Mee & My Garden …" Selected Letters, 1725 – 1768, of Peter Collinson, F.R.S.*, Alan W. Amstrong, ed. (Philadelphia: American Philosophical Society, 2002), 204.

[57] David Hosack to Amos Eaton, 20 August 1810. Collection of American Physicians and Surgeons, Gift of Simon Gratz. NYPL.

"morals of youth … as the mind is naturally led from the contemplation of the beauties of creation to that intelligence and power which gave them birth – thereby improving their virtue as well as their wisdom." Botanical interest and work had great scope, from the strictly exploitative and commercial, to the helpful and scientifically-inclined, to the purely artistic or ornamental.

Benjamin Franklin's 1749 plan for the "Education of Youth" was explicit in drawing that connection between the study of science and the display of cultural polish.[58] Franklin encouraged the study of the "best *Histories of Nature*" at least in part in order to improve "Conversation," making it "instructive, agreeable, and entertaining in almost all Companies."[59] Franklin argued that this kind of knowledge gave both pleasure and profit. Nature, however, did not have to be read only from books, especially in the open-air laboratory of America. "A Garden, a Country, a Plantation, are all so many Books which lie open to them; but they must have been taught and accustomed to read in them." Paul Dudley saw much the same in the botanical bounty of the colonies. Writing to the Royal Society with an account of evergreens, Dudley ventured first into an historical review of the biblical trees of "Judea" and then into an aesthetic evaluation of the trees and shrubbery found in England and New England.[60] In Dudley's view, "the publick and private Gardens" of Britain "offer'd the best collection, for beauty, variety & number of all sorts of Evergreens that [were] anywhere

[58] Benjamin Franklin, "Proposals Relating to the Education of Youth in Pensilvania," in *Writings*, 323 – 344.

[59] Franklin, "Proposals Relating to the Education of Youth in Pensilvania," 339.

[60] Paul Dudley, "Description of evergreens," 24 October 1735. Materials Pertaining to the History of American Science; Letters and Communications from Americans, 1662 – 1900. Reel 7; frame 3400. Register Book 19. 370-85. APS.

to be found" since antiquity, and yet, those that were considered "of the first class" could no longer found there in "Nature." He marveled that in New England, quite the reverse was true. Though Dudley cautioned that Americans "must not pretend as yet to usefull Hedges, fine Groves, beautifull figures and Parterre's of Evergreens" such as those in Great Britain, "bountifull Nature" had so endowed the colonial "Woods" that they could luxuriate in the natural abundance as if a gift from nature, as the colonists were "at no expence or Sollicitude about them."

Understanding that all the scientific disciplines served more than one purpose is fundamental to the examination of the role of science in early American culture. The Virginia planter and landholder William Byrd II offers great insight into the ways science was implicated in the provincial and somewhat subservient relationships the colonists carried on relative to the metropolis. Byrd's sometimes-fraught correspondence with the Royal Society is also illustrative of the nearly inextricable ties between natural science, especially botany, and commerce – a connection present from the earliest days of colonization and continuing through the founding of the new nation.[61]

Byrd was elected a Fellow of the Royal Society in 1696, while living in England during his youth.[62] Upon the death of his father in 1706, Byrd returned to Virginia, but maintained a sporadic correspondence with the Society, and several of its members, until his own death at mid-century. When he returned to his plantation, Byrd had lived the

[61] See Kenneth A. Lockridge, *The Diary, and Life, of William Byrd II of Virginia, 1674 – 1744* (Chapel Hill: University of North Carolina Press, 1987) for a broad reading of Byrd's predicament, never fully accepted as an English gentleman nor fully satisfied with the scope of his life as a Virginia planter.

[62] Maude H. Woodfin, "William Byrd and the Royal Society," *The Virginia Magazine of History and Biography* 40, no.1 (Jan., 1932): 23 – 34; and 40, no. 2 (April, 1932): 111 – 123.

majority of his life in England, yet he was well aware that the colonies afforded "a large feild for Natural inquiry."[63] At the same time, Byrd "lamented that we have not some people of Skil and curiosity amongst us." In his estimation, the colonies could claim no one talented or knowledgeable enough to make any "very great discoveries so that Nature has thrown away a vast deal of her bounty upon us to no purpose." Byrd wished for a "missionary Philosopher that might instruct us in ye many usefull things" for which the colonists could find no "purpose."[64]

Very likely, Byrd had himself in mind when he grieved over colonial ignorance of "Plants or the other parts of Natural History." Although Byrd was responsible for several exciting zoological contributions to the Royal Society (the rattlesnake and the opossum in particular), his letters once he was permanently established at Westover were filled with plangent calls for help from the Fellows. The issue really was not that neither Byrd nor apparently anyone he knew had "Skil or curiosity" enough – far graver was that Byrd did not know how to turn the natural productions of his natal land to profitable account. Writing in 1708 to Hans Sloane, secretary to the Royal Society, Byrd took the trouble to correct his eminent friend about nature of some "Lippocorcanna" that Byrd had shipped several years before. Despite its rarity or expense in Europe, the plant grew in "so few places and there so thin" that Byrd was convinced it was "worth no bodies while to get it for Sale."[65] Just to be sure he missed no economic opportunities, nor any occasion to ingratiate himself with the Royal Society, however, Byrd professed himself

[63] Woodfin, "William Byrd," 23.

[64] Stearns, *Science in the British Colonies*, 282.

[65] William Byrd II to Hans Sloane, 10 September 1708, "A Letter from William Byrd, Esq. to F.R.S. concerning some Virginia Plants &c Materials Pertaining to the History of American Science; Letters and Communications from Americans, 1662 – 1900. Reel 7; frame 3526. Letter Books 14. 268-71. APS.

"glad to hear how much it will sell for a Pound however," so that he himself could "Judge whether it be Encouragement Sufficient to Employ any body about it."

Not willing to pin all his botanical hopes on the "Lippocorcanna," however, Byrd shipped "a Box" of horticultural plenty, "with some more Roots and Seeds, that the Society may try if there be any Vertue in them." In particular, Byrd drew Sloane's attention to the "Poke" plant: its "purple Berry" would "Dye an admirable color" if only the way of "fixing" the color were well-understood. Indeed, Byrd pleaded with Sloane to convey to him the "best ways to fix Dyes of which we are very ignorant." Byrd assured Sloane that the "good of [his] country" depended upon receiving such scientific knowledge. Ores as well – if Sloane would only send Byrd some "Samples of Several ores," then he might "make some judgments of them" and so determine whether the "mines and minerals in this country" were worth the exploitation. Not to be seen as one-sided, however, Byrd assured Sloane that he had "Strong Inclinations to promote Natural History and to do Service to the Society." He was hampered in this ambition only by his self-professed ignorance.

Sloane replied rather unhelpfully, making clear the provincial dependency of the relationship between the two men, and their respective countries as well. Not only did Sloane express his annoyance and regret that Virginia could not be counted on to supply "Ipecodeanna," which might fetch "30 s p pound" in London, but he also flatly refused to send Byrd any minerals.[66] In his defense, Sloane explained that they existed in "such

[66] Hans Sloane to William Byrd II, "A Letter from Dr. Sloane in Answer to the foregoing letter." Materials Pertaining to the History of American Science; Letters and Communications from Americans, 1662 – 1900. Reel 7; frame 3529. Letter Books 14.271-274. APS. Almost certainly, the root under discussion was that of the South American plant known as ipecacuanha (*Psychotria ipecacuanha*) from which the emetic syrup of ipecac is derived. Stearns refers to it as such, as well. *Science in the British Colonies*, 283.

a Variety" that it would be "impossible to send … the Severall Sorts." He encouraged Byrd to ship to London any that he wished to be "Informed of" and promised the Society would do what they could to satisfy Byrd. As a last bit of 'fatherly' advice, and perhaps also as a way to encourage Byrd in his pursuit of botanical knowledge, Sloane urged Byrd "never to take physick … and not to make use of any medicines but such as are very well tryed." In Sloane's educated opinion, "Observation and Experience" offered the very "best way to find out the Virtues of Plants."

Over time, Byrd came to express a less overtly commercial point of view. He instead made the case to his British interlocutors that the study of science and nature, in America, was as a deliverance. In this more expansive rhetorical mode, Byrd foreshadowed the language that would be employed by Americans during and after the Revolution. In a break with the tone of his earliest letters to his English correspondents, when Byrd had decried American scientific abilities and pleaded for help in turning the domestic botanical bounty to commercial profit, Byrd instead came to emphasize the *intellectual* and *humanitarian* benefits that exploration "into this new World" would bring.[67] Rather than pleading for appraisals and verdicts from the Royal Society Fellows, Byrd instead sought to encourage the conferral of a "competent Exhibition upon some young Physician to travel" through the colonies. As Byrd asked, "[w]hat signifies the Tour of France and Italy" – such travels produced "Fops" and not "Physicians." In Byrd's American world, "everything would be perfectly new." New and also inspiring, because its large "Field of Knowledge would discover itself to the ingenious Enquirers."

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[67] William Byrd, II to Peter Collinson, 5 July 1737, "Letter … concerning the Ginseng and Rattle Snake Root &c." Materials Pertaining to the History of American Science; Letters and Communications from Americans, 1662 – 1900. Reel 7; frame 3638. Letter Books. 24. 217-19. APS.

According to Byrd, American travel and investigations would be "pious" and "worthy" work – more helpful to humanity than any number of "Hospitals" and certainly carrying greater weight than the "building … of Churches." Byrd had already proposed such a "Scheme" to Hans Sloane, when he wrote to promote American Ginseng, and the newly discovered rattlesnake root. In that letter, Byrd openly urged Sloane to "bequeath in your Will an Exhibition for one, or more, Planetary Physicians" who would "Travel" exclusively in Byrd's "part of the World … where Nature seems to be more in her Youth, and to come later and fresher out of her Creator's hands."[68] Byrd made no apology for "the Freedom of this Hint" because he claimed to be "well acquainted with [Sloane's] Humanity;" which Byrd commended, flatteringly, was "ever seeking occasions of bestowing the blessings of Heaven." Byrd argued that such "Generosity" on Sloane's part would do more good than any other "kind of Charity (not even the erecting an Hospital four foundling Children)."

Byrd was hardly alone in his view of the value to be derived from the bounty taken out of "his part of the World" and the benefits that might accrue from European study of the American habitat. The English doctor Samuel Johnson argued explicitly for such "traveling fellowships" when he said that he knew "nothing that has been imported" by botanical study restricted to "France, and Italy, and Germany."[69] Johnson was certain that "many additions to our medical knowledge might be got in foreign

[68] William Byrd II to Hans Sloane, 31 May 1737, "A Letter from Colonel Byrd to the President, concerning the Ginseng, the Rattle Snake Root, the Soil of Virginia." Materials Pertaining to the History of American Science; Letters and Communications from Americans, 1662 – 1900. Reel 7; frame 3626; Letter Books 24.17-20. APS.

[69] In James Boswell, *The Life of Samuel Johnson* (New York: Alfred A. Knopf, 1992), 1144. Boswell dates the remarks to 1784.

countries. Inoculation" was a life-saving measure "and the cures performed by the Peruvian-bark [we]re innumerable." Johnson wanted to banish medical students entirely from "Christendom" and instead "send them among barbarous nations." The French mathematician and natural historian Pierre-Louis Moreau de Maupertuis, the first director of the Académie des Sciences, went further, denying any that useful medical knowledge had come even from European study. Moreau de Maupertuis claimed in 1752, somewhat hyperbolically, that it was "quite by accident and only from savage nations that we owe our knowledge of specifics [medicines]; we owe not one to the science of the physicians."[70]

Byrd used his engagement with science as a civilizing credential and his geographic position as a source of authority as he tried to burnish his own actions and compare them favorably to that charitable "Humanity" he ascribed to Sloane. "Ever since I came back to my own Country," wrote Byrd, "I have employ'd my Endeavours in some Scheme or other for its improvements." Byrd listed his failed agricultural ventures, hemp and wine, and his latest attempts to be of "great service to England, settling a "Colony of Switzers near the Mountains" in order to grow "Vines" and try their hands at "Silk and Potash." Byrd held fast to his opinions, and to his hopes, writing to Mark Catesby that he could not agree with Catesby's assertion that "Wine may not be made in this Country." Byrd knew that all the "parts of the Earth of our Latitude produce good Wine." America could be made to do so as well. It was simply a matter of using "good

[70] P.-l. Moreau de Maupertuis, quoted in Schiebinger, *Plants and Empire*, 73.

Management" to prevail over "difficulties."[71] Good horticulture would surely result in productive vines, and the desirable ginseng, too. Byrd continued in his quest to have American ginseng accepted as a "the same with that of Tartary," as he dared to promote his knowledge of the local fauna over the views of the supposed experts in London.[72] Byrd freely 'beg[ged] leave to differ from … Hans Sloane," who disagreed with Byrd about the nature of that domestic ginseng plant.

Notwithstanding the liberality and altruism that Byrd brought to his later correspondence with the Royal Society, he remained optimistic that one of his "Projects" would pay off. Moreover, Byrd no longer pleaded his ignorance, nor asked for guidance from London. Instead, he sought to impose his own authority about the meaning and utility of the natural productions of America, and to persuade his London correspondents to accept those views. Writing to Peter Collinson in 1737, Byrd regretted that he was unable to satisfy Collinson's persistent demands for samples of the American "Ginseng" root.[73] Reminding Collinson that the plant grew only in the distant "Mountains, and consequently not easy to get," Byrd instead sent an "exact Draught of it" in order to "satisfy the Curiosity of your Friends." Byrd directed Collinson's attention to the "Book called The Travels of the Jesuits by Father Tarloux" where "nicely executed" images of

[71] William Byrd, II to Mark Catesby, 27 June 1737, Part of a Letter from Colonel Byrd to Mr. Catesby ." Materials Pertaining to the History of American Science; Letters and Communications from Americans, 1662 – 1900. Reel 7; frame 3622; Letter Book C. 24.115-118. APS.

[72] Byrd to Sloane, 31 May 1737.

[73] William Byrd, II to Peter Collinson, 5 July 1737, "Letter from Colonel Byrd to Mr. [Peter] Collinson concerning the Ginseng and Rattle Snake Root &c." Materials Pertaining to the History of American Science; Letters and Communications from Americans, 1662 – 1900. Reel 7; frame 3638. Letter Books 24.217-219. APS.

the plant could be examined at leisure.[74] The plant "described by Father Tarloux," however, was the Chinese ginseng, and Byrd more than once attempted to use the inherent authority of Tarloux's botanical text to support his own hypothesis that American and Chinese ginseng were botanically identical.[75] Byrd said as much to Marc Catesby, writing about his local ginseng that the "Plant in all its parts is exactly the same with that described by Father Tarloux, and the virtues alike ." Byrd was mindful that Chinese ginseng (*Panax schinseng)* was a very valuable commodity in England and although Byrd did not go to the mountains to find a specimen for Collinson, he did send a half-dozen letters over the course of the next several years in which he argued – erroneously – that American ginseng (*Panax quinquefolium)* was botanically identical to that found in China.[76]

In that letter to Collinson, Byrd reported "another happy discovery in the vegetable Kingdom," and one that might be "very usefull to mankind."[77] (Byrd referred to the Rattlesnake root, about which he wrote enthusiastically for the next several

[74] The title Byrd referenced has not come to hand.

[75] Byrd to Castesby, 27 June, 1737.

[76] Byrd to Sloane, 31 May 1737. Also, Byrd to Mark Catesby, 27 June 1737; Byrd to Peter Collinson, 10 July 1739, "A letter from Colonel William Byrd to Mr. Petter Collinson, concerning the Virtues and manner of exhibiting the Rattlesnake Root and Ginseng ." Materials Pertaining to the History of American Science; Letters and Communications from Americans, 1662 – 1900. Reel 7; frame 3695 Letter Books 26.381-5; William Byrd to Hans Sloane, 20 August 1738, "A Letter … concerning the virtues of the American Ginseng and Rattle Snake Root ." Materials Pertaining to the History of American Science, Letters and Communications from Americans, 1662 - 1900. Reel 7; frame 3649. Letter Books. 25.101-3. APS. See also Stearns, *Science in the British Colonies*; 288 n. 112.

[77] William Byrd, II to Peter Collinson, 5 July 1737, "Letter … concerning the Ginseng and Rattle Snake Root &c." Materials Pertaining to the History of American Science, Letters and Communications from Americans, 1662 - 1900. Reel 7; frame 3638. Letter Books. 24. 217-19. APS.

years.[78]) Although the Royal Society never did confirm the reputed medicinal properties of this new wonder plant, despite having received large quantities of it from the colonies, the commercial implications of the plant – should it prove effective – lent it great value.[79] Byrd reassured the Royal Society that "many useful tryals" of the plant had "found it almost a Specifick in Pleurisies, which are the most fatal of all Distempers in this Climate amongst the Negroes."[80] Byrd assured Sloane that a concentration of the roots also did "wonders in the Gout and Dropsy, and probably might cure the bite of a mad Dog, as well as other poisons." With such implications of its healing powers, the first importations of the plant initially caused something of a sensation, even absent any actual proof of efficacy.

Byrd's promotion of the new rattlesnake root made it a popular sensation, if not a profitable and cultivatable commodity, putting him, if at a remove, at the center of metropolitan transactions. The English physician and naturalist John Fothergill sent a small portion of it to Charles Aston, Professor of Botany at Edinburgh, almost immediately upon its arrival in the British Isles. Fothergill's report offered "only a very

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78 A new and different Rattlesnake root, believed to be a curative for the bite of the rattlesnake. Byrd sent a letter of introduction to Hans Sloane and the Royal Society for the Virginia doctor John Tennent, as a way of launching Tennent's snakeroot decoction. Byrd to Sloane, 31 May 1737 Materials Pertaining to the History of American Science; Letters and Communications from Americans, 1662 – 1900. Reel 7; frame 3626. Letter Books. 24.17-20. APS. The letter from Tennent himself to Sloane is dated 28 September 1737, "Letter from Mr. Tennent to Sir Hans Sloane … concerning his newly discover'd Rattlesnake Root." Materials Pertaining to the History of American Science; Letters and Communications from Americans, 1662 – 1900. Reel 7: frame 3629. Letter Books 24.21-22. APS.

79 Stearns, *Science in the British Colonies*, 289.

80 Byrd to Sloane, 31 May 1737.

imperfect account of it" but he assured Alston that the plant would be "very much in vogue" and that a "printed relation of its virtues &c." would soon be made "publick."[81]

Although Byrd had not yet found a way to strike it "very rich," nonetheless he professed himself satisfied with being a "benefit" to his "Country," and "usefull to Great Britain." Raymond Stearns, in his great chronicle of early American science, slighted Byrd as a "backward student of experimental science," and accused him of interests that were more "utilitarian than scientific."[82] While Byrd was more liable to "accept tales of 'wondrous cures' than the less spectacular results of experimental medicine," his activities fell squarely within an expansive view of science that focuses less on the results and more on the engagement. To laud experimental science for its results, as did Stearns, is to bring a teleological approach to the past. Byrd's botanizing, his mineralogy, his zoological pursuits, and his horticultural schemes – however misguided or fanciful – were nonetheless connected to the sciences of his day, as well as to their practitioners. Indeed, those businesslike or commercial concerns that come through loudly in Byrd's correspondence were never really absent from most of the scientific activities his correspondents engaged in.

Those multiple uses to which the colonists could put the results of their scientific efforts were never more in evidence than in the extensive preparations that they put into their work surrounding the 1769 Transit of Venus. From settled coastal towns in North

[81] John Fothergill to Charles Alston, 13 / 8 [October] 1737. APS, from originals in possession of the University of Edinburgh. Byrd's introductory letter of Tennent to Sloane was dated 31 May 1737; before the end of September, Tennent was in London, when he wrote to Sloane offering a "Copper Plate Cutt of the Plant" so that Sloane could see how different his plant was from other rattlesnake roots in the Chelsea Garden. Alston had sent that small portion of the American root weeks later.

[82] Stearns, *Science in the British Colonies*, 292 – 293.

America to more remote locations around the globe, the third of June 1769 found "People of all Ranks, Ages, Sexes and Colours" sharing an ardent yet uncomplicated desire: they were hoping for cloudless skies.[83] If the weather held, purposeful astronomers, fascinated stargazers, and the merely curious from California to Quebec, Providence to Pondicherry, Cap Henlopen to the Caribbean, all could expect to enjoy a remarkable and exquisitely rare spectacle. Venus that day would cross the Sun's face, "conspicuous all over North America ."[84] First predicted by the English astronomer Jeremiah Horrocks, the timing of its appearance refined to perfection by the brilliant Edmond Halley, and eagerly awaited since the companion transit of 1761, here indeed

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[83] *Newport Mercury*, 19 June 1769. See also, among others, *Providence Gazette, and Country Journal*, 27 May 1769; *New-York Journal, or, the General Advertiser*, 1 June 1769; *New-York Gazette; or the Weekly Post-Boy*, 12 June 1769; *New-York Gazette; and the Weekly Mercury*, 26 June 1769; *Pennsylvania Chronicle*, 26 June 1769; *Boston Post Boy*, 28 August 1769.

[84] *Mein and Fleming's register for New-England and Nova Scotia … and an almanack for 1769 ….* Boston, 1768. Planetary transits across the Sun occur when two [or more] planets are lined up with it, and one appears to pass directly across its face. Obviously, only transits of Mercury and Venus are visible from Earth.

Reports of astronomical observations taken in North America at Quebec, California, Martinique and St. Domingue were communicated to the Royal Society of London. Materials Pertaining to the History of American Science, Letters and Communications from Americans, 1662 - 1900. Reel 8; frame 4448. Letters and Papers, V. 44. 117 – 119; Reel 10; frame 5519. Letters and Papers. V. 44. 122; Reel 8; frame 4359. Letters and Papers. V. 46. 191; Reel 8; frame 4364. Letters and Papers. V. 46. 201. APS. These accounts were published in the Society's journal, as were reports from elsewhere around the world. See *Philosophical Transactions* LIX, (1769), 247–252; 253–261; 273–280; and *Phil. Trans.* LX, (1770), 497 – 501; 552.

Visibility of the Transit was not limited strictly to North America. Among other European ventures in search of transit data, the Royal Society of London engaged James Cook to travel to the southern Pacific Ocean, where his team took observations at Tahiti; the French sent an astronomical team to their colony in Pondicherry, India. Two very readable accounts are Nicholas Thomas, *The Extraordinary Voyages of Captain James Cook* (New York: Walker & Co., 2003) and Timothy Ferris, *Coming of Age in the Milky Way* (New York: William Morrow & Company, Inc., 1988).

was "a rare Phaenomenon, and such as [would] not be again seen" by any alive on that late spring day.[85]

The next transit of Venus was not to occur until 1874 and in the colonies, as in "every civilized nation in the world," Americans resolved to profit from this last remaining occasion in the eighteenth century.[86] "Great Preparations [we]re making at King's College," in New York, at Harvard, in Philadelphia and at Providence "for accurately observing the Transit ."[87] And while not as extensive, preparations were also afoot outside of the academies and colleges, in Newport, New Jersey, Virginia, and elsewhere throughout the colonies. "People in general," having heard "much every where said on the subject, and seeing the preparations making for the occasion, had their curiosity wonderfully excited."[88]

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[85] *Providence Gazette, and Country Journal*, 27 May 1769. Peter Aughton, *The Brief, Brilliant Life of Jeremiah Horrocks, Father of British Astronomy (* London: Weidenfeld & Nicolson, 2004); Dr. Edmund Halley, "A New Method of Determining the Parallax of the Sun, or His Distance from the Earth," *Phil. Trans.* 29 (1714 – 1716), 454-464.

[86] Rev. John Ewing, quoted in William Barton, *Memoirs of the Life of David Rittenhouse* (Philadelphia: Edward Parker, 1813), 164.

Transits of Venus are the rarest of predictable astronomical phenomena. They occur in pairs, eight years apart, separated by century-long gaps (currently, these are 105 and 121 years' long). Fortunately, we have just entered into a cycle of transits. Venus crossed the Sun in June 2004 and will again transit across the Sun's disc on 6 June 2012. Unfortunately, only the beginning of the transit will be visible in North America before the sun sets. Should you plan to observe the transit, in no case should you look directly at the sun! Filters are **essential** to avoid permanent ocular damage.

[87] *New-York Journal, or, the General Advertiser,* 1 June 1769. For a fuller accounting of all the preparations leading up to the 1769 transit, see Hindle, *Pursuit of Science,*146 – 165; and Stearns, *Science in the British Colonies,* 660 – 674. Though dated, both texts remain highly relevant. For the 1761 and 1769 transits generally, see Harry Woolf, *The Transits of Venus: A Study of Eighteenth-Century Science* (Princeton, NJ: Princeton University Press, 1959).

[88] *New-York Journal, or, the General Advertiser*, 1 June 1769. Twenty-two sets of American-made observations were printed in the first journal published by the APS, although there is no way ultimately to know just how many others were taken. See *Transactions of the American Philosophical Society* 1 (1769 – 1771), 4–116. Four of these reports taken by Americans in the mainland colonies of Pennsylvania, Massachusetts and Maryland were first printed by the R.S.L. See *Phil. Trans.*, LIX (1769), 289–326; 351–358; 414–421; and 444–445.

Thus it was that the "ignorant" no less than the "scientific men" in the colonies drew together that day in June, and "big with Expectation, impatiently waited the arrival of this extraordinary Phenomenon."[89] While perhaps not prepared to take precise mathematical observations such as some teams intended, ordinary men and women nonetheless organized after a fashion. Outfitted with makeshift instruments, instructions for the manufacture of some having appeared in recently published accounts, people gathered in crowds large and small. "[S]ome furnished with Quadrants, and some with Perspective Glasses, others with smoked Spectacles and smoked Window Glass, and a few with perforated Boots and Pig Yokes" they "all were ambitiously attentive to catch the very Instant of the external and internal Contact of the Planet."[90]

The enjoyment and communal engagement that were part of the public efforts to observe the Transit were as valuable as the scientific analyses, although less frequently acknowledged. Thousands of colonists gathered in the open to watch as "a round, black spot" slowly crawled across the Sun's face.[91] The Transit's rarity value certainly stimulated widespread notice, but rarity *as such* did not alone instigate the furor of attention and activity surrounding American preparations for viewing the Transit.

To read contemporary accounts (to say nothing of historians'), it was both the Transit's rarity and the knowledge about the physical universe to be gleaned from it that spawned the high expectations indulged in by so many observers, and that provided the

[89] *Newport Mercury*, 19 June 1769; John Winthrop, *Two Lectures on the Parallax and Distance of the Sun, as Deducible from the Transit of Venus* (Boston: Edes & Gill, 1769), 45 - 46; *Providence Gazette, and Country Journal*, 29 May 1769.

[90] *Newport Mercury*, 19 June 1769; Barton, *Memoirs*, 164. See as well *New-York Gazette, or the Weekly Post-Boy*, 12 June 1769; *Essex Gazette*, 13 June 1769; *New-York Gazette, and Weekly Mercury*, 19 June 1769. Hindle also refers to the extensive publicity and preparations, *Pursuit of Science*, 156.

[91] Winthrop, *Two Lectures*, p.n.n.

driving force behind the several learned preparations. Without a doubt, curiosity about so rare an event drew many people out-of-doors, particularly as newspapers and almanacs throughout the colonies had publicized the event very broadly. It was hard *not* to know about. That lent the curiosity a certain sheen, lifting it above ordinary, eager inquisitiveness: the Transit's "rarity alone … afford[ed] an exquisite entertainment to an astronomical taste." But the Transit had value far beyond the intellectual pleasure it might afford. It was also collectively declared to be somehow <u>useful</u>, providing as it might the only accessible key to the solution of "a very grand and difficult Problem in Astronomy," indeed the "noblest problem in all the celestial science."[92] The Transit was widely expected to "furnish the only adequate means of … determining the true distance of the Sun from the Earth."[93]

There was some theoretically practical use for the data to be derived from the Transit. However, unlike the international quest for an accurate method of determining longitude at sea, the practical 'utility' derived from measuring the Earth's distance from the Sun was less immediately evident.[94] Indeed, many of the onlookers took a somewhat casual approach to the results of the observations. Inexplicably, several sets of data collected that day (at New York and Newport, at a minimum) were never published in any learned journals.[95] Evidently the experience was as valuable as the learning.

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[92] *New York Gazette, and Weekly Mercury*, 19 June 1769; Benjamin West, *An Account of the Observation of Venus Upon the Sun … at Providence …* (Providence: John Carter, 1769), 1.

[93] Winthrop, *Two Lectures*, 17.

[94] See Dava Sobel, *Longitude: The True Story of a Lone Genius Who Solved the Greatest Scientific Problem of His Time* (New York: Walker Publishing Company, Inc.: 1995) for a wonderfully readable account of John Harrison's efforts to solve the puzzle of determining longitude by devising an accurate sea-going clock.

[95] Hindle, *Pursuit of Science*, 157.

No less an authority than John Winthrop, perhaps the premier mathematician in the colonies and holder of the Hollis Chair of Mathematics at Harvard – where he introduced the experimental method of doing science as well as the study of Newtonian fluxions – declared the Transit necessary to arrive at that that measurement which had always been "a principal object of astronomical inquiry." Indeed, the quest to discover the astronomical unit, and thus solve the last puzzle of the Newtonian mechanical universe, fueled the earnest, and international, attempts to measure the Transit, and *did* animate many of the more ambitious colonists' missions as well. Its importance as a link to acquiring that knowledge can hardly be overstated. Winthrop himself – the only American to field an observation team for the 1761 transit – took an orthodox and not uncommon view of that interest. He too saw it as having roots in usefulness and curiosity, and therefore offered advice in his public lectures to all "that desire to observe the transit, for use as well as entertainment."[96]

The attention lavished on the transit had roots both shallow and deep. The range and lack of clarity about motive speaks to Americans' engagement with science overall. On the one hand, the extensive groundwork put in to the 'serious' observations represented the fruits of long-standing and gradually developed rhetoric concerning the value of astronomy. But the several lackadaisical observers and the fleeting interest from many in the crowds of casual onlookers, perhaps the natural result of the great ado heralding the transit, deny a sense of serious inquiry and partly belie the hue and cry of "utility." In looking at the public approach to Transit, we see the culmination of

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[96] Winthrop, *Two Lectures*, 46. The lectures were delivered in March and printed and advertised for sale soon after, *Boston Post-Boy*, 29 May 1769. Hindle, *Pursuit of Science*, 99 – 100.

practices and expectations long intertwined with, but not directly connected to, explicit goals of knowledge.

Those crowds of observers took part not only out of the curiosity of seeing a rare celestial event, but also as the apotheosis of a century of engagement with events astronomic. Joining with thousands of Britons and others on the Continent in a global expression of scientific interest, the American observations capped a century of scientific observation and exchange with the metropolis. As with the botanical and mineralogical endeavors pursued by William Byrd, II, the collaborative nature of the information gathering displayed during the transit emerged from the longstanding approach to the pursuit of science in the colonies, and reflected a connection to the larger metropolitan world.

The natural history of America could only be done in America, if not always by Americans. British North Americans understood that the center of their scientific universe revolved around metropolitan Great Britain and its Royal Society of London. As provincials, the colonists had long sought to communicate with that center, whether they belonged to the officially sanctioned world of science or not. The Royal Society was in the vanguard of the stratification and organization of the new sciences and acted as gatekeeper. “Fellows” were invited to join; the Society sponsored lectures; it funded expeditions; its publication of a learned journal gave it the authority to determine which scientific papers would circulate widely and receive the imprimatur granted by inclusion in its *Philosophical Transactions.* Though we know who were the colonial Fellows invited to join the Royal Society, there has been less focus on the numerous unsolicited communications they received from an assortment of colonists.[97] Those correspondents who compelled the Royal Society to attend to them helped set the stage for the rise of an authentically American culture of science.

The much remarked "public expectation and anxiety," ranging as it did from "wonderfully excited" curiosity to "exalted hopes," sprang from an intricate amalgam of complex aspirations, both private and political, and an emergent social and intellectual preparedness, brought together by fortuitous timing.[98] Colonial activities surrounding the transit ran the gamut from those extensive, carefully orchestrated and deeply considered preparations in Providence and Philadelphia and the colleges in Cambridge and New York, to the carnival-like atmosphere that comes through in some of the newspaper accounts. Likely we can never know the true extent and nature of the ways in which the colonists greeted the transit. And yet, more than the transit's pertinence, or its oddity, drove colonists to stand about in clusters large and small, harboring expectations that stretched from the entirely frivolous to the universally grand.

The claims about its utility were ambiguous. True enough, the 1769 Transit of Venus provided the last opportunity in over a lifetime for the international network of observers to collaborate and calculate, with a hitherto unavailable precision, the solar parallax. The parallax of the Sun is the apparent change in its position against the background of the sky when seen from different locations. By deploying observers in multiple locations, eighteenth-century astronomers hoped to work out these differences with a meticulousness that had eluded the observers of the earlier transit. This was a

[97] Frederick E. Brasch, "The Royal Society of London and its Influence Upon Scientific Thought in the American Colonies," *The Scientific Monthly* 33, (Oct-Nov 1931), 336-355, 448-469.

[98] Barton, *Memoirs*, 164 - 165.

multi-part, multi-stage calculation that required generous collaboration among trustworthy observers. By carefully timing the events at widely separated locations whose precise latitudes and longitudes where known, and using trigonometry and geometry, the exact distance of the Earth from the Sun could finally be determined. This measurement (the astronomical unit) could then be used to work out *all* of the distances in the universe, permitting an accurate scale model of the whole solar system to be conceived. Triangulation is the key here: the observers could solve for the angles and sides in the triangles created by these different points on Earth relative to the Sun because they could know the angles and the length of at least one its sides (that of the distance between the observation points). Modern astronomers use the astronomical unit to work through calculations on the size of the solar system, and hence its age. But eighteenth-century astronomers did not think in terms of the age of the universe.

Thus, even the momentous reasons regularly attributed to the flurry of activities surrounding the transit – whether explicitly stated or tacitly understood – do not adequately explain those activities. David Rittenhouse provides a wonderful example of the complexity at the heart of the multiple colonial responses. He certainly understood the need for absolutely accurate data measuring the transit. And yet, at the crucial moment he found himself so overcome with emotion that at the first sight of the Transit that he remained speechless for several seconds, jeopardizing the value of his data. "In our Philosopher, it excited – in the instant of one of the contacts of the planet with sun, an emotion of delight so exquisite and powerful, as to induce fainting."[99] What was at the root of the "delight" that so overcame Rittenhouse? Awe, astonishment, gratification,

[99] Barton, *Memoirs*, 183.

pleasure? We cannot know with any certainty. Perhaps even Rittenhouse could not have explained his reaction. But while most observers chose to stress the civic and public demands that obliged lovers of science everywhere to record the transit, Rittenhouse embodied the complicated and many-sided effects and responses the colonial engagement with the transit called forth. Unstated, certainly; perhaps even inchoate. Yet Rittenhouse's reaction highlights the enthusiastic and contradictory impulses inherent in the American approach to the Transit specifically, and science more generally.

Called on to provide astronomical observations as well as mathematical calculations, the 1769 Transit offered Americans the opportunity to move into the heart of the international metropolitan centers of science on whose fringes they had long operated. The Transit put Americans at the heart of what was regarded as the most important scientific venture of the day, and their participation called upon a common, shared heritage of observation and reportage. In the colonies, the prospect of observing the 1769 Transit connected both to longstanding public interest in astronomy, as well as to a rising commitment to social and civic improvements that appeared ever more accessible via scientific endeavors. From the deeply serious efforts of the newly-reconstituted American Philosophical Society to the cheerful perforating of boots for sun-scopes by nameless gawkers, and all points in between, the Transit served both as a culmination and a cusp, a transitional point where the arc of scientific investigations in America as Britons gave way to American science.

Even in the midst of the burgeoning crisis with Britain, Americans from many stations and of all abilities concerned themselves with the Transit, and sought to profit in various ways from its visibility in the mainland colonies. The 1769 Transit of Venus schooled Americans, if not quite fully in empire, then certainly in "fashion and … folly" as well as in "philosophy and science."[100] The Transit was expected to play to spectacle as well as to scientific service, and colonists spoke of it in precisely those terms. Science and spectacle, utility and pleasure: though constituent elements of the frenzied interest in the 1769 Transit, (indeed of much interest in all the new sciences), their meanings are difficult to apprehend. And while at first glance they might appear to be at odds with one another, in fact they quite accurately describe the value of the knowledge sought from the transit in particular, and, perhaps, astronomy in general.

Though the Americans primarily addressed the need to determine the solar parallax, they understood that such knowledge, abstract in and of itself, had value beyond the intellectual pleasure, or even the theological certainty it might present. John Winthrop (himself the object Benjamin Franklin's blandishments and entreaties on behalf of the Royal Society seeking transit data) appealed to James Bowdoin, a wealthy Boston merchant deeply interested in natural history, to use his "influence in procuring an observation" of the 1769 Transit at Lake Superior, the only place in British North America where the end of the transit would be visible.[101] In Winthrop's view, the reasons in favor of provincial support for the expense and trouble of such a mission were many, as it would produce "great advantages" in astronomy, as well as other areas of learning. By "exploring the unknown parts about the Lakes, ascertaining the longitude

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[100] William Patterson to John Macpherson, Jr., 1 May 1770, in W. Jay Mills, *Glimpses of Colonial Society and the Life at Princeton College, 1766 – 1773* (Philadelphia: J. B. Lippincott Company, 1903), 75.

[101] John Winthrop to James Bowdoin, 18 January 1769. The Bowdoin and Temple Papers. MHS.

& latitude … and thereby rectifying the geography and correcting the maps of this country," they might arrive at topographical certainty. Such corrected information would be more than intellectually useful; it might prove critical in influencing "both private property and the divisional lines between the several governments." Always optimistic about the general good brought about by natural inquiry, Winthrop also expected that the almost-astronomers "may also probably make some useful discoveries that we have no idea of at present."

Such general and unspecified usefulness was evident to all: the British general Thomas Gage, commander in chief of the North American forces, responded to Bowdoin's application very favorably, assuring him of "all the assistance in [his] power to afford them." Indeed, the Massachusetts' application was not the first he had received. "Some gentlemen from Philadelphia made applications to me some months ago, concerning the like intentions of sending some astronomers from that province to Lake Superior …," though they never did. But the notion that the observation and collection of intangible and theoretical astronomical information had real-world applications was evident to more than Winthrop *et al*. Gage cautioned Bowdoin that any such trip north would require not only an interpreter, but also "some Indians of Lake Superior to accompany them," and most importantly, prior "notice to the nations residing on the above lake of the intention & design of the observers." The mere "sight of the instruments, which they conceive of used only to survey lands," would incite jealousy and immediate suspicions about the Americans' "designs upon their lands."[102] In the end, no joint colonial venture to observe the Transit at Lake Superior took place.

[102] Thomas Gage to James Bowdoin, 30 January 1769. Bowdoin and Temple Papers, MHS.

In an age when the pursuit and development of science marched in concert with civic as well as imperial aspirations, it was the use – unwitting as well as intended – to which such learning could be put that in part explains the widespread attention lavished on the Transit.[103] However, the Transit's utility was not limited to intellectual abstractions or territorial expansion. High quality information "on so important a Subject as the Transit of Venus" called for "the utmost Caution, and Regard to Truth" because without them, "not only the Philosophic Part of Mankind, but the Mercantile may be led into Errors of the utmost Consequence to Society."[104]

Americans, no less than Europeans, made these multiple connections. Indeed, David Rittenhouse saw it as a civilizing discipline as well as a subject both "entertaining and instructive," and profoundly consequential, as well.[105] "ASTRONOMY ... has a much

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[103] For the intrinsic connections between empire and science, see Michael Adas, *Machines as the Measure of Men: Science, Technology, and the Ideologies of Western Dominance* (Ithaca, N.Y.: Cornell University Press, 1989); P.J. Cain and A.G. Hopkins, *British Imperialism: Innovation and Expansion, 1688* – 1814 (London: Longman, 1993); Roy McLeod, ed. *Osiris* 2nd Series 15, "Nature and Empire: Science and the Colonial Enterprise" (2000); Richard Sorrenson, "The State's demand for accurate astronomical and navigational instruments in eighteenth-century Britain," in Ann Bermingham and John Brewer, eds., *The Consumption of Culture, 1600 – 1800: Image, Object, Text* (New York: Routledge, 1994).

For science, politeness and self-fashioning, see William Clark, Jan Golinski, and Simon Shaffer, eds., *The Sciences in Enlightened Europe* (Chicago: University of Chicago Press, 1999); Brandon Brame Fortune and Deborah J. Warner, *Franklin and his Friends: Portraying the Man of Science in Eighteenth-Century* America (Philadelphia: University of Pennsylvania Press, 1999); Jan Golinski, *Science as Public Culture: Chemistry and Enlightenment in Britain, 1760* – 1820 (New York: Cambridge University Press, 1992); Alan Q. Morton and Jane A. Wess, *Public & Private Science: The King George III Collection* (New York: Oxford University Press, 1993); Simon Schaffer, "The consuming flame: electrical showmen and Tory mystics in the world of goods," in John Brewer and Roy Porter, eds., *Consumption and the World of* Goods, (New York: Routledge, 1993), 489 – 526; Barbara Maria Stafford, *Artful Science: Enlightenment, Entertainment, and the Eclipse of Visual Education*, (Cambridge, Mass.: MIT Press, 1994); Geoffrey V. Sutton, *Science for a Polite Society: Gender, Culture and the Demonstration of Enlightenment* (New York: Westview Press, 1995); Alice N. Walters, "Conversation Pieces: Science and Politeness in Eighteenth-Century England," *History of Science* 35, no. 2 (1997), 121 – 154.

[104] *New-York Gazette, and the Weekly Mercury*, 26 June 1769.

[105] David Rittenhouse, *An oration, delivered February 24, 1775, before the American Philosophical Society, held at Philadelphia, for Promoting Useful Knowledge* (Philadelphia: John Dunlap, 1775), 7 – 8.

greater influence on our knowledge in general, and perhaps on our manners too, than is commonly imagined. Though but few men are its particular votaries, yet the light it affords is universally diffused amongst us."

In the aftermath of the transit, colonists learned that observing it had been an extensive affair, as newspapers printed not only the accounts of and the observations made locally, but those of other colonies as well.[106] Colonial activities surrounding the event were tied to descriptions of 1761 transit as well. Benjamin West's account of the transit in Providence directly associated their efforts to the past, as well as to the many people involved. Outlining the role that astronomers and men of science in the "polite" and "civilized" nations of Europe played in charting the Transit in 1761, West connected royalty, gentility, and science into one grand design.[107] Describing the observers of the 1761 Transit as "emulously engaged in this affair," West seemed to suggest that the importance of the question, and the needs of natural philosophy, in and of themselves obliged the emulation of a certain behavior and of this particular inquiry in particular.

Americans from all ranks were invited to participate meaningfully in the scientific work needed to interpret the Transit fully. Their help was instrumental in assisting the colonial astronomers take their rightful place among the recognized, international experts. The social connectedness required to take on this project comes through very clearly in West's account, as do the ways in which polite knowledge was transmitted. It was the reading of John Winthrop's account of his 1761 observations that

[106] *New-York Gazette, and Weekly Post Boy*, 12 June 1769; *Essex Gazette*, 13 June 1769; *New-York Gazette, and Weekly Mercury*, 19 June 1769; *Philadelphia Chronicle*, 26 June 1769; *Virginia Gazette*, 29 June 1769; *Georgia Gazette*, 5 July 1769.

[107] West, *An Account*, 6 – 8.

"induced" the Providence merchant Joseph Brown, "a gentleman of a solid, active genius, strongly turned to the study of mechanics and natural philosophy," to outfit himself with the instruments necessary to observe the 1769 transit. Quite apart from the great expense of the "apparatus," Brown and "his servants" spent "near a month's time … in making the necessary … experiments and preparations."[108] Indeed, as the third of June neared, it was not only Joseph Brown's servants who were called upon to further the interests of science. The townspeople of Providence were asked to help the astronomical team make their "observations as useful as possible." Thus, those in town who found their "curiosity excited" by the many preparations that went into the Providence observatory were advised that the "Gentlemen who propose making an Observation of the Transit, will fire a Cannon at Twelve o'Clock on Thursday next … by which the Inhabitants of the Town may make meridional Lines … from the Stile or Casement of the Door or Window, at their Leisure." The townspeople accommodated the "gentlemen" and "most of the inhabitants marked meridian lines in the windows, or on their floors."[109] (Inexplicably, the story of how local participation helped ensure the accuracy of the observers' timepieces was omitted from the account printed in the American Philosophical Society's journal.)[110]

But it was not only at Providence, admittedly somewhat far from the mid-Atlantic center of colonial scientific activity, where ordinary people were called on to be

[108] West, *An Account*, 10 – 11.

[109] The *Providence Gazette, And Country Journal*. 27 May, 1769; West, *An Account*, 14 – 15.

[110] *Transactions of the American Philosophical Society* 1 (1769 – 1771), 97 – 105.

more than passive observers.[111] The preparations at Norriton, David Rittenhouse's seat near Philadelphia, were "entrusted … to a gentleman on the spot, who had joined to a complete skill in *mechanics*, so extensive an *astronomical* and *mathematical* knowledge, that the use, management, and even the construction of the necessary apparatus, were perfectly familiar to him." Independent of the gentlemen from the APS, he "fitted up the different instruments, and made a great number of observations, to ascertain the going of his Time-piece, and to determine the latitude and longitude of his Observatory."[112] Unfortunately, no one thought to record his name.

Through a variety of actions, these and other ordinary people took part in this extraordinary scientific event, news of which circulated in ways almost lost to us. And while perhaps not imagining themselves as quite so grand as some, those Americans could compare their festivities to those of the Duke of Northumberland who "gave a grand entertainment at his house at Sion, to a great number of the Nobility, & the foreign Ministers." While few, if any, colonists might ever be entertained by His Grace at so glittering a gathering, many could imagine being a small part of what followed. "After dinner the company went from Sion-house to the Star and Garter on Richmond-hill, to a room which his Grace had previously engaged, to observe the transit of Venus over the disk of the Sun."[113] Notwithstanding the absent British nobility, the colonial "mixed

[111] Eleven of the twenty-two American observations printed by the APS in its first journal had been carried out with its sponsorship. Hindle, *Pursuit of Science*, 159.

[112] William Smith quoted in Barton, *Memoirs*, 173.

[113] *Boston Post-Boy*, 28 August 1769.

Multitudes" enjoying the merry preparations saw in print how their experiences connected to myriad others, across time and space.[114]

But American engagement with astronomy had long been the province and the playground of many more than just those with the ostensible training to engage with it, however much such popular involvement has been overlooked both by contemporary observers and historians. The effort was pan-colonial as well as trans-Atlantic. Benjamin Franklin had approached not his fellow Philadelphians but instead John Winthrop's Massachusetts when he conveyed the British Astronomer Royal's wish to have observations made at Lake Superior. Franklin professed to "know of no one ... likely to have a spirit for such an undertaking unless it be the Massachusetts" government; more pessimistic still, he did not expect the other provinces to have any "person & instruments sutable [*sic*] to the task."[115] Franklin was mistaken, although there was a limit to the number of observers with the skill to take the kinds of observations hoped for by the Royal Society. While we know more than Franklin did about the state of natural philosophy in America, too many historians have agreed with Franklin, mourning the scarcity of 'suitable' persons and the sparsity of necessary instruments. The serious colonial efforts at scientific inquiry have received nearly the whole of historians' attention and interpretation, yet even that has mustered but little commendation.[116] Indeed, it is the Transit's role in institution building that historians have emphasized; the focus has been on the formation of the American Philosophical

[114] *Newport Mercury*, 19 June 1769.

[115] Benjamin Franklin to John Winthrop, quoted in Winthrop to James Bowdoin, 18 January 1769. Bowdoin and Temple Papers. MHS.

[116] Hindle, *Pursuit of Science*; Stearns, *Science in the British Colonies*; Woolf, *The Transits of Venus*.

Society and the acclaim it received for the unanticipated fineness of the observations made under its auspices. To be sure, this institutional maturity surprised both European observers and the colonists themselves.[117] But the popular interest so much in evidence throughout the colonies has been dismissed straight away with little more than an acknowledgement.

Although the efforts surrounding the Transit may have symbolized a "Crowning Point" and "an appropriate climax to scientific developments" in the Anglo-America, the unheralded public fanfare also represented the culmination of a nearly century-long and decidedly mixed pursuit of scientific knowledge in America.[118] Many Americans – in the midst of a burgeoning imperial crisis – fully expected to take part as well as pleasure in solving one of the great mysteries of the natural world. Longstanding traditions supported and peopled the many activities surrounding the event. Scientifically, the work published in the learned journals of the day amounted to little of great moment. Historians of American science traditionally downplay, if not ignore outright, the public participation in astronomy, and its increasingly important and widespread role in society. But the stealth movement towards this grand outpouring of interest capped a cultural movement that had been building ever so slowly, and augured the developing integration of the colonies into the larger metropolitan culture. Yes, many of the observers were brought together by the twin lures of curiosity and usefulness. But the Transit also brought together many past efforts made by Anglo-Americans to involve themselves in the world of science – negligible, sporadic, or inconsequential as they were – with

[117] Stearns, *Science in the British Colonies*, 674.

[118] Stearns, *Science in the British Colonies*, 670; Hindle, *Pursuit of Science*, 146.

assurance and certainty that seemed to announce a new era of learning, expedience, and elegance.

As difficult as can be to chart the participation by ordinary colonists in these new sciences, their activities took root and formed part of a different scientific revolution emerging not only in Europe but in the colonies as well. Although this engagement could be seen as provincial and dependent upon the metropolis across the Atlantic, the broad sweep of participation was also an expression of an emerging American scientific maturity. The changes that the practice of the new sciences brought about were not restricted to the development of the disciplines themselves. Practicing these new sciences brought radical alterations in society as well. The new scientific enterprises, the new organizations, and the new traditions that they engendered introduced substantial changes in social mobility and personal status. The observation and management of nature provided entrée into the wider world. Exquisitely self-conscious about their colonial status, American colonists discovered that taking part in the study of the whole universe opened an avenue onto a cosmopolitan life. The 1769 Transit of Venus turned the American disadvantage in the new scientific endeavors – always collectors of raw materials, to be shipped to overseas and interpreted by Europeans – suddenly to their advantage. The very hope of the entire enterprise relied on the accurate collection of observable data. That need for transit data to calculate the parallax upended the traditional scientific hierarchy in the colonies and helped Americans re-imagine their participation. At a critical political juncture, Americans developed their intellectual independence and were able to perceive themselves anew.

Thus we begin to understand that the events surrounding the 1769 Transit of Venus were remarkable not for their singularity but rather for their connection to practices that had long been present in Anglo-American society. These came together in a rather showy way, but were not a new thing; they were merely a newly public face to longstanding practices and behaviors. Many of the colonial efforts to observe the Transit were dismissed at the time as meaningless celebrations of a rarity. Historians certainly have taken little note of them. Even the purportedly scientific work done in all earnestness by the colonial men of science has been, if not discredited, then written off as inconsequential. But looking at science in a more inclusive and imaginative way than allowed by the narrow search for magnificent results from great men permits a fresh appreciation of the influence of science on social, cultural, and intellectual transformations across the eighteenth century. Rather than bemoaning the lack of institutions or weighty consequences, we begin to see how very influential American collaboration with science actually was. By dint of their fringe status, and lack of institutions – all long-established drawbacks acknowledged to have hampered the progress and output of eighteenth-century colonial science – Americans were free to make something different, as they engaged in fashion and folly, philosophy and science.

Chapter Five. "Science Sets Her Sons Among the Stars"

Anglo-Americans deployed myriad concepts of science throughout the eighteenth century, engaging with it practically as well as rhetorically. They pursued science in projects of personal enhancement and civic improvement, for private amusement as well as public entertainment, and as a vehicle for commercial advancement and imperial expansion. Science had always been linked both to individual and national progress, and it should come as no surprise to see that the oratory surrounding the subject of science took on added urgency in the aftermath of the American war for independence. Many of the calls for a free and separate American science heard during the political crises of the 1760s and 1770s and the early national period of the new United States had at their heart the economic realities the mainland colonies faced and their need to promote both domestic manufacturing and agriculture. However, those often-florid and extravagant appeals to, and commendations of, science also included a current of hope. The call for science as a necessary advantage to the new nation frequently went hand-in-hand with the expectation that the new nation would prove a boon to science. America could, and should, establish itself as much a haven to science as to liberty. In return for such sanctuary, science would reward America.

Despite the protracted and multi-layered dependence on Europe that was long at the heart of Americans' engagement with science, some Europeans no less than Americans by mid-century promoted the illusion that American science not only could, but should, operate independently. While a certain part of any push for a uniquely American science likely stemmed from the sheer geographic distance of European centers of learning, more was perhaps due to the growing realization among many observers that Americans were not in fact Britons. As the political crises in the last quarter of eighteenth century escalated into outright rebellion, the rhetoric around science more and more focused on an idealized intellectual independence and the potential for American greatness. This developed in the face of the many bonds linking Anglo-Americans with Europe to the contrary – informal circles of correspondence, established communications with scientific societies, the continued importation and reliance on books and journals, the many colonists who finished their scientific education overseas.

The notion of an independent American science emerged even before political independence. Pieter van Musschenbroek, the Dutch natural philosopher instrumental in developing the Leyden jar capacitor, explicitly encouraged Benjamin Franklin to ignore European science. Writing to Franklin in 1759, Van Musschenbroek urged him to "go entirely on [his] own initiative." By working independently, freed from international influences, Franklin would "thereby pursue a path entirely different from that of Europeans." Such a state of intellectual independence was highly desirable, van Musschenbroek claimed, because if Franklin could liberate himself from the burdens of Europe, he would "certainly find many other things which have been hidden to natural philosophers throughout."[1]

Just as Americans had developed into critics of British rule, so too had they matured in their abilities to evaluate British fitness in science. At least, some occasionally saw fit to make such criticisms. Thomas Bond, American physician and

[1] Pieter van Musschenbroek to Benjamin Franklin, 15 April 1759, in *Papers* 8:329 – 330. Van Musschenbroek's letter to Franklin is entirely in Latin. The English translation is taken from I. Bernard Cohen, *Benjamin Franklin's Science* (Cambridge, Mass.: Harvard University Press, 1990), 27.

surgeon, wrote to Franklin – with whom Bond had co-founded the Pennsylvania Hospital in 1752 – seeking his advice on the best place for Bond's son to finish his surgical studies "to the greatest Advantage."[2] Many American physicians at the time completed their studies either in Edinburgh or London; in fact, although Bond studied first at Annapolis, he also studied at London and Paris. However, by the 1770s times had evidently changed and Bond had his doubts about several of the European medical centers. Bond wrote that, from distant Philadelphia, Edinburgh seemed "better calculated to please the Fancy, than to form the Judgement." Indeed, so fashionable had Edinburgh grown that Bond feared the "many extraordinary Novelties inculcated there" would hinder his son's advancement, as they "would be a Barr to public Confidence" in the colonies. The London surgical training, Bond and his fellow Americans found to be nothing more than "a mere *mechanic Art*, well executed." The "Academy of Surgery in Paris," however, Bond approved of, since by aspiring to join "Science to their Profession" they had "done thereby Honour to it."[3]

These developments accelerated as Americans began to claim that the new nation required an educated citizenry. The Philadelphia book merchant William Pritchard beseeched "Lovers of Literature" to attend his auction, where he guaranteed that his

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[2] Benjamin Franklin, "Autobiography," in *Benjamin Franklin, Writings*, ed. J.A. Leo Lemay (New York: Library of America, 1987), 1422. Also, "Thomas Bond," in *Patriot-Improvers: Biographical Sketches of Members of the American Philosophical Society, 1743 – 1768* Vol. 1 (Philadelphia: American Philosophical Society, 1997), 37 – 47.

Thomas Bond to Benjamin Franklin, 6 July 1771, *Writings* 18:164a

[3] Perhaps because of the outbreak of the Revolutionary War, it appears that Thomas Bond, Jr. did not go overseas for any additional medical training. He studied medicine under his father and in 1776, was made surgeon of the "Flying Camp," a mobile reserve of troops. The Flying Camp saw battle at the capture of Fort Washington and also at Princeton and Trenton. *Ancestral Records and Portraits: A Compilation from the Archives of Chapter I, Colonial Dames* …2 vols. (Baltimore, Md.: Grafton, 1910) 2: 690.

"instructive" assortment of books would permit readers to please themselves and meet their civic obligations at one sitting.[4] Promising that the texts he offered all were "choice and curious … *food for the mind*, adapted to every taste, in … arts and sciences," Pritchard submitted that the books on offer were a "cheap advancement of learning," all the more necessary in the new nation because the "happiness of society, and a free state, depend[ed] upon the knowledge of its individuals." Assuring the public that while "there may be books without a polished language, yet there can be no polished language without books," Pritchard's stock – and the subjects contained within their covers – promised polish, luxury, and patriotism all at once. Pritchard's call was a new variation on the mission of the Library Company of Philadelphia and its stated "Endeavour however small to propagate Knowledge and improve the Minds of Men, by rendering useful Science more cheap and easy of Access."[5]

Certainly, utilitarianism, if not nationalism, was present even in the earliest appeals for organized science in the colonies. Recall that Benjamin Franklin's 1743 broadside proposing the establishment of the American Philosophical Society called on "Men of Speculation" to participate in natural history and philosophy in order to "produce Discoveries to the Advantage of … the *British* Plantations."[6] However, Franklin did not envision that those "Discoveries" should be limited to one nation – he imagined they also would be turned to "the Benefit of Mankind in general." The utility

[4] *Loudon's New-York Packet,* 6 January 1785.

[5] Library Company of Philadelphia, Minutes, vol. 1, pp. 26 – 28; quoted in Silvio Bedini, *Thinkers and Tinkers: Early American Men of Science* (New York: Charles Scribner's Sons, 1975), 180.

[6] "A Proposal for Promoting Useful Knowledge Among the British Plantations in America" 17 May 1743 in Benjamin Franklin, *Writings*, comp. J. A. Leo Lemay, Library of America Series (New York: Literary Classics of the United States, Inc., 1987), 295.

of science had long been present in any American discussion on the subject; the ties binding science to the republic were new. Introducing two young and worthy graduates of the “Philadelphia University,” Thomas Bond wrote to Benjamin Franklin in France, certain that “countenancing & encouraging Merit in your American Children” would provide Franklin the “agreable Opportunity” of “directing them to the paths of Public Usefulness.” Botany, though a “delightful & Gentlemanly accomplishment” in Bond’s view, remained vitally important for American national development; indeed the nation’s “Wealth, Happiness & Commerce” depended not only on the ability to build “Canals, Water Works, Machines &ac” but equally on botany and applied botanical knowledge, such as the “Propagation of Fruits, Fermentation of Wine, Beer, Cyder &ac.”

The onset of the Revolution gave the discourse on science in America a blatantly nationalistic turn. Many who publicly weighed the possibilities for science in the new nation had large, and seemingly unambiguous, civic goals. Philip Freneau and Hugh Henry Brackenridge extolled America’s “sweet liberty” without which, they feared, “science irretrievably must die.”[7] The physician David Ramsay, writing in H. H. Brackenridge’s *United States Magazine,* asserted that “[e]very circumstance concurs … that the arts and sciences will be cultivated, extended, and improved in independent America.”[8] Indeed, a close examination of “the whole circle of the arts and sciences” while the colonists had “remained British subjects, cramped and restrained by the limited

[7] Philip Freneau and H. H. Brackenridge, "The Rising Glory of America," in Fred L. Pattee, ed., *The Poems of Philip Freneau, Poet of the American Revolution* (Princeton, N.J.: The University Library, 1902), I, 71.

[8] David Ramsay “An Oration on the Advantages of American Independence,” *United States Magazine* I, nos. 1 and 2 (1779): 21 – 25; 53 – 58.

views of dependence," would reveal them to have "dwindle[d] and decay[ed]."[9] In an independent America, science would bloom.[10]

By the American Revolution, then, patriotic oratory was almost commonplace in any analysis of science, frequently smothering other interests. And in the aftermath of the war, notice of those associations grew more pronounced. A 1783 newspaper encomium to George Washington took stock of his endowments to the new nation. "Our freedom is established – the sciences flourish – and the gates of human happiness are thrown open to mankind."[11] Washington was especially to be commended by "the learned professions" who would "ever consider [him] as their patron and protector." He was to be honored for having "enabled science once more to lift up her head ." The American Philosophical Society joined in these sentiments when they "present[ed] their Congratulations on the Establishment of Peace …. Contemplate[d] with Pleasure that the Arts and Sciences … those Friends to Liberty and Virtue …" were now permanently coupled in the welcoming, protective embrace of the United States.[12]

When David Hosack, American physician, botanist, and educator, opened the Elgin Garden – the first public botanic garden in America – he made precisely such claims, if phrased slightly differently. A national public garden, in Hosack's view, should serve not only as "a repository of the native plants" found in the United States,

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[9] Ramsay, *Oration*, 24.

[10] For a fuller discussion of post-Revolutionary literary calls to science, see Brooke Hindle, "The Prophets of Glory and Their Temples of Science," in *Pursuit of Science*, 248 – 279.

[11] *Pennsylvania Gazette*, 7 December 1783.

[12] American Philosophical Society, *Minutes from Early Proceedings of the American Philosophical Society for the Promotion of Useful Knowledge, compiled by one of the Secretaries from the Manuscript Minutes of its Meetings from 1744 to 1838* (Philadelphia: McCalla & Stavely, 1885), 12 December 1783.

but also as a valuable means of advancing “medicine, agriculture, and the arts.” The “advantages to be derived” from such a garden were expected to be of “great importance.”[13] While the Elgin’s primary goal was to “collect and cultivate … the native plants of this country,” in particular those that were “useful” and “especially such as are possessed of medicinal properties,” the gardens were nonetheless “planted agreeably to the most approved style of ornamental gardens.”[14] Aesthetic concerns were on a par with the stated educational purpose of the garden, acquainting medical students with the *material medica* of their profession. Yet medical students were not the only intended audience for either the lessons or the pleasure of the garden. In order “to render it not only useful as a source of instruction to the students of medicine but beneficial to the public,” the citizens of New York were duly “informed that they [could] be supplied with *Medicinal Herbs and Plants*, and a large assortment of *Green and Hot House* plants.” They were also promised the imminent ability to buy the “best Fruits, Shrubs and Trees” both domestic and imported.[15]

Botanicals, of course, could be pressed into service in many ways. A letter from one member of the Royal Society sheds light on the avid international interest generated by plants that could be commoditized. Forster was reporting on his examination of the “curiosities presented by the Hudson’s Bay Company” to the Society.[16] The most

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[13] David Hosack, *Hortus Elginensis, or A catalogue of plants, indigenous and exotic, cultivated in the Elgin Botanic Garden ….* (New York, 1811), 1.

[14] Hosack, *Hortus Elginensis*, 2.

[15] *American Citizen* [New York], 4 June 1807.

[16] Johann Reinhold Forster to William Watson, 16 January 1772, “On the root used by Indians to dye porcupine quills.” Materials Pertaining to the History of American Science; Letters and Communications from Americans, 1662 – 1900. Reel 8; frame 4352. Letters and Papers, V. 49.282. APS. Forster’s account appears in *Philosophical Transactions* 62 (1772): 54 – 59.

significant “curiosities” were the red and yellow dyed porcupine quills. These had been shipped alongside the plant roots used for the dying and it was actually the roots themselves that commanded the Society’s interest. They wanted to know how to make useful dyes from them, as some Indian dyes were known to stay colorfast even when exposed to air, water and sun. Forster examined the roots carefully, identified them, and experimented at length until he managed to “hit upon the right method” of extracting and fixing the yellow color. Forster hoped that this success would “prompt the directors of the Hudson’s-bay Company to order large quantities of this root from their settlements,” as Forster was convinced that it would “become a useful article of commerce.”

In this venture, both commerce and national prestige were at stake. Forster knew that the Spaniards had recently learned from the “inhabitants of California” how to dye cloth “the deepest and most lasting black, that was ever yet known.” Forster was unable to extract the “vibrant and lasting” red color from the other root, however, and was certain that the Indians used a secret method, one he was eager to find out. He hoped that the Company’s directors would engage in acts of espionage, and “order their servants at the settlements to examine carefully and minutely, the method employed by the Indians in dying red … to send an account thereof … and greater quantities” of the root. Forster observed that the “wild inhabitants of North America are certainly possessed of many important arts.” If these “arts” were more “thoroughly known, [they] would enable the Europeans to make a better, more extensive use of the many unnoticed plants, and productions of this vast continent…..” Such use would benefit the English “both in physic, and in improving our manufactures, and erecting new branches of commerce.” Forster could only hope that because of the similar latitudes between

California and some of the British holdings "near the Mississippi, or one of the Florida's" the plant used for the dye might grown there since its "acquisition" would be of "infinite use" in manufacturing.

How to manufacture this dye had long been of question of interest to the Anglo-Americans. The geographer and botanist John Mitchell wrote an extensive letter to the New Yorker Cadwallader Colden, laying out a number of "queries" about the natural environment of the New World that he had received from the Duke of Argyll and more than a few "in power, who are frequently asking me about happens in our colonies."[17] Among the assorted questions on "the Natural & Medical History of N. America" that Mitchell posed to Colden were many questions about the "virtues & uses of your natural Productions." One in particular that Mitchell desired information on was whether Colden knew "what the Indians dye their Red & black colours with?" Mitchell claimed that in the Chesapeake region, they "dye[d] red with a small Rubia that grows in the streams, but their black dye" was completely "unknown" to him. John Drayton, governor of South Carolina, wrote from Charleston in 1804 to the naturalist Benjamin Smith Barton, enclosing specimens of a new botanical, which Drayton was unable to identify except in the negative (it was "not the Sanguinara Canadensis"), and "said to produce an excellent crimson dye." [18] A few weeks later, Drayton enclosed some further

[17] John Mitchell to Cadwallader Colden, 25 March 1749. HEH. John Mitchell was the Virginia-born, Edinburgh-trained doctor who created and published in 1755 the comprehensive and highly influential map of eastern North America, known as the Mitchell Map.

[18] John Drayton to Benjamin SmithBarton, 30 June 1804. Benjamin Smith Barton Papers, 1778 – 1813. HSP.

information, "respecting a plant of [that] place," presumably the same, and with which he was "partially" familiar. It reputedly "produce[d] an excellent scarlet dye."[19]

Even those who might have no interest in employing such scientific ventures in the commercial realm were interested in the manufacture of textile dyes from botanicals. A Miss Moore of Philadelphia wrote in 1771 to a friend with whom she previously exchanged home-dyed fabrics, and included "some samples of the little success that ha[d] attended [her] attempts in the manufacturing way & particularly in the art of dyeing."[20] In this letter, Moore forwarded to Wright "a p^{r} of silk garters rais'd, dyed & wove in our own House." However, she had evidently been "trying [her] Hand at shades" and sent samples of her work. Moore was unsure how stable her dyes were and although she had given the cloths "several rincings in warm water," she would not promise that her "scarlet … & the Purple" would "stand." Moore share with Wright the experimental methods by which she had achieved the different hues, having procured the scarlet with "Brazilletto Salt Tartar & Allum," to which she added some "Pot Ash dissolved in a cup of Water" to achieve the purple. This purple she further "wash'd with hard soap" to yield a "pretty Crimson." A yellow dye Moore devised on her own, "with Barberry root." Although she had "never heard of its being made use of for this purpose," she nonetheless decided to try it for making a dye. She explained to Wright that as she "was planting a Root" of it the previous summer, she had appreciated its "bright pritty yellow" color. Moore was unafraid to experiment with the plant and "boil'd some of with a little

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[19] John Drayton to Benjamin Smith Barton, 26 July 1804. Benjamin Smith Barton Papers, 1778 – 1813. HSP.

[20] M. Moore to Susanna Wright, 20 February 1771. "Notes and Queries," *The Pennsylvania Magazine of History and Biography* 38, no. 1 (1914): 123 – 124.

Allum, and was much pleas'd with the colour it produced." Moore sent small scraps of dyed fabrics to Wright and also a "small Phial of [her] blue dye" along with instructions on the quantity to be used and the duration of the soaking period, depending on the depth of the hue desired.

Moore explained the methods she used to derive her blue dye, which was used by "the Ladies … to dye their old White Ribbons" and other small fabric items that "were soil'd." Though the dye was available for purchase in her local stores – the dye itself was imported from New York – the cost "was very great" and Moore had a "very great inclination to know of what it [was] made." Moore wrote that she "try'd almost everything that [she] could think of" and finally "hit upon some Sp^{r} Salt or Vitriol …& mix'd it very well with Prussian blue finely pwder'd." Moore further experimented with her blue-dyed fabrics and alerted Wright that they could also be dipped in the yellow, to make a "beautiful Green." Moore shared the details of her experimentation with Wright at length and wrote that she would "be very much obliged" if Wright would send "the exact receipt for dyeing the colours" she had sent previously. Both Moore and her sister had attempted to color "a yellow Cotton" but could "not get it to fix in" the fabric and need further details from Wright.

Though it appears that both Moore and Wright were employing these chemical experiments for their own use, Moore was entirely aware of the commercial possibilities attractive and stable dyes for cloth would have. She cautioned Wright that, although the colors she had developed were lovely, she did not think they would "stand, as …such a pritty thing woul'd not have lain so long unnoticed had it been good for much." The Virginia planter William Byrd II, a regular correspondent of the Royal Society of

London earlier in the century, had concerned himself with plant dyes as well. Writing to the Society with native botanicals found in the Cheseapeake region, Byrd enclosed a bulb "very like a Tulop." Byrd reported that this "Poke" plant bore a "purple Berry which would Dye an admirable color if we understood the right way of fixing it." Byrd pleaded with the Fellows of the Royal Society, "for the good of [his] country" to send him "the best ways to fix Dyes."[21]

The clearest manifestation of this tie between the search for botanicals that could be used "for the good of" the United States was seen at the 1793 funeral of the South Carolina planter and agriculturalist Eliza Pinckney. In the 1740s, Pinckney experimented with indigo and succeeded in developing it on a large scale as a cultivatable botanical. Within a few years, indigo was the second largest crop in Carolina after rice. Pinckney was so highly regarded as a boon to the commercial advantage of her country that George Washington insisted on serving as a pallbearer at her funeral.[22]

The benefits of science could also be turned towards the protection of the nation. While President, Thomas Jefferson was approached by William Caruthers with an idea he had "dared not mention" previously for "fear of ridicule," and one he hoped would turn the electrical "branch of Science" towards the promotion of the national defense.[23] Caruthers was wary of troubling Jefferson with his "Nonsense," yet he took the

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[21] William Byrd II to Hans Sloane, 10 September 1708, "A Letter from William Byrd, Esq. to F.R.S. concerning some Virginia Plants &c." Materials pertaining to the history of American Science, Letters and Communications from Americans, 1662 – 1900. Reel 7; frame 3526. Letter Books 14. 268-71. APS.

[22] See Eliza Lucas Pinckney, *The Letterbook of Eliza Lucas Pinckney, 1739 – 1762,* Elise Pinckney with Marvin R. Zahniser, eds. (Chapel Hill: University of North Carolina Press, 1972); Caroline Bird, *Enterprising* Women (New York: W.W. Norton, 1976); Leigh Frances Williams, *Plantation Patriot: A Biography of Eliza Lucas Pinckney* (New York: Harcourt, Brace, and World, 1967).

[23] William Caruthers to Thomas Jefferson, 29 July 1801. Thomas Jefferson Papers. MHS.

"liberty … to communicate …an Oppinion" he had for "some time entertained." Caruthers hypothesized that a Leyden jar "highly Charged hermetically Sealed and Violently projected" might "Discharge" a great shock. These could be "Constructed" in the "form of Boms" and "made use of as a means of Annoying … enemies."

John Adams described the less-martial reciprocating advantages of science in a letter to his wife Abigail, where he detailed just which of the scientific arts America needed, and when. Adams envisioned useful, material outcomes from the practice of science, to the benefit of the new nation. He declared that none of the "fine arts" were immediately necessary for the country and looked instead to the "useful, the mechanic arts."[24] Adams was calling for improvements in transportation as well as manufacturing, a general application to engineering and the development of infrastructure, as well as improvements in investment, monetary policy, and trade. Adams personally resigned himself to the self-imposed, and mandatory, practice of the "science of government," arguing that the historical moment in which he found himself demanded he exert himself in the "arts of legislation and administration and negotiation" to the exclusion of all others. It was Adams' hope, however, that his efforts would grant his sons "the liberty to study mathematics and philosophy … geography and natural history."

Though Adams stressed the immediate, practical needs of the nation that he expected a steady application to science would serve, he never lost sight of the personal pleasures to be derived from its study. Writing to his friend Benjamin Waterhouse, the medical doctor responsible for introducing smallpox vaccination in the United States,

[24] John Adams to Abigail Adams, 1780, quoted in "Science and Politics: Some Aspects on the Thought and Career of John Adams," in I. Bernard Cohen, *Science and the Founding Fathers: Science in the Political Thought of Jefferson, Franklin, Adams, and Madison* (New York: W.W. Norton & Company, 1995): 136 – 236, 235.

Adams again mentioned with regret his alienation from science, as the "incessant Drudgery … in the dull fields and forests of Law and Politicks" usually kept him from "disquisitions of natural knowledge."[25] Yet, whenever "any Thing" relating to "natural knowledge" had "accidentally fallen [his] Way" it gave him "more pleasure than" Adams could "account for." Indeed, once retired from public life, Adams wrote that his "relation to the Sciences" was like that of "an old Widower, who meets an ancient Widow … one of the flames of his Youth, falls in love with her a Second time, and marries her ."[26]

In contrast to Adams' view that governance trumped science, Thomas Jefferson, a great dabbler in science as well as a staunch promoter of the national good, wrote to the astronomer David Rittenhouse in the midst of the Revolutionary War to urge him to turn away from the obligations of "civil government."[27] Jefferson declared that Rittenhouse belonged to "an order of geniusses above that obligation; & therefore exempted from it." Rittenhouse's mental powers were such, according to Jefferson, that, "like air & light," they were to be considered as "the world's common property" and never to be wasted on the "commonplace drudgery of governing." Such work might "be executed by men of an ordinary stature, such as are always & everywhere found." Though Jefferson spoke of Rittenhouse's "powers" as "being intended for the erudition of the world," he also hoped to employ them in a more restricted setting. Jefferson had in mind his "own country in particular," and recalled to Rittenhouse's memory an earlier

[25] John Adams to Benjamin Waterhouse, 24 February 1791. Adams-Waterhouse Letters. MHS.

[26] John Adams to Benjamin Waterhouse, 9 August 1805. Adams-Waterhouse Letters. MHS.

[27] Thomas Jefferson to David Rittenhouse, 19 July 1778, Benjamin Smith Barton Papers. HSP.

"promise that it should be adorned" with an orrery of his construction. Jefferson excused his doggedness in pursuing this object at a time of war by attributing it to the "zeal of a true Whig in science" and the "desire of promoting the diffusion of knowledge" as well as Rittenhouse's "fame."

Jefferson would soon take another opportunity to commend Rittenhouse to the world's attention as a uniquely talented, and particularly American, man of science. In 1780, Jefferson composed an extensive treatise on the natural history of Virginia, in response to a series of 22 questions posed by François Marbois, the secretary of the French legation to the new United States.[28] Jefferson's lengthy reply to "Query VI," concerning the "Productions mineral, vegetable and animal," was expansive not only in the sheer mass of evidence he presented but also in the varied threads of his reply.[29] Jefferson was especially keen to rebut the theories propounded by the French naturalist Georges-Louis Leclerc, Comte de Buffon, about the degenerative powers of the New World's purported cool and humid environment on all living things.[30] Jefferson's treatise on "Mines and other Subterranous Riches; its Trees, Plants, Fruits, &c." covered the gamut of mineral resources and fossil evidence, the animal, birds, and plants of the region.[31]

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[28] Thomas Jefferson, *Notes on the State of Virginia*, ed. Frank C. Shuffleton (New York: Penguin Books, 1999).

[29] Jefferson, *Notes on the State of Virginia*, xxiii.

[30] Between 1749 and 1788, Buffon published the 36-volume *Histoire naturelle, générale et particulière*, his attempt to deal systematically with the whole of nature. Buffon proposed his theory of degeneracy in volume 5 of his *Histoire*, published in 1766.

[31] Jefferson, *Notes on the State of Virginia*, 28 – 71.

Jefferson then staked a claim for the power and might of America and its science, moving to disprove Buffon's slur against the nation's human inhabitants. Buffon had bolstered his "theory of the tendency of nature to belittle her productions on this side of the Atlantic" by claiming that America had never produced "one able mathematician, one man of genius in a single art or a single science."[32] Jefferson countered with three examples of homegrown genius, all of whom he expected Europeans to recognize immediately and to acknowledge: George Washington, a genius in the art of war; Benjamin Franklin, a genius in physics; and David Rittenhouse, "second to no astronomer living" not only due to the fineness of his works, but also because he was "self-taught." Jefferson crowed "that, of the geniuses that adorn the present age, America contributes its full share."[33] Moreover, because the recent war had "so long cut off communication with Great-Britain," it was impossible "to make a fair estimate of the state of science in that country." Not only was America properly considered to belong to the first order in the sciences when compared with Europe, but the possibility existed that Britain had fallen behind.

Taking Jefferson's admonition to Rittenhouse together with his boasts about him helps us see how Rittenhouse and his science were integral to a national self-image. The results of Rittenhouse's work, especially the orrery, were the product of the American environment – which practically demanded self-training – and also a welcome contribution to its political identification as an independent nation.

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[32] Jefferson, *Notes on the State of Virginia*, 69.

[33] Jefferson, *Notes on the State of Virginia*, 70.

Promoting American genius in science was a goal that others shared. The schoolmistress Eliza Harriot O'Connor sought help from many whom she believed might assist her in establishing an academy for girls at Alexandria.[34] Writing to Sarah Franklin Bache, Mrs. O'Connor thought that as "Mrs. Beach" had "honor'd [her] humble efforts at the University," she might approve and support her plan for a girl's school. O'Connor wrote of that the "tendency" of her "propositions" was "an attempt to smooth the way to Science ."[35] The Calliopean Society formed in 1788, with both literary and social ambitions.[36] It is not clear from the record, however, how or if the members distinguished between literature and science. The "compositions" produced by the club members that were "deemed meritorious" by the committee charged with examining them "in a critical manner" would be published in the *New-York Magazine, or, Literary Repository.*[37] Those not suitable for publication were "entered at large in the minutes of the committee." Entry "XIX," an "Ode for the fifth Anniversary of the Calliopean

[34] George Washington received several importuning letters from her, but he declined either to be officially involved with her Academy for Young Ladies at Alexandria, Virginia or to solicit others who might be. His replies are dated 20 June 1788 and 17 October 1788. George Washington, *The Papers of George Washington: Presidential Series*, Dorothy Twohig, ed. (Charlottesville: University of Virginia Press, 1987 -), 1:41; 4:139.

[35] Eliza Harriot O'Connor to Sarah Franklin Bache, 17 June 1787. APS.

[36] Critical Remarks by the Committee of Examination on the Compositions &c. Presented to the Calliopean Society. Vol:m 1. Calliopean Society Proceedings, 1795 – 1799. NYPL.

See Bryan Waterman and *Republic of Intellect*: *The Friendly Club of New York City and the Making of American Literature* (Baltimore, Md.: Johns Hopkins University Press, 2007), 27 – 28 for other New York City clubs formed during the 1790s. Also, Eleanor Bryce Scott, "Early Literary Clubs in New York City," *American Literature* 5 (March 1933): 3 – 16; and Thomas Bender, *New York Intellect: A History of Intellectual Life in New York City, from 1750 to the Beginnings of Our Own Time* (New York: Knopf, 1987), esp. 7 – 88.

[37] See Robb K. Haberman, "Magazines, Presentation Networks, and The Cultivation of Authorship in Post-Revolutionary America" in *American Periodicals* 18, No. 2 (2008): 141 – 162. Also, Edward W.R. Pitcher, comp., *The New-York Magazine, or, Literary Repository (1790 – 1797): A Record of the Contents with Notes on Authors and Sources* (New York: Edwin Mellen Press, 2006).

Society" in 1793 was rendered in the "most beautiful language, and the most affectionate sentiments" that made it "at once a monument of taste and sensibility." Sung to the tune of "The Dauphin," the club members could boast of their association "[w]here Science lights the genial fire, and friendship fans the flame."

That praise for the cultivation of "Friendship and Science" was featured in an "Elegy" to a recently deceased club member as well.[38] In a twist on the usual sentiments meant to comfort the bereaved – recalling that the dead are in a better place – the elegy celebrated the late Dr. Youle's new-found freedom to explore "Infinite space, eternal time," to "dart among the worlds of light" with Isaac Newton, and "With Franklin" exert control over lighting and thunder. When the committee met irregularly and neglected to record the club members' compositions, an author submitted his "Thoughts on Improvement." The committee joined with the author in wishing to see the Society reinvigorated in order to "prevent so fair a branch being lopped from the tree of science."[39]

The Introductory Dialogue of Martinet's *Catechism of Nature* drew attention to the egalitarian undercurrent often present in attitudes towards science, that its benefits could be spread widely.[40] "What may I expect from contemplating the works of nature?" asked the pupil. "Both profit and pleasure," assured the Tutor, inasmuch as the "beauties of nature" were both "agreeable and useful." Moreover, and contrary to the pupil's conviction that such a "pleasure" would be confined only to "the learned," both

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[38] No. LXXXIII, Critical Remarks by the Committee of Examination, Calliopean Society. NYPL.

[39] No. LII, Critical Remarks by the Committee of Examination, Calliopean Society. NYPL.

[40] Joannes Florentius Martinet, *The Catechism of Nature; for the Use of Children* (Boston, 1790), 6 – 7.

"the peasant, as well as the philosopher" could enjoy such pleasures. They required only "observation" and a "moderate share of knowledge."

The democratization of science can be seen in the way some areas of knowledge were explicitly opened up to a wider audience. In geography, for instance, the British author George Adams, prior to the Revolutionary War, dedicated his book on the use of the "new Celestial and Terrestrial Globes" to the British King, remarking that "geography was in a peculiar manner the science of Princes."[41] Adams was certainly using long-established language and sentiments to connect the sciences with refinement. He also assured his readers that the "Study of the Mathematicks" was universally understood to be "necessary … Part of every Gentleman's Education." However, Adams was also emphasizing the political influence that attached to such learning. To gaze on the "oceans and continents" was also to bring to mind a "large … part of mankind" and to think on how they suffered or benefited from the governance they endured. By 1790, however, an updated edition of Adams' essays on astronomy and geography asserted that their "connection … was so evident, and both in conjunction so necessary to a liberal education," that no one who aspired to be well-regarded by the "republic of letters" would neglect them.[42] The American geographer Jedediah Morse was even more explicit when writing the first U.S. geography, informing the "Young Gentlemen and Ladies, Throughout the United States" that geography could not longer be considered "a Science … esteemed as a polite and agreeable Accomplishment only,

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[41] George Adams, *A Treatise Describing the Construction, and Explaining the Use, of the New Celestial and Terrestrial Globes* … 3rd ed. (London, 1772), v.

[42] George Adams, *Astronomical and Geographical Essays* (London, 1790), v.

but as a very necessary and important Part of Education."[43] And the public examiner of the graduates of John Poor's Young Ladies Academy in Philadelphia declared "the cultivation of letters" were a "mark of the progress of society."[44] Such improvements would be "productive of much good to [the] rising empire" that was America.

The anthem Jezaniah Sumners wrote to celebrate the inaugural exhibition of the Bristol Academy in Taunton, Massachusetts in 1798 perfectly captured the rhetoric linking science to a glorious America.[45] By rights, Sumner's "Ode on Science" should be as lost to us as countless other flattering songs written to commemorate a particular occasion, put on with gusto by those involved, and soon forgotten.[46] Sumner employed somewhat clichéd imagery, likening science to the "morning sun." Just as the Sun's beams brought illumination from east to west, so too would "Science" stretch "her lucid ray" across "fair Columbia," thereby setting "her sons among the stars." Science, accompanied by "Fair Freedom" would "crown the young and rising States," promised Sumner. Beyond those hackneyed phrases linking the glories of America and science, however, the Ode was also explicitly political and quite topical, addressing the conflicts of the moment, when war with France seemed all but inevitable. Although the "British yoke, the Gallic chain" had been "urg'd upon [their] necks in vain," the song celebrated

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[43] Jedediah Morse, *Geography Made Easy* (New Haven, 1784), p.n.n.

[44] *American Herald* [Worcester, Mass.], 9 July 1789.

[45] Marion J. Hatchett, *A Companion to the New Harp of Columbia* (Knoxville: University of Tennessee Press, 2003), 9.

[46] For a modern rendition of the tune, hear Boston Camerata and Joel Cohen, "Ode on Science," *Liberty Tree: American Music, 1776 – 1861* (Erato 3984-21668-2, compact disc; 1997).

the Americans' ability those "haughty tyrants [to] disdain," while shouting, "long live America!"[47]

Yet while current both in its lively jingoism and its use of shape note (a newly-invented style of simplified musical notation), the Ode was not merely trendy. Sumner's secular song of praise proved incredibly robust, establishing itself as a lasting favorite and performed throughout the nineteenth century in both private settings and public concerts. Long after the diplomatic tensions of the late 1790s had eased, through the domestic political divisions of the Federalists and the Republicans, indeed to the eve of the Civil War, the "Ode on Science" consistently made its way into print and performance.

Examining the Ode itself, along with the contexts in which it circulated, reveals that widespread preoccupations and concerns common to Americans in the early republic were in many ways perennials, present since colonial times. Likewise, the very permanence of the Ode illuminates the ways in which "Science," in all its mutable, multiple and capacious guises had always intersected with Americans' knowledge cultures, pleasure realms, and political and personal spheres. Finally, the Ode – though frequently used to bolster national pride – was not in the end a national anthem, but rather a personal one. Featured at one faction's celebration or another's commemoration, in fact it served all equally well. No one group could ever claim it exclusively because, at bottom, it spoke to people neither about science nor the United States, but rather about whom the citizens, as Americans, *might be*.

[47] *Suffolk Gazette* [Sag Harbor, NY]. 30 December 1805. The lyrics appeared in countless newspapers.

The Ode was a part of the everyday music of the nation, and as such, represented the tastes and interests of the everyday people who popularized it and sang it year after year. It has a march tune in the second half that is quite lively, and is musically related to the now more familiar "Turkey in the Straw." However, the Ode's lyrics about science were as important to its longevity as its music. Its ubiquity makes the Ode a revealing if neglected artifact – at once ephemeral and enduring, and always influential. Sumner's Ode, well-liked and widely performed, was a constant in nineteenth-century tunebooks, printed in numerous titles.[48] It is part of a style of American folk music that is inherently contradictory: in its simplicity, shape note was not elegant or complex enough to be considered a cultured or high art form, yet it still had the weight and permanence of print. Though the music *was* often humble, even ordinary (notated simply, almost crudely, with harmonies derided by elites), these works nonetheless enjoyed great popularity, and contributed significantly to the musical literacy of Americans across racial, geographic and class divisions.[49] From the beginning, the "Ode

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[48] Among the earliest tunebooks were *The Easy Instructor,* and *The Art of Singing; The Social Harmonist,* 1803; *Delights of Harmony, or the Norfolk Compiler, 1*805); *Wyeth's Repository of Sacred Music*, 1810; *Missouri Harmony*, 1816; Ananias Davisson's *The Kentucky Harmony*, 1817, considered the first Southern shape note tunebook and actually printed in Virginia; *Tennessee Harmony*, 1818.

By the middle of the century, many more tunebooks were in print, among them the most famous: *The Southern Harmony,* 1835 and *The Sacred Harp*, 1844 – the most enduring of all the shape note tunebooks and still in use today. The 1854 edition of the *Southern Harmony* is used annually at the "Big Singing" in Benton, Kentucky. See William Walker, *The Southern Harmony and Musical Companion,* ed. Glenn C. Wilcox (Lexington: University of Kentucky Press, 1987).

[49] Gilbert Chase, *America's Music: From the Pilgrims to the Present,* 3rd ed., rev. (Urbana: University of Illinois Press, 1984), esp. Chapter 10, "Fasola Folk," 170-191; Daniel W. Patterson, "William Hauser's Hesperian Harp and Olive Leaf: Shape-Note Tunebooks as Emblems of Change and Progress," *The Journal of American Folklore* 101, no. 399 (1988): 23-36.

Printed as ephemera in newspapers and inexpensive tunebooks, this style of music is intricately connected to the production and promotion of books and thus part of both the print and market revolutions. Even though the use of shape note was a change from established musical traditions of notation and harmonization, both of which would soon be disfavored by musical elites, these tunebooks made their way on Science" was one of the most famous and best-loved tunes of this popular folk musical tradition. Its continued use – pressed into service out-of-doors as a celebratory tune during public proceedings, enjoyed equally as well in private settings – tells us that political leaders as well as regular folk felt a deep connection not only to its melody but also to its lofty pronouncements.

Most significantly, Sumner's rhetoric drew on sentiments long held by the Ode*'s* performers and audiences at the same time that it inspired fresh objectives for their ambitions. Certainly, its music and lyrics were thoroughly *à la mode* and as such offered novelty, but they also courted tradition – and by tapping into a longstanding wellspring of aspiration and desire, contributed to the Ode*'s* durability as a cultural production.[50] In its praise of science, the Ode spoke to the peoplehood of the new nation, encouraging them to look forward as well as back, inward as well as out. It allowed them to enjoy a measure of self-satisfaction for their accomplishments as well as to articulate high hopes for their prospects, and to do so in soothing ways, by transcending boundaries both personal and political. The Ode deployed familiar, indeed almost shopworn, notions about the relationship between the individual, science, and the nation. Though the circumstances were new, those exalted connections – science! freedom! glory! – were not necessarily fresh. Yet they persisted, as did the Ode. Clearly, it struck a resonant chord among many.

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everywhere in the country. John Bealle, *Public Worship, Private Faith: Sacred Harp and American Folksong* (Athens, Ga.: University of Georgia Press, 1997); George Pullen Jackson, *White Spirituals in the Southern Uplands: the Story of the Fasola Folk, their Songs, Singings, and "Buckwheat Notes"* (1933; reprint New York: Dover Publications, 1963).

[50] For more about the changes and continuities of musical traditions in shape note in general, see Patterson, "William Hauser's Hesperian Harp," 28-31.

Deacon Jezaniah penned his patriotic anthem just as the shape note style of writing music developed. Its immediate appearance in tunebooks and advertisements attests to the song's broad appeal. The first shape note tunebooks appeared in print around 1800, and were immensely popular, despite being denounced by musical elites for teaching "dunce" notes.[51] Shape note is a simplified style of musical notation that uses various shapes – diamonds, circles, triangles and squares – to represent the notes on the staff.[52] Anathema though this basic style of notation was to music masters and the learned, shape note put musical literacy within the reach of nearly all and, indeed, the tunebooks made no apologies. One of the earliest advertisements for *The Easy Instructor* (perhaps the best-selling title until 1830), promised that it contained "the rudiments of music on an improved plan … familiarized to the weakest capacity."[53]

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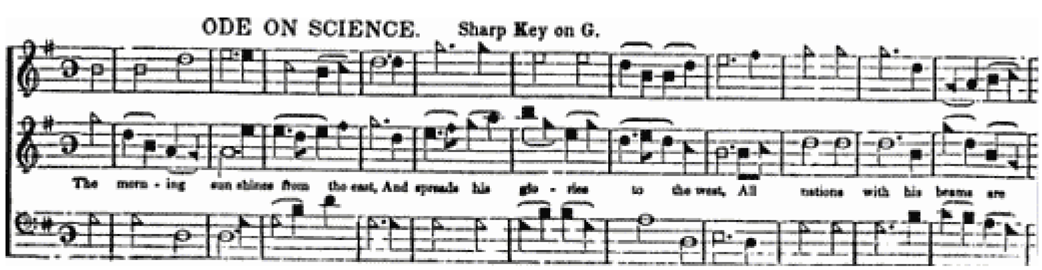
[51] Chase, *America's Music*, 170.

The bibliography of the earliest shape note tunebooks is complicated. *The Easy Instructor* by William Little and William Smith was the first earliest <u>advertised</u> shape note tune book, receiving a recommendation in a committee report by the Uranian Society in 1798, and entered for Pennsylvania copyright that year as well. However, to my knowledge, no known copy of that book has been found and it is far more likely the book was in print no earlier than 1802. See Irving Lowens and Allen P. Britton, "'The Easy Instructor' (1798-1831): A History and Bibliography of the First Shape Note Tune Book," *Journal of Research in Music Education* 1, no. 1 (1953): 30 – 55; Frank J. Metcalf, "'The Easy Instructor': A Bibliographic Study," *The Musical Quarterly* 23, no. 1 (1937): 89 – 97.

Andrew Law published his shape note tunebook, *The Art of Singing*, in 1803.

[52] An example of the "Ode on Science" notated in shape note, from Walker, *The Southern Harmony*, 210:



[53] *The Genius of Liberty*, Morristown, NJ, 3 December 1802. Chase, *America's Music*, 170.

Regardless, the Ode made its way into print very quickly and very widely.[54] As early as 1805, the "Ode on Science" appeared not only in new tunebooks but the lyrics themselves were reprinted in newspapers as "Poetry."[55] And when in 1806 a 32-page "Supplement" to the *Norfolk Compiler* became available – the tunebook itself had been published the previous year – the advertisement made clear that "an Ode on Science, by *Sumner*," was included.[56] It was the only piece contained in the Supplement that the advertisement identified by name.

The Ode, while employing at least in part a similar if more muted patriotic swagger and tone similar to contemporary tunes like "Hail! Columbia," did not see its popularity break down along partisan lines.[57] Which is not to say that differing parties

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[54] Hatchett asserts that the first appearance of the "Ode" was in Lewis Edson, Jr.'s third edition of *The Social Harmonist* which attributed it to "Hall." However, its next appearance in the 1805 *Columbian Harmony* credits Sumner. Hatchett, *Companion*, 186-187. The "Ode to Science" is ubiquitous in 19th- and 20th-century tunebooks and in all other instances is ascribed to Sumner.

Whether Sumner wrote his Ode in shape note or a compiler transposed it from round note, it appeared in the earliest of shape note tunebooks. Musically, the Ode falls within this category of semi-folk production, and Sumner is not identified as the composer of any traditionally notated music; indeed he is known for this one composition only. Although some standard airs were transposed into shape note by tunebook compilers, much of the music printed in the books was written for this simplified style. Patterson, "William Hauser's Hesperian Harp," 28.

[55] *Suffolk Gazette*, 30 December 1805. It is an open question whether the music was omitted because it was already so well-known, or simply still too difficult to print. Since it appeared under the heading of poetry, most likely the editor felt the prose held the value.

[56] *Norfolk Repository*, 4 November 1806. Also, *Connecticut Courant*, 4 February 1807. *Norfolk Collection of Sacred Harmony* (Dedham, Mass.: H Mann, 1805).

[57] With lyrics written for the express purpose of catching the public disposition and promoting a proud American patriotism at a time of political conflict, "Hail! Columbia" was an out-and-out success. Louis C. Elson, *The National Music of America and its Sources* (Boston: L.C. Page and Company, 1900), 160 – 162.

Its lyricist, Joseph Hopkinson, admitted that he intended for his lyrics to "get up an [independent] American spirit," one that would "look and feel exclusively for our honor and rights." Hopkinson, quoted in Anita Vickers, *The New Nation*, American Popular Culture through History, Ray B. Browne, ed. (Westport, Ct.: Greenwood Press, 2002), 119.

But though "Hail! Columbia" was received with even more public acclaim than the Ode, and while it almost certainly enjoyed a higher profile, it was immediately marked – even celebrated – for its domestic made no attempts to co-öpt it; certainly some did, but none succeeded in adopting it as an anthem in an exclusionary way. *The Fredonian*, printed in Boston in 1810, went so far as to add some stanzas to what it entitled the "Ode on Science and Liberty," railing against the "savage tribes infest[ing] our land."[58] This ersatz version of the Ode added a racialized danger to those facing Americans. But it is more significant that those new lyrics continued to emphasize the tight bonds between science and "virtuous freedom" that get at the reasons Federalists as well as Republicans both could celebrate their political visions with the same rendition of the Ode.

The Ode negotiates between its unabashed patriotism and rather treacly uplift very skillfully by using the concept of science to tie those patriotic feelings to fresh concepts of virtue as well as to long-established and deeply cherished notions of utility and education. It is the science that truly distinguished the Ode as a patriotic production, which were then legion, and gave it near-universal entrée, making it welcome in so many different settings. Indeed, the early Republic saw many instances of science being linked to freedom in popular song, among other print media. The song "Columbia" (as distinct from "Hail! Columbia") was regularly included in tunebooks from at least the 1790's on. Its verses were a commonplace: "Let the crimes of the east ne'er encrimson thy name / Be freedom, and science, and virtue thy fame…. Fair science her gate to thy sons shall unbar,/ And the East see thy morn hide the beams of her star ."[59]

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political partisanship and called the "Federal Song, Adapted to the Federal March." Elson, *National Music*, 104. See also John Task Howard, *Our American Music: Three Hundred Years of It* (New York: Thomas Y. Crowell, 1946), 118 – 119.

[58] *The Fredonian*, 10 April 1810.

[59] *The Nightingale of Liberty: or Delights of Harmony. A choice collection of patriotic, Masonic & Entertaining songs ….* (New York: John Harrison, 1797); *The Nightingale or, Ladies vocal companion*

The Ode, then, was pertinent and inspiring, welcoming and affecting, though to be sure how it may have circulated in individual settings remains difficult to flesh out. The memoirs of the Reverend Samuel Gilman’s New England choir days in the first decades of the nineteenth century inform us that the “Ode’s” “splendid movements” could “make every soul burn, and every cheek glow with lofty rapture” when played on the violoncello, though he himself, as a man of the cloth, claimed to prefer sacred music.[60] Nonetheless he details the custom and the enjoyment of vocal music, especially when describing the “rational pleasure” fellow choristers “extracted” from tunebooks as they “pass[ed] an evening with a few musical friends” instead of wasting their time in “frivolous” pastimes.[61] And though he calls it “rational” pleasure (which it surely was when compared to the salubrious pastimes of “cards, coquetry and scandal”), Gilman in fact understood quite well the seductive, almost enrapturing, power of communal singing, when he rebuked fellow music-makers for singing “to the praise and glory of our selves alone” instead of to God’s.[62]

Music was certainly a “vital force in the new nation,” and took on increased importance in public celebrations, especially (though not exclusively) in 4th of July

(New York: R. Packard, 1807); *The Town and country song book, a collection of new, favorite, and national songs* (Philadelphia: J. Biorden, 1813).

[60] Samuel Gilman, *Memoirs of a New England Village Choir. With Occasional Reflections*, (Boston: S.G. Goodrich & Company, 1829), 19. Gilman has very lightly fictionalized his work, mostly by changing the names of the town and its inhabitants. Though difficult to date with absolute precision, Gilman asserts that the entire work was written “before the Bunker Hill Monument Celebration,” 116. Gilman’s own movements help in dating his choir days, as he removed to South Caroline in 1819 and spent the rest of his life in Charleston.

[61] Gilman, *Memoirs*, 123.

[62] Gilman, *Memoirs*, 37.

merriment.[63] But the triumphant rituals of music were not reserved only for political revelry. Educators too gave thought to the role that music could play in the formation of the body politic in the aftermath of the Revolution. No less a proponent of education than Benjamin Rush wrote that to “those who have studied human nature, it will not appear paradoxical to recommend … a particular attention to vocal music.” As he saw it, music had “mechanical effects on civilizing the mind,” and prepared it to take in virtuous influences, thus producing virtuous acts. Music’s role in such civic formation was “so often felt and recorded” that Rush argued it was “unnecessary” to detail it any further.[64] He was by no means alone in his beliefs about the public good that would follow from universal training in music, and such instruction certainly had an expanded place in the curricula of the colleges in the years after the Revolution.[65] Even public lectures could include a musical component, designed specifically to imprint their lessons intellectually as well as expressively. Charles Willson Peale annually delivered public talks on natural history, beginning in 1799. His first course of lectures were just that, long talks on natural history. But the “Discourse introductory” to his second

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[63] Richard C. Spicer, “Popular Song for Public Celebration in Federal Portsmouth, New Hampshire,” *Popular Music and Society* 25, no. ½ (2001): 1 – 99. Spicer’s article examines a federalist port town, but the contemporary trends he examines are certainly reflected elsewhere, though especially in New England and along the eastern seaboard towns.

[64] Benjamin Rush, “A Plan for the Establishment of Public Schools and the Diffusion of Knowledge in Pennsylvania .” in Frederick Rudolph, ed., *Essays on Education in the Early Republic* (Cambridge, Mass.: Harvard University Press, 1965), 16. Rush published his essay in 1786.

[65] Phillips Exeter Academy, the University of Pennsylvania, Harvard and Yale, among others. See Kenneth Silverman, *A Cultural History of the American Revolution: Painting, Music, Literature, and the Theatre in the Colonies and the United States from the Treaty of Paris to the Inauguration of George Washington, 1763-1789* (New York: Thomas Y. Crowell, 1976), 477 – 478.

"course of lectures on the science of nature" in 1800 included "original music, composed for, and sung on, the occasion."[66]

In his talks, Peale capitalized on the power of music to better impress upon his listeners "how important [was] the knowledge of Natural Science to every class of citizen."[67] He "addressed the Farmer; the Merchant, and the Mechanic; … and all those professing the fine arts…" in order to convince them that their very "comfort, happiness and support" depended on such scientific knowledge. So too did their virtue and their freedom. Because the "mind of man is ever active," Peale proposed that it needed to be "employed continually." Only thusly could the citizen be "effectually … drawn from vicious habits."[68]

Peale did not articulate the emotive and conducive powers of music, but the intriguing link he did choose to highlight, between science and liberty, was one that had emerged in public talk prior to the Revolution, when the "Sons of Science" (presumably related to the Sons of Liberty) could be "supplied with … capital works" from a Philadelphia bookseller.[69]

The claims for the utility of scientific subjects grew increased, especially when such usefulness could be framed in ways that would shed luster on America. Addressing the American Philosophical Society in 1774, Benjamin Rush linked science to liberty – and charged Americans with maintaining an ideal environment in which science would

[66] Charles W. Peale, *Introduction to a course of lectures on natural history. Delivered in the University of Pennsylvania, Nov. 16, 1799* ; *Discourse introductory to a course of lectures on the science of nature; with original music … Nov. 8, 1800.* The songs themselves were written by Rembrandt Peale.

[67] Peale, *Discourse introductory*, 4.

[68] Peale, *Discourse introductory*, 10.

[69] *Pennsylvania Gazette*, 5 May 1773; 7 September 1774.

thrive.[70] In *his* address before the Philosophical Society the following year, the pre-eminent American astronomer David Rittenhouse reiterated just such sentiments, explicitly linking "Improvement in Science" to "Happiness," and entrusting both to "America."[71] On the "Future Glory of America … shall fair Science feast," assured one public pronouncement.[72] Looking to make American "independence … an object not unworthy" of French interest, one theorist proposed that nothing could be "more glorious" to France than helping to establish in the United States "a young empire, that will one day be the seat of science and the arts."[73]

As public celebrations of the 4th of July gained in prominence once the revolutionary generation died off, those jubilees in the first years of the nineteenth century frequently featured the "Ode on Science." And just as "Hail! Columbia" became the Federalist anthem, so too did the "Ode" find itself pressed into service by dueling partisans.[74] When in 1805 the Federalists of Bangor, Maine celebrated the "Independence of America," with what they deemed "splendour unequalled," they certainly included "Hail! Columbia" and "Washington's March." Not surprisingly, their toast to the "Arts and Sciences" was cheered with the singing of the "Ode on Science."[75]

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[70] Benjamin Rush, *An oration, delivered February 4, 1774, before the American Philosophical Society, held at Philadelphia…*, (Philadelphia: Joseph Crukshank, 1774).

[71] David Rittenhouse, *An oration, delivered February 24, 1775, before the American Philosophical Society, held at Philadelphia, for Promoting Useful Knowledge* (Philadelphia, 1775), p.n.n.

[72] *Pennsylvania Gazette*, 3 June 1778.

[73] *Pennsylvania Gazette*, 6 October 1779.

[74] Neither was it performed exclusively at independence celebrations, though most printed notices focus on 4th of July festivities. Several instances follow.

[75] *Gazette of Maine, & Hancock Advertiser*, 1 August 1805.

But when the "Republicans of New-London" held their celebration of the "Anniversary of American Independence … with a spirit highly patriotic," they commenced with "appropriate singing … of an Ode to Science."[76] When the Bunker Hill Association of Boston held its "Republican Celebration" the following year, they too opened the performances that followed the procession with "Ode on Science."[77] And although the published account of the celebration in Warren, Rhode Island, was not explicit as to the partisan leanings of the celebrants, it "noticed with peculiar pleasure the company of *Federal Blues* … in complete and elegant uniform;" the Ode "concluded the exercises" of the day.[78] For a generation at least the "Ode on Science" formed a part of communal 4th of July celebrations and other overtly political celebrations as well; New York Governor Clinton's re-election gala in 1820 toasted the "Arts & Sciences" with a rendition of the Ode.[79] And when in 1821 Andrew Jackson was installed as governor of the newest U.S. Territory, "a gentleman from Pensacola, Florida" transmitted an account of the proceedings in a letter to a "friend in Bedford, N.H." In it, he described the troops on the main public square as they "marched round the American flag" raised there "to the music, *Ode on science*. Thus closed the ceremony."[80]

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[76] *American Mercury*, 14 July 1808. The Ode is identified as "to" rather than "on" Science, an occasional error in nomenclature.

[77] *Independent Chronicle*, 6 July 1809.

[78] *Bristol County Register*, 8 July 1809.

[79] *New-York Daily Advertiser*, 16 May 1820. To be sure, most performances of the Ode published in news accounts did revolve around celebrations of national independence; however, a Shakespearean celebration held in 1864, to honor of his 300th birthday, also included a performance of the Ode. *Lowell Daily Citizen and News*, 25 April 1864.

[80] *New-Hampshire Patriot & State Gazette*, 3 September 1821. The Ode seemed to serve everyone equally well, including a group of Maine Whigs, who in 1838 composed their own original lyrics to the melody that honored their disdain for the Jacksons, the Tories, and the Loco Focos! *New Hampshire Sentinel*, 15 February 1838.

Jezaniah Sumner almost certainly had no expectation that his Ode would be so durable and so celebrated. The printed notice of the Bristol Academy's opening did not even mention the Ode by name, noting only that the witnesses first "were saluted with a piece of excellent music," then a benediction "which was succeeded by music."[81] Moreover, Sumner's was by no means the first or the only lyric poem Americans addressed to science during the eighteenth-century. The *Pennsylvania Gazette* carried an account of the anniversary commencement at "Princetown" which included "[t]he singing an Ode on Science, composed by the President of the College," the poet Samuel Davies.[82] Likening science to a "bright Beam of Light Divine" that tolled the "Dawn of immortal Day," Davies Ode was an invocation to science to take up residence in the "this Western World … And its wide Wastes refine." And the *Columbian Phoenix*, advertised in early 1800, listed an Ode to Science in its Contents, under Poetry.[83]

Sumner likely intended that his congratulatory Ode honor the occasion – the Bristol Academy's first exhibition. But by dedicating the Ode to the Academy's preceptor, he also paid tribute to the Reverend Simeon Doggett. That compliment must have pleased the Rev. Doggett, as the Ode*'s* exhortations aligned closely with his stated views on the benefits of education. These Doggett had laid out in full at the dedicatory address on the occasion of the Academy's "rise into Existence" in July 1796. Doggett's

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[81] *Boston Gazette, and Weekly Republican Journal*, 1 August 1796.

[82] *Pennsylvania Gazette*, 9 October 1760. The president of the college was Samuel Davies, a Presbyterian clergyman and poet, so we do in fact have a copy of the Ode's lyrics though not the melody. See Richard Beale Davis, ed., *The Collected Poems of Samuel Davies* (Gainesville, Fla.: Scholars' Facsimiles and Reprints, 1968).

[83] *Columbian Centinel*, 8 February 1800. Thus far an actual copy of the book has not come to hand; and which Ode this might be remains to be confirmed.

“very excellent Oration, in which the advantages of a good education were held up, in terms sufficient to do honor to any Gentlemen,” were published by the Trustees of the new Academy the following year.[84] Without delving into the specifics of his views on the responsibilities of American schools as they were then emerging, or what their role in the developing nation should be, we can say that Doggett dreamed big. His essay, like so many others issued in the aftermath of the Revolution, thought about education in a national context, and was “sustained by a dream of the nation that [was] to be.”[85] Doggett, like other thinkers, wanted an educated nation. Far from “merely repeated platitudes,” these discussions of education were overtly political, with political repercussions. To highlight them gives due credence to the rhetoric surrounding their schemes, as well as the ambitions they encapsulated.[86]

Benjamin Rush claimed “nothing was more common” than to confuse the “*American Revolution*” with the “*late American War…*”[87] As Rush saw it, the war had ended but the “American Revolution” was ongoing, and he called on “Philosophers and

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[84] Simeon Doggett, *A Discourse on Education, Delivered at the Dedication and Opening of Bristol Academy …* (New Bedford, Mass.: J. Spooner, 1797). Also in Frederick Rudolph, ed., *Essays on Education in the Early Republic* (Cambridge, Mass.: Harvard University Press, 1965). Advertised in the *Providence Gazette and Country Journal,* 18 June 1796; *Boston Gazette, and Weekly Republican Journal,* 1 August 1796.

[85] Rudolph, *Essays on Education*, ix.

[86] See Lawrence Cremin’s three volume opus on American education, which remains the most extensive treatment of the whole subject: *American Education: The Colonial Experience, 1607 – 1783* (New York: Harper, 1970); *American Education: The National Experience, 1783 – 1865* (New York: Harper, 1980).

Also, Richard D. Brown, *The Strength of a People: The Idea of an Informed Citizenry in America, 1650 – 1870* (Chapel Hill: University of North Carolina Press, 1996).

For an up-to-date summary of the historiographical debates, see Siobahn Moroney, “Birth of a Canon: The Historiography of Early Republican Educational Thought,” *History of Education Quarterly* 39, no. 4 (1999): 476 – 491. The dismissive phrase is Moroney’s, “Birth of a Canon,” 483.

[87] Benjamin Rush, “Address to the American People,” *The American Museum* 1, no. 1 (January 1787): 8 – 12; 8.

friends of mankind" to help in the creation of an American empire based on "*knowledge* as well as virtue."[88] The Ode condensed the arguments of the moment (over federalism, state or nation divisions of government; over educational curricula, public or private, for boys only or co-ed) and submerged them under the hazy yet laudable goal of being an American. What might that be? It was unclear, but part of that identification demanded adherence to particular virtues and support of certain goals, all largely unstated and of which "science" – abstract learning, concrete development, popular pursuit, applied technology, inchoate ambition – science, attended by freedom, bestowing immortality, was a constituent component.[89]

The Ode acted as a form of public discourse as well as a popular entertainment, as patriotic and political spectacle as well as personal inspiration. People turned to the comforts, the inspiration, the reassuring yet elevating promise of goodness, unity, and national glory intrinsic to it. Particularly at times of uncertainty and discord, extolling the benefits science in communal song reinforced a mutual dynamic: as Americans, Science called on them! The concept, much less the practice, of science permitted the

[88] Rush, "Address to the American People," 12.

[89] At another time in our national history, one possibly more uncertain and politically febrile than in the aftermath of the XYZ affair, when the future of the nation once again was doubt – would it continue? in what form? – Americans once again turned passionately to the public performance of shape note, and to the "Ode on Science" in particular. In what were called "Old Folks Concerts," a series of musical performances that revived the "ancient psalmody," of which the Ode formed a part, were put on all across the country. See Judith T. Steinberg, "Old Folks Concerts and the Revival of New England Psalmody," *The Musical Quarterly 59,* no. 4 (1973): 602 – 619. Steinberg, "Old Folks Concerts," 604; *San Francisco Bulletin*, 16 August 1860. Beginning in 1854 (and continuing for more than 50 years) these concerts, performed both by professional troupes as well as local community choirs, tapped into a yearning for the earliest days of the shared national past. Indeed, as part of that nostalgia, many of the choristers dressed in the fashions of their ancestors, including George and Martha Washington; they tuned to ancient pitch pipes. And the "Ode on Science" was a favored song of all those concerts, perhaps the best-loved of all. The first instance of an Old Folks Concert appears in the periodical literature in 1854. *Portsmouth Journal of Literature and Politics*, 18 November 1854; and the last in Duluth in 1905, *Duluth News Tribune,* 24 November 1905. In between, these concerts (and the Ode) were sung from Massachusetts to California.

ordinary as well as the influential to step out of the realm of politics in order to find the virtue that their politics both conferred and demanded. At the same time, the virtue they imbued themselves with naturally, as a consequence of their politics, led to accomplishments in science. And as it had when first written, slipping past the confines of that exhibition day at the Bristol Academy, the Ode inspired pride in the past and hope for the future, and pleasure and satisfaction in themselves. The "Ode on Science" spoke to Americans and for them, providing reassurance about the past and giving voice to their future hopes and aspirations.

In eighteenth-century America, science was not an exclusively elite activity. Rather, it was a feature in some form in most people's lives. While not a neutral ground, the concept, as well as the practice, of science invited people from many different backgrounds, urban and rural, native born or emigrant, elite as well as ordinary, to participate. They neither participated equally nor were made equal by their participation. However, those varied practitioners were able to engage with science without much regard to the mantle of parochial identifications. Science helped provide the tools and training to do, and to be, other things. This extended and democratized science, as expressed in the Ode, the pages of Morse's geography, the declarations of scientific contributions in Jefferson's *Notes on the State of Virginia*, and in a host of other sources, also came to represent both an American culture and a national identity that allowed the people of the new republic to proclaim that "science sets her sons among the stars."

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APS	American Philosophical Society Philadelphia, Pennsylvania
HEH	The Huntington Library, Art Collections, and Botanical Gardens San Marino, California
HSP	Historical Society of Pennsylvania Philadelphia, Pennsylvania
LC	Library Company of Philadelphia Philadelphia, Pennsylvania
MH	Massachusetts Historical Society Boston, Massachusetts
NYHS	New York Historical Society New York, New York
NYPL	Manuscript Division of the Research Libraries of The New York Public Library New York, New York

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