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Enlightened Pursuits:
Science and Civic Culture in Anglo-America, 1730-1760

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ABSTRACT

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This study explores how the world of popular science helped forge a new civic culture during the tumultuous decades of the mid-eighteenth century. I trace the activities of a wide cast of characters in both England and America, revealing the contours of a tightly knit community of scientists, merchants, doctors, landed gentlemen, ministers, craftsmen, and entrepreneurs, whose collaboration in scientific projects made "improvement" a cultural imperative of the age. By the 1740s, I argue, the realm of science-based improvement had emerged as a critical meeting ground for those who sought to bring greater cohesion and prosperity to the British empire at a time when society appeared to be splintering into religious and political factions. Over the course of several decades, these campaigns to promote useful knowledge carved out new civic arenas in which individuals could translate abstract notions of patriotism, collaboration, and self-improvement into a program of concerted action. My dissertation examines how popular science became, in many respects, an alternative to traditional politics—a new way of pursuing the public good that revolved around experimentation and the diffusion of useful knowledge, voluntary associations and networks of exchange, sociability and mutual improvement,

patriotism and projects. And I investigate how this mindset led to the formation of agricultural clubs, botanical gardens, hospitals, philosophical societies, and a host of practical projects that encouraged scientific exchange and experimentation as a way of fostering both moral and material progress. The associational world of science offered opportunities to bring diverse groups together, to encourage new modes of civic action that could heal the fractured nature of society while advancing such important fields as agriculture, manufacturing, navigation, transportation, and public health. This study explores, then, how these wide ranging activities formed the basis of a new civic culture that transformed key dimensions of public life on both sides of the Atlantic.

ACKNOWLEDGEMENTS

"History," Richard White once mused, "has seemed less and less about things or ideas or individual persons and more and more about *relationships*." It is this complex web of connections, he emphasized, that define the texture of life in particular moments of the past. I have often thought about this conception of history over the past several years, as I explored the personal ties and social networks that defined the world of popular science in the eighteenth-century. And I have also been keenly aware of how much my own project owes to the extensive web of people and organizations whose support has made this dissertation possible. Whether they expected to or not, many have found themselves tied to this project in countless ways—reading drafts, answering questions, offering ideas and suggestions, listening to complaints, giving encouragement, steering me away from potential pitfalls, and providing the necessary material and logistical support. Without this constant help—my own network of sustaining ties—I would never have completed this dissertation. I will always be grateful for these relationships.

In terms of institutional support, Northwestern has provided generous funding over the years in the form of fellowships, research grants, tuition waivers, and the like. I am particularly thankful to the Weinberg College of Arts and Sciences, and the donors of the Thomas G. and Mary Ayers Dissertation Fellowship, whose generous support allowed for an unencumbered year of writing. I would also like to thank the Andrew W.

Mellon Foundation, the Society of the Cincinnati, and the Daughters of the American Revolution, all of whom provided financial support at earlier stages of the project. For the past two years, Grinnell College has provided a supportive atmosphere as I worked to finish the dissertation; and I have come to rely heavily on the generosity and encouragement of my colleagues in the History Department.

While graduate school can be a trying experience at times, I was lucky enough to find my way into a remarkable community of graduate students at Northwestern who made life enjoyable, both inside and outside the classroom. Pat Griffin, a fellow colonialist, was the first person I ever met in Chicago. And he taught me more about the profession in the two years that he was in Evanston than he will probably ever realize. In a similar vein, I had the good fortune to spend my first two years in the company of Chris Beneke, Jim Brennan, Karen O'Brien, Sean Fields, Chris Front, and Karen Leroux—all of whom helped guide me through the sometimes rough process of adjusting to the demands of coursework, teaching, and research. Over the years, I developed friendships with an amazing group of colleagues in the History department who made academic life intellectually engaging and fun. I'll always appreciate the wit and good humor of Mark Jurdjevic, Caitlin Tillman, Chris Hodson, Tom Hajkowski, Chris Rogers, Amy Whipple, Frank Rzeczkowski, Guy Ortolano, Dave Collins, Michael Allen, Owen Stanwood, Jarod Roll, Rhiannon Stephens, Krzystof Kozubski, Erik Gellman, Debs Cane, Katie Burns-Howard, and Neil Kodesh.

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If it “takes a village to raise a child”, then it certainly takes an equally supportive web of family and kin to raise a dissertator. Over the years, I came to rely on the support of many relatives and family friends, not the least of whom were Bev, Ned, and Marnie Prevost, my in-laws, whose enthusiastic backing certainly helped bring this dissertation to a successful close. Above all, I am thankful to my parents, Ben and Arlene, and my brother, Lew, for always providing encouragement during this arduous process. They have also demonstrated considerable patience over the years, putting up with numerous absences during holidays, birthdays, and the like.

Yet, my deepest debt of gratitude is to my wife, Elizabeth, whose unwavering love and support made this project not only possible, but worthwhile. It is difficult to summon the words to express my feelings of appreciation for how she has enriched my life. I certainly see the world differently because of her. And only she will be able to appreciate the myriad ways that this dissertation, and my larger journey as a historian, are indebted to her. If relationships really determine the texture of life and the shape of history, as Richard White suggested, than there can be little doubt that our relationship lies at the heart of my personal story—it provides meaning and purpose to everything I do.

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CHAPTER ONE

Introduction:
Science and Civism in the Age of Improvement

> Liberty, science, and commerce, the great friends of man, are sister adventurers. They are intimately, indeed inseparably connected together…To them repair the patriots…who become the guardians of the people's rights, the protectors of learning, and the supporters of their countries trade.
>
> —Letter from a colonial correspondent (1773)

The American colonist Benjamin Franklin had many talents. His wide-ranging activities as a scientist, diplomat, inventor, author, and civic leader made him one of the most prominent figures of the eighteenth century. Yet, a common thread running throughout his various pursuits was a penchant for story telling. Whether Franklin was addressing popular audiences as "Poor Richard", the fictional persona of his best-selling almanac, or addressing diplomats and politicians about the intricate affairs of state, he always knew how to translate complex ideas into a compelling story. Even his scientific writings were published in epistolary form, presenting his research into electricity or other phenomena as engaging dialogues which captured the dynamic process of experimental investigation, collegiality, and speculation that constituted natural philosophy in the eighteenth century. Not surprisingly, Franklin applied the same narrative skills to his own life, producing one of the most influential autobiographies of the age—the grand tale of a grand story-teller.[1]

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[1] Carl Van Doren, *Benjamin Franklin* (New York, 1938); Esmond Wright, *Franklin of Philadelphia* (Cambridge, Ma., 1986); H.W. Brands, *The First American: The Life and Times of Benjamin Franklin* (New York, 2000); *Benjamin Franklin's Experiments. A New Edition of Franklin's Experiments and Observations on Electricity*, ed. I. Bernard Cohen (Cambridge, Ma., 1941); Ormond Seavey, *Becoming Benjamin Franklin: The Autobiography and the Life*

In the summer of 1766, this proclivity led Franklin to compose a short yet provocative story for *The Public Advertiser*, one of London's fashionable newspapers.[2] Like many of his compatriots, Franklin had spent the previous year embroiled in the political controversies surrounding the Stamp Act, a new revenue measure that Parliament passed in March of 1765, levying direct taxes on the American colonists for the first time. The polarizing debates that ensued—pitting the authority of Parliament against colonial assemblies, imperial oversight against local autonomy—seemed to expose ideological fault lines that threatened the cohesion and stability of the British Empire.[3] The sudden political crisis came as a shock to many contemporaries, Franklin included, who had come of age during the previous decades—a period when Britain's far-flung provinces had became more fully integrated into the dynamic economy and culture of metropolitan society.[4] By mid-century, the combined effects of commercial expansion, increased mobility, and improved communications had brought once distant communities into the expanding orbit of Britain, establishing a web of transatlantic connections that increasingly linked the disparate inhabitants of the Anglo-American

(University Park, Pa., 1988); P.M. Zall, "A Portrait of the Autobiographer as an Old Artificer," and J.A. Leo Lemay, "The Text, Rhetorical Strategies, and Themes of 'The Speech of Miss Polly Baker," in *The Oldest Revolutionary*, ed. J.A. Leo Lemay (Philadelphia, 1976), 53-67; 91-121. See also Franklin's revealing comments in his early essay, "On Conversation," *Pennsylvania Gazette*, 15 October 1730.

[2] Franklin's account in *The Public Advertiser* is reprinted as "'Americanus': On Obstructions in the Thames," in *The Papers of Benjamin Franklin*, ed. Leonard W. Labaree, 35 vols. (New Haven, Ct., 1959—), XIII, 382-3.

[3] On Franklin's complex role in the Stamp Act Crisis, see Verner W. Crane, *Benjamin Franklin and a Rising People* (Boston, 1954); Crane, ed., *Benjamin Franklin's Letters to the Press, 1758-1775* (Chapel Hill, 1950); and *The Examination of Dr. Benjamin Franklin before an august Assembly, relating to the repeal of the Stamp-Act, &c…* (London, 1766). For the broader dimensions of the controversy, see Edmund S. Morgan and Helen M. Morgan, *The Stamp Act Crisis: Prologue to Revolution*, 2nd ed. (Chapel Hill, 1995); Peter D. G. Thomas, *British Politics and the Stamp Act Crisis: The First Phase of the American Revolution, 1763-1767* (Oxford, 1975).

[4] Gordon S. Wood explores this sense of ironic surprise in *The Americanization of Benjamin Franklin* (New York, 2004).

world in new and meaningful ways. Ironically, then, the Stamp Act crisis erupted at the very moment when most people had begun to identify more closely with Britain and the imperial system that had brought new levels of prosperity and security to their communities.[5]

The irony was not lost on Franklin, whose entire career and outlook had been shaped by these earlier developments. Indeed, his rise to wealth and prominence had rested upon his canny ability to marshal the transatlantic forces of his age—to straddle the dynamic worlds of print, commerce, and enlightenment culture while assiduously cultivating personal connections throughout the British Empire. For nearly three decades, the up-start printer turned civic gentleman had carefully developed an extensive network of correspondents and colleagues who shared his interest in science, useful projects, and worldly "improvement".[6] Accordingly, Franklin had a hand in almost every major transatlantic initiative, ranging from the Albany conference in 1754, which proposed a blueprint for unifying the colonies, to a variety of schemes for creating better organized settlements in the West, experimenting with new crops and industries, establishing libraries and hospitals, philosophical societies and fire companies—any practical

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[5] H.V. Bowen, *Elites, Enterprise and the Making of the British Overseas Empire, 1688-1775* (New York, 1996), ch. 5-6; Ned C. Landsman, *From Colonials to Provincials: American Thought and Culture, 1680-1760* (Ithaca, NY, 2000); T.H. Breen, *The Marketplace of Revolution: How Consumer Politics Shaped American Independence* (New York, 2004), ch. 3-4; T. H. Breen, "Ideology and Nationalism on the Eve of the American Revolution: Revisions Once More in Need of Revising," *Journal of American History* 84 (1997): 13–39. Cf. Jon Butler, *Becoming America: The Revolution before 1776* (Cambridge, Ma., 2000).

[6] Franklin's Autobiography still remains one of the best accounts of how his career rested upon scientific connections, useful projects, and the civic-minded pursuit of improvement. Louis P. Masur, *The Autobiography of Benjamin Franklin with Related Documents* (Boston and New York, 2003). For scholarly assessments, see Brands, *The First American*; and Wright, *Franklin of Philadelphia*; John Heilbron, "Franklin as an Enlightened Natural Philosopher," in *Reappraising Benjamin Franklin: A Bicentennial Perspective*, ed. J.A. Leo Lemay (Newark, 1993), 196-220; Joyce E. Chaplin, *The First Scientific American: Benjamin Franklin and the Pursuit of Genius* (New York,

endeavors that would improve everyday life and strengthen communities. Franklin's whole career, in fact, had been wrapped up in this world of patriotic "improvement", where civic-minded groups experimented with new projects to advance the welfare and prosperity of society at large.[7] It was a model of civic life that galvanized Franklin's generation; and his August 22nd letter to *The Public Advertiser* tried to steer the nation's attention back to this shared vision of enlightened progress.[8] Hoping to put aside the acrimonious debates over political rights and taxation, Franklin wrote a timely story about one colonist's encounter with the Thames River, the pressing need for navigational improvements, and most importantly, the political culture that had allowed this problem to reach such a critical stage.[9]

2006); Carl and Jessica Bridenbaugh, *Rebels and Gentlemen: Philadelphia in the Age of Franklin* (New York, 1942); Landsman, *From Colonials to Provincials*, esp. 54, 144-6.

[7] For a discussion of the extent and appeal of "improvement"—"that ultimate Georgian buzzword", as the historian Roy Porter referred to it—see, Samuel Miller's *A Brief Retrospect of the Eighteenth Century*, 2 vols. (New York, 1803); Richard Drayton, *Nature's Government: Science, Imperial Britain, and the 'Improvement' of the World* (New Haven, 2000); Larry Stewart, *The Rise of Public Science: Rhetoric, Technology, and Natural Philosophy in Newtonian Britain, 1660-1750* (Cambridge, 1992); Carl Bridenbaugh, *Cities in Revolt: Urban Life in America, 1743-1776* (New York, 1955), ch. 5 & 10; Joyce E. Chaplin, *An Anxious Pursuit: Agricultural Innovation & Modernity in the Lower South, 1730-1815* (Chapel Hill, 1993), ch. 5; Roy Porter, *The Creation of the Modern World: The Untold Story of the British Enlightenment* (New York, 2000), ch. 6 & 19, (quote on p. 426); R.H. Campbell, "Scottish Improvers and the Course of Change in the Eighteenth Century," in *Comparative Aspects of Scottish and Irish Economic History, 1600-1900*, ed. L.M. Cullen and T.C. Smout (Edinburgh, 1977), 204-15; D.D. McElroy, *Scotland's Age of Improvement: A Survey of Eighteenth-Century Literary Clubs and Societies* (Pullman, Wa., 1969); Charles W.J. Withers, "Improvement and Enlightenment: Agriculture and Natural History in the work of the Rev. Dr. John Walker (1731-1803," in *Philosophy and Science in the Scottish Enlightenment*, ed. Peter Jones (Edinburgh, 1988), 102-16; C.A. Bayly, *Imperial Meridian: The British Empire and the World, 1780-1830* (London, 1989); John Gascoigne, *Joseph Banks and the English Enlightenment: Useful Knowledge and Polite Culture* (Cambridge, 1994); D.G.C. Allan, "Dear and Serviceable to Each Other": Benjamin Franklin and the Royal Society of Arts," *Proceedings of the American Philosophical Society* 144 (2000), 245-66; and David Hancock, *Citizens of the World: London Merchants and the Integration of the British Atlantic Community, 1735-1785* (Cambridge, 1995), ch. 9.

[8] Bob Harris provides an insightful analysis of how aspects of improvement, civic reform, and "patriotism" became woven together for Franklin's generation in his *Politics and the Nation: Britain in the Mid-Eighteenth Century* (Oxford, 2002).

[9] Franklin seemed particularly interested in hydraulic projects during this time period—river improvements, canals, and drainage schemes—a trend that reflected his recent tour across parts of the continent as well as the growing popularity of such issues among his circle of friends and associates. See Franklin's letter to Sir John Pringle reprinted in his *Experiments and Observations on Electricity…* (London, 1769), 492-6.

Recounting a failed trip across the Thames, Franklin's story sounded like a parable of enlightenment values, underscoring the importance of practical knowledge, useful projects, and civic engagement. Readers learned that the author, "Americanus", was a colonial "Gentleman" who had been touring England in the hopes of familiarizing himself with "the Customs of my dear Mother Country." Eager to visit the Temple Church, which housed the famed Inns of Court for the legal profession, the author decided to take a short cut. Rather than travel by foot across Westminster Bridge, he hired a local boat to ferry him across the Thames, expecting to arrive directly on the doorsteps of the Temple. But he soon discovered that his fare only took him as far as the large shoal or causeway blocking a significant portion of the river; and from there, "I had near as far to walk to get to the natural Shore as if I had walked all the Way." Concerned that such obstructions would be allowed to accumulate along this vital artery, the colonial visitor "thought it my Duty" to seek out the appropriate parties to resolve the problem, consulting with members of the bar and municipal government. Yet, his trips to the Inns of Court and Trinity House proved utterly futile. Neither group, he discovered, was interested in tackling the issue, leading the frustrated American to surmise that lawyers and political officials were "of no real Use to Mankind." And so, the author decided "to apply to the Public" instead, composing a short letter for the newspaper with his observations on the matter. Addressed to all civic-minded individuals, "Americanus" called on public-spirited groups to develop their own projects for improving the Thames, since "the Preservation of the City entirely depends upon it's Navigation."[10]

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[10] "On Obstructions in the Thames," *Papers of Benjamin Franklin*, 13: 382-3.

With his characteristic humor and barbed wit, Franklin's story used the example of the Thames to illustrate larger points about the nexus of British politics, patriotism, and imperial power. He clearly enjoyed puncturing the inflated sense of superiority that he encountered among certain segments of the ruling class in 1766. After all, British officials were busy lecturing colonists on the need for more energetic administration within the empire while the Thames river—the main artery of imperial commerce and metropolitan life—was slowly closing up in front of their very eyes. Indeed, "Americanus" seemed to relish turning the proverbial tables on his audience, revealing how provincial visitors might compare London unfavorably to their own experiences. "We Americans have the same Contempt for the Thames," Franklin declared quite provocatively, "as the Inhabitants of Gravesend have for Fleet Ditch"—the notorious mud-filled channel that had become largely consigned to waste disposal by the eighteenth century. Yet, the contemptible state of the river was not the fault of nature, but rather of the lawyers and politicians who refused to take action. Their abdication of responsibility highlighted the disquieting fact that many of the traditional arenas of public life—such as courts, municipal bodies, or government institutions—were of "no real Use to Mankind" when it came to a wide range of practical matters.[11] Members of the "public", therefore, would have to seize the initiative and develop their own schemes for improving the navigation of the river as well as other vital projects. The broader lesson seemed clear. Britons would have to look to the associational world of civil society, not the government, to revitalize the nation and ensure its continuing prosperity and power.

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[11] These themes were echoed in a similar anonymous piece, "On the Paving of Chancery Lane," that Franklin

The moral of Franklin's story has much to tell us about the cultural and political outlook of Britons on the eve of the imperial crisis. Indeed, his celebration of civic enterprise and improvement, along with his dismissive portrayal of the standing political order, reflected a particular worldview with deep historical roots. And the point of Franklin's story was to call the nation back to these "improving" roots—to remind his compatriots that the path to moral and material progress did not lie in the fractious world of politics, but rather, in the realm of civic improvement, where groups could experiment with a variety of practical projects for the betterment of themselves, their communities, and the nation at large. Since the beginning of the eighteenth century, this mindset had radiated outward from the coffee-houses and assembly rooms of London, finding a particularly receptive audience in the provincial regions of the empire, where aspiring inhabitants sought to emulate the most dynamic aspects of metropolitan culture.[12] Franklin certainly played a conspicuous role within this growing movement, emerging as a consummate improver whose pragmatic efforts covered everything from developing more efficient fireplaces to the promotion of silk culture and new agricultural machines. But his activities were by no means unique. A surprisingly large number of

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published in *The Gazetteer and New Daily Advertiser* earlier in 1766. *Papers of Benjamin Franklin*, 13:9.

[12] Roy Porter, "Science, Provincial Culture and Public Opinion in Enlightenment England," *British Journal for Eighteenth-Century Studies* 3 (1980), 20-46; Ned C. Landsman, "The Provinces and the Empire: Scotland, the American Colonies, and the Development of Provincial Identity," In *An Imperial State at War: Britain from 1689 to 1815* ed. Lawrence Stone (New York, 1994), 258-87; John Clive and Bernard Bailyn, "England's Cultural Provinces: Scotland and America," *William and Mary Quarterly* 11 (1954), 200-213; D.D. McElroy, *Scotland's Age of Improvement*; Nicholas Phillipson, "The Scottish Enlightenment," in *The Enlightenment in National Context* (Cambridge, 1981), 19-40; Richard Sher and Jeffrey Smitten, ed., *Scotland and America in the Age of the Enlightenment* (Princeton, 1990); Bridenbaugh, *Cities in Revolt*, ch. 5 & 8; John Money, *Experience and Identity: Birmingham and the West m Midlands, 1760-1800* (Manchester, 1977), ch. 4-6; Porter, *Creation of the Modern World*, 11-14, 36-46, 232-55; Peter Borsay, *The English Urban Renaissance: Culture and Society in the Provincial Town, 1660-1770* (Oxford, 1989), ch. 10; Kathleen Wilson, *The Sense of the People: Politics, Culture and Imperialism in England, 1715-1785* (Cambridge, 1995), ch. 1.

contemporaries participated in the various campaigns and projects that emerged by mid-century, forming a dense web of transatlantic groups who shared a commitment to the public-spirited goals of experimentation, practical science, and improvement.[13] Collectively, their efforts transformed the social and cultural landscape of many parts of the Anglo-American world. For the realm of enlightened improvement created new forms of sociability and collaboration; it changed the import of knowledge and leisure; it opened up new paths to respectability and personal advancement; and it fostered new modes of patriotism, public service, and civic life.

By 1766, Franklin and others worried that the imperial crisis might erase this legacy. It seemed that the vibrant culture of improvement, which had carved out a distinct social space linking the concerns and aspirations of diverse groups throughout the empire, was beginning to retreat as the political firestorm over taxation and imperial policy threatened to engulf the Anglo-American world. In this context, Americanus' figurative journey across the Thames was meant to remind contemporaries of the larger story that Britons shared, to underscore how the empire's dramatic rise to power and affluence was rooted in a particular brand of enlightened civic culture that had mobilized

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[13] Stewart, *The Rise of Public Science*; Drayton, *Nature's Government*; John Gascoigne, "The Eighteenth-Century Scientific Community: A Prosopographical Study," *Social Studies of Science* 25 (1995), 575-81; Gascoigne, *Joseph Banks and the English Enlightenment*; Alan Q. Morton and J.A. Wess, *Public and Private Science: The King George III Collection* (Oxford, 19943); Chaplin, *An Anxious Pursuit*, ch. 5; A.E. Musson and Eric Robinson, *Science and Technology in the Industrial Revolution* (Manchester, 1969); John R. Millburn, *Benjamin Martin: Author, Instrument-maker, and 'Country Showman'* (Leiden, 1976); Carl Bridenbaugh, "Philosophy Put to Use: Voluntary Associations for Propagating the Enlightenment in Philadelphia, 1727-1776," *Pennsylvania Magazine of History and Biography* 101 (1977), 70-88; Raymond Stearns, *Science in the British Colonies of America* (Urbana, Ill., 1970); Whitfield J. Bell, Jr., *Patriot Improvers: Biographical Sketches of Members of the American Philosophical Society*, 2 vols. (Philadelphia, 1997); Margaret C. Jacob, *The Cultural Meaning of the Scientific Revolution* (New York, 1988); and Jacob, *Scientific Culture and the Making of the Industrial West* (New York, 1997).

the intellectual and social capital of the nation in the name of worldly improvement. This dissertation tries to reconstruct that story.

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While many of the individual themes and issues that lie at the heart of this study will appear familiar to students of the period, the overall picture that emerges offers a strikingly different interpretation of the historical dynamics shaping Anglo-American society in the eighteenth century. In particular, my project reveals how the expanding world of popular science emerged as one of the major engines of social and cultural change during the turbulent decades of mid-century.[14] It explores how the popularization of natural philosophy, and its appropriation by different social groups throughout the empire, laid the foundation for the public's embrace of "improvement" as well as the unique brand of civic culture it entailed. From Scotland and Ireland to the colonies of the American South, the expanding world of science transformed the nature of civic life within many provincial communities by establishing a shared framework of activities and

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[14] While the literature devoted to history of science in eighteenth-century Britain is much larger than the scholarship devoted to colonial science, the field has grown significantly in the past few decades. The standard introductory works still remain Brook Hindle's *The Pursuit of Science in Revolutionary America, 1735-1789* (Chapel Hill, 1956); Raymond P. Stearns, *Science in the British Colonies of America* (Urbana, Ill., 1970); Theodore Hornberger, *Scientific Thought in the American Colleges, 1638-1800* (New York, 1968); and Silvio A. Bedini, *Thinkers and Tinkers: Early American Men of Science* (New York, 1975). Some of the more recent studies include Joyce E. Chaplin, *Subject Matter: Technology, the Body, and Science on the Anglo-American Frontier, 1500-1676* (2001); Chaplin, *First Scientific American*, Carla Mulford, "New Science and the Question of Identity in Eighteenth-Century British America," in *Finding Colonial Americas: Essays Honoring J.A. Leo Lemay*, ed. Carla Mulford and David S. Shields (Newark, Del., 2001); Susan Scott Parrish, *American Curiosity: Cultures of Natural History in the Colonial British Atlantic World* (Chapell Hill, 2006); John C. Greene, *American Science in the Age of Jefferson* (Ames, Ia., 1984); I. Bernard Cohen, *Science and the Founding Fathers: Science in the Political Thought of Jefferson, Franklin, Adams, and Madison* (New York, 1995); Chaplin, James Delbourgo, *The Most Amazing Scene of Wonders: Electricity and Enlightenment in Early America* (Cambridge, Ma., 2006); Alfred Hoermann, *Cadwallader Colden: A Figure of the American Enlightenment* (Westport, Ct., 2002); and Sara Gronim, *Everyday Nature: Knowledge of the Natural World in Colonial New York* (New Brunswick, NJ, 2007).

cultural practices, ideals and institutional arrangements, that resonated with the concerns of the public. Indeed, eighteenth-century science was more than simply a respected branch of knowledge. It was a distinct form of community—one bound together by new associational ties, an ethos of collaboration, and a particular ideology of progress. And by mid-century, the "republic of science" was increasingly celebrated as a model of how to effectively organize social relationships and collective action on a broader scale.[15] As we shall see, the considerable appeal of this model lay in the peculiar mix of enlightened optimism and public anxiety that informed Anglo-American society during this transformative period, c. 1730-1760.[16]

With its vision of worldly improvement, science appeared to reconcile the private interests and desires of individuals with older notions of civic responsibility, public service, and a dedication to the common good. For individual participants, eighteenth-century science provided a respectable avenue to personal advancement, gentility, and refinement. The pleasures of enlightened sociability also drew many people into the ranks of natural philosophy, where individuals could enjoy rational conversation, edifying leisure, and collaborative friendships. Piety and moral character would be enhanced as well by the careful study of God's creation.[17] But as many contemporaries

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[15] As Steven Shapin and Arnold Thackray have pointed out, the "perceived rules and structure of the scientific community as a social system…offered a vision of a new rational order" that appealed to many groups within British society. For their comments on this aspect of the "republic of science," see Shapin and Thackray, "Prosopography as a Research Tool in the History of Science: The British Scientific Community, 1700-1900," *History of Science* 12 (1974), 4-6. See also, Michael R. Lynn, *Popular Science and Public Opinion in Eighteenth-Century France* (Manchester, 2006).

[16] On the optimism and anxiety of mid-century, see Chapter Three.

[17] On the malleable appeal of science—its connections to polite culture, pleasure, profitability, and social advancement—see, Golinski, *Science as Public Culture*; ch. 1; Gascoigne, *Joseph Banks and the English*

emphasized, popular science was unique in its ability to harness these desires for self-improvement, pleasure, and piety to a broader vision of public service—creating its own moral economy of civic engagement. Under the banner of enlightened improvement, natural philosophy invited groups to participate in a meaningful endeavor that fused personal ambitions, collaborative experiments, the cultivation of useful knowledge and discoveries, and a patriotic concern for the well-being of the nation at large.[18] In an age when contemporaries bemoaned the splintering effects of sectarian rivalries, political factionalism, and rampant self-interest, much of the appeal of popular science derived from the fact that it could channel these anxieties and interests into a concerted program of civic renewal. This deep-seated desire for restoring communal ties and a spirit of participation within a common endeavor—what the political philosopher Michael Walzer has called "civism"—found a powerful avenue of expression in the form of popular science with its commitment to cooperation and public sociability, mutual improvement and civic stewardship, polite learning and patriotic projects.[19] As one participant noted, the collegial network of clubs and associations created a space within civil society "for

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Enlightenment, ch. 3 & 5; Porter, *The Creation of the Modern World*, ch. 6; Geoffrey V. Sutton, *Science for a Polite Society: Gender, Culture, and the Demonstration of Enlightenment* (Boulder, CO, 1995); Morton and Wess, *Public and Private Science*; Alice Walters, "Conversation Pieces: Science and Politeness in Eighteenth Century England," *History of Science* 35 (1997), 121-54; and Larry Stewart and Paul Weindling, "Philosophical Threads: Natural Philosophy and Public Experiment Among the Weavers of Spitalfields," *British Journal for the History of Science* 28 (1995), 37-62; Hancock, *Citizens of the World*, ch. 9-10.

[18] While my focus on the realm of science differs significantly from the Peter N. Miller's study of moral, religious, and political philosophy during this time period, I do share his interest in exploring the pervasive concern and debate over "the common good" and its relationship to both civil society and the political order. Miller, *Defining the Common Good: Empire, Religion, and Philosophy in Eighteenth-Century Britain* (Cambridge, 1994). These same themes are explored in Bob Harris' *Politics and the Nation*.

[19] Michael Walzer, "The Idea of Civil Society: A Path to Social Reconstruction," *Dissent* 39 (1991), 293-304; Walzer, "The Civil Society Argument," in *Dimensions of Radical Democracy: Pluralism, Citizenship and Community*, ed. Chantal Mouffe (London, 1992); Walzer, Rescuing Civil Society," *Dissent* 47 (1999), 62-68. For an example of

mutual improvement, for increasing our knowledge, and mending our hearts", offering a welcomed respite from the fragmented realities of a commercializing market, religious pluralism, geographic mobility, and party politics.[20] For eighteenth-century Britons, then, the realm of scientific improvement seemed to fuse the yearnings of civism with the dreams of material progress, giving rise to an enticing vision of civic renewal.

Indeed, the culture of enlightenment science was flexible enough to encompass a remarkable range of private ambitions and interests, while still managing to rally diverse groups around a common ideal of improvement in all spheres of life. A scientific-minded club or project, for example, might bring together craftsmen and genteel landholders, Whigs and Tories, urbanites and provincial inhabitants, high-church Anglicans and Scottish Presbyterians.[21] "Such a union of classes around the altar of improvement," as one historian has pointed out, reflected the fact that this growing faith in scientific experimentation was "a creed elastic enough" to encompass interests in agriculture, navigation, manufacturing, transportation, and indeed, almost every aspect of daily life.[22] Connected by common goals, and drawn together by an ideology that associated the promotion of useful knowledge with patriotic service, individuals could participate in a shared endeavor that bridged the growing social divides of Hanoverian society. To be sure, there were other cultural venues where "mixed" company might

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how the dynamics of civism might inform historical analysis, see Steven Watt's *The Republic Reborn: War and the Making of Liberal America, 1790-1820* (Baltimore and London, 1989), esp. 100-108.

[20] Quoted in Peter Clark's *British Clubs and Societies, 1580-1800: The Origins of an Associational World* (Oxford, 2000), 413. This theme is addressed in greater detail in Chapter Two.

[21] Shapin and Thackray, "Prosopography as a Research Tool: The British Scientific Community," 6-12.

[22] Gascoigne, *Joseph Banks and the English Enlightenment*, 228.

assemble for conviviality or mutual interest. Such groups often congregated in the polite assembly rooms and concert halls of urban centers, or converged to discuss art and antiquities in fashionable clubs.[23] But the world of science stood apart because of its vaunted connections to the moral and material progress of society, making the pursuit of natural knowledge a civic-minded endeavor. "All Improvers of this Country," one commentator exclaimed, were "free spirited *PATRIOTS*…who ought to be esteemed for undertaking such laudable Actions." And there were hardly any limits "to what may be performed by private Gentlemen," he continued, "when stimulated by enterprising Spirits" and connected by the collaborative networks of science.[24]

Few contemporaries understood this relationship between science and civic culture better than Benjamin Franklin, who was in a enviable position to evaluate the constellation of ideas and practices that underpinned the transatlantic movement of improvers. Since the 1730s, Franklin had emerged as one of the leading civic "projectors" of the day—someone who worked tirelessly to form clubs, subscription campaigns and civic institutions for the betterment of society. Whether the issue involved street cleaning or the creation of public hospitals, Franklin seemed to know, almost instinctively, how to organize people and resources to accomplish these public-spirited goals. Yet, Franklin's success had less to do with personal brilliance or charisma, than his ability to mobilize the intellectual and social capital of the age. To do

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[23] Wilson, *A Sense of the People,* ch. 1; Borsay, *English Urban Renaissance*; Clark, *British Clubs and Societies*, 194-273.

[24] [Anon.], *Considerations on Agriculture: Treating Of Several Methods Practiced in Different Parts of the Kingdom of Ireland, with Remarks thereon…* (Dublin, 1730), 85.

so, Franklin drew upon his experiences and connections from the realm of natural philosophy. Since his early days as a young journeyman in London, Franklin's interest in science had provided an important entrée into the world of polite metropolitan society. The aspiring printer quickly learned how to navigate this new cultural terrain, catching the attention of worldly scientists like Sir Hans Sloane, the president of the Royal Society and one of the most well-connected figures in Hanoverian Britain. As he moved through these circles, Franklin learned how to excel in the art of conversation; to interact in a sociable manner; to cultivate beneficial friendships and correspondents; to exchange information and material support; and perhaps most importantly, to master the associational techniques of the day. Participating in a variety of philosophical societies and clubs in London, he witnessed first hand the fusion of rational inquiry, enlightened sociability, and mutual improvement that was so characteristic of eighteenth-century science and the larger British Enlightenment. Franklin's involvement in this scientific world provided a hands-on apprenticeship in the skills and outlook that inspired the enterprising business of improvement. And over the subsequent decades, he put these resources to work, building up an extensive network of correspondents and scientific colleagues whom he could draw upon for information and support.[25] In other words,

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[25] My thinking about the popularization of science in eighteenth-century America—and in particular, the ways in which science became a cultural commodity promoted by various groups whose motives were often as pragmatic and worldly as they were philosophical—is rooted in certain strands of Enlightenment historiography that have tended to emphasize the "business of enlightenment" and the "social history of ideas." Particularly helpful, in this regard, have been: Robert Darnton, *Mesmerism and the End of the Enlightenment in France* (Cambridge, Ma., 1968); Darnton, *The Business of Enlightenment: A Publishing History of the Encyclopedie, 1775-1800* (Cambridge, Ma., 1979); Darnton, *The Literary Underground of the Old Regime* (Cambridge, 1982); J.H. Plumb, *The Commercialisation of Leisure in Eighteenth-Century England* (Reading, Eng., 1974); John Money, *Experience and Identity: Birmingham and the West Midlands*; John Brewer and Roy Porter, eds., *Consumption and the World of Goods* (London, 1993); Margaret Jacob, *Living the Enlightenment: Freemasonry and Politics in Eighteenth-Century Europe* (Oxford, 1991); John Brewer, *The Pleasures of the Imagination: English Culture in the Eighteenth Century* (London, 1997); Porter, *The Creation of the*

science provided the cultural capital needed to engage in the sorts of collaborative endeavors that drove the expanding realm of improvement

While few scholars would dispute the central role that science played in shaping Franklin's worldview or his improving zeal, they often discount the larger impact of natural philosophy among his contemporaries. This approach is rooted in the fact that historians have typically treated science as an isolated endeavor—an intellectual venture essentially removed from the more worldly affairs of the people they study. Many biographies of eighteenth-century figures, for example, tend to confine scientific pursuits and interests to a separate chapter, proceeding as if such philosophical endeavors had little bearing on their subject's cultural identity, their social and economic connections, or their political outlook. Like a predilection for music or poetry, then, scientific interests are assigned to the private realm of personal attainments, far removed from the concerns of public life. In a similar vein, local histories and thematic surveys often deal with science in a compartmentalized fashion, essentially drawing an interpretive boundary between it and other spheres of eighteenth-century life. And while such organizational strategies have their place, there is a potential danger in carving up the past into such neat categories—ones that may very well obscure how contemporaries understood their own activities or the connections between different parts of their lives. A revealing example can be found in Thomas Pownall, one of Franklin's close friends and a prominent figure within the political and intellectual circles of mid-century Britain.

Modern World; and David Jaffee, "The Village Enlightenment in New England, 1760-1820," *William and Mary Quarterly* 47 (1990), 327-46.

Born into a modest family, Pownall rose from a position as a personal secretary to become governor of Massachusetts and eventually a respected Member of Parliament with strong ties to the leading politicians and *literati* of the day. The dramatic trajectory of his career, along with his influential writings on the nature of the imperial system, have long made Pownall a subject of interest among historians, especially those trying to gauge the evolving relationship between metropolitan Britain and the colonial provinces during the transformative years leading up to the American Revolution.[26] But unlike Franklin, scholars have tended to downplay the role of science in Pownall's life, treating his wide-ranging interests in natural philosophy and useful projects as a kind of cultural sideshow—something that reflected his cultivated tastes as a man of the Enlightenment, but did not shape the real drama unfolding on the center stage of Anglo-American politics. Yet, the story of Pownall's career can be viewed from a different perspective.[27] His ability to establish close ties with important individuals on both sides of the Atlantic—gentlemanly improvers like Franklin, the Earl of Halifax, Peter Collinson, or Arthur Young—was due in large part to his scientific interests and his penchant for projecting. Pownall knew how to use these enlightened credentials to attract powerful patrons and to cultivate working relationships with like-minded associates. His correspondence was filled with various schemes for improvement, ranging from

[26] A good overview can be found in John Shy, "Thomas Pownall, Henry Ellis, and the Spectrum of Possibilities, 1763-1775," in *Anglo-American Political Relations, 1675-1775*, ed. Alison Gilbert Olson and Richard M. Brown (New Brunswick, NJ, 1970), 183-6; and John A Schutz, *Thomas Pownall, British Defender of American Liberty: A Study of Anglo-American Relations in the Eighteenth Century* (Glendale, Ca., 1951).

[27] Those who have focused more heavily on Pownall's scientific interests, such as I. Bernard Cohen, have tended to explore the role of natural philosophy in shaping Pownall's political theory; whereas I am more interested in examining the role of science in shaping Pownall's social connections and his worldly pursuits as an aspiring gentleman. Cohen, *Science and the Founding Fathers*, 36-41.

agricultural reforms to charting the ocean's currents to clearing rivers for internal navigation. The latter topic appears to have been a major preoccupation of Pownall's around the same time that Franklin was writing his story of "Americanus" and the deteriorating state of the Thames. Pownall's extensive research and experiments into the techniques of engineering river channels exemplified the kind of enlightened pursuit of useful knowledge that increasingly defined gentleman as patriotic and public-spirited.[28] Science, in other words, represented a key part of his public persona, a cultural marker that conveyed social standing, education, and genteel service.[29] It also required tapping into a broader network of human capital, accessing information and collaborative support from colleagues around the Anglo-Atlantic world.

Like Franklin, then, Pownall's identity and his sense of purpose were intimately tied to the world of scientific improvement. Gentlemanly science provided a dense web of social connections, a cultural framework that guided everyday practices, and an ideology that invited participants to see their activities as a unique form of civism. When Pownall extolled the new spirit of enlightened patriotism emerging in certain quarters of the nation, he captured the sense of possibility and common purpose that such a worldview could instill. "There seems to be a temper for mutual communication instead of altercation," Pownall explained, and it was part of a broader "temper in business, that *public spirit*, which will look to the interest of the whole, and to that of each part, only as

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[28] Thomas Pownall, *A Topographical Description…* (London, 1776); Pownall, *A Memoir, Entitled Drainage and Navigation But One United Work…* (London, 1775).

[29] See, for example, Pownall's address in the *Boston Weekly News-Letter*, 25 August 1757.

it is a part of that whole."[30] For Pownall and his associates, this change in the nation's civic "temper"—the desire for collaboration and a focus on the common good—was intimately tied to the culture of scientific improvement.

As the examples of Franklin and Pownall suggest, the central argument of this dissertation is grounded in a reappraisal of the nature and scope of eighteenth-century science, the social consequences of its expansion, and the ideological context that infused new meaning into scientific pursuits. Consequently, the following chapters trace the evolving connections between science and three key developments in the Anglo-American world of the mid-eighteenth century—namely, the cultural politics associated with civility and refinement; the advent of new forms of public sociability and personal networks; and the transatlantic forces of "anglicization" and imperialism that exerted such a powerful influence on provincial communities. Each of these issues constitutes a significant theme in the historiography of the period.[31] And this dissertation tries to explain how the sphere of popular science managed to channel these forces into a

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[30] Pownall, *A Memoir, Entitled Drainage and Navigation*, 5.

[31] The literature in these areas has become voluminous, but some of the more important scholarly works on politeness and civility include: Lawrence E. Klein, *Shaftesbury and the Culture of Politeness: Moral Discourse and Cultural Politics in Early Eighteenth Century England* (Cambridge, 1994); J.G.A. Pocock, "Virtues, Rights, and Manners: A Model for Historians of Political Thought," in his *Virtue, Commerce, and History: Essays on Political Thought and History, Chiefly in the Eighteenth Century* (Cambridge, 1985), 37-50; Richard L. Bushman, *The Refinement of America: Persons, Houses, Cities* (New York, 1992); David S. Shields, *Civil Tongues & Polite Letters in British America* (Chapel Hill, 1997); C. Dallett Hemphill, *Bowing to Necessities: A History of Manners in America, 1620-1860* (New York, 1999). For analysis of sociability, see: Clark, *British Clubs and Societies*; Peter Clark, *Sociability and Urbanity: Clubs and Societies in the Eighteenth Century* (Leicester, Eng., 2000); Jonathan Barry, "Bourgeois Collectivism? Urban Association and the Middling Sort," in *The Middling Sort of People: Culture, Society, and Politics in England, 1550-1800*, ed. Jonathan Barry and Christopher Brooks (New York, 1994), 84-112; Alexandra Shepard and Phil Withington, eds., *Communities in Early Modern England: Networks, Place, Rhetoric* (Manchester, 2000); Richard D. Brown, *Knowledge is Power: The Diffusion of Information in Early America, 1700-1865* (New York, 1989). Finally, for Anglicization, see: John M. Murrin, "The Legal Transformation: The Bench and Bar of Eighteenth-Century Massachusetts," in *Colonial America: Essays in Politics and Social Development*, ed. Stanley N. Katz (Boston, 1971), 415-49; T.H. Breen, "An Empire of Goods: The Anglicization of Colonial America, 1690-1776," *Journal of British Studies* 25 (1986), 467-99; Breen, "Ideology and Nationalism,"; Bowen, *Elites, Enterprise and the Making of the British Overseas Empire*, ch. 5.

concerted campaign for improvement and civic renewal—one that spoke to the shared concerns of Britons throughout the Anglo-Atlantic world.

Viewing the developments of mid-century through the lens of popular science invites historians to reconsider the role of the Enlightenment in shaping the lived experiences and cultural aspirations of many provincial inhabitants. Scholars of the Enlightenment, as well as historians of science, have long stressed the need to move beyond the narrow circle of *philosophes* and scientists who made noteworthy contributions to their respective fields of knowledge. They argue that confining one's attention to the intellectual cannon of this "high" Enlightenment runs the risk of ignoring the broader social and cultural currents affecting how different groups produced, disseminated, and appropriated the new ideas of the Enlightenment. In the past few decades, scholars have pursued these insights to good effect, reconstructing the social context surrounding the world of science and the Enlightenment, while also exploring how they became part of the broader public culture.[32] This dissertation tries to build upon such scholarly inquiry—particularly the "social history of ideas"—to examine the underlying connections between the culture of the Enlightenment and the transformations sweeping Anglo-American society in the decades leading up to the Revolution.

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[32] In addition to the new scholarship on the Enlightenment discussed above (note 25), and on the history of science (note 13 & 17), see Jan Golinski, *Making Natural Knowledge: Constructivism and the History of Science* (Chicago, 2005); Steven Shapin, "Social Uses of Science," in *The Ferment of Knowledge: Studies in the Historiography of Eighteenth-Century Science*, ed. G.S. Rousseau and Roy Porter (Cambridge, 1980), 93-139; Shapin, *A Social History of Truth: Civility and Science in Seventeenth-Century England* (Chicago, 1994); Roger Cooter and Stephen Pumfrey, "Separate Spheres and Public Places: Reflections on the History of Science Popularization and Science in Popular Culture," *History of Science* 32 (1994), 237-67; Simon Schaffer, "Natural Philosophy and Public Spectacle in the Eighteenth Century," *History of Science* 21 (1983), 1-43; and Ken Alder, *Engineering the Revolution: Arms and Enlightenment in France, 1763-1815* (Princeton, 1997).

Until recently, historians of early America have been surprisingly ambivalent about the impact of the Enlightenment, or how to interpret its role within the broader narrative of America's historical evolution.[33] While surveys and textbooks usually make some obligatory references to it, the Enlightenment typically serves as an abstract indicator of the colonies' transition into modernity—a sign of rationalism and perhaps a vehicle for the natural rights theory of John Locke and the Revolutionary movement to come. All too often, the Enlightenment is something referenced, but rarely explored in detail or interpreted in light of other historical developments. This trend has begun to change as scholars reacted to the rich literature on print culture and the "public sphere" of the eighteenth century, which offered new ways of connecting the world of the Enlightenment to social and even political change.[34] Yet, by focusing on the realm of popular science, my project offers a different interpretive perspective on these connections—one that tries to illuminate aspects of the Enlightenment that have continued to be overlooked. It focuses, for example, on the realm of concrete action rather than public opinion or debate; it emphasizes personal networks rather than the diffusion of ideas or texts; it provides equal weight to provincial and metropolitan

[33] The two classic surveys of the American Enlightenment still remain Henry May's *The Enlightenment in America* (New York, 1976), and Donald Meyer's *The Democratic Enlightenment* (New York, 1976). And since the colonial historian Carl Bridenbaugh—who wrote a number of surveys and monographs on American society and culture in the 1950s and 1960s—few scholars have put much emphasis on the Enlightenment's role in the historical evolution of colonial America. As an example, most of the noteworthy surveys that have appeared in the past twenty years—written by Jack Greene, Alan Taylor, Bernard Bailyn, James Henretta, and David Hacket Fischer—contain very few references to the Enlightenment.

[34] See, John L. Brooke, "Review: Reason and Passion in the Public Sphere: Habermas and the Cultural Historians," *Journal of Interdisciplinary History* 29 (1998), 43-67; Margaret C. Jacob, "The Mental Landscape of the Public Sphere: A European Perspective," *Eighteenth-Century Studies* 28 (1994), 95-113; Michael Warner, *The Letters of the Republic: Publication and the Public Sphere in Eighteenth-Century America* (Cambridge, Ma., 1990); Charles E. Clark, *The Public Prints: The Newspaper in Anglo-American Culture, 1665-1740* (New York, 1994); Hugh Amory and

concerns; and it examines the civic culture of the Enlightenment rather than its critique of the *ancien régime*. Above all, the study of popular science offers a new window onto the complex role that the culture of improvement played in helping colonists negotiate the dynamic forces changing their world at mid-century. Provincial communities faced an increasing range of challenges and opportunities as the effects of imperial conflicts, commercialization, ethnic migration, and Anglicization began to exert a powerful influence on their daily lives. From Scotland to America, aspiring groups embraced scientific improvement—and the broader vision of civic life it embodied—as part of a conscious attempt to appropriate the most dynamic aspects of metropolitan society to address the mounting challenges of public life.

What follows is an attempt to reconstruct the historical origins, context, and evolution of this popular movement. It explores how the world of science carved out new arenas of civic engagement and action, inscribing patriotic meaning and collaborative values onto the improving activities that unfolded within its expanding domain. Yet, the fusion of science, civism, and improvement was neither inevitable nor impervious to change. Indeed, the period in question—from roughly 1730 to 1760—represented a distinct historical moment which fundamentally shaped the meaning and import of these enlightened pursuits. Explaining how and why these developments occurred is the central focus of the story that ensues.

David D. Hall, eds., *The Colonial Book in the Atlantic World* (Worcester, Ma., 2000); and Carol Armbruster, ed., *Publishing and Readership in Revolutionary France and America* (Westport, Ct., 1993).

CHAPTER TWO

Reconfiguring Public Life: Science and the Civic Culture of Improvement in Britain

> Were kings & their ministers to consider themselves as a Royal Society for the promotion of Arts and Sciences and of every thing that can enlighten and ameliorate the condition of their Subjects, they then would reign in the hearts of the great overwhelming mass of the people, which no conspiracy of Nobles could ever upset.
>
> —Thomas Bewick, *Memoirs*

The reign of George II (1727-60) witnessed the birth of a new civic culture. For the first time, ordinary men and women throughout Britain assumed a more activist role in public affairs, joining together to establish a broad network of societies and voluntary associations dedicated to promoting the common good. Meeting in countless assembly rooms and coffee houses throughout the nation, these groups championed an impressive range of programs for improving the moral and material well-being of society, making the ideology of "improvement" a principal feature of the Georgian Age. Whether they focused on advancing public health, education, agriculture, navigation or commerce, these movements allowed private subjects to experiment with new forms of public leadership and service. Even critics acknowledged the transformation under way. "We are become a Nation of Statesmen," one observer quipped, "and our Coffee-houses and Taverns are full of them."[1]

To be sure, Britons could boast of a long tradition of voluntary associations that had been woven into the fabric of civic life. But the guilds, confraternities, or social

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[1] *The Craftsman*, 4 October 1729.

clubs of the past had always served a more narrow purpose—they sought to sustain the local bonds of family, religion, or occupation that gave meaning to life within a particular community. By contrast, the multitude of clubs and societies that emerged by mid-century were aggressively public in orientation, seeking to unite individuals from diverse backgrounds who shared a common desire to improve the prosperity and well being of the nation at large.[2] In the process, these groups laid the foundation for a new arena of civic engagement where "the *greatest*, as well as the *meanest* subjects" could translate abstract patriotism into a program of concerted action.[3]

Like many of his contemporaries, Jonas Hanway found these new opportunities exhilarating. Born and raised in the provinces, Hanway settled in London in the 1750s after having spent more than a decade abroad working for English mercantile firms. An active member of the Russian Company, he could have easily been content with a quiet and comfortable existence, plying his trade from John's Coffee House near the Royal Exchange.[4] But in 1756, several associates convinced Hanway to join them in supporting the new Foundling Hospital created by private subscriptions to care for abandoned and orphaned children. That same year, Hanway also became a member of the newly formed Society for the Encouragement of Arts, Manufactures and Commerce, a popular

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[2] Peter Clark explores certain aspects of this change in *British Clubs and Societies, 1580-1800: The Origins of an Associational World* (Oxford, 2000), and *Sociability and Urbanity: Clubs and Societies in the Eighteenth Century* (Leicester, Eng., 2000). See also, Kathleen Wilson, *The Sense of the People: Politics, Culture and Imperialism in England, 1715-1785* (Cambridge, 1995), 54-80.

[3] Jonas Hanway, *A Letter from a Member of the Marine Society…*, 4th ed. (London, 1757), 12.

[4] The best modern biography of Hanway is James Stephen Taylor's *Jonas Hanway: Founder of the Marine Society: Charity and Policy in Eighteenth-Century Britain* (London, 1985). But John Pugh's contemporary account, *Remarkable Occurrences in the Life of Jonas Hanway, Esq.* (London, 1787), still contains useful material and captures the milieu of Hanway's circle.

organization that sought to stimulate improvements in a variety of practical fields by offering premiums to successful innovators.[5] In both cases, what began with small donations and committee assignments sparked a lifelong mission to bolster the foundations of the British Empire by promoting advancements in science and public health.[6] In an age when population was seen as the ultimate source of national strength, Hanway worked tirelessly to launch dozens of societies and subscription campaigns that would mobilize public support to save the thousands of lives that were lost each year to epidemics, infant mortality, and poor sanitation.[7] "Increase alone," he explained to his compatriots, "can make our Natural strength in Men correspond with our artificial Power in Riches, and both with the grandeur and Extent of the British Empire."[8]

While such patriotic impulses had certainly existed before, Hanway discovered that Georgian society offered new ways for individuals to contribute to the welfare of the nation. "I am conscious of my own insignificancy as to the *power* of doing good," he

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[5] Hanway participated in various ad hoc committees, dealing with everything from the evaluation of "silk paper" to methods for preventing worm rot in ships. In 1760, he was elected to serve as chairman for the committee of manufactures, a position he held for several years. D.G.C. Allan discusses Hanway's active involvement in the society's internal workings in "Jonas Hanway and the Society of Arts," Royal Society of Arts *Journal* 134 (1986), 650-2.

[6] Charles Wilson first drew attention to Hanway and this strand of imperial reform in his, "The Other Face of Mercantilism," *Transactions of the Royal Historical Society*, 5th Ser., 9 (1959), 97-98. See also Wilson, *England's Apprenticeship, 1603-1763* (New York, 1965), 356-57.

[7] James Stephen Taylor, "Philanthropy and Empire: Jonas Hanway and the Infant Poor of London" *Eighteenth-Century Studies* 12 (1979), 285-305. For a thoughtful examination of the underlying connections between public health, population, and national strength, see Andrea Alice Rusnock, *Vital Accounts: Quantifying Health and Population in Eighteenth-Century England and France* (Cambridge, 2002), and Frederick Whelan, "Population and Ideology in the Enlightenment," *History of Political Thought* 11 (1991), 38-54.

[8] Hanway, *Serious Considerations of the Salutary design…for a regular, uniform register of the parish-poor…* (London, 1762), 26. While the creation of voluntary hospitals has attracted considerable scholarly attention, the advent of charitable dispensaries, funded by public subscriptions, represented an equally important aspect of the broader civic campaigns for improving public health. And as Bronwyn Croxson has shown, the public's support for these initiatives involved the same concerns over demography, national strength, and civic unity that animated Hanway's efforts. See

confessed, but by joining with others in a "society composed of the highest and lowest, of both sexes, of all parties and complexions" it became possible for any person to render "an important service to the public."[9] Yet, private societies did more than pool the collective resources of civic-minded individuals. They could experiment with bold initiatives, testing new ideas and practices that the government was either unable or unwilling to try.[10] Hanway stressed, for example, that "many improvements might be proposed that cannot be done by men in *public* offices who are tied down to rules" and constrained by budgetary concerns. After all, "it can hardly be expected they will be forward to enter upon new projects, where Money is required, unless it should appear to them, that it must be done, and can be done in no other way"[11] By contrast, private organizations were free to experiment, using their resources and ingenuity to promote improvements through the application of new techniques, methods, and inventions.[12]

The Marine Society, founded by Hanway and others in 1757, provides a telling example. Appalled by the high rates of mortality on naval ships, the Society encouraged

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Croxson, "The Public and Private Faces of Eighteenth-Century London Dispensary Charity." *Medical History* 41 (1997), 127-49.

[9] Hanway, *Letter from a Member of the Marine Society*, pp. 1, 30. See also, Jonas Hanway, *Thoughts on the Duty of a Good Citizen* (London, 1759).

[10] As the historian T.S. Ashton once remarked, "In the eighteenth century the characteristic instrument of social purpose was not the individual or the State, but the club." For some provocative insights into the emerging relationship between science, private societies, and innovation, see D.C.G. Allen, *William Shipley, Founder of the Royal Society of Arts* (London, 1968), and Roy Porter, "Science, Provincial Culture and Public Opinion in Enlightenment England," *British Journal for Eighteenth-Century Studies* 3 (1980), 20-46.

[11] Hanway, *Letter from a Member of the Marine Society*, pp. 6, 29.

[12] Such logic resonated with contemporaries. Even the hardnosed Malachy Postlethwayt, one of the most popular economists of the day, took genuine comfort and inspiration from the efforts of these private societies, whose contribution to the "security, strength and grandeur" of the nation led him to proclaim that "one may hope for any rational provision in this age." Postlethwayt, *Universal Dictionary of Trade and Commerce…*, 2 vols. (London, 1751-5), I, 426.

doctors and apothecaries to experiment with new medicines to combat scurvy and other prevalent diseases. They promoted the work of scientists, such as Dr. Stephen Hales, whose elaborate ventilating machines promised to revolutionize sanitary conditions aboard ships by circulating fresh air throughout the confined quarters below decks. No aspect was too small to warrant attention. The Society even sponsored research into the victuals and clothing used by the navy, putting forward changes they believed would reduce sickness and disease among sailors.[13]

For decades, Hanway epitomized the life of Britain's coffee-house "statesmen", working within a dense network of like-minded individuals and voluntary organizations promoting improvement in all spheres of public life. He collaborated with those studying the effects of diet and nutrition on infant mortality. He encouraged the use of inoculation, and more generally, reliable access to medical care for the poor. Although Hanway had little in the way of formal education, he quickly became versed in all of the latest scientific fields touching upon public health. Working with others, he launched campaigns to combat the negative affects of tea drinking, poor ventilation, venereal disease, and the adulteration of food supplies.[14] Underlying these myriad activities was the deeply held conviction that the fate of the nation, and the empire, depended upon Britain's ability to harness the power of science to increase its population. And while

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[13] Taylor, *Jonas Hanway, Founder of the Marine Society*; D.G.C. Allan and R.E. Schofield, *Stephen Hales, Scientist and Philanthropist* (London, 1980), Ch. 4; Larry Stewart, *The Rise of Public Science: Rhetoric, Technology, and Natural Philosophy in Newtonian Britain, 1660-1750* (Cambridge, 1992), 232-3. On the close connection between science, experimentation, and reform of the naval and merchant marines, see N.A.M. Rodger, *The Insatiable Earl: A Life of John Montagu, Fourth Earl of Sandwich, 1718-1792* (New York, 1994); Kathleen Wilson also provides an interesting look at the Marine Society and its place within the larger movement of association-led reform in her *The Sense of the People: Politics, Culture and Imperialism in England, 1715-1785* (Cambridge, 1995), ch.1.

[14] Taylor, "Philanthropy and Empire," pp. 295-96; .

Hanway certainly welcomed government support—either in terms of useful regulations or subsidies—he remained committed to working through the civic world of associations where experimentation and scientific knowledge could be applied to the nation's problems.[15]

Today, visitors to Westminster Abbey are no doubt surprised to see a memorial dedicated to Jonas Hanway, a seemingly obscure merchant whose charitable donations were often measured in shillings not pounds. If the modern public recognizes his name at all, it is usually associated with the advent of the umbrella—a health-conscious device that he introduced to the British Isles. The most unlikely of candidates, this precocious "improver" managed to secure a place in the pantheon of national achievement, surrounded by monuments to famous generals, bishops and statesmen. Yet, the public recognition he achieved only underscores the enormous appeal of those who embodied what Daniel Defoe called the "Improving Temper of the present Age."[16] Without holding a single office, Hanway managed to fire the public's imagination, mobilizing broad support for a series of campaigns which firmly linked science, material progress, and improvement in the minds of his contemporaries.

This chapter explores the historical roots of this "Improving Temper." It traces the constellation of scientific ideas, practices and concerns that underpinned the burgeoning civic culture of the early eighteenth century—one oriented around the

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[15] Many of Hanway's improving projects received some minor state funding and support over the years. On the relationship between improving societies and the British government in the eighteenth century, see D.G.C. Allen, "The Society of Arts and Government, 1754-1800: Public Encouragement of Arts, Manufactures, and Commerce in Eighteenth-Century England" *Eighteenth-Century Studies* 7 (1974), 434-452; John Gascoigne, *Science in the Service of Empire: Joseph Banks, the British State and the Uses of Science in the Age of Revolution* (Cambridge, 1998), ch. 2.

imperatives of useful knowledge, public experimentation, and civic renewal. Placing science at the heart of this story certainly represents an interpretive departure from the dominant historiography of the period. Scholars of Hanoverian Britain have tended to employ other frameworks for making sense of the growing import of associational life, projects, and the boisterous cult of improvement. A number of recent studies, for example, have focused on how these movements intersected with, and built upon, evolving patterns of urbanization and class formation, commercialization and polite sociability, print culture and popular politics. Within this literature, figures like Jonas Hanway appear as part of larger historical narratives stressing the growing assertiveness of the urban middle classes or the emergence of a robust "public sphere" legitimating the principles of open debate and public engagement.[17] To be sure, many of these themes capture important elements of the story, helping to explain the historical forces that shaped the world of civic-minded improvers. But what propelled this movement—what gave its activities cohesion and purpose—was a vision of progress that emerged largely from the realm of science. Natural philosophy, in fact, provided more than simply a set of pragmatic tools for improving agriculture or manufacturing or the material conditions of everyday life. It also offered a cultural blueprint for organizing people in new ways,

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[16] Daniel Defoe, *A Tour thro' the Whole Island of Great Britain*, 2 vols. (London, 1724-6), I, 45.

[17] See, Frank O'Gorman, "The Recent Historiography of the Hanoverian Regime," *Historical Journal* 29 (1986), 1005-20; John Brewer, "Clubs, Commercialization and Politics" in *The Birth of a Consumer Society: The Commercialization of Eighteenth-Century England*, ed. Neil McKendrick, John Brewer, and J.H. Plumb (Bloomington, Ind., 1982); Brewer, "The Number 45: A Wilkite Political Symbol," in *England's Rise to Greatness, 1660-1763*, ed. Stephen B. Baxter (Berkeley, 1983), 349-80; Peter Borsay, *The English Urban Renaissance: Culture and Society in the Provincial Town, 1660-1770* (Oxford, 1989); Wilson, *Sense of the People*, esp. ch. 2; Harris, *Politics and the Nation: Britain in the Mid-Eighteenth Century* (Oxford, 2002); Lawrence E. Klein, *Shaftesbury and the Culture of Politeness: Moral Discourse and Cultural Politics in early Eighteenth-Century England* (Cambridge, 1994); Paul Langford, *A Polite and Commercial People: England, 1727-1783* (Oxford, 1989).

emphasizing a distinct mode of life based upon principles of civility and collaboration; patterns of productive work and exchange; goals of pious study and profitable service.[18] Natural philosophy, in other words, put forward an appealing model of social life that spoke to the moral and material aspirations of many Britons, laying the foundation for the "improving" mentality and projects that defined the age.

Understanding these developments, however, requires a closer look at the historical evolution of natural philosophy in Britain. The story actually begins in the seventeenth century, when the proponents of the scientific revolution sought to refashion the nature and purpose of intellectual life—a project that extended well beyond the confines of the scientific community to include a broader reformation of civil society and public culture. This chapter explores how the architects of this "new philosophy" broke with the past in developing new purposes for knowledge, new audiences and participants, new institutional venues, and new modes of collaboration, authority and sociability. While these seventeenth-century reformers certainly experienced their share of obstacles and setbacks, over time they managed to transform the scientific enterprise into a more accessible pursuit that resonated with larger segments of society. Nor were they alone in this respect. By the turn of the century, they were joined by a broader cast of characters, ranging from prominent churchmen to entrepreneurs and politicians, whose combined efforts helped to establish science as a pious, polite, and profitable endeavor. As this chapter argues, a number of intellectual and social currents converged in the early

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[18] Shapin and Simon Schaffer, *Leviathan and the Air-Pump: Hobbes, Boyle, and the Experimental Life* (Princeton, 1985); Steven Shapin, *A Social History of Truth: Civility and Science in Seventeenth-Century England* (Chicago, 1994); Jan Golinski, *Science as Public Culture: Chemistry and Enlightenment in Britain, 1760-1820* 9 (Cambridge,

decades of the eighteenth century, making natural philosophy a keystone of the emerging cultural order.

Yet, focusing on the relationship between science, the world of improvement, and Britain's evolving civic culture is not meant to suggest that natural philosophy, alone, reshaped the terrain of public life. Such a view would distort the complex patterns of civil society in the eighteenth century, which evolved in response to a number of social, economic, and ideological factors. But it remains striking that cultural authorities of the age—individuals like Joseph Addison, Richard Steele, or Daniel Defoe—relied so heavily upon the new philosophy to serve as a model for the kind of public culture they envisioned.[19] The world of science, in their view, offered not only a series of polite and edifying endeavors, but also a potential bridge across the bitter divides that increasingly separated the nation along the lines of party, class, or creed. Hoping to overcome such divisions, the first "polite" periodicals—cultural icons like the *Athenian Mercury* or the *Spectator*—consciously modeled themselves after the journals of scientific clubs.[20] Pretending to be a philosophical society, with fictitious members and correspondents, these magazines exemplified the creative process by which Britons appropriated the codes and conventions of scientific life to support new forms of sociability and enlightened pleasure. For many contemporaries, then, the expanding orbit of science had

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1992); Anne Goldar, *Impolite Learning: Conduct and Community in the Republic of Letters, 1680-1750* (New Haven, 1995).

[19] Ilse Vickers, *Defoe and the New Sciences* (Cambridge, 1996); Calhoun Winton, *Captain Steele; the Early Career of Richard Steele* (Baltimore, 1964); Roy Porter, *The Creation of the Modern World: The Untold Story of the British Enlightenment* (New York, 2000).

[20] Urmi Bhowmik, "Facts and Norms in the Marketplace of Print: John Dunton's *Athenian Mercury*," *Eighteenth-Century Studies* 36 (2003), 345-65.

opened up a range of suggestive possibilities by carving out unique cultural spaces, predicated upon distinct social relations, and oriented towards new activities and goals. Over time, such patterns gave rise to a broader culture of improvement that envisioned the public's embrace of science as the key to regenerating the material progress and civic health of the nation.

The appeal of this vision could prove quite powerful. As Thomas Bewick, a provincial craftsman, explained in his memoirs, the time was fast approaching when even "Kings and their ministers" would need to conform to the patterns of public life emerging from the world of scientific improvement. Despite their lofty station, these leaders should act like a "Royal Society for the promotion of Arts and Sciences," he explained, eschewing traditional politics in favor of promoting the kind of practical research and experimentation that would "enlighten and ameliorate the condition of their Subjects." Then, and only then, would they secure the public gratitude and civic unity that traditional politics had consistently failed to achieve.[21] The logic and audacity of such a claim only serves to highlight the potential magnitude of the transformations that were quietly reconfiguring the contours of public life in the eighteenth century.

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[21] Thomas Bewick, *A Memoir*, ed. Iain Bain (Oxford, 1979), 93-4. Bewick represented a growing trend within English radicalism linking science, wholesale reform, and rational politics. For a thoughtful analysis of these patterns, see Isaac Kramnick, "Joseph Priestley's Scientific Liberalism" in his *Republicanism & Bourgeois Radicalism: Political Ideology in Late Eighteenth-Century England and America* (Ithaca, NY, 1990), 71-98; and the suggestive remarks in Steven Shapin and Arnold Thackray, "Prosopography as a Research Tool in the History of Science: The British Scientific Community, 1700-1900," *History of Science* 12 (1974), 5-10.

The Virtues of Scientific Life: Civility, Collaboration, and the "New Philosophy"

To understand how and why science achieved such a prominent role in the public culture of eighteenth-century Britain, one must first explore the constellation of values and practices that crystallized into a dramatic reform of natural philosophy in the previous century. The proponents of this movement—what eventually became known as the "scientific revolution"—sought to replace traditional scholasticism with an entirely new approach to explaining the natural world. Not surprisingly, historians have focused considerable attention on the emergence of more exacting methods for obtaining and validating knowledge, particularly the advent of empirical observation and experimentation.[22] Ancient authorities, such as Aristotle or Ptolemy, were shelved by reformers who insisted that the active study of nature, itself, should be the ultimate source of all genuine knowledge. As the English naturalist William Harvey (1578-1657) proclaimed, "it is base to receive instructions from other's comments without examination of the objects themselves, [since] the book of Nature lies so open and is so easy of consultation"[23] For many scholars, this shift in the basis of knowledge lies at the

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[22] A. Rupert Hall, *The Scientific Revolution, 1500-1800: The Formation of the Modern Scientific Attitude* (Boston, 1966); E. A. Burtt, *The Metaphysical Foundations of Modern Physical Science* (New York, 1954); Herbert Butterfield, *The Origins of Modern Science, 1300-1800* (New York, 1965). For a more recent evaluation of the historiography surrounding the Scientific Revolution, see David C. Lindberg and Robert S. Westman, eds., *Reappraisals of the Scientific Revolution* (Cambridge, 1990).

[23] Quoted in Steven Shapin, *The Scientific Revolution* (Chicago, 1996), 68.

heart of the seventeenth-century revolution in science. Put simply, the rise of the "new philosophy" is a story of profound *epistemological* change.[24]

But such a focus should not loose sight of the broader concerns animating the campaign to reform natural philosophy. The promoters of the new science, in fact, took aim at more than just the methodology of their predecessors. Rather, they viewed the development of new approaches to knowledge as part of a larger effort to transform the very nature and purpose of the scientific community as well as its place within society, at large.[25] Such a full-scale campaign entailed a cultural revolution as much as an epistemological shift, ensuring that the reconstruction of natural philosophy carried a range of social and ideological implications. Understanding these broader concerns, in fact, is crucial to comprehending the dynamic relationship that would eventually emerge between science and public life in the eighteenth century.

The following discussion, therefore, places the interpretive focus squarely on the social and cultural dimensions of the scientific revolution, rather than the development of new paradigms or bodies of knowledge. In so doing, it draws upon the work of sociologists and historians who have sought to dramatically contextualize the process by which scientific knowledge is produced. In particular, these studies highlight the web of

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[24] I. Bernard Cohen, *The Birth of a New Physics* (New York, 1985); Niklas Luhmann, "The Differentiation of Advances in Knowledge: The Genesis of Science" in *Society and Knowledge: Contemporary Perspectives in the Sociology of Knowledge*, eds. Nico Stehr and Volker Meja (New Brunswick, NJ, 1984), 103-48. Knud Haakonssen has explored the broader tendency to employ an "epistemological paradigm" to interpret the essential meaning of the scientific and philosophical revolutions in early modern thought. See his "The History of Eighteenth-Century Philosophy: History or Philosophy?" in *The Cambridge History of Eighteenth-Century Philosophy*, ed. Knud Haakonssen, 2 vols. (Cambridge, 2006), I, 3-25, esp. 13-20.

[25] On the breadth of vision that inspired the architects of the new science, see Richard Foster Jones, *Ancients and Moderns: A Study of the Rise of the Scientific Movement in Seventeenth-Century England* (St. Louis, 1961); Robert K. Merton, *Science, Technology & Society in Seventeenth Century Eng*land (New York, 1970); Charles Webster, *The Great Instauration: Science, Medicine, and Reform, 1626-1660* (London, 1975); Shapin, *The Scientific Revolution*.

values, practices, and social relations that structure the meaning and validity of knowledge-claims in particular settings. And while scholars often employ different models and metaphors to explain this process—ranging from "language-games" to semiotic "codes" to the dramaturgical "roles"—all provide a similar focus on the powerful, yet subtle, conventions governing the social construction of knowledge.[26] Often, these knowledge-making practices go unnoticed, especially during periods of calm or consensus. But the intense debates of the scientific revolution, and the desire for sweeping reform, exposed these issues in dramatic fashion. It would be fair to say, in fact, that proponents of the new science found themselves having to invent entirely new modes of social and intellectual life that could redress the wide-ranging problems of scholasticism.

The multi-pronged indictment of traditional learned culture offers a revealing window into some of these wider issues. The problem of relying upon the textual authority of ancient writers, while significant, represented only one of a number of faults that made scholasticism so objectionable to English reformers. Many contemporaries appeared equally troubled, for example, by the central role that rhetoric and public disputation had assumed within the culture of traditional philosophy. They argued that such an obsessive focus on language did not lead to greater truth, but instead produced

[26] Jan Golinski, *Making Natural Knowledge: Constructivism and the History of Science* (Chicago, 2005); Bruno Latour, *Science in Action: How to Follow Scientists and Engineers through Society* (Cambridge, MA, 1987; Steven Shapin and Simon Schaffer, *Leviathan and the Air-Pump: Hobbes, Boyle, and the Experimental Life* (Princeton, 1985); Steven Shapin, *A Social History of Truth: Civility and Science in Seventeenth-Century England* (Chicago, 1994).

incessant wrangling over empty words—what one critic called “Wars of the Tongue.”[27] Opponents denounced this contentious, often intemperate, use of verbal sparring that all too often degenerated into “monstrous altercations and barking questions.” As a result, peripatetic philosophy was increasingly perceived as a divisive, even unruly, form of culture. Critics charged that the practices of scholastic discourse ruled out any possibility for collaboration or consensus within the realm of natural philosophy. This growing frustration was aptly expressed by one writer who described it as a “a civil war of words, a verbal contest, a combat of cunning craftiness, violence and altercation, wherein all verbal force, by impudence, insolence, opposition, contradiction, derision, diversion, trifling, jeering, humming, hissing, brawling, quarrelling, scolding, scandalizing, and the like, are equally allowed and accounted just.”[28] A major goal of English reformers, therefore, would be to root out such divisive practices that had turned the study of nature into a combative and poisonous enterprise.

The intemperate use of language, however, tied into larger debates over the cultural values which sustained traditional modes of scholarly life. Proponents of a “new” approach to knowledge also highlighted the role of personal character.[29] The contentious behavior of philosophers, they argued, reflected a deeper problem with their

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[27] Thomas Sprat, *History of the Royal Society, For the Improving of Natural Knowledge* (London, 1667), 12. On the centrality of disputation to scholastic science, see Brian Lawn, *The Rise and Decline of the Scholastic "Quaestio Disputa": With Special Reference on its Use in the Teaching of Mathematics and Science* (Leiden, 1993). For a discussion of the widely shared revulsion to these practices and the associated abuse of language and rhetoric, see William T. Lynch, *Solomon's Child: Method in the Early Royal Society of London* (Stanford, 2001), ch. 4-5; Martin Elsky, “Bacon’s Hieroglyphs and the Separation of Words and Things,” *Philological Quarterly* 63 (1984), 449-60.

[28] Lynch, *Solomon's Child*, 171-9; Shapin, *The Scientific Revolution*, 121-9, 122.

moral and intellectual temperament. The schoolmen, according to critics, had an irresistible penchant for dogmatism; men whose arrogance and obstinacy led them to browbeat their colleagues and students. This intellectual zealotry—what many referred to derisively as "enthusiasm"—increasingly appeared as a moral and psychological problem.[30] As Bishop Thomas Sprat explained, the traditional philosopher lacked "all the modest, humble, friendly Vertues." Instead, scholastic culture inculcated a set of values which turned its practitioners into "insulting Wits, who can neither bear partnership, nor opposition."[31] In expressing these views, Sprat echoed a growing sentiment which insisted that the very character and "temper of the mind" of natural philosophers would have to change in order for knowledge to be improved. In fundamental ways, then, the reformation of science required a broader restructuring of values—a campaign which proponents argued would make individuals capable of participating in a more orderly and collaborative form of science.[32]

Seventeenth-century writers also drew attention to the cultural sites where scholastic knowledge was produced. Here, Francis Bacon set the early tone when he singled out the universities as a primary cause of the "distempers" which plagued

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[29] During the seventeenth century, as Steven Shapin has explained, "standard portrayals of the professional scholar depicted him as…melancholic, disputatious, pedantic, lacking in civility and sense of decorum." Shapin, *A Social History of Truth: Civility and Science in Seventeenth-Century England* (Chicago, 1994), 171.

[30] Joseph Glanvill, *Scepsis Scientifica: or, Confest Ignorance, the Way to Science* (London, 1665); Jones, *Ancients and Moderns*; Michael Heyd, "Robert Burton's Sources on Enthusiasm and Melancholy: From a Medical Tradition to Religious Controversy," *History of European Ideas* 5 (1984), 17-44; Shapin, "'The Mind Is Its Own Place': Science and Solitude in Seventeenth-Century England," *Science in Context* 4 (1991), 192-203.

[31] Sprat, *History of the Royal Society*, 33-34.

[32] Steven Shapin and Simon Schaffer, *Leviathan and the Air-Pump: Hobbes, Boyle, and the Experimental Life* (Princeton, 1985), esp. 65, 72-6, 138-9.

traditional philosophy. The rituals of public disputation, the hierarchical structure, and the authoritarian nature of teaching all made the universities into breeding grounds of dogmatism.[33] "Philosophers have bin always *Masters*, & Scholars;" one critic complained, "some imposing, & all others submitting." "Very mischievous consequences" had resulted, therefore, from the fact that "the Seats of Knowledge, have been for the most part heretofore, not Labratories, as they out to be; but only *Schools*, where some have *taught*, and all the rest subscribed."[34] For many observers, then, the institutional setting provided by the universities had warped the proper social relations that should govern an intellectual community. The master-student relationship structured how scholars interacted, and consequently, how knowledge was produced—giving both an authoritarian stamp.[35] Not all philosophers, of course, taught at the universities or colleges. But critics were quick to point out that the alternative sites of inquiry that existed, such as the scholar's study or the alchemist's private laboratory, raised many of the same concerns. Shut off from the world, such sites encouraged individuals to become completely engrossed in their personal theories, leading to a myopic form of

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[33] On the growing Baconian movement that defined the new science through increasingly sharp attacks on the traditional universities, see Charles Webster, *The Great Instauration: Science, Medicine, and Reform, 1626-1660* (London, 1975); Jones, *Ancients and Moderns*; Stephen Clucas, "In Search of 'The True Logick': Methodological Eclecticism among the 'Baconian Reformers,'" in Mark Greengrass, Michael Leslie, and Timothy Raylor, eds., *Samuel Hartlib and Universal Reformation: Studies in Intellectual Communication* (Cambridge, 1994), 51-74.

[34] Sprat, *History of the Royal Society*, 68.

[35] Allen G. Debus, *Science and Education in the Seventeenth Century: The Webster-Ward Debate* (London, 1970). Steven Shapin, "The House of Experiment in Seventeenth-Century England," *Isis* 79 (1988), 395-98. Thomas Sprat—while recognizing the importance of education—went so far as to suggest that it was improper for any true scientist to pursue teaching as a career because it threatened to instill a dogmatic temper. Sprat, *History of the Royal Society*, p. 60.

knowledge.[36] Truly constructive philosophy, therefore, would require the creation of new spaces in which philosophers could engage with other people or ideas.[37]

The "old" philosophy also faced growing criticism for its failure to produce useful knowledge that would serve the broader needs of society. Bacon complained that traditional philosophy "is endless, and brings forth indeed cobwebs of learning, admirable for the fineness of thread and work, but of no substance or profit." By contrast, he argued that "knowledge must be subjected to that use for which God hath granted it; which is the benefit and relief of the state and society of man." In expressing this view, Bacon rejected the ideals of the contemplative life which had sustained scholastic culture and infused it with meaning. He insisted that "all knowledge is to be referred to use and action"—its purpose was to serve the worldly concerns of mankind.[38] This emphasis on the utility of knowledge, along with its privileging of the active life, gained widespread acceptance over the course of the seventeenth century.[39] A broad circle of reformers argued that science should contribute directly to improving the human condition and the welfare of society, not simply indulge the personal gratification of the chosen few who made it their special calling.[40] The ultimate purpose of knowledge, therefore, became a

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[36] John Evelyn, *Publick Employment and an Active Life Prefer'd to Solitude…* London, 1667), 7-31; Sprat, *History of the Royal Society*, 102-3, 335-9; For the prevalence of these views, see Shapin, "'The Mind Is Its Own Place,'" 191-218; Shapin, "The House of Experiment," 378.

[37] Merton, *Science, Technology & Society*, 223.

[38] Quoted in Webster, *The Great Instauration*, 22.

[39] Webster, *The Great Instauration*, Alvin Snider, "Bacon, Legitimation, and the "Origins" of Restoration Science," *The Eighteenth Century* 32 (1991), 119-38; Richard Foster Jones, *Ancients and Moderns*.

[40] Robert Boyle, "Some Considerations Touching the Usefulness of Experimental Natural Philosophy," in *The Works of the Honourable Robert Boyle*, Thomas Birch, ed. (London, 1772), II, 1-246. Charles Webster's work, *The*

hotly debated issue as proponents of the new science created an alternative conception of natural philosophy—one that transformed the pursuit of science into a civic endeavor aimed at furthering the common good.[41]

It is important to remember that the movement for scientific reform did not unfold in a historical vacuum. Promoters and polemicists took part in a much broader conversation about the nature of truth and individual judgment, authority and order, that resonated powerfully with the concerns of seventeenth-century Englishmen and women.[42] The ideological turmoil unleashed by the Civil Wars, along with heated battles over the future direction of the Anglican Church, left a deep impression on the minds of many contemporaries who worried about the perceived relationship between dogmatism and sectarian strife. In almost every field of literature, writers sought to explain how public cohesion and order could be maintained in the face of growing civil discord.[43] After all, the fragmentation of religious and political authority threatened to undermine the consensus which held society together, pushing the topic of "enthusiasm" and zealotry to the forefront of debate.[44]

Great Instauration, still provides the most exhaustive look at the reform movement and the utilitarian conception of science underlying it.

[41] Hunter, *Science and Society*, esp. 20-23; William Eamon, *Science and the Secrets of Nature: Books of Secrets in Medieval and Early Modern Culture* (Princeton, 1994), ch. 10; Michael Hunter, *Establishing the New Science: The Experience of the Early Royal Society* (Woodbridge, Eng., 1989), 76-9, 90.

[42] See Steven Shapin, "'A Scholar and a Gentlemen': The Problematic Identity of the Scientific Practitioner in Early Modern England," *History of Science* 29 (1991), 279-327; Shapin, *The Social History of Truth: Civility and Science in Seventeenth-Century England* (Chicago, 1994), 116-18, 170-5, 309.

[43] Michael Heyd, "The Reaction to Enthusiasm in the Seventeenth Century: Towards an Integrative Approach," *Journal of Modern History* 53 (1981), 258-80.

[44] For an illuminating discussion of this issue, see George Williamson's piece, "The Restoration Revolt against Enthusiasm," in his collected essays, *Seventeenth Century Contexts* (London, 1960), 202-39.

Against this backdrop, the proponents of the new science managed to garner widespread support for their attack on scholasticism—a campaign that focused precisely on the lack of moderation, order, and cooperation within traditional philosophy. They blamed the unruly culture of scholasticism for fueling much of the sectarian rancor that plagued society. As Thomas Sprat explained:

> The most fruitful Parent of Sedition is Pride, and a lofty conceit of men's own wisdom; whereby they presently imagine themselves sufficient to direct and censure all the actions of their Governors…The Science that is acquir'd by Disputation [i.e. traditional philosophy], teaches men to cavail well, and to find fault with accurate subtlety; it gives them a fearless confidence of their own judgements; it leads them from contending in sport, to opposition in earnest; it makes them believe that everything is to be handled for, and against, in the State, as well as in the Schools

As Sprat made clear, the traditional modes of scholarly life contributed directly to the "fury of enthusiasm" and the resulting instability.[45] This connection between scholasticism, dogmatism, and civil unrest only served to elevate the ideological stakes surrounding the reform of traditional philosophy.[46] It also underscored the potential links between scientific life and public life, suggesting how the values and practices of natural philosophy could exert considerable influence on the patterns of civil society.

Within this broader context, the new science emerged as an attractive remedy to the religious and political passions of the day. Like the Restoration settlement that accompanied it, the wholesale reform of natural philosophy promised to bring moderation

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[45] Sprat, *History of the Royal Society*, 428-9.

[46] The defenders of traditional philosophy vehemently insisted that that it was their opponents—the practitioners of the new science—who were responsible for fuelling enthusiasm and dissension. On the contentious debate that revolved around this issues, see Michael Heyd, "The New Experimental Philosophy: A Manifestation of "Enthusiasm" or an Antidote to It?" *Minerva* 25 (1987), 423-40; Lynch, *Solomon's Child*, ch. 5.

and consensus to a society weary of conflict.[47] Promoters of the new science dwelled emphatically upon this point. They insisted that the study of nature, if properly organized, would create a unique cultural atmosphere in which gentlemen could acquire the skills necessary to put aside their sectarian differences and collaborate for the good of the nation. As the staunch supporter Joseph Glanvill explained, the new science "will in its progress dispose men's Spirits to more calmness and modesty, charity and prudence in their Differences…and is a Specifick against Disputes and Divisions."[48] A growing number of contemporaries echoed such sentiments, casting science as a healing endeavor that would calm the storms of enthusiasm and extremism battering the nation.[49] They pointed out that natural philosophy could perform this role precisely because its subject matter and approach offered a welcome respite from the controversial issues of the moment. By participating in the cooperative study of nature, one writer emphasized, science offered gentlemen an opportunity to "assemble about some calm, and indifferent things, especially Experiments…where they may agree, or dissent without faction, or fierceness: and so enduring each others company, they may rise to a bearing of each

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[47] James R. Jacob, "Restoration, Reformation and the Origins of the Royal Society," *History of Science* 13 (1975), 155-76. See also, Barbara J. Shapiro, *John Wilkins 1614-1672: An Intellectual Biography* (Berkeley, 1969).

[48] Joseph Glanvill, *Plus Ultra: or, the Progress and Advancement of Knowledge…* (London, 1668), 149; The same theme was echoed in Glanvill's *The Vanity of Dogmatizing* (London, 1661) and his, *Philisophia Pia, Or, A Discourse of the Religious Temper and Tendencies of the Experimental Philosophy* (London, 1671).

[49] Lotte Mulligan, "Anglicanism, Latitudinarianism and Science in Seventeenth Century England," *Annals of Science* 30 (1973), 213-19; Barbara J. Shapiro, "Latitudinarianism and Science in Seventeenth-Century England," in *The Intellectual Revolution of the Seventeenth Century*, ed. Charles Webster (London, 1974), 286-316; Richard Westfall, *Science and Religion in Seventeenth-Century England* (Ann Arbor, 1973); Shapin and Schaffer, *Leviathan and the Air Pump*.

others opinions; from thence to an exchange of good Offices; and from thence to real Friendship."[50]

The notion that science could assuage religious, political, and social divisions gained added credibility from the actual diversity of the scientific community which included members of almost every background and persuasion. As one commentator observed:

> We behold an unusual sight to the English Nation, that men of disagreeing parties, and ways of life, have forgotten to hate, and have met in the unanimous advancement of the same Works…the Soldier, the Tradesmen, the Merchant, the Scholar, the Gentleman, the Courtier, the Divine, the Presbyterian, the papist, the Independent, and those of Orthodox Judgement, have laid aside their names of distinction, and calmly conspir'd in a mutual agreement of labors and desires: A Blessing which seems even to have exceeded that Evangelical Promise, *that the lion and the Lamb shall lye down together*. [51]

While skeptics certainly doubted the power of science to usher in such halcyon days, a growing number of writers and commentators embraced the notion that natural philosophy might well offer a new, and more fruitful, arena where individuals could foster the civility and consensual practices needed to rebuild the nation at large. Such views not only conditioned the way seventeenth-century contemporaries thought about science and society, but they also provided the foundation for latter attitudes and assumptions that would inform the outlook of eighteenth-century Britons.

If moderation served as the ideological touchstone of the new science, then a methodology rooted in experimentation offered the specific means for achieving this goal. Ever mindful of the failures of scholasticism, promoters of the new philosophy spent considerable time and energy describing how experimental practices would remedy

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[50] Sprat, *History of the Royal Society*, 426.

the pernicious tendencies of the past.[52] This new approach to knowledge, they argued, would focus attention on the actual workings of nature, elevating the study of *things* over *words*.[53] Such a move proved crucial to reformers who believed that divisive language and abstract ideas had fanned the flames of dogmatism.[54] Natural philosophers should eschew "the establishment of *Theories*, and *Speculative Doctrines*," Joseph Glanvill proclaimed, since their "*first* and *chief* Imployments, [are] carefully to *seek*, and to *report* how things are *de facto*." By bringing science "down to the *plain Objects* of the *Senses*," reformers such as Glanvill hoped to remove any temptation to engage in the kinds of abstract debates that had proven so contentious in the past and were simply incapable of being resolved.[55] A science grounded in experimentation, by contrast, would secure consensus and mutual respect among its practitioners by avoiding theory and rhetoric in favor of facts. As authors repeatedly stressed, individuals had no personal investment in facts; they could be calmly evaluated without impinging upon the interests or sensibilities of various members.[56] Indeed, experimentalism seemed to produce a kind of factual

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[51] Ibid, 327.

[52] Marie Boas Hall, *Promoting Experimental Learning: Experiment and the Royal Society, 1660-1727* (Cambridge, 1991).

[53] Larry Stewart, *The Rise of Public Science: Rhetoric, Technology, and Natural Philosophy in Newtonian Britain, 1660-1750* (Cambridge, 1992), ch. 1; A. C. Howell, "Res et verba: Words and Things," *English Literary History* 13 (1946), 131-42; George Williamson, *The Senecan Amble* (Chicago, 1951).

[54] Robert E. Stillman, "Assessing the Revolution: Ideology, Language, and Rhetoric in the New Philosophy of Early Modern England," *The Eighteenth Century* 35 (1994), 99-118; Lynch, *Solomon's Child*, 157-196

[55] Quoted in Eamon, *Science and the Secrets of Nature*, 336. Barbara J. Shapiro has explored how the rise of empiricism and the elevation of facts responded to widespread concerns about the problems of certitude within knowledge. See Shapiro, *Probability and Certainty in Seventeenth Century England…* (Princeton, 1983); and more recently, Shapiro, *Culture of Facts, England 1550-1720* (Ithaca, 2000).

[56] Lorraine Daston, "Baconian Facts, Academic Civility, and the Prehistory of Objectivity," *Annals of scholarship* 8 (1991), 337-63.Ludwick Fleck, *Genesis and Development of a Scientific Fact*, trans. Fred Bradley (Chicago, 1979).

knowledge—which because it could be publicly replicated and tested—offered a mechanism for the difficult task of securing broad agreement and assent.[57] In other words, the elevation of matters of fact was understood as creating the necessary framework for agreement and collaboration that had eluded natural philosophers in the past.

As many contemporaries recognized, an experimental approach to knowledge also had the potential to transform the very nature of the scientific community and its practitioners. One important aspect of this change lay in the fact that experimental knowledge promised to remove some of the practical barriers to science, encouraging more participation among the those groups who had neither the time nor the inclination to pursue a traditional scholarly career. One need not spend a lifetime learning the intricacies of logic or metaphysics to partake in a collaborative endeavor based upon the judicious observation of nature and the collection of facts.[58] With a little time and attention, men of public affairs and business could join the ranks of a reformed natural philosophy. Indeed, Thomas Sprat went so far as to suggest that "any plain industrious Man" was "likely to make a good Philosopher" in the new world of experimental science.[59]

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[57] Shapin and Schaffer, *Leviathan and the Air Pump*, ch.2; Hall, *Promoting Experimental Learning*.

[58] Peter Dear, "*Totius in Verba*: Rhetoric and Authority in the Early Royal Society," *Isis* 76 (1985), esp. 151-2.

[59] Sprat, *History of The Royal Society*, 34. The emphasis which contemporaries placed on the lowering of barriers has been reinforced by the work of modern historians such as Michael Hunter who has stressed the "leveling effects of Baconianism" that allowed large numbers of individuals to participate in the empirical work of the new philosophy. See Hunter, *Science and Society in Restoration England*, 65.

Yet, promoters also stressed that an experimental approach to knowledge would help to eliminate important cultural barriers which had prevented many respectable members of society from participating in traditional philosophy. The scholarly way of life, according to many contemporaries, proved entirely incompatible with the values and practices of men engaged in worldly affairs.[60] Put simply, philosophy made individuals unfit for society. It encouraged a kind of obstinacy, contentious spirit, and fanciful outlook that clashed with the responsibilities of practical life.[61] Experimental philosophy, by contrast, would prove extremely "useful, both in respect to men's public practice, and the private government of their own minds."[62] The attentive study of nature and the careful weighing of facts supposedly trained men to be modest, prudent, and open-minded. Far from encouraging a "lofty and romantic" disposition, such an approach immersed practitioners in the concrete realities of nature, replacing idle speculation with diligent and purposeful work.[63] Proponents argued that such a "sober and generous knowledge", as one writer described it, was perfectly tailored to the "men of active and busy lives" who had avoided philosophy in the past.[64] In other words, it constituted a philosophy of action and experience that complemented the imperatives of everyday life.

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[60] Shapin, "Scholar and Gentlemen"; Sprat, *History of the Royal Society*, 332-5.

[61] John Evelyn, *Publick Employement and an Active Life Prefer'd to Solitude…* (1664) reprinted in *Public and Private Life in the Seventeenth Century: the Mackenzie-Evelyn Debate*, ed., Brian Vickers (New York, 1986). See also John Bowle, *John Evelyn and His World* (London, 1981).

[62] Sprat, *History of the Royal Society*, 411.

[63] Merton, *Science, Technology, and Society*, ch. 5; Williamson, *The Senecan Amble*; Shapin, "Science and Solitude."

[64] Glanvill, *Philosophia Pia*, p. 5. The integration of science into gentlemanly culture created a new cultural archetype: the virtuoso. See, Walter E. Houghton, "The English Virtuoso in the Seventeenth Century," *Journal of the History of Ideas* 3 (1942), 51-73, 190-219.

Indeed, this new scientific *personae*—a "presentation of self" that drew upon distinct webs of meaning to reorient the nature and purpose of intellectual pursuits—bridged the potential chasm between the active and contemplative life, between private solitude and public responsibilities.[65] Far from creating a conflict, the experimental life actually enhanced the civic outlook and values of worldly practitioners.

Expanding the ranks of science to include broader segments of the public, especially gentlemen, played a key role in the larger program of reform. On a practical level, a science devoted to observing and cataloguing the myriad workings of nature would need many hands. "As for persons," one writer explained, "we cannot be too many employ'd, since we have all [of] Nature" to explore.[66] Having set such ambitious goals, the architects of the new science would require the active involvement of the public on a scale simply unprecedented.[67] Furthermore, any successful reform of natural philosophy would have to circumvent the traditional community of scholars, many of whom fiercely opposed the tenants of the new science. In a tactical sense, then, reaching out to civic gentlemen represented a shrewd move since it allowed reformers to create a new constituency for science—one that proved more receptive to, and in keeping with, their overarching goals.[68] But above all, proponents recognized the centrality of broader participation to their expansive vision of science as a civic enterprise—one capable of

[65] Erving Goffman, *The Presentation of Self in Everyday Life* (Garden City, NY, 1959).

[66] Quoted in Eamon, *Science and the Secrets of Nature*, p. 347.

[67] Sprat, *History of the Royal Society*, esp. 72; Dear, "Totius in Verba," 152.

[68] Stewart, *The Rise of Public Science*; Margaret C. Jacob, *Scientific Culture and the Making of the Industrial West* (New York, 1997), ch. 1.

improving the character of individuals while regenerating the public life of the nation.[69] And without the involvement of gentlemen or other respectable groups, the new science would be as pedantic and parochial as the scholastic philosophy it sought to replace.

The considerable stakes involved in this sweeping reform of science became the subject of a revealing speech composed by a young Oxford student in 1693. Inside the Sheldonian Theatre, he delivered “An Oration, in Defense of the New Philosophy”—a short but cogent indictment of scholastic life and the knowledge it produced. The orator attacked everything from the sheer uselessness of peripatetic philosophy to the “barbarous” discursive practices and values that informed scholastic culture. “Let us therefore sentence for ever this Troop of Commentators,” he concluded, “to be tied up in Chains and Libraries, Food only for Moths and Worms.”[70] The student, Joseph Addison, would eventually become famous, not for his scientific achievements, but for articulating the norms and values of polite society—a kind of cultural politics revolving around manners, civility, and more edifying modes of conversation and sociability. His passionate focus on the proper ways of interacting with others—one that included relentless attacks on overbearing, pedantic behavior—was rooted in his early rejection of traditional learned culture. “Man,” Addison pointed out, “is said to be a sociable animal”; yet the boorish sensibilities that dominated the schools and society, at large, underscored

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[69] Samuel Hartlib, *A Further Discoverie of the Office of Publick Addresse for Accommodations* (London, 1648); George Snell, *The Right Teaching of Useful Knowledge* (London, 1649). See also, Webster, *The Great Instauration*; and G.H. Turnbull, *Hartlib, Dury and Comenius. Gleanings from Hartlib’s Papers* (London, 1947).

[70] “An Oration, in Defense of the New Philosophy Spoken in the Theatre at Oxford, July 7, 1693” reprinted in *A Week’s Conversation on the Plurality of Worlds. By Monsieur De Fontenelle…*, 6th ed. (London, 1737), 183-9.

the need for wholesale reform.[71] And he did not hesitate to draw upon the new philosophy as a source of inspiration for new models of deportment, conversation, social interaction, or entertainment. Comparing himself to Socrates, who it was said brought philosophy down from heaven to inhabit among men, Addison declared that his *Spectator* would bring “Philosophy out of Closets and Libraries, Schools and Colleges, to dwell in Clubs and Assemblies, at Tea-Tables, and in Coffee-Houses."[72] For Addison, a fundamental connection existed between the reform of intellectual life and social life. The polite society required the new philosophy and vice versa.

Such views made a lasting impression. Even decades later, British writers continued to reflect upon the links between the new philosophy and the changing social climate of the late seventeenth century. One observer, for instance, noted that “this nation, having [then] a surfeit of religious and political controversy, sought relief in studies of another kind.” Hoping to calm the enthusiasm and growing factionalism, science “became the fashion of the times, and even the ladies commenced profound adepts in the *Newtonian* philosophy.” As the eighteenth century progressed, he concluded, other activities joined natural philosophy as polite and popular endeavors.[73] But the unique role of science in these early years—its apotheosis as a potent “relief” to the endemic “religious and political controversy” of the day—set the stage for important transformations in civil society and public life.

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[71] Bond, ed., *The Spectator* 3 vols. (Oxford, 1965), I, 39.

[72] Ibid, 1:42.

[73] Malachy Postlethwayt, *The British Mercantile Academy: or the Accomplished Merchant* (London, 1750), 71.

Improving Spaces: The Organization of Public Science

As the world of science changed dramatically—in terms of methodology, composition, and purpose—it required new cultural and institutional venues that would provide a more appropriate site for the kind of intellectual endeavor being pursued. Ironically, the same moment of time at which modern science began to develop a conception of physical space as both uniform and absolute, the scientific *virtuosi* began to carve out certain human spaces as unique and culturally bound. Indeed, the creation of privileged settings for intellectual inquiry, sociability, and improving activities represented a key element of the new science and the Enlightenment, more broadly. Seen from this perspective, the unfolding of the Enlightenment rested upon a reconfiguration of the cultural landscape, a process by which certain spaces began to take meaningful shape and provide new structures of lived experience. In settings such as coffee houses, and assembly rooms, lectures and clubs, people would not only familiarize themselves with the conventions and outlook of the new philosophy, but would also help establish the patterns of associational life that characterized these sites. Examining such improving spaces, therefore, provides a crucial window onto the expansion of scientific culture and its broader effects on society.[74]

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[74] In different ways, the work of Charles J. Withers and Margaret C. Jacob have illuminated the importance of space and setting to the world of science and the Enlightenment project. See, Withers, "Towards a Geography of Trust," *Geographie et Culture* 33 (2000), 3-17; Withers, "Where Wass the Atlantic Enlightenment?—Questions of Geography," in *The Atlantic Enlightenment*, ed. Susan Manning and Francis D. Cogliano (Burlington, VT, 2008), 61-93; Withers, *Placing the Enlightenment: Thinking Geographically about the Age of Reason* (Chicago, 2007); Margaret Jacob, "The Mental Landscape of the Public Sphere: A European Perspective," *Eighteenth-Century Studies* 28 (1994), 95-113; Jacob, *Living the Enlightenment: Freemasonry and Politics in Eighteenth-Century Europe* (New York, 1991).

While a handful of individuals believed that colleges might provide a suitable home for the new philosophy, the overwhelming majority of reformers agreed that the universities fueled the divisiveness and dogmatism of scholastic culture, rendering them entirely inappropriate as sites for constructive inquiry. What was needed, in the minds of many contemporaries, was a new institutional space that would properly structure the way individuals interacted and the way knowledge was produced. A variety of proposals were suggested and tried in the decades leading up to the Restoration. These schemes ranged from the simplicity of informal groupings to the establishment of an elaborate state agency under the Protectorate.[75] Yet, over time, and with the help of continental examples, what emerged in Britain was the development of the scientific society as *the* ideal setting for natural philosophy. Combining different aspects of the gentlemanly club, the state-chartered corporation, and the expanding world of print; scientific societies created an innovative forum for the production, evaluation, and dissemination of knowledge.[76] The master-student relationship—so central to the structure of universities—was replaced by a model of collaborative inquiry among equals. To ensure that proper order and civility governed meetings, strict rules pertaining to speech and

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[75] Charles Webster, *Samuel Hartlib and the Advancement of Learning* (Cambridge, 1970); Webster, *The Great Instauration*.

[76] Michael Hunter, *Establishing the New Science: The Experience of the Early Royal Society* (Woodbridge, 1989). For the broader European context, see Tore Frangsmyr, ed. *Solomon's House Revisited: The Organization and Institutionalization of Science* (Canton, Ma., 1990); David Lux, "Societies, Circles, Academies, and Organizations: A Historiographical Essay on Seventeenth-Century Science" in *Revolution and Continuity: Essays in the History and Philosophy of Early Modern Science*, eds. Peter Barker and Roger Ariew (Washington, D.C., 1991), 23-43; and Theodore K. Hoppen, *The Common Scientist in the Seventeenth Century: A Study of the Dublin Philosophical Society, 1683-1708* (London, 1970); James E. McClellan III, *Science Reorganized: Scientific Societies in the Eighteenth Century* (New York, 1985), ch. 1. Still helpful are two older surveys: Martha Ornstein, *The Role of Scientific Societies in the Seventeenth Century* (Chicago, 1928), and Hartcourt Brown, *Scientific Organizations in Seventeenth Century France* (New York, 1934).

decorum were universally adopted by the new societies.[77] After all, moderation and consensus could only be fostered in the appropriate environment where certitude and aggressive debate were held firmly in check. The establishment of standing committees—each focusing on a particular field of knowledge—embodied the new ideals of science as a corporate enterprise, allowing members to effectively coordinate research priorities and results.[78] In a similar vein, published journals and corresponding secretaries played an important role in helping to circulate experimental knowledge to wider audiences.[79] In these and other respects, the establishment of philosophical societies embodied the vision of science as a polite and collaborative endeavor worthy of the public's involvement.

Nowhere was this more evident than in the Royal Society of London—an institution that set much of the tone for the new science in Restoration England. Emerging from the reformist circles which had proliferated during the interregnum, the members of the society were officially incorporated by royal charter in 1662. A core group of these scientists had worked together in the past, articulating a common vision of what a reformed philosophy might accomplish.[80] Yet this group was soon joined by a growing number of aristocrats, gentry, clerics, and businessmen, who had little formal training or experience in matters of science. As contemporaries noted, and modern scholarship has confirmed, this expanding body of fellows included individuals from a

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[77] Shapin, *The Scientific Revolution*, 131-4.

[78] Hunter, *Science and Society*, 112-9; Marie Boas Hall, "Solomon's House Emergent: The Early Royal Society and Cooperative Research," in *The Analytical Spirit: Essays in the History o f Science in Honor of Henry Guerlac*, ed. Harry Woolf (Ithaca, NY, 1981), 177-94.

[79] Hall, *Promoting Experimental Learning*; Marie Boas Hall, "The Royal Society's Role in the Diffusion of Information in the Seventeenth Century," *Notes and Records of the Royal Society of London* 29 (1975), 173-92; Eamon *Science and the Secrets of Nature*, 334-5.

broad array of religious, political, and social perspectives.[81] Such a diverse group would provide the ultimate testing ground for the principles and practices of the new science.

To avoid contentious debate and heal the ideological rifts between members, the Royal Society was determined to focus attention squarely on matters of fact and experimental knowledge. Any topics which raised the specter of religious, political, or even theoretical controversy were to be diligently avoided.[82] It became critically important, therefore, that fellows learn to think and communicate in the appropriate ways. Indeed, for a collaborative environment to succeed, any legitimate contribution to knowledge would have to be couched in the modest and factual language of experience. Generalized statements about how nature operated were therefore considered deeply problematic. Instead, fellows were encouraged to provide extremely detailed observations, describing how nature operated in a specific *time* and *place*.[83] By following such epistemological and narrative conventions, an individual could record a discrete experience—a scientific fact—capable of being calmly evaluated and accepted by the larger community. Even figures like Isaac Newton were careful to frame their ideas in this new manner. A landmark paper he submitted in 1672, for example, contained a detailed account of specific experiments he conducted into prisms and the refraction of

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[80] Lynch, *Solomon's Child*, 1-33.

[81] Michael Hunter, *The Royal Society and Its Fellows, 1660-1700: The Morphology of an Early Scientific Society* (Calfont St. Giles, Eng., 1982).

[82] Shapin and Schaffer, *Leviathan and the Air Pump*, ch. 4; Shapin, *Social History of Truth*, ch. 7.

[83] Peter Dear has explored how the changing emphasis on facts, probability, and experience led to a new style of observational reporting that was designed to minimize the likelihood of conflict and ensure a more cooperative approach to natural philosophy. Dear, "Totius in Verba," 144-161.

light. The report presented all the appropriate dates and locations, as well as the kind of elaborate detail that conveyed an authoritative set of experiences. But as historians have shown, it completely distorted the actual process by which Newton came to recognize certain properties of light. What he presented to the Royal Society, in fact, was a fictitious account of his scientific work—one that replaced a long and complicated process of speculative musing with a series of neat, historical experiments.[84] As Newton understood all too well, playing by the rules of the experimental game meant that all participants had to conform to a new set of knowledge-making practices designed to safeguard science from contentious debate.[85] Without such rules, natural philosophy might easily loose the intellectual framework that allowed disparate gentlemen to participate in an orderly and cooperative endeavor based upon authoritative facts.

The Royal Society also sought to foster a more collaborative setting for science by developing rules of civility that would govern conduct and speech at its meetings. Ever mindful of the divisive atmosphere created in the universities, fellows were determined to provide a polite and orderly forum for discussion.[86] One characteristic that often struck seventeenth-century observers was the fact that the Royal Society had created a cultural space which largely ignored the prerogatives of rank and social prestige. "It cannot be discerned that any Authority prevails here," one surprised visitor noted, because "in their meetings, no precedence or distinction of place is observed,

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[84] Simon Schaffer, "Glass Works: Newton's Prisms and the Uses of Experiment," in David Gooding, Trevor Pinch, and Simon Schaffer, eds., *The Uses of Experiment: Studies in the Natural Sciences* (Cambridge, 1989), 67-104.

[85] Dear, "Totius in Verba," 154-55; See also Hall, "The Royal Society and Cooperative Research," 177-94.

except by the president and the secretary."[87] Fellows sat wherever they pleased and they rejected the common practice of having social rank determine the order of speaking. The rules of the society were thus designed to create an unusual atmosphere of equality and congeniality. When members spoke, they always removed their hats as a gesture of respect and individuals were strictly prohibited from interrupting one another while speaking. Indeed, all fellows addressed their comments and questions directly to the President—a rule which reinforced the symbolic point that members were addressing topics, not each other.[88] Such discursive conventions were a far cry from the traditional rituals of public disputation that had often turned philosophical debates into *ad hominem* attacks. Members of the Royal Society were keenly aware that codes of polite decorum were essential in their efforts to create a setting more conducive to the collaborative ideals of experimental philosophy. The result, as one observer noted, was that their meetings were conducted in a "language of civility and moderation" unusual for the time. Another individual praised the fellows for their ability to "lay aside all set Speeches and Eloquent Harangues"—leading him to wish that "all Civil Assemblies" could follow the Royal Society's lead in banishing such "woeful" practices that proved "fatal to Peace and good Manners."[89]

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[86] On the attempt to reform language see Joel Reed, "Restoration and Repression: The Language Projects of the Royal Society," *Studies in Eighteenth-Century Culture* 19 (1989), 399-412. Lynch, *Solomon's Child*, ch. 5.

[87] Quoted in Shapin, "House of Experiment," 391.

[88] Margery Purver, *The Royal Society: Concept and Creation* (Cambridge, Ma., 1967), 18.

[89] Shapin, "House of Experiment," 388-93.

The Society's elevated tone was matched by its elevated goals, which sought to marshal useful knowledge for the good of society. Unlike the pedantic nature of scholasticism, the new science would demonstrate its worth by improving everyday life. The members of the Royal Society, therefore, focused much of their attention on observations, discoveries, and inventions that promised to advance the material well being of the nation at large. Standing committees were established to promote improvements in a wide range of fields including the mechanical arts, navigation, surveying, agriculture, mining, and public health.[90] Popular works—such as Joseph Glanvill's *Plus Ultra: Or the Progress and Advancement of Knowledge* (1668), Andrew Yarranton's *England's Improvement By Sea and Land* (1677), and John Evelyn's *Navigation and Commerce* (1674)—trumpeted the economic benefits of scientific know-how and innovation.[91] Such utilitarian ideals were reinforced by the close ties that actually developed between the societies' membership and the larger community of merchants, tradesmen, and landlords who were increasingly interested in the potential fruits of experimental knowledge.[92] Figures like Robert Hooke, John Houghton, Charles Povey, and John Beale offered revealing examples of the growing links between the world of natural philosophy and the world of enterprise. Each of these members

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[90] Jacobs, *Science and the Making of the Industrial Wes*t, Walter E. Houghton, "The History of Trades: Its Relation to Seventeenth-Century Thought as Seen in Bacon, Petty, Evelyn, and Boyle," *Journal of the History of Ideas* 2 (1941), 33-60.

[91] Such a focus also pervaded the *Philosophical Transactions*. See Marie Boas Hall, "Oldenburg, the *Philosophical Transactions* and Technology," in John G. Burke, ed., *The Uses of Science in the Age of Newton* (Berkeley, 1983), 21-47.

[92] Rob Illife, "Material Doubts: Hooke, Artisan Culture and the Exchange of Information in 1670s London," *British Journal for the History of Science* 28 (1995), 285-318; E.G.R. Taylor, *The Mathematical Practitioners of Tudor and Stuart England* (Cambridge, 1954)

participated in a seemingly endless litany of practical schemes which used science to address pressing technological challenges facing their contemporaries.[93] While there were certainly natural philosophers who remained detached from such worldly affairs, most members of the Royal Society endorsed the fundamental vision of science as a form of public knowledge that would advance the common interests of the nation by gathering and disseminating useful discoveries.[94]

In the closing decades of the seventeenth century, then, the ambitious project to reform natural philosophy appeared to be making significant progress. Proponents of the new science could boast a large measure of success in their efforts to extricate the study of nature from its traditional place within scholastic philosophy. New experimental practices—reinforced by the appropriate social conventions and institutional settings—transformed natural philosophy into an orderly and collaborative enterprise well suited for the needs of both civic gentlemen and the larger society. Such sweeping reform was pursued by advocates who insisted that proper knowledge could only be secured if the teetering structure of the old philosophy was demolished and replaced with a more solid foundation. As one observer noted in the 1670s, the goal of the Royal Society was "not to

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[93] Stephen Pumfrey, "Ideas Above his Station: A Social Study of Hooke's Curatorship of Experiments, *History of Science* 29 (1991), 1-44; Steven Shapin, "Who was Robert Hooke?" in Michael Hunter and Simon Schaffer, eds., *Robert Hooke. New Studies* (Woodbridge, Eng., 1989), 253-83; James R. Jacob, "Restoration Ideologies and the Royal Society," *History of Science* 18 (1980), 28-32; Kathleen H. Ochs, "The Royal Society of London's History of Trades Program: An Early Episode in Applied Science," *Notes and Records of the Royal Society* 39 (1985), 129-58; Mayling Stubbs, "John Beale, Philosophical Gardener of Herefordshire. Part II. The Improvement of Agriculture and Trade in the Royal Society (1663-1683)," *Annals of Science* 46 (1989), 323-63;

[94] Eamon, *Science and the Secrets of Nature*, 319-341, Stewart, *Rise of Public Science*, 3-59; Hunter, *Science and Society*, 90-1; Sprat, *History of the Royal Society*, 77-8.

whiten the walls of an old house, but to build a new one…& really mend its faults."[95] This new house of science was intended to serve as a model for how English society could be rebuilt in the wake of civil war and sectarian strife. It offered a blueprint for public life that espoused new forms of sociability, collaborative practices, and disciplined settings. For proponents, natural philosophy showed that ideological differences could be managed without the need for a Leviathan or harsh codes of orthodoxy. Indeed, science revealed workable solutions to the broader problem of authority and order that were needed to sustain a disparate community.[96]

And yet, the overall impact of this movement proved to be more subtle and complex than might appear at first glance. By the 1680s, individuals were already expressing noticeable anxiety and debate about the future direction of the new science.[97] Some members of the Royal Society, for instance, began to question just how open the doors to experimental philosophy should be. A minority suggested that the scientific community might be well served by turning inward for the time being. After all, they argued, it was perfectly acceptable for science to become a specialized pursuit, encompassing only those with the dedication and expertise to produce original research.[98]

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[95] Quoted in Shapin, "House of Experiment," p. 393.

[96] For an illuminating discussion of this issue, see Shapin and Schaffer, *Leviathan and the Air-Pump*.

[97] Margaret Espinasse, "The Decline and Fall of Restoration Science," in *The Intellectual Revolution of the Seventeenth Century*, ed. Charles Webster (London, 1974), 347-68.

[98] Michael Hunter and Paul B. Wood, "Towards Solomon's House: Rival Strategies for Reforming the Early Royal Society," *History of Science* 24 (1986), 49-108. See for example John Sargent's attempt to draw sharper distinctions between true natural *philosophers*, who rigorously examined the causes of natural phenomenon and deployed the analytical tools of mathematics, and those who simply "observe facts and records them faithfully." The latter were certainly deserving of "thanks and esteem" but to bestow upon them the title of Natural Philosophers was "to bring science into contempt." Sargent, *Method to Science* (London, 1696).

In some ways, this more narrow conception of science reflected a natural reaction among certain practitioners who sensed the potential benefits of professionalization. But it also gave voice to some of the frustration that had arisen from earlier efforts to link the work of the Royal Society to the broader public. The attempt to establish a "history of trades", which would publicize advancements in different commercial fields, along with proposals to involve the society in the licensing of patents, had introduced thorny issues concerning trade secrets, public knowledge, legal authority, and proprietary rights.[99] While such experiences did not lead the Royal Society to abandon its broader mission of establishing a public role for science, it did create some sense of ambivalence and hesitation about how exactly this should be pursued. In the tense climate surrounding the Exclusion Crisis and the reign of James II, the scientific community expressed understandable caution about its relationship to the broader cause of public reform.[100]

But if the new science faced certain obstacles to assuming a role of public authority and political sway, it managed to exert considerable influence within the realm of civil society. The Royal Society, for example, served as an archetype for countless clubs and organizations that sought to imitate its brand of enlightened sociability and improvement. Throughout the empire, various groups modeled their rules and meetings after the example set by the London's premier society; and its widely read *Philosophical Transactions* encouraged many clubs to attempt their own journals. Some of these

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[99] Rob Illife, "'In the Warehouse": Privacy, Property and Priority in the Early Royal Society," *History of Science* 30 (1992), 29-68; Stewart, *Rise of Public Science*, 21-30.

[100] M.C.W. Hunter, "The Crown, the Public and the New Science, 1689-1702," *Notes and Records of the Royal Society of London* 43 (1989), 99-116.

organizations—such as the Dublin Society, the Society of Arts, or the American Philosophical Society—would achieve notable success and longevity. Most of the clubs and societies would prove more fleeting, consisting of small groups who gathered in coffee houses or spare rooms to focus on useful knowledge, polite conversation, and practical improvement. But such informal groupings underscore the significance of scientific culture to the improving spaces of civic life. In Philadelphia, for instance, an ad-hoc club known as the "Junto" began meeting in the 1720s, led by the young, Benjamin Franklin. Comprised of provincial tradesmen—glaziers, tailors, cobblers, and the like—it might appear to share little in common with the Royal Society or the new science. But this small club imitated the *virtuosi* of London in almost every respect.[101] They even adopted similar codes governing civility and speech, requiring any member to pay a fine if they violated the rules. In short, they demonstrated how the model of collaborative inquiry, polite sociability, and edifying pleasure could cross barriers of geography and class, extending the influence of scientific culture to different segments of civil society. The creation of these enlightened spaces, and the modes of social interaction embedded within them, played a key role in the expansion of popular science and the culture of improvement.

Natural Philosophy and the Providential World

As the pursuits of science began to intersect with the concerns of worldly gentleman and tradesmen throughout Britain, Augustan divines were busy articulating a

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[101] In addition to Franklin's *Autobiography*, see Dorothy F. Grimm, "Franklin's Scientific Institution,"

vision of the natural world that lent considerable support to these activities. Drawing their inspiration from the discoveries of the new science, clergymen and philosophers sought to explain how nature, rightly understood, offered a window into the intentions and mysterious workings of the Creator. They viewed the diligent study of nature, therefore, as a pious endeavor that would supplement the scriptural teachings of Christianity and the Church. Yet the rise of "physico-theology"—as this intellectual movement was called—also focused attention on the inherent relationship between the divine ordering of nature and that of society. Responding to changing conceptions of the physical universe, thinkers began to reexamine the nature and purpose of human society, what many termed the "world politick."[102] In the hands of physico-theologians, the new science helped foster a providential worldview that portrayed the increase of knowledge and control over nature as the fulfillment of God's divine plan for the human race. Appearing in countless sermons and printed works, this ideology of a providential nature, created for man's use, shaped the way eighteenth-century Britons understood science and their interactions with the material world around them.

It would be difficult, in fact, to overstate the lasting import of this ideology, which resonated throughout the Anglo-Atlantic world for more than a century. As a genre, the literature of physico-theology—in the form of sermons, poetry, essays, and textbooks—were among the most popular items in print. And while different authors developed their own perspectives, most of these sources emphasized a common set of themes revolving

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Pennsylvania History 23 (1956), 437-62.

[102] Margaret Jacob, *The Newtonians and the English Revolution, 1689-1720* (Ithaca, NY, 1976).

around the pious study of nature, the providential designs of the Creator, and the right uses of natural philosophy. As the eighteenth-century minister and naturalist, Stephen Hales, explained, "The study of Natural Philosophy" allows one "to see in every thing the Wisdom of the great Architect of Nature: But it is also the most likely means, to make the Gift of kind Providence, this natural world, the more beneficial to us, by teaching us how, both to avoid what is Hurtful, and to pursue what is most beneficial to us."[103] Viewing the material world through the lens of "kind Providence" sanctified natural knowledge while making the improvement of its "gifts" a pious endeavor. These religious sentiments helped condition the public appeal of science and its place within the civic culture of Britain.

To be sure, such views built upon powerful strands of thought which had gained currency during the turbulent decades of the mid-seventeenth century. Many of the early proponents of the new philosophy, for example, believed that their efforts to reform science were part of a larger millennial design. Passages from the Book of Daniel and from the Book of Revelations suggested that the future millennium would usher in a complete restoration of human knowledge and mastery over the physical world.[104] In this earthly paradise, mankind would regain its rightful dominion over nature that had been lost with Adam's fall from grace.[105] If the corruption of knowledge had been the

[103] Hales, *Description of Ventilators…* (London, 1743), vii-viii.

[104] The famous frontispiece of Bacon's *Instauratio Manga* (1620)—which portrays a ship passing through the pillars of Hercules, heading out to explore open waters—contains a passage from Daniel 12:4 ("Many shall go to and fro, and knowledge shall be increased").

[105] Peter Harrison, "Original Sin and the Problem of Knowledge in Early Modern Europe," *Journal of the History of Ideas* 63 (2002), 239-59

consequence of original sin, reformers argued that the advancement of science was the providential means by which humans could work to reinstate the Edenic era of prosperity and power.[106] As historians have shown, these ideas infused the outlook of Puritans and other radical sects which proliferated during the English Civil War.[107] New philosophies of nature, combined with millenarian beliefs, underpinned the dramatic campaigns to transform the body politic and threatened to turn the existing world upside down. Although the Restoration put an end to this radical period, subsequent generations continued to worry about the social and political views which might be drawn from different theories of the natural world. Augustan divines were anxious, therefore, to demonstrate that the proper conception of nature supported the established order of English society. A moderate brand of providentialism—one stripped of its militant Puritan excesses—became a cornerstone of natural theologians who sought to reconcile the teachings of the new science with the values of Anglicanism and the English polity.[108] Claiming that nature was on their side, leading churchmen articulated a compelling vision of the world that drew part of its strength from an inherited protestant tradition concerning knowledge, God's providence, and the uses of his creation.

Natural philosophy, preached from Restoration pulpits, sought to combat the spread of potentially subversive approaches to understanding nature. This campaign involved a widespread attack on everything from the sophisticated versions of

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[106] Caroline Merchant, *The Death of Nature*, 165-84.

[107] Christopher Hill, *The World Turned Upside Down* (London, 1972), ch. 14; Webster, ed., *The Intellectual Revolution of the Seventeenth Century* (London, 1974)

philosophical materialism associated with the likes of Descartes, Hobbes, Spinoza and Epicurus, to the pagan naturalism and hermetic magic of popular culture. According to natural theologians, all of these approaches threatened to distort the cosmic order by portraying a world filled with only self-animated matter, removing God from any active role in sustaining his creation.[109] Such materialism and pantheism not only challenged God's authority in the physical world, but it had also emboldened radicals to challenge the authority of human institutions, as witnessed in the tumultuous upheavals of the Civil War. The specter of intellectual and political radicalism haunted the minds of contemporaries who believed that such heterodoxy was rooted in pernicious views of nature. Accordingly, the promoters of the new science in Restoration England—men such as Robert Boyle, John Wilkins, Isaac Barrow, Joseph Glanvill, and Henry More—were determined to develop a mechanical philosophy of nature that would retain spiritual forces acting on matter.[110] Such a theistic framework would firmly establish God's role in upholding the stable order of the universe, endowing the material world with a deeper moral foundation that discredited the views of atheists and sectarian enthusiasts alike.[111],

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[108] James R. Jacob and Margaret C. Jacob, "The Anglican Origins of Modern Science: The Metaphysical Foundations of the Whig Constitution," *Isis* 71 (1980), 251-67.

[109] Richard S. Westfall, *Science and Religion in Seventeenth-Century England* (New Haven, 1958); Keith Thomas, *Religion and the Decline of Magic: Studies in Popular Beliefs in Sixteenth and Seventeenth Century England* (London, 1971); idem, *Man and the Natural World: Changing Attitudes in England, 1500-1800* (London, 1983);

[110] Robert Boyle, "A Free Inquiry into the Vulgarly Received Notion of Nature," Thomas Birch, ed., *Works of Robert Boyle* 5 vols. (London, 1744), 358-424. John Wilkins, *Of the Principles and Duties of Natural Religion*, (London, 1675), esp. ch. 6-7; Henry More, *An Antidote against Atheisme* (London, 1653); Ralph Cudworth, *The True Intellectual System of the Universe* (London, 1678) J.E. McGuire, "Boyle's Conception of Nature," *Journal of the History of Ideas* 33 (1972), 523-42.

[111] The importance of upholding this theistic framework would continue well into the eighteenth century, when many scientific writers and textbooks still went out of their way to attack the idea of "unthinking matter", as one author put it. Joseph Randall, *A System of Geography…* (London, 1744), viii.

These efforts to create a new experimental philosophy—one that would provide a bulwark against the heresies of materialism and vulgar naturalism—found powerful support in the work of Sir Isaac Newton and his portrayal of the divinely ordered cosmos.

Newtonian philosophy offered a compelling interpretation of the material universe that addressed the pressing concerns of natural theologians. Like many of his associates, Newton wanted to demonstrate that motion was not a quality inherent in matter. "However we cast about," he explained in an early manuscript, "we find almost no other reason for atheism than this notion of bodies having, as it were, a complete, absolute and independent reality in themselves."[112] Newton rejected out of hand this conception of a world filled with self-animated matter and the dangerous consequences it posed. Instead, he envisioned a universe governed by the "active principles" of divine will. These spiritual forces were responsible for the motion of all inert matter, exerting their control over bodies from a distance and even through vacuums. Newton's laws of motion and universal gravitation enshrined this concept of immaterial forces through which God continually governed the workings of his creation. Although many contemporaries might find the complex mathematics of the *Principia Mathematica* (1687) too difficult to understand, they quickly grasped the deeper implications of Newton's worldview. The image of a harmonious universe, driven by the forces of divine will, revealed a stable and providential nature that left a deep impression on lay audiences.[113] In the hands of natural theologians, Newtonian science offered a powerful,

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[112] J.E. McGuire, "Force, Active Principles, and Newton's Invisible Realm," *Ambix* 15 (1968), 89

[113] Some of the public's reactions to Newton's work, in this regard, can be found in the clippings and extracts assembled by his colleague and relative, John Conduitt F.R.S., which are now housed in the library of King's College,

anti-materialist, explanation of how God actively ensured the orderly workings of the physical universe, and by extension, the orderly workings of human society.[114]

These scientific views would become increasingly central to the efforts of moderate churchmen who wished to foster a kind of rational Christianity that would heal the sectarian divisions of the nation. The "Latitudinarians", as they were called, represented a large, albeit loosely organized, segment of the Anglican Church. They believed that reason, not personal faith or an "inner light," should determine the parameters of Christian doctrine and piety. The unity of the Church, they argued, was essential to fulfilling the original purposes of the Reformation; and they rejected the notion that such unity could be attained through the enforcement of strict rituals and creeds. Rather, they hoped to reconcile dissenters to the Church by downplaying these divisive issues in favor of a broad Protestant Christianity which could appeal to all groups. While Latitudinarians often held different political affiliations, they shared a common outlook stressing the need for moderation, reason, and unity—values that would regenerate the Church and allow it to assert greater leadership over the religious life of the nation. Natural philosophy became an important means of pursuing these goals. Latitudinarians drew heavily from the new science to emphasize the essential aspects of

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Cambridge. Keynes Ms. 129-132. The broad embrace of Newtonian matter theory and "active principles" is explored in P.M. Heimann, "Voluntarism and Immanence: Conceptions of Nature in Eighteenth Century Thought," *Journal of the History of Ideas* 39 (1978), 271-83.

[114] William Whiston recalled discussing these issues with Newton, himself, who felt that his central ideas about the "immaterial power and presence of the Deity…in the Constitution of the World" would be apparent to most readers. As to the complex moral, religious, and political "Consequences" that could be extrapolated from this worldview, he preferred to be rather light-handed because he "thought it better to let his readers draw them first of themselves." But he also approved of the interpretive work done by natural theologians and expositors that turned his philosophy into a powerful bulwark of the religious and social order. And according to Whiston, the two discussed how these issues were brought more consciously to the fore in Newton's later works, such as the *Opticks* (1704; 1706; 1717) or the

Christianity revealed to all in God's physical creation. This natural theology, they claimed, would be a powerful ally in the Reformed Church's ongoing search to recover the fundamental truths of primitive Christianity obscured by centuries of Roman Catholic distortion. Thus, natural philosophy would help illuminate the reasonable tenants of Christianity, laying the foundation for social harmony, Protestant unity, and a shared culture of sober piety.[115]

The Latitudinarians gained an advantageous platform for airing their views when Robert Boyle endowed a special lectureship in 1691. His will had set aside money to pay for a series of monthly sermons, preached in London, that would expound the principles of rational Christianity against all unbelievers. Boyle specifically directed, however, that the lecturers were not to engage in "any Controversies that are among Christians themselves."[116] Polemical battles over scripture or doctrine were precisely the kind of divisive disputes that Boyle's lectureship hoped to render obsolete. Administered by a set of trustees—fellow Latitudinarians such as John Evelyn and Thomas Tenison, the future Archbishop of Canterbury—the sermons became a vehicle for trumpeting the central tenants of the new science and rational religion to the broader public. Newton, himself, took an active interest in the lectures and many of his close associates were

General Scholium appended to subsequent additions of the *Principia* (1713; 1726). See, *Collections of Authentick Records…* (1728), 1072-74

[115] Edward Fowler, *Principles and Practices of Certain Moderate Divines of the Church of England, Abusively Called Latitudinarians…* (London, 1670); Martin I.J. Griffin, Jr. *Latitudinarianism in the Seventeenth-Century Church of England* (New York, 1992)

[116] Quoted in Jacob, *Newtonians and the English Revolution*, 144.

appointed to deliver sermons.[117] Figures such as Richard Bentley, Samuel Clarke, and William Derham provided an overview of Newtonian science, interpreting the meaning of God's providential design for both Christianity and the state of worldly affairs. William Whiston and John Harris delivered sermons echoing similar themes, discussing how the new philosophy laid the foundation for rational religion by revealing the ways in which God's beneficent designs were embedded within the structure of creation and upheld by his active presence in the Universe. Such views would provide a necessary antidote to the licentious philosophies of Thomas Hobbes and other freethinkers, who were always lurking in the background of these physico-theological sermons.

While most of the Boyle lecturers went out of their way to denounce the philosophical materialism associated with Hobbes, they were equally concerned with the corrosive social relations that it supposedly fostered. Drawing upon his own conception of science, Hobbes had presented a mechanistic theory of society devoid of any moral or religious underpinnings. The dictates of reason and Christian ethics, he insisted, had no place in a world where individuals were driven by selfish passions, responding only to the fear of punishment or the desire for pleasure. The rules that would impose order and discipline on such a society, therefore, were not grounded in some external morality. But rather, they were imposed by a Leviathan who would devise the necessary restraints to effectively harness the natural impulses of rapacious men. Seen as sanctioning human vice and selfishness, Hobbes was constantly blamed by Augustan writers for helping to fuel the moral decay, greed, and irreligion they witnessed around them. The Boyle

[117] William Whiston, *Historical Memoirs of the Life of Dr. Samuel Clarke* (London, 1738).

lecturers never tired of attacking the perceived connections between materialist philosophies of nature, on the one hand, and the excesses of a materialist culture, on the other. They argued that the proper conception of the natural world—one set forward by Newton, Boyle and others—recognized the inherent moral order woven into the very fabric of creation. God's providence, seen most visibly in the harmonious workings of the universe, extended to human society as well. Indeed, natural religion aimed to show how mankind's possession of reason was a divine gift that allowed people to both understand and participate in the benevolent designs of the Creator. Reason would direct men to channel their energies into salutary pursuits, ensuring their own well-being and that of society, at large. In contrast to the cut-throat world of Hobbes and other libertines, the physico-theologians stressed that true individual happiness was divinely tied to the advancement of social cohesion and the common good. Just as God's rational powers maintained harmony and order within nature, rational Christianity would cultivate the social virtues and enlightened self-interest that maintained harmony in the "world politick."[118] Preaching to urbane congregations, immersed in the busy affairs of London, the Boyle lecturers articulated a compelling social ideology that wove together science, Christian providentialism, and the rational pursuits of gain. Such an ideology helped condition an outlook in which the active study and appropriation of nature were seen as central to God's plan for the orderly progress of society. And this growing blend of natural philosophy and providential religion, as several scholars have underscored,

[118] *A Defence of Natural and Revealed Religion: Being an Abridgment of the Sermons Preached at the Lecture founded by the Honble Robert Boyle, Esq.*, 4 vols. (London, 1737), I, 9-15, 22-4, 67-75; 261-62; 421-7; II, 119-54; 403, 448; III, 423-40; IV, 1-18.

"made science far more relevant to worldly concerns than did the weighty tomes of the French Cartesians" or the English admirers.[119]

The ideas of the physico-theologians, in fact, reached enormous audiences through the printed word. Many of the Boyle sermons, for example, were published in expanded form and went through numerous editions over the years. The first lecturer, Richard Bentley, achieved considerable success with the release of his eight sermons in 1692, demonstrating the fruitful marriage of science and rational Christianity. Within a few decades, Bentley's work was updated and republished on five separate occasions.[120] His colleague, Samuel Clarke, fared even better. His sermons, printed as *A Discourse Concerning the Unchangeable Obligations of Natural Religion* (1706), became a tremendously popular tract, appearing in no less than ten editions by the 1760s. Not to be outdone, William Derham's *Physico-Theology* (1713) achieved a similar level of success, spawning twelve editions over the same period of time. Indeed, Durham was so taken with the popular demand for such material that he created a somewhat condensed sequel, *Astro-Theology* (1715) which became a best seller in its own right.[121] By the 1730s, individuals could also purchase compellations that included selections of the most popular sermons while excerpts continued to appear in magazines and miscellanies until

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[119] Margaret C. Jacob, *The Cultural Meaning of the Scientific Revolution* (New York, 1988), 61

[120] Richard Bentley, *Confutation of Atheism* (London, 1692); subsequently republished as *Eight Sermons Preach'd at the Honourable Robert Boyle's Lecture, in the first year…* (London, 1696). The Sixth edition was printed in Cambridge in 1735.

[121] William Derham, *Astro-theology: or, a Demonstration of the Being and Attributes of God, from a survey of the Heavens* (London, 1715). The popular work appeared in 14 editions, printed in London, Glasgow, and Edinburgh by 1775. In a similar vein, William Whiston published his *Astronomical Principles of Religion, Natural and Reveal'd…* (London, 1725).

the end of the century.[122] Yet the genre was by no means confined to the Boyle lecturers. Influential works such as John Wilkins' *Of the Principles and Duties of Natural Religion* (1675), Thomas Burnet's *Theory of the Earth* (1691), William Wollaston's, *Religion of Nature Delineated* (1722), George Cheyne's *Philosophical Principles of Natural Religion* (1705), John Ray's *The Wisdom of God Manifested in the Works of the Creation* (1691), and his later *Three Physico-Theological Discourses* (1713) all helped to fuel the public's growing fascination with the providential world being illuminated by the new science.[123]

Widely echoed in the press, the pulpit, and the growing array of schools that emerged at the end of the seventeenth century, this ideology provided a powerful framework for interpreting the natural order, sanctifying the need to explore and utilize God's creation.[124] Even religious dissenters, who largely resisted the call to return to the Anglican fold, enthusiastically embraced the value of scientific inquiry to spiritual life and the diligent pursuit of one's "calling" in the here and now. "Among ministers and laity of the nonconformists," one contemporary observed, "a taste for science prevails to

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[122] Gilbert Burnet created the first compilation, *A Defence of Natural and Revealed Religion: Being an Abridgment of the Sermons preached at the Lecture founded by the Honourable Robert Boyle, Esq*, 4 vols. (London, 1737). Within two years, Sampson Letsome and John Nicholl produced their own 3 volume collection of the Boyle lectures, published in London in 1739. Burnet's original compilation also appeared in a second edition in 1752.

[123] All of these works appeared in repeated editions that were published throughout the eighteenth century. There were also translated works of continental physico-theologians that were popular at the time—especially, Hugo Grotius' *The Truth of the Christian Religion* (1711) and Bernard Niewentyt, *The Religious Philosopher* (1718). The latter was even included among the choice technical and scientific works being advertised by the famed instrument-maker and Printer, John Senex F.R.S., underscoring its perceived merits as an important treatise in natural philosophy. See, "Books Printed for John Senex in Salisbury Court" appended to Whiston's *Longitude and Latitude* (1721). On Senex's role in the publishing of key scientific works, see Taylor, *Mathematical Practitioners*, 143.

[124] Nearly 700 schools and academies opened in the period from 1690-1710, many of which pursued a non-classical curriculum which incorporated science and natural philosophy alongside history, logic, grammar, and various forms of practical knowledge. See, Holmes, *Augustan England*, 63-70; Nicholas Hans, *New Trends in Education in the*

a greater degree than a taste for literature and their clergy are better mathematicians and experimentalists than scholars."[125] In this respect, dissenters participated fully in the emerging culture of Augustan England, where the fusion of science and scripture created an activist role for Christian believers who were expected to study the workings of nature and make its providential gifts more useful to humankind. This growing tide of natural theology, in sum, worked to underpin the emerging position of science within public life—both legitimating and linking the energetic pursuit of philosophy, piety, and profit.

In fundamental ways, therefore, the culture of "improvement" rested squarely upon providential foundations, endowing the material world with divine purpose and a pious mandate for human use. So while the famed sociologist Max Weber had a point when he claimed that the emergence of modern science, with its mechanistic framework, led to a "disenchanting" of the world—i.e. the disappearance of spiritual and supernatural relations embedded within nature. The popularity and thrust of natural theology would suggest that the material world, in certain respects, had become even more "enchanted" in the eyes of contemporaries, more infused with providential meaning, than in the past.

Science, Projects, and the New Social Order

The Glorious Revolution of 1688-1689 ushered in a period of dramatic transformation that reshaped the political, social, and intellectual landscape of the

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Eighteenth Century (London, 1971), ch. 1. For a broader assessment of the spread of natural philosophy and providentialism, see Jacob, *Cultural Meaning of the Scientific Revolution*, ch. 3.

[125] Quoted in Stewart, *The Rise of Public Science*, 204.

nation.[126] Few recognized this fact more clearly than the practitioners of the new science, who were quick to capitalize on the expanding opportunities that unfolded in the wake of the revolutionary settlement. Beginning in the 1690s, natural philosophy made tremendous gains both in terms of popularity and prestige, establishing a broad public following that had long been desired, but never fully realized, by earlier promoters of science.[127] Throughout this period, a growing array of books, magazines, and newspaper articles expounded the principles and discoveries of the new science to ordinary readers, providing a level of cultural literacy that allowed larger segments of the public to understand, and often participate in, the expanding world of natural science. The popular appetite for knowledge was also fed by a new cast of characters—entrepreneurs, lecturers, enlightened clergymen, private tutors and engineers—who made it their business to entertain and edify audiences with the practical uses of natural philosophy.[128] Their numbers seemed to increase so rapidly, according to one critic, that society was in danger of being overwhelmed by the "vulgar herds of chemists, naturalists, and

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[126] For an overview of the broad transformations which began in 1689, with the Glorious Revolution serving as a "great divide," see: Frank O'Gorman, *The Long Eighteenth Century: British Political and Social History, 1688-1832* (London, 1997), 29-174; Geoffrey Holmes, *The Making of a Great Power: Late Stuart and early Georgian Britain, 1660-1722* (London, 1993); Brewer, *Sinews of Power*; Wilson, *Sense of the People*, 3-83. For the contrasting view, which emphasizes the preservation of an older social, political, and confessional order, see J.C.D. Clark, *English Society, 1688-1832: Ideology, Social Structure and Political Practice During the Ancien Regime* (Cambridge, 1985).

[127] Margaret Jacob, in particular, has stressed that the period immediately following the Glorious Revolution marked a critical turning point when science gained widespread interest and support among the literate segments of society. Indeed, she has argued that, beginning in the 1690s, science became an integral part of the Whig and Erastian order which characterized Hanoverian Britain. Margaret C. Jacob, *The Newtonians and the English Revolution, 1689-1720* (Ithaca, 1976); *The Cultural Meaning of the Scientific Revolution* (New York, 1988), 105-131.

[128] E.G.R. Taylor, *The Mathematical Practitioners of Hanoverian England, 1714-1840* (1966); Stewart, *The Rise of Public Science*; esp. ch. 4-5; Simon Schaffer, "Natural Philosophy and Public Spectacle in the Eighteenth Century," *History of Science* 21 (1983), 1-43; and Stephen Pumfrey, "Who did the Work? Experimental Philosophers and Public Demonstrators in Augustan England" *British Journal for the History of Science* 28 (1995), 131-56; Larry Stewart, "The Selling of Newton: Science and Technology in Early Eighteenth-Century England," *Journal of British Studies* 25 (1986), 178-92.

philosophers" who now roamed freely throughout the land.[129] There were many people, of course, who remained either untouched or indifferent to science altogether. But as historians have begun to reveal, the first half of the eighteenth century marked a critical moment in the popularization of science in Britain.[130] In a relatively short span of time, natural philosophy assumed a conspicuous role in the public life of the nation, raising important questions about the relationship between the growing authority and appeal of science, on the one hand, and the broader transformations that were sweeping eighteenth-century Britain, on the other.

One contemporary who focused precisely on this issue was Jonathan Swift. Few writers could match his talents when it came to the art of satire or social criticism. Swift had an uncanny ability to sense the pulse of the nation, to dissect the complex forces that were threatening to undermine the traditional society he cherished. Armed with the tools of ridicule, he set out to expose the absurdity of a world that he believed had increasingly lost its way. In particular, Swift railed against the tides of change that had accompanied the political upheavals of the Glorious Revolution. Much of his scorn was directed at the financial and commercial order which emerged in England in the decades following

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[129] Thomas Birch quoted in Stewart, *The Rise of Public Science*, xix. For a more celebratory assessment of the flourishing state of science in the period after 1689, see William Stuckeley, "Memoirs of Sir Isaac Newton's Life..." Royal Society MS. 142/5.

[130] Margaret C. Jacob, "Scientific Culture in the Early English Enlightenment: Mechanisms, Industry and Gentlemanly Facts," in *Anticipations of the Enlightenment in England, France, and Germany*, eds. Alan Charles Kors and Paul J. Korshin (Philadelphia, 1987), 134-64; Roy Porter, *Creation of the Modern World*, 24-47, 130-55; Golinsky, *Science as Public Culture*, ch. 1; Alan Q. Morton and Jane .A. Wess, *Pubic and Private Science: The King George III Collection* (Oxford, 1993); Patricia Fara, *Sympathetic Attractions: Magnetic Practices, Beliefs, and Symbolism in Eighteenth-Century England* (Princeton, 1996); Paul Elliot, "The Birth of Public Science in the English Provinces: Natural Philosophy in Derby, c.1690-1760" *Annals of Science* 57 (2000), 61-100; Stewart, *The Rise of Public Science*; Special issue of the *British Journal for the History of Science* (March 1995) devoted to "Science Lecturing in the Eighteenth Century." For a discussion of the issues surrounding the popular appropriation of science, see Roger Cooter

1689.[131] He portrayed this new world of high-flying finance and commercial "projects" as a breeding ground of corruption, stock-jobbing, and a spirit of rampant speculation that bordered on hysteria.[132] Such dangerous innovation, however, was not confined to the bustling alleys surrounding the Royal Exchange. Swift detected the same enthusiasm and mentality in the religious sphere, where Latitudinarians and proponents of rational religion were quietly, but effectively, chipping away at the very foundations of Anglican orthodoxy. These developments, combined with the political ascendancy of the Whigs, led Swift to conclude that the nation was on the verge of a complete transformation—poised to loose both its soul and its common sense.[133]

But what is perhaps most striking about Swift's analysis, is his recognition of the central role that science played in cementing this new social and political order. Natural philosophy, with its dynamic vision of moral and material progress, was responsible for fueling the pretentious outlook of the low churchman, projectors, and Whig politicians he despised. Indeed, throughout his writings, Swift identified the new science as a fundamental source of the conceited belief in the power of reason and man's ability to

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and Stephen Pumfrey, "Separate Spheres and Public Places: Reflections on the History of Science Popularization and Science in Popular Culture," *History of Science* 32 (1994), 237-67.

[131] David Armitage, "The Projecting Age: William Peterson and the Bank of England," *History Today* 44 (1994); Julian Hoppit provides an excellent survey of the financial and commercial opportunism that defined the "Age of Projects," including the economic and social toll caused by the numerous collapses, in *Risk and Failure in English Business, 1700-1800* (Cambridge, 1987).

[132] Swift's attack on the world of projectors, Whig placemen, and financial corruption is best displayed in his classic series of pamphlets written between 1724-5, *The Drapier's Letters*, attacking William Wood, the arch projector whose schemes for the Irish coinage and political machinations enraged Swift. *The Works of Jonathan Swift, Dean of St. Patrick's Dublin…*, 9 vols. (Dublin, 1758), III. 14-166. See also, J. M. Treadwell, "Swift, William Wood, and the Factual Basis of Satire," *Journal of British Studies* 15 (1976), 76-91, 77.

[133] Williams, *Swift and the Age of Compromise*, esp. 161-78; F.P. Lock, *The Politics of "Gulliver's Travels,"* (Oxford, 1980).

reshape the world—convictions that led people to recklessly abandon the prudent ways of the past.[134] Nowhere was this view more evident than in Swift's celebrated work, *Gulliver's Travels,* where the flying island of Luputa—led by the delusional engineers and scientists of its Academy of Lagados—offered a withering portrayal of how natural philosophy encouraged the kind of chimerical schemes and craze for innovation that were infecting all aspects of society.[135]

Swift's anxiety over science no doubt reflected his personal experiences within the new cultural milieu of Augustan London, where experimental philosophy and projecting interests abounded. In the early part of the century, Swift spent a considerable amount of time rubbing elbows with the politicians, merchants, clergymen, and literati who gathered in the fashionable coffee houses that were beginning to dominate the city's cultural landscape. Surrounded by busy markets and financial hubs, these sites had become important meeting places for various members of respectable society who, despite their different backgrounds and interests, converged to discuss the latest news, ideas, and worldly affairs over a bowl of coffee.[136] With a typical admission price of one penny, these establishments offered patrons a host of amenities ranging from newspaper

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[134] See especially, Douglas Lane Patey, "Swift's Satire on 'Science' and the Structure of *Gulliver's Travels*," *ELH* 58 (1991), 809-39.

[135] Jonathan Swift, *Travels into Several Remote Nations of the World…By Lemuel Gulliver…*, 2 vols. (London, 1726), II, 7-175; For contemporary discussions of this attack on science, see John Boyle, *Remarks on the Life and Writings of Dr. Jonathan Swift* (London, 1752), 147. See also Pat Rogers, "Gulliver and the Engineers," *Modern Language Review* 70 (1975); Ernest Tuveson, "Swift and the World-Makers," *Journal of the History of Ideas* 11 (1950), 54-74.;

[136] On the close link between the world of science and the new institutional space of the coffee houses, see: Robert Iliffe, 'Material Doubts: Hooke, Artisan Culture, and the Exchange of Information in 1670s London," *British Journal for the History of Science* 28 (1995), 285-318; Raymond P. Stearns, "James Petiver, Promoter of Natural Science, c.1663-1718," *Proceedings of the American Antiquarian Society* 62 1952, 243-365; Larry Stewart, "Other Centres of Calculation, or, Where the Royal Society didn't Count: Commerce, Coffee-Houses and Natural Philosophy in Early

collections and specialized libraries to additional rooms set aside for private meetings and lectures. While the atmosphere of sobriety and business reflected the heavily mercantile orientation of many coffee houses, it also provided exactly the kind of polite and orderly setting in which members of the new urban elite could gratify their appetite for more genteel forms of sociability, entertainment, and personal networking. Such opportunities appealed to men like John Houghton—a busy author, scientist and projector—who extolled the virtues of these new institutions:

> Coffee-houses make all sorts of People sociable, the rich and the poor meet together, as also do the learned and the unlearned: It improves arts, merchandize, and all other knowledge; for here an inquisitive man, that aims at good learning, may get more in an evening than he shall by Books in a month: he may find out such coffee-houses, where men frequent who are studious in such matters as his enquiry tends to, and he may in short space gain the pith and marrow of the others reading and studies.[137]

As Houghton suggested, an "inquisitive" soul would have to make certain choices since London already contained an array of establishments catering to distinct groups. In fact, by the time Swift had arrived during the reign of Queen Anne, the capital alone contained some 600 coffee houses—a phenomenon that was quickly spreading to provincial towns and seaports throughout the empire.[138]

An important dimension of the coffee house's success was its ability to combine sobriety, sociability, and personal improvement in a way that soothed some of the fractious divisions of the past. The congenial yet restrained atmosphere served to quell

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Modern London," *British Journal for the History of Science* 32 (1999), 133-53. On the rise of the professions see Holmes, *Augustan England: Professions, State and Society, 1680-1730* (London, 1982).

[137] John Houghton, *A Collection for Improvement of Husbandry and Trade*, 15:461 (Friday 23 May 1701).

[138] A. Ellis, *The Penny Universities: A History of the Coffee-Houses* (1956), 18-19; B. Lillywhite, *London Coffee-Houses* (1963), 761-823. On their spread and function in provincial communities, see Borsay, *The English Urban Renaissance,* 144-6, 280

not only the potential frictions between "rich and poor" or "learned and unlearned", as Houghton pointed out, but also the more ominous strife that could arise when individuals from different religious, political, or ethnic backgrounds tried to socialize in mixed company. Echoing this common sentiment, one observer praised coffee-houses, bookseller's shops, and other such "polite" new venues for their ability to bring such disparate groups together:

> [These] are places where the social virtues reign triumphant over prejudice and prepossession. The easy freedom, and cheerful gaiety, arising from the nature of a public place, extends its influence over them, and every species of party spirit is entirely stripped of those malignant qualities which render it so destructive of the peace of mankind. Here divines and philosophers, Deists and Christians, Whigs and Tories, Scotch and English, debate without anger, dispute with politeness, and judge with candour…"[139]

Social virtues could trump party spirit, but only in the proper setting. It would be misleading, of course, to suggest that coffee houses had the power to somehow compel social harmony amongst all people, in all places, and at all times. But the genuine novelty and excitement which surrounded these institutions, and the diverse clientele who frequented them, suggest that important historical currents were at work here.

Indeed, such vitality sprang from the fact that coffee houses catered to the most dynamic elements of Augustan society. As many contemporaries pointed out, and later scholarship has confirmed, these sites served as microcosms of a rapidly changing order. They came to embody such trends as the expanding culture of print, the growing enchantment with finance and trade, the emergence of polite forms of leisure and sociability, the rising assertiveness of the professional and middle classes, and above all,

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[139] Quoted in Borsay, *English Urban Renaissance*, 280.

the intellectual ferment surrounding the early stages of the English Enlightenment.[140] Coffee houses also benefited considerably from the declining appeal of court life under Queen Anne, whose notorious embrace of rigid protocol, soporific tastes, and meager patronage drained the court of much of its traditional allure as the preeminent site where the genteel classes converged to mingle and seek preferment.[141] Like other aspiring writers, Swift was increasingly drawn instead to the vibrant culture that set London's coffeehouses apart. Yet it was precisely in such settings—where individuals were said to mingle and "discourse freely of everything"—that Swift witnessed first hand the unholy alliance between science, politics, and commercial speculation that would eventually become his *bête noire*.[142]

In this respect, Button's Coffee-House left a particularly deep impression on Swift. Here, he encountered the growing coterie of politicians, intellectuals, and projectors that had assembled around two of the leading lights of Queen Anne's reign—Richard Steele and Joseph Addison.[143] Under the patronage of these two Whig *virtuosi*,

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[140] Klein, *Shaftesbury and the Culture of Politeness*, 10-14

[141] See Robert O. Bucholz, *The Augustan Court: Queen Anne and the Decline of Court Culture* (Stanford, 1993), 202-48. Court life under Queen Anne was not completely moribund, as Bucholz notes, but it no longer attracted the dynamic elements it once had—few Whigs, parliamentarians, commercial and financial magnates, or artists were to be found. Instead, the court mainly attracted "diehard Tories" and "solid citizens" who seemed to attend the court out of a sense of obligation. Whereas, the "big political, cultural, and social fish of the Augustan Age" chose to exploit the "more exciting and more lucrative opportunities" to be found in the dynamic atmosphere of London's assembly rooms, concert halls, clubs, taverns, and coffee houses. (247-8).

[142] Quoted in Clark, *British Clubs and Societies*, 162. On the role of science in shaping the cultural atmosphere of England's coffeehouses, see Stewart, "Other Centres of Calculation," 133-53; A.E. Musson and Eric Robinson, *Science and Technology in the Industrial Revolution* (Manchester, 1969), 58.

[143] Robert J. Allen, *The Clubs of Augustan London* (Cambridge, MA, 1933), 239-48. Button's coffee house was also famous at the time for its lion's head letterbox in which correspondence and articles for Steele's popular journal, *The Guardian*, were to be dropped off. For the activities of Addison and Steele, see Peter Smithers, *The Life of Joseph Addison* (Oxford, 1954), and Calhoun Winton, *Captain Steele: The Early Career of Sir Richard Steele* (Baltimore, Md., 1964)

Button’s had evolved into one of the premier cultural institutions of London, gaining a wide reputation as a hotbed of free-thinking, literary wit, and political intrigue. Although a number of conservative figures, such as Swift and Alexander Pope, frequented the Covent Garden establishment, it was known for its emphatically Whig tendencies—a characteristic that became even more evident after the Hanoverian Succession elevated the Whig party to power in 1714, catapulting many of Button’s clientele into positions of influence and profit under the new regime.[144] In fact, the rising political fortunes of this group caused Pope to refer to them, rather enviously, as the “Little Senate” and the “*Grand Société*”[145]

Yet, this tightly-knit circle was more than just a political cabal. Button’s coffee-house also provided an ideal setting for scientific and entrepreneurial pursuits that catered to the wide-ranging interests of its members. It was here, for example, that the controversial William Whiston launched his series of popular lectures on astronomy and Newtonian physics after his expulsion from Cambridge for suspected heresy. Having incurred the wrath of High-Church officials as well as the loss of his comfortable post as the Lucasian Professor of Mathematics—the chair held previously by Newton—Whiston was forced to move to London where he began marketing his scientific expertise and

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[144] Addison, in particular, rose to high rank in the new Whig regime—becoming Secretary of State for the South and Commissioner of the Board of Trade—providing him with considerable patronage to dole out among his associates such as Eustace Budgell, Ambrose Philips, Thomas Tickell, and Thomas Burnet. Smithers, *Life of Joseph Addison*, 371-2.

[145] Worth, “Swift’s ‘Flying Island,’” 353-54; On Pope’s ambivalent relationship with the Button’s circle, and especially there blend of science and politics, see M.H. Nicolson and G.S. Rousseau, *“This Long Disease, My Life”, Alexander Pope and the Sciences* (Princeton, 1968), 137-87.

knowledge to an increasingly receptive public.[146] His friends, Addison and Steele, had persuaded the charismatic philosopher to make Button's his temporary home where he delivered "many lectures…to the agreeable entertainment of a good number of curious persons" as he later recalled.[147] Whiston was soon joined by other prominent scientists like Francis Hauksbee and Humphrey Ditton. Indeed, according to one account the Whig haunt was often crowded with a variety of these "ingenious Gentlemen, Who meet…to settle the Mechanical, Physical, and Moral World."[148] Such purveyors of natural knowledge would likely have included lecturers, instrument makers, engineers, mechanics, surveyors, and other "mathematical practitioners"—all of whom gravitated to establishments like Button's in the hopes of achieving recognition and reward from their well-connected clientele. Committed to the worldly uses of natural philosophy, and eager to transform their skills into marketable commodities, these men relished the opportunity to discuss issues of science and technology with leaders of the business community and improving land magnates who shared their enterprising attitude.[149]

Out of this dynamic environment emerged a variety of schemes and projects which fired the imagination of scientists, merchants and Whig politicians alike. Perhaps

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[146] James E. Force, *William Whiston: Honest Newtonian* (Cambridge, 1985), 19-22; Allen, *Clubs of Augustan London*, 240-5

[147] William Whiston, *Memoirs of the Life and Writings of Mr. William Whiston…*, 2 vols. (London 1753), 1:256; As Steele announced in his journal, *The Englishman*, Button's was also the site of "a course of Philosophical Lectures on Mechanics, Hydrostatics, Pneumatics, Opticks" which were performed by "Mr. William Whiston and Francis Hauksbee." *"The Englishman": A Political Journal by Richard Steele*, ed. Rae Blanchard (Oxford, 1955), 436.

[148] J.T. Desaguliers, *The York-Buildings Dragons…* (London, 1726), 10.

[149] Stewart, "Other Centres of Calculation," 133-53. "Larry Stewart, "Public Lectures and Private Patronage in Newtonian England," *Isis* 77 (1986), 47-58; Shelley Costa, "Marketing Mathematics in Early Eighteenth-Century England: Henry Beighton, Certainty, and the Public Sphere," *History of Science* 40 (2002), 211-32; Stewart, *The Rise of Public Science*, 143-211.

the most famous example was the successful effort—hatched at Button's—to enact a Parliamentary bill offering an enormous reward of £20,000 to anyone who discovered a reliable and accurate method for determining Longitude at Sea.[150] While issues surrounding navigation had certainly garnered public attention before, the historian Larry Stewart has aptly shown that Parliament's striking intervention in this matter heralded the emergence of science as a vital force in public affairs. Natural philosophy, he points out, "was all the rage in the summer of 1713" when London's scientific community galvanized a coalition of politicians and projectors to lobby for this unusual initiative.[151] Hailed as a triumph for the Whig and mercantile interests, the Longitude Act (1714) underscored the perceived links between scientific advancement, technical prowess, and national prosperity—giving financial and institutional support to the dreams of improvement. For precisely this reason, it embodied all that was wrong with the world in the eyes of Swift.[152] The popular initiative epitomized the growing hubris that arose from the nexus of scientific enthusiasm, speculative fever, and political machinations. Such a heady brew, which Swift had encountered so often in the bustling atmosphere of

[150] For the original proposals—addressed to the gentlemen of Button's—see, *The Guardian*, 14 July 1713. Later publicity along this front included an article in Steele's *The Englishman*, 10 December 1713, and William Whiston and Humphry Ditton, *A New Method for Discovering the Longitude…* (London, 1714).

[151] Stewart, *The Rise of Public Science*, 185.

[152] One of the great follies that Swift decried was the tendency of many "to mistake the echo of a London Coffee-house for the Voice of the Kingdom." Swift, "Conduct of the Allies," in *Political Tracts, 1711-1713,* ed. H. Davis (Oxford, 1973), 53. The Longitude Act would become synonymous with "projecting." Indeed, Samuel Johnson's Dictionary of 1755 used quotes from Addison's *Guardian* (concerning the Longitude Act) to explain the very meaning of the term "project." For details on the creation of the Longitude Board, as well as the financial and institutional support it gave to various schemes, see Derek Howse, *Greenwich Time and the Discovery of the Longitude* (Oxford, 1980).

London's coffeehouses and exchanges, was now beginning to reshape the broader contours of society in profound ways.

Hoping to capitalize on this advantageous mood, William Whiston and his associates drew up a variety of experimental schemes to involve the public in the worldly business of scientific improvement. One early project centered on the use of exploding projectiles to determine longitude along Britain's hazardous coastline.[153] Inspired by a series of popular fireworks celebrating the Peace of Utrecht, Whiston and his colleagues discussed the possibility of establishing precise geographic coordinates based upon the interval of time which elapsed between an explosion and the moment when a distant observer recorded the sound. Such an idea became even more promising, as Whiston recalled, when Humphrey Ditton developed "a sure method of Trigonometrical Calculation" that would translate the difference in time into "the difference of Longitude in Degrees."[154] Whiston's circle decided to go public with their project, recruiting gentlemen, scientists, and Whig grandees into a campaign for experimental trials. Relying on public support—in terms of both subscriptions and volunteers—the effort aimed to demonstrate how a network of elaborately timed rocket explosions along the coast would allow mariners to ascertain longitude from as far away as 60 miles.[155] Whiston and his supporters also attempted to apply the same principles to inland surveying, hoping to persuade Parliament to finance this unusual approach to

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[153] William Whiston, *A proposal for a Bill for the Better Direction and Preservation of Ships that use the British Channel* ([London?], 1717).

[154] William Whiston, *A New Method for Discovering the Longitude, Both at Sea and at Land*…, 2nd ed. (London, 1715), 18, 24.

cartography.[156] Although these measures failed on all fronts, as Swift would have predicted, Whiston's group simply shifted their focus, devising a new program in the 1720s to investigate the magnetic variation in compasses as a way of solving Britain's navigational problems.[157]

Yet, such efforts had to compete in an evolving marketplace where technical projects and schemes for improvement abounded. Various groups were busy pitching their own ideas to influential patrons as well as courting the public, at large. In coffee houses such as the Marine, the Swan, Garraway's, the Grecian, or Child's, one could find lecturers and experimentalists building broader constituencies for natural philosophy and its relevance to everyday concerns.[158] Nor was the creation of new scientific spaces and audiences confined to simply coffeehouse philosophers. The emergence of subscription libraries, itinerant lecturers, private academies, tutors, and social clubs all multiplied the arenas in which scientific discussion merged with goals for personal and public improvement.[159] Groups like the Spitalfields Mathematical Society (1717)—which drew

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[155] Whiston, *A New Method for Discovering Longitude*, 31, 39, 56-68, 88-89,

[156] Force, *William Whiston: Honest Newtonian*, 31-7.

[157] William Whiston, *The Longitude and Latitude Found by the Inclinatory or Dipping Needle…* (London, 1721). Whiston gained considerable backing for this project as well as for his later schemes to use astronomical means to tackle the same problems. For the later, see William Whiston, *The Longitude Discovered by the Eclipses, Occultations and Conjunctions of Jupiter's Planets…* (London, 1738). The goal of improving navigation through a giant compendium of recorded magnetic compass variation did not end with Whiston and his associates. William Mountaine and James Dodson assembled nearly 50,000 such recordings and presented them to the Royal Society a few decades later. See Royal Society Journal Book (RSJB), 10 November 1757.

[158] Margaret C. Jacob, "Scientific Culture in the Early English Enlightenment: Mechanisms, Industry and Gentlemanly Facts," in *Anticipations of the Enlightenment in England, France, and Germany*, eds. Alan Charles Kors and Paul J. Korshin (Philadelphia, 1987), 134-64; Stewart, *The Rise of Public Science*, ch. 5, 6, 8.

[159] Cooter and Pumfrey, "Separate Spheres and Public Places," 237-67; Margaret C. Jacob, *The Cultural Meaning of the Scientific Revolution* (New York, 1988), Jacob, *Scientific Culture and the Making of the Industrial West* (New York, 1997), ch. 4-5; Paul Elliott, "The Birth of Public Science in the English Provinces: Natural Philosophy in Derby,

together weavers, craftsmen, gardeners and apothecaries—met in different locations throughout east London to witness lectures and experiments as well as to educate themselves in useful knowledge for their mutual advancement.[160] Within such diverse environments, science became increasingly central to a nascent outlook that embraced natural philosophy and collaborative inquiry as key to achieving "improvement", in all its manifold forms. Daniel Defoe, who in many respects straddled the worlds of aspiring tradesmen, enterprising merchants, and polished gentlemen, probably spoke for a growing number of his contemporaries when he declared that "experimental and natural phylosophy" was "the most agreeable as well as profitable study in the world."[161]

Conclusion

In subtle yet powerful ways, the expanding culture of science helped reconfigure the terrain of civil society and public life in Hanoverian Britain. Not only did natural philosophy disseminate a powerful set of values and practices among its followers; but as Swift and other critics knew all too well, it played a crucial role in fostering a broader culture of innovation which fueled the aspirations of various groups on the make. Georgian science had the capacity to enlarge the imaginative horizons of the public, opening up new realms of possibility by inviting people to imagine an orderly world

c. 1690-1760," *Annals of Science* 57 (2000), 61-100; John R. Millburn, "The London Evening Courses of Benjamin Martin and James Ferguson, Eighteenth-Century Lecturers on Experimental Philosophy," *Annals of Science* 40 (1983), 437-55;

[160] Larry Stewart and Paul Weindling, "Philosophical Threads: Natural Philosophy and Public Experiment among the Weavers of Spitalfields," *British Journal for the History of Science* 28 (1995), 37-62.

[161] Daniel Defoe, *The Compleat English Gentleman*, ed. Karl D. Bulbring (London, 1890), 228.

capable of endless improvement and control. The tenants of natural theology, emanating from the pulpit and press, only sanctified this outlook, laying a providential foundation for the projecting spirit of the age. And as this link between science and material progress became ingrained in popular culture, the wide-ranging pursuits of natural philosophy assumed greater meaning and civic purpose. Once mundane activities, like recording the weather, studying plants, or experimenting with new machines, now appeared as enlightened forms of public service, celebrated in the newspapers, churches, and assembly rooms of Georgian Britain. The expanding world of science, in other words, delineated new civic roles for individuals, allowing many people to see their work as contributing directly to the welfare of the nation.

The rise of popular science, furthermore, was tied to the emergence of new forms of sociability which broadened the arenas of civic life. As groups carved out new spaces for collaborative inquiry and conversation—sites ranging from coffee houses to assembly rooms to social libraries—the pursuit of useful knowledge became woven into popular initiatives to improve local roads, develop better fertilizers, clear rivers, experiment with new chemicals, design more efficient machines, and the like. The sectarian "enthusiasm" of the seventeenth century seemed to gradually recede as broader segments of the public channeled their energy into the worldly schemes and projects that defined the age.[162] Intersecting with emerging forms of politeness, piety and profit, the new science managed to weave these potent strands into a pattern of civic culture that placed natural philosophy at the heart of public life. Swift and other critics would decry such trends,

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[162] Daniel Defoe, *The Age of Projects* (London, 1697).

heaping scorn on the gentlemanly improvers who labored to make natural knowledge a primary arbiter of the nation's progress.[163] But many Britons chose a different path, finding the realm of public science and improvement far too appealing to ignore.

In crucial ways, then, Jonas Hanway and his colleagues inhabited a world that was decisively shaped by the convergence of scientific reform, Christian providentialism, and polite projecting. Whether Hanway realized it or not, his brand of civic improvement—emphasizing collaboration, useful knowledge, experimentation, and non-partisanship—had deep historical roots. Indeed, the heady brew of "Improvement" resonated with such force throughout Hanoverian society because of the long campaign waged on its behalf by numerous scientists, lecturers, merchants, enterprising landowners, doctors, clergy, and artisans. In so doing, they transformed not only the nature of popular science, but the contours of civic life as well.

[163] William King, *A Journey to London, in the Year 1698…*, 3rd ed. (London, 1704), 16-17; idem., *The Original Works of William King…*, 3 vols. (London, 1776), I, 196-200; II, 9-23, 61-138. William Hunt, *The Projectors: A Comedy…* (London, 1739); John Hill, *A Dissertation on Royal Societies in Three Letters…* (London, 1750). See also Bertrand A. Goldar, "Fielding, the Flood Makers, and Natural Philosophy: 'Covent-Garden' no. 70," *Modern Philology* 80 (1982), 136-44.

CHAPTER THREE

The Imperial Crucible:
Scientific Projects and the Consolidation of Empire

> Bid harbors open, public Ways extend,
> Bid Temples, worthier of the God, ascend;
> Bid the broad Arch the dang'rous Flood contain,
> The Mole projected break the roaring Main;
> Back to his bounds their subject Sea command,
> And roll obedient Rivers thro' the Land:
> These Honours, Peace to happy Britain brings,
> These are Imperial Works, and worthy Things.
>
> —Alexander Pope, *Epistle to the Earl of Burlington*

At mid-century, the fate of Britain's empire seemed to loom large in the public consciousness. The 1740s, in fact, ushered in a critical period when many contemporaries began to examine more closely the foundations of their shared community. Whether one lived in metropolitan London or the far-flung provinces, individuals attempted to make sense of Britain's rising commercial empire as well as the mounting challenges it faced. And whatever previous generations had thought about such matters, a series of dramatic forces swept through the Anglo-Atlantic world of mid-century, forever changing the nature of the imperial connection and Britain's position in the world. The period witnessed intense global warfare, imperial rivalries, ethnic migration, commercial and territorial expansion, rebellion, political turmoil, and religious awakenings. Trying to make sense of these developments as best they could, Britons at home and abroad found themselves in an increasingly anxious mood—both recognizing the centrality of the empire to their shared prosperity and power while sensing that it was beginning to disintegrate under the pressures of factionalism, religious and ethnic conflict, poor oversight, and foreign aggression. Indeed, some observers were already writing obituaries for the British Empire, explaining the reasons for its spectacular rise and fall within such a short span of time.[1]

Yet, this imperial crucible also forged a number of reform movements, giving rise to an array of "patriot" clubs and societies at mid-century that focused on regenerating the imperial nation. Within this context, the realm of science emerged as a popular meeting ground for many who sought to bring greater cohesion and prosperity to Britain's colonial system. Natural philosophy offered the practical tools, organizational resources, and social capital that could potentially change the direction of Britain's faltering empire. In the minds of supporters, the world of public science already possessed a vast web of institutions and collaborative networks that could transmit useful information and technologies across geographic distances. The scientific community, in other words, encompassed a complex *economy of knowledge* in which information or artifacts could be recorded, aggregated, and made accessible to dispersed groups. For precisely this reason, patriotic improvers increasingly turned to the world of science as an avenue for reviving and consolidating the imperial project. They sought to aggressively recruit colonists and merchants, sailors and military officers, clerics and farmers, into the ranks of science, establishing popular campaigns to promote useful knowledge, experimentation and improvement.

Dr. Alexander Hamilton (1712-56) witnessed many of these historical developments first hand. A Scottish physician trained at the University of Edinburgh,

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[1] See, for example, the revealing essay by "Thomas Touchit," in the *Westminster Journal*, 10 February, 1750; also

Hamilton emigrated to the Chesapeake in 1738, hoping to improve his fortunes and future prospects by settling in the colonies. In this respect, he personified one of the distinct demographic and social trends of the period: the large wave of Scottish immigrants who began flooding into British North America.[2] Hamilton also embodied some of the unique characteristics that defined the background and outlook of these new arrivals. His extensive education, his "middling" class background, his place within the world of professions, and his avid support for stronger imperial ties were features shared by many of the North Britons who began to infiltrate colonial society by the middle of the eighteenth century. Indeed, Scots quickly became involved in various scientific, educational, and administrative endeavors. Figures like Cadwallader Colden, James Alexander, William Douglass, or Robert Hunter Morris rose to prominence within their respective colonies as they promoted a new brand of metropolitan culture based upon philosophical clubs, enlightened urbanity, ambitious civic projects, and more robust imperial governance.[3] As a new arrival, Dr. Hamilton closely scrutinized the efforts of his provincial neighbors to appropriate these patterns of metropolitan life, often painting an unflattering portrait of colonial parvenus trying to adapt to a rapidly changing world. When Hamilton decided to travel from Maryland to Maine in the summer of 1744, he recorded in rich detail his observations on such matters. And his journal, the *Itinerarium*, offers an unparalleled window into this turbulent period when science and metropolitan

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reprinted in *The Boston Weekly News-Letter* 17 May 1750.

[2] Elaine G. Breslaw, *Dr. Alexander Hamilton and Provincial America: Expanding the Orbit of Scottish Culture* (Baton Rouge, La., 2008).

ideals of improvement began to speak directly to the concerns of many Britons dismayed by the rising factionalism, imperial rivalries, religious enthusiasm, and economic decline they witnessed around them.[4]

As Hamilton discovered throughout his journey, the breadth of interest in science and improvement extended throughout colonial society. No sooner had he departed from Annapolis, his newly adopted home, than he met a "Mr. D—gs" who was all too eager to display his "knowledge in natural philosophy." Although Hamilton surmised that some of this "was but superficial," he did acknowledge that the man was "a virtuoso in botany." The two conversed for some time about local flora, examining "a print or figure of the gensing" plant which the naturalist happened to be carrying with him. This "spicy drug," as Hamilton called it, had only recently been found growing in the "rich bottoms near Susquehanna"; and the Scottish physician was genuinely eager to learn more about the prized commodity that had quickly become a lucrative article in the growing British trade with Asia.[5] The discovery of ginseng, however, was no fortuitous event. Rather, this breakthrough had been the result of a coordinated campaign by scientists, merchants and enterprising gentlemen, who exemplified the growing conviction that Britain's fate as a commercial and imperial power hinged upon the cultivation of useful knowledge

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[3] Ned C. Landsman, *From Colonials to Provincials: American Thought and Culture, 1680-1760* (Ithaca, 1997), 20-24; 57-91.

[4] Carl Bridenbaugh, ed., *Gentleman's Progress: The Itinerarium of Dr. Alexander Hamilton, 1744* (Chapel Hill, 1948), 109-110.

[5] Ibid, 5-6; *New-York Weekly Journal*, 21 August 1738. Rapid deforestation in China had led to a dwindling supply of the much-prized Asian ginseng (*Panax ginseng*), resulting in a wide-ranging search for alternative sources for the Asian market. By the eighteenth century, botanists and merchants had focused their sights on Appalachia, where American ginseng (*Panax quinquefolium*) was discovered by John Bartram in 1738. News of the discovery traveled quickly, spreading throughout the colonies and Europe, inaugurating a veritable "ginseng boom."

throughout its far-flung territories. For more than two decades, in fact, groups had carefully gathered and disseminated information about the plant, including detailed "prints" to serve as visual aids.[6] In all likelihood, then, the drawing that Hamilton encountered in the hands of "Mr. D—gs" was one of these copies—a product of the emerging scientific networks that circulated information throughout the Anglo-Atlantic world. Such efforts helped add ginseng to the growing list of discoveries and "improvements" which many Britons celebrated as the peculiar feature of their age.[7] It was an outlook that Dr. Hamilton certainly embraced, and one that he encountered repeatedly on his travels throughout the colonies.

While relaxing at a road-side tavern in New Jersey, for example, Hamilton came across another well-connected, scientific "projector", the Rev. Joseph Morgan. At first glance, Hamilton probably expected little interesting conversation from the "solemn old fellow" who was clad "in a homely rustick dress." But Morgan surprised the good doctor when he launched into "a learned discourse concerning…the causes of the tides, the shape and dimensions of the earth, the laws of gravitation, and 50 other physical

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[6] The print of ginseng that Hamilton examined was probably one of a number sent to the American colonies by Peter Collinson, a London merchant who developed a vast network of correspondence and exchange that linked naturalists, collectors, and gentlemen throughout the empire. Collinson suspected that ginseng grew in certain parts of America that shared the same latitude as those regions of "Tartary where this plant is found." Accordingly, he made multiple copies of the engraving of ginseng that appeared in Ephraim Chamber's *Cyclopaedia*, sending them to "several of my Country Acquaintances" in America. Ephraim Chamber's drawing, and the various written descriptions of the plant that circulated as well, were themselves the products of gentlemanly scientists who collected and translated foreign traveler's reports from China. For a discussion of these overlapping scientific and commercial campaigns, see John H. Appleby, "Ginseng and the Royal Society," *Notes and Records of the Royal Society of London* 37 (1983), esp. 131-5; and A. Owen Aldridge, *The Dragon and the Eagle: The Presence of China in the American Enlightenment* (Detroit, 1993), 47-65.

[7] For the details of a similar campaign focused on raising Rhubarb within the empire—a medicinal plant that Britons expended large sums to import from Tartary—see Robert Dossie, *Memoirs of Agriculture and other Oeconomical Arts*, 3 vols. (London, 1768-82), II, 258-91. Organizations like the Society of Arts focused on dozens of other exotic plants and crops it sought to encourage through the dissemination of printed material, seeds, and financial incentives.

subjects." He would have stopped talking sooner and finished his glass of wine had not the landlord, who was particularly interested in these topics, kept prodding him with question after question. When Morgan finally left, the proprietor explained how this "old philosopher" was also a mathematician, busy working on a solution to the problem of longitude—an issue that had attracted the attention of numerous scientists throughout the Atlantic world.[8]

Yet, Hamilton only glimpsed a small portion of Morgan's wide ranging interests, which included a host of projects directed towards improving the transportation and commercial sinews of the British Empire.[9] Chief among these was his design for a new kind of boat that relied upon a complex system of booms, springs, and wheels to transfer the power of a single boatman to several oars at once, making it far easier to surmount the forces of wind or tide. Morgan worked tirelessly to promote his beloved contraption. He organized a public demonstration along the shoreline of Manhattan, drawing a large crowd of curious bystanders that included most of the members of the New York Assembly, the royal governor, and leading citizens.[10] When local authorities failed to

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[8] *Gentleman's Progress*, 36-7. Joseph Morgan later published an article on his methods for determining longitude in the *Pennsylvania Gazette*, 30 May 1745, and *The Boston Weekly News-Letter*, 2 January 1746. It was also reprinted in the *American Magazine and Historical Chronicle* (1746).

[9] The details of Morgan's background, as well as his trying career as both a minister and projector, are discussed in Whitfield J. Bell, Jr., "The Reverend Mr. Joseph Morgan, an American Correspondent of the Royal Society, 1732-1739," *Proceedings of the American Philosophical Society* 95 (1951), 254-6.

[10] On Morgan's public demonstration, see Sara S. Gronim, *Everyday Nature: Knowledge of the Natural World in Colonial New York* (New Brunswick, NJ, 2007), 81. In the first half of the eighteenth century, several British inventors received royal patents for similar devices "to row Ships a Head with Oars against the Wind or Tide, or swimming a Current, carrying Ships of War in or out of Harbours, etc." See the notice of Thomas Smith's *letters patent* in *American Weekly Mercury*, 27 May 1725. For the English press coverage of similar machines, see *Weekly Journal or British Gazetteer*, 27 July 1723; *Daily Journal* 9 August 1723, 12 March 1725; *London Journal* 10 August 1723, 31 August 1723; *Universal Spectator and Weekly Journal* 1 July 1732; *London Evening Post* 13 July 1732; 23 December 1736; and *Daily Post*, 31 March 1737.

adopt his scheme, Morgan trained his sights on metropolitan institutions in the hopes that they would display greater enthusiasm for his project. He drafted a memorandum for the Board of Trade to consider, replete with 15 illustrations depicting various components of the device. He forwarded detailed descriptions to the Royal Society; and even wrote directly to Admiral Peter Warren, hoping to peak the navy's interest in the vessel. All the while, Morgan was busy propounding other schemes for improvement, ranging from new kinds of river locks for internal navigation to a variety of agricultural machines. Such projects, as he never tired of pointing out, were necessary if Britain wanted to sustain its commercial and imperial fortunes in the face of aggressive competition from its rivals, France and Spain. Indeed, Morgan's letters to the Royal Society and other agencies often contained lengthy discussions about the urgent need for systematic reform of the empire to fend off the rising challenges it faced.[11] In many ways, Morgan represented the kind of zealous projector that Dr. Hamilton would have expected to meet in the coffee houses and drawing rooms of London or Edinburgh.[12] That such characters could be found in the rural hinterlands of New Jersey—individuals who were able to communicate directly with scientists and administrators throughout the empire—only serves to underscore just how broad the reach of science and metropolitan culture were becoming by the middle decades of the eighteenth century. Morgan certainly knew how to tap into the expanding economy of knowledge.

[11] Bell, "The Reverend Mr. Joseph Morgan," 256-61; and Raymond Stearns, *Science in the British Colonies of America* (Urbana, Il., 1970), 497-99. See also, Joseph Morgan to Benjamin Franklin, 11 October 1738 in *The Papers of Benjamin Franklin*, ed. Leonard W. Labaree, 35 vols. (New Haven, Ct., 1959—), II, 208; *Pennsylvania Gazette* , 18 May, 25 May, 8 June 1732.

[12] Larry Stewart, *The Rise of Public Science: Rhetoric, Technology, and Natural Philosophy in Newtonian Britain, 1660-1750* (Cambridge, 1992),

To be sure, the number of career projectors was always small compared to the wider array of colonists who simply looked upon natural philosophy as an edifying and useful endeavor. Such individuals appear repeatedly in Hamilton's journal, offering a revealing snapshot of the provincial world of science that he encountered as he traveled extensively through bustling seaports as well as quiet villages and farms. Not surprisingly, he spent a considerable amount of time in the company of fellow doctors who impressed and entertained the weary traveler with anatomical models, microscopes, solar projectors, and plenty of what Hamilton described succinctly as "learned discourse."[13] But the sociable world of science was by no means the unique preserve of the medical fraternity. Hamilton participated, for example, in many enlightened gatherings such as the "Philosophical" club in Newport, Boston's "Physical" club, and the "Governor's" club in Philadelphia.[14] Committed to the rational pleasures of conversation and gentlemanly knowledge, these associations brought together a "mixed company of philosophers and men of sense."[15] The subject of natural philosophy also

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[13] *Gentleman's Progress*, 19, 21, 31, 42-3, 47-8, 61-3, 67, 86, 102-3, 115, **156**, 158, 189. The close fraternal bonds within the medical community and their active role within the scientific republic of letters—particularly, the large number of Scottish and Edinburgh-trained physicians—has long attracted the notice of historians. See Hindle, *Pursuit of Science*, 36-58, 61-4; Bridenbaugh, *Cities in Revolt: Urban Life in America, 1743-1776* (New York, 1964), 199-209; Ned C. Landsmen, *From Colonials to Provincials: American Thought and Culture, 1680-1760* (Ithaca, NY, 1997), 23, 82-84; Breslaw, *Dr. Alexander Hamilton and Provincial America.*

[14] Ibid, 115-117, 137, 151, 190. Only a few weeks before Hamilton's visit, the members of the Governor's Club in Philadelphia had attended the scientific lectures of Dr. Archibald Spencer, who addressed various branches of experimental philosophy including the nascent field of electricity. See William Black, "Journal of William Black," *The Pennsylvania Magazine of History and Biography* 1 (1877), 245-6.

[15] *Gentleman's Progress*, 190. It is helpful to read Hamilton's *Itinerarium* in conjunction with Benjamin Franklin's *Autobiography*, since both accounts underscore just how much the growing culture of the enlightenment was rooted in conviviality and conversation—a point that stands in sharp contrast to the traditional presumptions that often equate intellectual movements with the systematic thought of individuals and the solitary world of texts. For recent scholarship that focuses more on the sociable dimensions of the Anglo-American Enlightenment, see Roy Porter, *The Creation of the Modern World: The Untold Story of the British Enlightenment* (New York, 2000), esp. 4-71; David S. Shields, *Civil Tongues & Polite Letters in British America* (Chapel Hill, 1997); Richard D. Brown, *Knowledge is*

appeared in less formal settings. At a dinner in New York, for instance, much of the discussion revolved around Newtonian physics and matter theory. The spirited conversation, which seemed to include both women and men, focused upon “attraction, condensation, gravitation, rarification…and the mathematical and astronomical problems of the illustrious Newton.”[16]

The appetite for such edifying knowledge had led to a growing number of public lectures and demonstrations. Colonial audiences gathered to see men like Dr. Archibald Spencer who, as Hamilton described, was busy presenting “a course of physical lectures of the experimental kind” to various groups throughout the colonies.[17] The parishioners of King’s Chapel, a fashionable Anglican Church in Boston, could apparently receive such lessons directly from the pulpit. When Hamilton attended services in July, he noted that the minister, Stephen Roe, “gave us rather a philosophical lecture than a sermon.” Roe, had prepared a lengthy scientific discourse on the “the specific gravity of air and water, the exhalation of vapours, the expansion and condensation of clouds, the operation

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Power: The Diffusion of Information in Early America, 1700-1865 (Oxford, 1989), ch. 2; and Richard Bushman, *The Refinement of America: Persons, Houses, Cities* (New York, 1992), esp. 79-89.

[16] Ibid, 85-6. The interest in Newton seemed to be reaching new heights by the time Hamilton made his tour through the middle and northern colonies in 1744. Indeed, shortly after Hamilton’s dinner party in New York, one of the city’s printers ran an advertisement warning that someone had walked off with his collection of “Sir Isaac Newton’s Works”, underscoring how Newton was becoming something of a hot commodity. See, Esther Singleton, *Social New York Under the Georges, 1714-1776* (New York, 1902), 339. Although his items were not stolen, Thomas Godfrey of Philadelphia likewise had to advertise for his missing copy of Newton’s *Optics* and Willem ‘sGravesend’s two-volume survey of Newtonian philosophy around this same period. He had voluntarily lent these books to someone, but he could no longer remember who had borrowed them, suggesting that the potential pool of readers for Newtonian literature was quite broad (large enough to require paying for a printed advertisement). See, *Pennsylvania Gazette,* November 5, 1747. Hamilton’s travel diary also provides considerable evidence of the broad interest in Newtonianism, describing repeated occasions in which individuals wanted to discuss Newton or Newtonian philosophy. Even when he sat down at a coffee house in Newport, hoping to chat about the latest news or gossip, he was accosted by the proprietor, an “old whimsical fellow” who talked endlessly about Newton and a host of scientific projects he had in mind. *Gentleman’s Progress,* 154-5.

of distillation, and the chemistry of nature." Hamilton was no doubt surprised to hear the gospel of science preached so zealously in provincial churches.[18] While traveling on a ship to Albany, Hamilton encountered another pious lecturer. He and other passengers listened patiently as one enthusiastic minister read out loud "a treatise upon microscopes." Clearly enamoured with the subject, the reverend dwelt in painstaking detail upon "every little trite observation of the author's," trying to impress upon his captive audience the hidden wonders revealed by science.[19] For a small fee, individuals could see an impressive microscope in person, a devise imported directly from London and billed as "the most Entertaining of any Microscope whatsoever." Like Hamilton, this curious instrument was making a tour of its own through the colonies in the summer of 1744, appearing at public demonstrations as well as private showings in genteel homes.[20]

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[17] Ibid, 189. For details surrounding Spencer's scientific lectures throughout the colonies, see *The Boston Weekly News-Letter* 4 August 1743, *Boston Evening Post*, 30 May & 1 August 1743, *New York Weekly Journal* 24 October 1743, *Pennsylvania Gazette* 26 April & 26 July 1744; *Virginia Gazette* 9 January 1746.

[18] *Gentleman's Progress*, 110. On the spread of science in American pulpits, see Merle Curti, *The Growth of American Thought* (New York, 1964), 86. Although little is known about Stephen Roe's background or education, his intellectual attributes appear to have impressed some contemporaries. One of these included William Shirley, the recently installed royal governor of Massachusetts, who felt that Roe's talents equipped him to become the new head master of a proposed Anglican school in Boston—an institution that Shirley was trying to establish as a way of promoting "Polite Literature" and Anglican sentiments in counterpoint to the "Calvanistical" education of Harvard and traditional Puritan schools. William Shirley to the SPG Secretary, 8 July 1743, printed in *Historical Collections Relating to the American Colonial Church*, ed. William Stevens Perry, 4 vols. (Hartford, 1870-78), III, 371-2.

[19] *Gentleman's Progress*, 52-3.

[20] The touring microscope in question was a "solar or camera obscura microscope" made by Dr. Liberkhun, which used a fitted mirror and lenses to harness the suns rays in order to project the magnified image of a glass slide onto a wall in a darkened chamber for all to see. It was particularly well suited, therefore, for the kind of public spectacle and demonstration that would entertain large groups. Hamilton was quite taken by a smaller version he saw at Dr. Moffat's house in Newport, describing how the "very curious apparatus not only magnifys the object incredibly upon the moveable screen but affords a beautifull variety and surprising intermixture of colours." *Gentleman's Progress*, 158. Henry Baker F.R.S., one of the leading contemporary authorities on microscopes, gave a description of Liberkhun's solar microscopes in his *The Microscope Made Easie...* (London, 1743), 21-26 and in the *Philosophical Transactions* 41 (1739 - 1741), pp. 516-19. For advertisements of the traveling microscope in Philadelphia and Boston, see the folio circular, *Just Arrived from London, For the Entertainment of the Curious and Others…* (Philadelphia, 1744); *Pennsylvania Gazette*, 12 July 1744; 30 August 1744; *Boston Gazette* 27 December 1743; *Boston Evening Post* 30 April 1744.

Natural philosophy, as Hamilton discovered, was becoming an increasingly conspicuous aspect of public culture, creating a shared set of activities and interests that connected the aspiring inhabitants of distant communities like Philadelphia, Edinburgh, or Birmingham.[21]

Only a year earlier, a group of colonists had hoped to capitalize on the growing interest in science by creating the American Philosophical Society.[22] In a published circular, Benjamin Franklin articulated his vision for a new kind of inter-colonial organization dedicated to advancing "the common stock of Knowledge." Noting that the colonies were filled with "ingenious Men," he argued that the potential for capitalizing on these talents had been frustrated by the lack of communication and proper organization. Spread out over a vast continent, "such Persons are widely separated, and seldom can see and converse or be acquainted with one another."[23] Like other scientific bodies, the American Philosophical Society aimed to overcome such obstacles by establishing broad networks of correspondence and exchange, incorporating colonists into larger economies of knowledge that would circulate useful information and discoveries throughout the

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[21] Roy Porter, "Science, Provincial Culture and Public Opinion in Enlightenment England," *British Journal for Eighteenth-Century Studies* 3 (1980), 20-46.

[22] Brooke Hindle explores the background and collaborative work surrounding the creation of the American Philosophical Society in *The Pursuit of Science*, 66-74. Whitfield J. Bell, Jr. has compiled excellent biographical sketches of the original 25 members of the society from the 1743-1746 period in *Patriot-Improvers: Biographical Sketches of Members of the American Philosophical Society*, 2 vols. (Philadelphia, 1997), 10-172. The period also witnessed a series of similar efforts to organize various medical, philosophical, or improvement-oriented societies throughout the colonies. For a brief overview of these developments, see Stearns, *Science in the British Colonies*, 671-2.

[23] Franklin, *Proposal for Promoting Useful Knowledge among the British Plantations in America* (Philadelphia, 1743), 1.

empire.[24] The actual task of maintaining such a "constant correspondence" would fall upon the society's officers and principle members who would meet regularly in Philadelphia. Led by a President, Secretary and Treasurer, Franklin envisioned a core group of seven committee chairs who would sort through the correspondence and decide what material should be passed along to other members or scientific bodies; what material should be published; and what queries should be circulated on the society's behalf.[25] Individuals were invited to share their insights on a host of topics ranging from experimental agriculture to "mechanical inventions for saving Labour." Indeed, the society welcomed any "new improvements…that let Light into the Nature of Things, tend to increase the Power of Man over Matter, and multiply the Conveniences or Pleasures of Life."[26] The organization seemed well-suited, therefore, to harness the growing enthusiasm for science and improvement that Hamilton documented throughout his tour of the colonies.

Yet, the society's goal of advancing the material prosperity of the British colonies was also tied to deeper concerns over the lack of social cohesion in America and the

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[24] In this respect, Franklin's project was consciously modeled after the Royal Society and the Dublin Society for Improving Husbandry, Manufactures and other Useful Arts, both of which are explicitly mentioned in Franklin's proposal. Ibid, 2.

[25] Ibid, 2. By April of 1744, Franklin informed Cadwallader Colden that "the Society, as far as relates to Philadelphia, is actually formed, and has had several Meetings to mutual Satisfaction." He also included a list of the members and officers who would serve as the seven committee chairs, "viz. a Physician, a Botanist, a Mathematician, a Chemist, a Mechanic, a Geographer, and a general Natural Philosopher." See, Benjamin Franklin to Cadwallader Colden, 5 April 1744, *Papers of Benjamin Franklin*, 2:406-7. The structure and workings of the American Philosophical Society exemplified many of the trends that were the hallmark of the "organizational revolution" of the late seventeenth century. As the historian James E. McClellan III has documented, this multi-faceted revolution spread throughout the first half of the eighteenth century, providing the distinctive model for learned societies based upon certain patterns of institutional life, networks of communication, and modes of publication that were pioneered by the Royal Society (1662) and the Académie Royale des Sciences (1666). See, McClellan III, *Science Reorganized: Scientific Societies in the Eighteenth Century* (New York, 1985), 41-108.

[26] Franklin, *Proposal for Promoting Useful Knowledge*, 2.

empire more broadly. At a time when religious and political factions were becoming deeply entrenched, many individuals embraced science as a public-spirited endeavor that would foster greater cooperation and trust among disparate groups. The "improvement of natural knowledge," one supporter explained, "will be a means of uniting ingenious men of all societies" and "will begin to ware away by degrees any harsh opinions parties may have conceived of each other." By participating in the collaborative world of science, he continued, colonists would inevitably develop "benevolence and good will to each other in every capacity."[27] Such views built upon the widely shared conviction that the most potent antidote to factionalism was the development of civic-minded clubs and societies where individuals of all political, religious, and social persuasions could learn to interact in more productive ways. "'Tis in such bodies," proclaimed the influential Earl of Shaftesbury, that people learned to cultivate the "associating spirits" that underpinned a healthy civil society.[28] And the pursuit of science offered one of the most promising avenues to experiment with new forms of civic and associational life that would transcend the divisions threatening society.

In the tense climate of the 1740s, such opportunities took on a greater sense of urgency as Britons suffered through a resurgence of political infighting, sectarian rancor, and foreign hostilities.[29] This context permeates Dr. Hamilton's travel account, in which

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[27] Peter Collinson to Cadwallader Colden, 23 August 1744, in *The Papers of Cadwallader Colden: Volume III (1743-1747)*, New-York Historical Society *Collections* 82 (1918), 69. See also Peter Collinson to John Bartram, 10 July 1739 in *Memorials of John Bartram and Humphrey Marshall…*, ed. William Darlington (Philadelphia, 1849), 131-3.

[28] Shaftesbury, *Characteristics of Men, Manners, Opinions, Times…*, 3 vols. (London, 1732), I, 114

[29] For an analysis of this turbulent period—which witnessed increasing anxieties as well as a critical rethinking of fundamental assumptions that had become unsettled—see, Bridenbaugh, *Cities in Revolt*, 3-212; Bob Harris, *Politics*

the subject of natural philosophy appears alongside growing concerns with party polemics, evangelical schisms, fluctuating trade, and talk of a looming war with France. Amidst all of these anxious developments, provincial inhabitants seemed eager to demonstrate their scientific knowledge and enlightened aspirations, hoping to mirror the patterns of metropolitan "improvement" that proclaimed the centrality of useful knowledge to ensuring the moral and material progress of the nation. This growing article of faith, as Hamilton's journal suggests, had considerable appeal throughout the empire, especially among certain segments of society. Indeed, his text offers a revealing glimpse into the role that scientific culture played in helping many eighteenth-century Britons—even those living in remote communities—develop a shared sense of imperial belonging as well as a framework for addressing the common problems facing the empire as a whole.

This chapter explores how the imperial crucible of mid-century transformed the world of science into such a popular avenue for patriotic reform, attracting new participants from around the Anglo-Atlantic world. The 1740s—as both Hamilton and Franklin understood—was a critical period when many Britons began to realize both the centrality and vulnerabilities of the imperial project.[30] Over time, a growing consensus

and the Nation: Britain in the Mid-Eighteenth Century (Oxford, 2002); Timothy Hall and T.H. Breen, "Structuring Provincial Imagination: The Rhetoric and Experience of Social Change in Eighteenth-Century New England," *American Historical Review* 103 (1998), 1411-39; Jack P. Greene, "Search for Identity: An Interpretation of the Meaning of Selected Patters of Social Response in Eighteenth-Century America," *Journal of Social History* 3 (1970), 189-220.

[30] For a discussion of the changing import and meaning of the imperial connection during this period, see Bob Harris, "'American Idols': Empire, War and the Middling Ranks in Mid-Eighteenth-Century Britain," *Past and Present* 150 (1996), 111-41; Kathleen Wilson, "'Empire of Virtue": The Imperial Project and Hanoverian Culture, c. 1720-1785," in *An Imperial State at War: Britain from 1689-1815* (1994), 128-64; T.H. Breen, "Ideology and Nationalism on the Eve of the American Revolution: Revisions *Once More* in Need of Revising," *Journal of American History* 84 (1997), 13-39; Ned C. Landsman, "The Provinces and the Empire: Scotland, the American Colonies and the

formed around the notion that the empire had been poorly managed. Observers could point to a number of alarming trends such as the frailty of imperial institutions and governance or the growing internal tensions that made Britain's colonial possessions seem like a Byzantine patchwork of competing settlements, rather than a well-planned or well-integrated system. These criticisms fueled a series of popular campaigns focusing on the need to revitalize and reform the empire—a politics of imperial consolidation. And at the heart of this movement lay a vision of gentlemanly improvement that emphasized the potential benefits of scientific knowledge dispersed in the hands of enterprising groups around the Atlantic. Tied together by a vast network of institutions and collaborative projects, the world of science offered the hope of developing a more cohesive and prosperous empire. And while this vision represented a different kind of "informal empire" than that which arose during the capitalistic hey-day of the nineteenth century, it shared a similar faith in the power of private enterprise and innovation to achieve what formal institutions and bureaucracies could not.

Popular Conceptions of Trade and Empire

Locating the precise moment at which British men and women became fully conscious of the inseparable connection between colonial settlements, overseas trade, and the evolving social and economic order at home—what we might call the awareness of an "imperial condition"—is a difficult task for historians. For one thing, popular interest in

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Development of British Provincial Identity," in *An Imperial State at War*, 258-87; P.J. Marshall, "Britain and the World in the Eighteenth Century: I, Reshaping the World," *Transactions of the Royal Historical Society*, 6th ser., 8 (1998), 1-18; and "Britain and the World in the Eighteenth Century: II, Britons and Americans," *Transactions of the Royal Historical Society*, 6th ser., 9 (1999), 1-16.

the empire had a tendency to ebb and flow throughout much of the eighteenth century, mirroring the tumultuous patterns of warfare, international crisis, cycles of trade, and dramatic events that galvanized public attention. Accordingly, perceptions of empire and the deeper ideological significance drawn from them tended to fluctuate as the dynamics of news and public debate brought certain issues into sharper focus only to recede again.[31] Yet a growing consensus among scholars has focused on the middle decades of the eighteenth century as a critical period when the imperial project began to reshape the imagination and priorities of certain segments of the public. In the fall of 1739, Britain became entangled in a new phase of international warfare, centering on an intense struggle with the nation's traditional enemies, France and Spain. Although much of the fighting occurred on the continent—involving the time-honored issues of dynastic politics and the European balance of power—contemporaries were often impressed by the global dimensions of the conflict which featured an intense struggle over commercial and imperial resources. In the two decades between Admiral Vernon's surprising naval victory at Porto Bello in 1739 and the apotheosis of British military and imperial success in the *annus mirabilis* of 1759, metropolitan society watched the fate of empire unfold on a global stage, forcing many individuals to think seriously about issues of trade, overseas expansion, and the common interests of the nation. Out of the crucible forged by war, international rivalry, and dramatic economic change arose both a popular embrace of

[31] Jacob M. Price, "Who Cared About the Colonies? The Impact of the Thirteen Colonies on British Society and Politics, circa 1714-1775," in *Strangers within the Realm: Cultural Margins of the First British Empire*, ed. Bernard Bailyn and Philip D. Morgan (Chapel Hill, 1991), 395-436; P.J. Marshal, "Imperial Britain," *Journal of Imperial and Commonwealth History* 23 (1995), 379-94; Harris, "Empire, War and the Middling Ranks," esp. 113-5.

empire and a profound anxiety over the nation's ability to sustain its imperial destiny.[32]

International conflict, however, did not provide the initial spark that ignited the public's fascination with imperial affairs. Even before the outbreak of hostilities, one can discern a marked upswing in the amount of attention paid by both the press and the public to the dynamics of overseas colonization. Discussions of trade, in point of fact, were largely responsible for the initial focus on the centrality of empire to national life.[33] As early as 1721, the Board of Trade issued a widely publicized report showing that roughly a third of all foreign trade was devoted to colonial imports and exports. Not only were such figures striking in terms of the relative importance of imperial trade, but the very ability to quantify commerce—to translate the flow of goods into stable and reliable numbers—must have impressed contemporaries. After all, no previous generation had access to such compiled statistics since England's system of customs inspection, ship registering, and Board of Trade had only been in place for twenty some years. And while it is difficult to determine how the literate public initially viewed this "political arithmetic," the coming decade saw numerous pamphlets, essays, and newspaper articles which competed to offer readers the latest analysis and information on the state of

[32] See, Kathleen Wilson, "Empire, Trade and Popular Politics in Mid-Hanoverian Britain: The Case of Admiral Vernon," *Past and Present* 121 (1988), 74-109; Wilson, *The Sense of the People: Politics, Culture and Imperialism in England, 1715-1785* (Cambridge, 1995); Linda Colley, *Britons: Forging the Nation, 1707-1837* (New Haven, 1992), ch. 2; Nicholas Rogers, *Whigs and Cities: Popular Politics in the Age of Walpole and Pitt* (Oxford, 1989), ch. 3; P.J. Marshall, "A Nation Defined by Empire, 1755-1776," in *Uniting the Kingdom? The Making of British History*, ed. Alexander Grant and Keith J. Stringer (London, 1995), 208-222; H.V. Bowen, *Elites, Enterprise and the Making of the British Overseas Empire, 1688-1775* (London, 1996); Harris, "Empire, War and the Middling Ranks," 111-41; and Eliga H. Gould, *The Persistence of Empire: British Political Culture in the Age of the American Revolution* (Chapel Hill, 2000).

[33] David Armitage explores the central role of the discourse of political economy to the ideological construction of empire in his *Ideological Origins of the British Empire* (Cambridge, 2000), 146-69. See also, Bowen, *Elites, Enterprise and the Making of Empire*, 32-35; Wilson, "Empire, Trade, and Popular Politics," esp. 76.

colonial affairs.[34]

John Bennet, an author of several works in this vein, expressed his pleasure with the new-found attentiveness given to such critical matters. Reminding his compatriots that the overseas settlements "are the greatest Support of the Power and Affluence of this nation," he found it rather embarrassing that they had been "so little understood and so much neglected" in the past.[35] No one could afford to sit back and remain "idle or indifferent spectators" when the fate of the nation increasingly hinged on a proper understanding of the "Science of Trade, and the Benefits of our Colonies."[36] To rectify this situation, he proposed the establishment of an imperial chamber of commerce—what he called "Britannia's Royal Court of Merchants"—that would bring together economists and traders from around the empire to inform both the public and public policy. Its suggested motto, "Remember the Colonies," says much about the changing tone of the 1730s.[37]

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[34] Julian Hoppit, "Political Arithmetic in Eighteenth-Century England," *Economic History Review*, 2nd ser., 49 (1996), 519, 528. See, also, Joshua Gee, *Trade and Navigation of Great Britain Considered* (London, 1728); [Anon.], *A Letter to a Member of Parliament, Concerning the Naval Store-Bill* (1721), 18-21; Daniel Defoe, *A Plan of the English Commerce…* (London, 1728), 256-70; and Fayrer Hall, *The Importance of the British Plantations in America…* (London, 1731), For modern figures on the growth of imperial trade, see Ralph Davies, "English Overseas Trade, 1700-1774," *Economic History Review*, 2nd ser., 15 (1962), 285-303.

[35] John Bennet, *The National Merchant: or, Discourses on Commerce and Colonies…* (London, 1736),93, 113; See also, Bennet, *Two Letters and Several Calculations on the Sugar Colonies and Trade…* (London, 1738), 36-44.

[36] Bennet, *National Merchant*, 99.

[37] Ibid, 116-24. Bennet was part of a growing chorus of authors who referred to this period as a "critical juncture" in terms of overseas development, colonial trade, and the public's embrace of empire. Some of the more influential tracts exploring this theme, include: Defoe, *A Plan of English Commerce*; Gee, *Trade and Navigation*; Arthur Dobbs, *An Essay on the Trade and Improvement of Ireland* (Dublin 1729); George Lyttelton, *Considerations upon the Present State of Affairs, at Home and Abroad* (London, 1739); and John Ashley, *Memorials and Considerations Concerning the Trade and Revenues of the British Colonies in America…* (London, 1743); William Bollan, *The Importance and Advantage of Cape Breton* (London, 1746). Martin Bladen explained to the ministry in 1739 that while the public had been indifferent to colonial matters in the past, "the Case is altered." "As the Plantations have for some Years been the Subject of Our Enquirys," he contined, "so they have in some Measure become the Object of our Concern." In fact, "the General Voice of the People has called upon the Crown, to enter into a War [with Spain] for the preservation of it

Sensing this new public mood, the *London Journal* inaugurated a special column in 1736 entitled, “News from the Plantations.” The editors explained this departure by reminding readers that “the British Colonies are of so much importance to the trade and commerce of Great Britain” that they certainly deserved “a separate article” of their own.[38] Most competitors followed suit, increasing dramatically their coverage of imperial affairs and transatlantic trade by mid-century in an attempt to keep pace with the evolving demand for such information.[39] Being knowledgeable about these matters had become a requisite part of genteel culture, so much so that educational tracts began including sections on the current state of British colonies and trade. Members of polite society, after all, had to posses a competent understanding of how their commercial empire functioned, and more importantly, how its vitality was rooted in patterns of overseas development.[40] Even morality had to be updated in light of this new orientation, as one observer quipped, so that “virtue and vice” would consist less in “their moral Differences, than their influence on Trade.”[41]

[i.e. colonial trade].” 521-22. Bladen’s manuscript is reprinted in Jack P. Greene, “Martin Bladen’s Blueprint for a Colonial Union,” *William and Mary Quarterly* 17 (1960), 521-22.

[38] Quoted in Jeremy Black, “Continuity and Change in the British Press, 1750-1833,” *Publishing History* 26 (1994), 67.

[39] Wilson, *Sense of the People*, 39; Wilson, “Empire of Virtue,” 132-3; Bowen, *Elites, Enterprise and the Making of Empire*, 74-6.

[40] See, for example, Robert Dodsley’s revealing discussion in his *Preceptor: Containing a General Course of Education…*, 2nd ed., 2 vols. (London, 1754), xxviii-xxix; and Daniel Defoe, *An Essay, on Ways and Means for the Advancement of Trade…* (London, 1726), 3.

[41] Richard Parrott, *Reflections on Various Subjects Relating to Arts and Commerce…* (London, 1752), 34. Parrott, of course, was responding to both contemporary attitudes and the broader intellectual currents made fashionable by works like Bernard Mandeville’s *Fable of the Bees: or, Private Vices, Publick Benefits* (London, 1714).

This growing fascination was particularly true among certain regions and classes that were heavily involved in Atlantic commerce by the 1740s and 1750s. Recent scholarship on the urban middle classes—in both London and throughout the provinces—has focused attention on the patterns of economic development and investment which increasingly tied the interests of small producers, merchants, bankers, shopkeepers, and even professionals to the dynamics of imperial trade.[42] As one of the fastest growing sectors of the economy, overseas commerce created a vast web of linkages that could be felt throughout many communities. Large numbers of people, for example, bought shares in shipping ventures, invested in larger mercantile firms, provided supplies and services to the maritime industry, invested in projects overseas, or were involved in the manufacturing sectors that sustained an "empire of goods." Although a modern term like the "multiplier effect" would have been alien to eighteenth-century ears, contemporaries certainly understood and espoused the basic notion that the effects of foreign trade were widely dispersed, influencing branches of commercial life that were not directly involved in trafficking.[43] "Trade," as Daniel Defoe proclaimed, "is the universal Fund of Wealth…it encourages Manufacture, prompts Invention, employs People, increases

[42] Wilson, "Empire, Trade and Popular Politics," 132; Bowen, *Elites, Enterprise and the Making of the British Empire*, 70-5; Rogers, *Whigs and Cities*, ch. 3; and Harris, "Empire, War and the Middling Ranks," 111-41.

[43] Dobbs, *Trade and Improvement of Ireland*, 112-6; Ashley, *Memorials Concerning Trade and Revenue*, 11-23; [Anon.], *Letter to a Member of Parliament*, 18; Richard Parrott, *Reflections on Subjects Relating to Arts and Commerce*, 48-49; T.H. Breen, "An Empire of Goods: The Anglicization of Colonial America, 1690-1776," *Journal of British Studies* 25 (1986), 467-99; Paul Langford, *A Polite and Commercial People: England, 1727-1783* (Oxford, 1989), 167-70; Brewer, *Sinews of Power*, 184-5, 93-4; and Wilson, "Empire, Trade and Popular Politics," esp. 132. On the relative growth of overseas commerce, see Davis, "English Overseas Trade," 285-303

Labour, and pays Wage."[44] It was for good reasons, therefore, that the inhabitants of Liverpool or Bristol or Glasgow perceived themselves as having a personal stake in Britain's imperial position in the world. Indeed, as historians have shown rather convincingly, popular enthusiasm for imperial and commercial aggrandizement pervaded the outlook and aspirations of many people in the swelling urban ranks.[45]

Not to be outdone, the kingdom's gentry and landed orders participated in many of the same commercial investments as well as the overall celebration of trade and empire that were becoming fashionable by mid-century.[46] Whereas previous generations had accepted an inevitable conflict between the landed interests, on the one hand, and the "monied" and trading interests, on the other, historians have shown that such perceptions became far less salient as the eighteenth century progressed.[47] Certainly, writers and opinion makers were keen to erase this potential conflict, arguing that all classes stood to benefit equally from the fruits of imperial prosperity. The idea of clashing interests, they mused, was simply a product of misunderstanding.[48] No doubt, the fact that a good many

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[44] Daniel Defoe, *A Plan of English Commerce…* (London, 1737), 13, 17. See also "Sally Fisher," *Britain's Golden Mines Discover'd* (London, 1720), 22-3.

[45] Wilson, *A Sense of the People*, ch. 3; Rogers, *Whigs and Cities*, ch. 3; Harris, "Empire, War and the Middling Ranks," 111-41.

[46] P.J. Cain and A.G. Hopkins, *British Imperialism: Innovation and Expansion, 1688-1914* (1993), 12-24; G.E. Mingay, *English Landed Society in the Eighteenth Century* (London, 1963); Bowen, *Elites, Enterprise and the Making of Empire*, 48-53.

[47] As Julian Hoppit notes, the talk about a 'landed interest'—one distinctly separated from the financial and commercial sectors—disappeared throughout much of the middle-portion of the eighteenth century. See, Hoppit, "The Landed Interest and the National Interest, 1600-1800," in *Parliaments, Nations, and Identities in Britain and Ireland, 1660-1850*, ed. Julian Hoppit (Manchester, 2003), 84-5; Paul Langford, *Public Life and the Propertied Englishman, 1689-1798* (Oxford, 1991), ch.5.

[48] For contemporary discussions about this topic, see: *Gentlemen's Magazine* 10 (1740), 448-51; John Campbell, *The Present state of Europe…* (London, 1752), 510; Thomas Salmon, *The History and Present State of the British Islands…*, 2 vols. (London, 1743), I, 162; Daniel Defoe, *The Complete English Tradesmen*, 5th ed., 2 vols. (London,

country gentlemen and aristocrats began reaping the rewards of their investments in banks, stocks, public securities, and overseas land speculation helped ease this transition along.[49] As the Earl of Halifax reminded his fellow members of the House of Lords, all of England was deeply implicated in the fate of empire; so that if the American colonies were "exposed to the ravages of the French, a national bankruptcy would probably in a very few years ensue."[50] This ideological and social *rapprochement* among Britain's diverse propertied classes represented a significant development by mid-century. The very notion of a "national interest"—something that evolved out of the period's boisterous "cult of commerce"—helped many Georgian elites find common ground in a shared vision of imperial plenty.[51]

The growing centrality of trade and empire even threatened to reshape the curriculum of England's universities, arguably the most hide-bound institutions in the country. In the fall of 1754, for instance, the 3rd Viscount Townshend decided to endow a new prize institution at Cambridge University for "the study of the Theory of Trade."[52]

1745), I, 316-31; George Coade, *A Letter…Wherein the Grand Concern of Trade is Asserted and Maintained…* (London, 1747); and "T.W.", *The Present Condition of Great-Britain…* (London, 1746), 29, 32-3, 37.

[49] Cain and Hopkins, *British imperialism: Innovation and Expansion*, ch. 1.

[50] Quoted in Bowen, *Elites, Enterprise and the Making of Empire*, 175; For similar sentiments, see Postlethwayt, *Universal Dictionary of Trade and Commerce*, 11.

[51] Colley, *Britons: Forging the Nation*, 56; Hoppit, "Landed Interest and National Interest," 84-5; Langford, *Public Life and the Propertied Englishman*, 288

[52] Charles Townshend (3rd Viscount Townshend) was born into a noble family whose estates were located in Norfolk. His father, the 2nd Viscount Townshend, combined his service in high office with a passion for agricultural experiments, earning him the nickname "Turnip Townshend" and a reputation as one of the chief proponents of the "Norfolk system" of crop rotation. The 3rd Viscount was more interested in matters of imperial trade, corresponding with writers such as Josiah Tucker, and authoring some minor works on the subject. American historians are more familiar with his son, Charles Townshend, who served as Chancellor of the Exchequer and designed a series of revenue measures that escalated the imperial crisis in 1767. For the Townshend Prize and the activities of the 3rd Viscount, see

Modeled after some of the prestigious prizes given annually in fields such as classics, poetry, or religion, Townshend wanted to establish an annual competition in which candidates would submit public dissertations addressing topics relating to commerce and imperial trade. He confidently asserted the "infinite advantage" that would accrue to the students, the university, and the nation "if young men could be led early in Life to a diligent Study and correct knowledge of a Science so very important in itself and so intimately connected with the affairs and Interests of this Kingdom as the subject of Trade is." Yet, the unorthodox proposal raised some eyebrows within the halls of Cambridge. While university officials assured Townshend of their "desire to promote all kinds of knowledge," and agreed that research into imperial trade would be highly beneficial to the Pubic, they confessed that it was "so entirely foreign to the present System of our Education that the introduction of it will most probably be attended with some difficulties."[53] But in the end, Townshend had his way, and the "science of trade" found a place along side the more traditional branches of humane learning.[54] Or, as one of the first prize winners explained, Cambridge had finally embraced "a Science, the proper Cultivation of which, instead of diminishing from her Dignity, or being attended with any circumstances of Disgrace, may be productive of the best and greatest

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J.R. Raven, "Viscount Townshend and the Cambridge Prize for Trade Theory, 1754-1756," *Historical Journal* 28 (1985), 535-55.

[53] Ibid, 537, 544. It did not help matters that Townshend wanted the dissertations to be written in English, not Latin, or that he insisted on supervising the details surrounding the prize questions.

[54] Ibid, 544-9. On the need to cultivate the study of trade and imperial commerce within universities, see also, William Temple, *A Vindication of Commerce and the Arts…* (London, 1758), xiv-xvi.

Consequences both to herself and to the Public."[55] Despite the condescending tone, such a statement revealed the quiet transformation taking place within the intellectual world.

One reason why imperial trade elicited such widespread support and scrutiny was its perceived role as a foundation for British military power and security. Wyndham Beawes captured the prevailing sentiment when he declared that "Trade is the Nursery of Sailors, that Sailors are the Soul of the Navy, that the Navy is the Security of Commerce, and that these two united, produce the Riches, Power and Glory of Great Britain."[56] Like a mathematician developing a proof, Beawes laid bare the logical train of thought that led contemporaries to see the underlying connection between trade and security. The vast maritime fleet, which serviced the commercial needs of the empire in times of peace, provided the necessary men and material that made British naval power a formidable adversary in times of war.[57] This subject became a favorite theme of writers and orators who dwelt incessantly upon the virtues of an "empire of the seas"—a bundle of loosely related ideas and attitudes which crystallized around the notion that Britain's geographic position, its eschewal of territorial conquest, and its natural desire for peaceful trade made the island nation a unique type of empire in the annals of history.[58] Unlike Rome,

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[55] Benjamin Newton, *Another Dissertation on the Mutual Support of Trade and Civil Liberty…* (London, 1756), 9.

[56] Wyndham Beawes, *Mercatoria Rediva…Being a Complete Guide to Men in Business* (London, 1761), 573.

[57] Francis Cawood, *An Essay, or Scheme: Towards Establishing and Improving the Fishery, and other Manufactures of Britain* (London, 1721), 4; Hall, *The Importance of the British Plantations*, 6; James Oglethorpe, *A New and Accurate Account of the provinces of South-Carolina and Georgia…* (London 1733), 65-68; Ashley, *Memoirs Concerning Trade and Revenues*, 24; [Anon.], *The American Traveller…* (London, 1741), 91; Postlethwayt, *Universal Dictionary of Trade and Commerce…*, 2 vols. (London, 1751-5), I, 318-19; Postlethwayt, *Britain's Commercial Interest Explained and Improved…*, 2 vols. (London, 1757), I, 296-7; [Anon.], *An Essay on Ways and Means for…Increasing the Number of Sailors in Great-Britain* (London, 1741);

[58] Daniel A. Baugh, "Maritime Strength and Atlantic Commerce: The Uses of a 'Grand Marine Empire,'" in Stone, ed., *An Imperial State at War*, 185-223; Harris, *Politics and the Nation*, 102-47.

Britain's blue-water empire would be capable of preserving the liberty, security and prosperity of its citizens by avoiding the need for dangerous standing armies and costly administration. If many aspects of this vision appear fanciful and self-serving, contemporaries were much closer to the mark when they emphasized the power and resources that could be mobilized by a commercial empire. In the 1750s, for example, the Royal Navy conscripted some 60,000 sailors from the merchant marine, bolstering the public's conviction that empire and trade were the pillars of national defense.[59]

Not surprisingly, the sheer wealth generated by the expansion of overseas commerce also figured prominently within the calculus of imperial might. The government's ability to raise enormous sums of money, through taxation and publicly-supported credit, allowed the state to pay for expensive armies, navies, and subsidies to continental allies.[60] As many contemporaries recognized, success in eighteenth-century warfare increasingly boiled down to a test of who could marshal the financial resources necessary to sustain lengthy campaigns in a variety of theatres. "'Tis the longest Purse that conquers now," Daniel Defoe aptly surmised, "not the longest sword."[61] The favorable balance of trade with the colonies, and their beneficial role as both a source of raw materials and a captive market for finished goods, laid the economic foundation upon which Britain erected its impressive commercial and military machine. Therefore, when

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[59] Stephen Conway, *War, State, and Society in Mid-Eighteenth-Century Britain and Ireland* (Oxford, 2006), 57-8. See also, William Webster, *The Consequences of Trade as to the Wealth and Strength of any Nation…* (London, 1740), 18.

[60] John Brewer, *The Sinews of Power: War, Money and the English State, 1688-1783* (London, 1989)

[61] Defoe, *A Plan of English Commerce*, 52; See also, [Anon.], *An Address to the Merchants of Great-Britain* (London, 1739), 6; Webster, *The Consequences of Trade*, 9-11; Malachy Postlethwayt, *Observations on Trade and Taxes…* (London, 1751), 37-40.

writers and statesmen extolled the benefits of empire—the “fountain of our riches” as one magazine described it—they were deeply aware that imperial wealth served the noble cause of bankrolling Britain’s security and its position of power in the wider world.[62]

By mid-century, then, matters of empire and trade carried enormous ideological weight. Broad segments of the public had come to accept, indeed celebrate, the notion that maritime commerce, imperial possessions, and British power were inseparably linked. Such views did not mean, of course, that individuals ignored local affairs or developments on the continent in favor of a rigidly Atlantic perspective. Rather, they became increasingly attuned to the ways in which metropolitan life and European states-craft had been dramatically transformed by the growth of England’s commercial empire. It was this growing awareness—hammered out in the popular press as well as in public debates—that made mid-century Britons so concerned with the fate of their empire. As people examined the state of the colonies more closely, particularly in light of the escalating rivalry with France, the future of their imperial project seemed in considerable doubt.[63]

The Crisis of Empire at Mid-Century

The resurgence of French power represented a particularly ominous development for those who surveyed the horizon of imperial affairs in the 1740s and 1750s. To be

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[62] *Newcastle General Magazine* (1755) quoted in Wilson, *A Sense of the People*, 179;

[63] On the increasing climate of doubt and anxiety during mid-century, see Wilson, *A Sense of the People*, 165-89; Bob Harris, *A Patriot Press: National Politics and the London Press in the 1740s* (Oxford, 1993), ch.4; and Harris, *Politics and the Nation*.

sure, anxiety towards France and the military threat it posed had a long pedigree in English history. Ideas of Gallic treachery, ambition, and might had become something akin to stock images in British culture, trotted out repeatedly in sermons, poetry, newspapers, and speeches for much of the late-seventeenth and eighteenth centuries. [64] Louis XIV's unending quest to erect a "Universal Monarchy" on the ashes of a Protestant Europe colored the outlook and sensibilities of Britons long after the Sun King was buried. Popular portrayals of Louis XV's regime continued to emphasize the same themes, for example, stressing France's unbridled ambition and its ruthless aggression which threatened not only Britain but the entire European state-system.[65] If there were obvious continuities in how the British public perceived the Anglo-French rivalry, then, there were also new developments and understandings which emerged by mid-century to cast the issues in an entirely different light.[66] As a growing chorus of writers warned, France had begun to change tactics, using the advantages of peacetime to pursue a new insidious strategy of commercial and imperial expansion that would undermine Britain's traditional maritime advantages.[67] Since the Treaty of Utrecht (1713), which ended

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[64] Stephen Pincus, "Popery, Trade and Universal Monarchy: The Ideological Context of the Outbreak of the Second Dutch War," *English Historical Review* 107 (1992), 1-29.

[65] The anonymous author of *The Progress of the French in their views of Universal Monarchy* (London, 1756), felt it necessary, for instance, to publish all of France's "Plots, Plans, and Conspiracies" over the past 100 years in order to sound the alarm against "this ambitious, perfidious, restless, bigoted, persecuting, plundering Power, which has long been the common Disturber of the western World, and as long struggled for Universal Monarchy" (2).

[66] Jeremy Black, *Natural and Necessary Enemies: Anglo-French Relations in the Eighteenth Century* (London, 1986); Gerald Newman, *The Rise of English Nationalism: A Cultural History, 1740-1830* (London, 1987), Colley, *Britons: Forging the Nation*.

[67] William Perrin, *The Present State of the British and French Sugar Colonies, and our own Northern Colonies, Considered…* (London, 1740); Mathew Decker, *Essay on the Causes of the Decline in Foreign Trade* (London, 1743); [Anon.], *The Political Views of the Court of France…* (London, 1744); [Anon.], *The Present State of the British and French Trade to Africa and America…* (London, 1745); William Bollan, *The Importance and Advantage of Cape*

Anglo-French hostilities, France had thrown all of its energies into a coordinated campaign to improve its economy, its merchant and naval fleets, and its overseas territories. The growing recognition of these schemes lent an ominous tone too much of the public discussions in mid-century Britain.

To many, it appeared that France was essentially beating Britain at its own game. Contemporaries took note of the fact that French manufacturing and international commerce were growing at an alarming rate since 1713—on pace to rival Britain's own mercantile trade in the not too distant future. France, it seemed, was quickly learning how to mobilize its enormous resources in men and material to compete in the global arena of imperial commerce.[68] One author, reflecting on these "astonishing" developments, warned of "the Advantages the *French* have gain'd over the English in several Branches of Commerce since the Peace of Utrecht"[69] No longer content with a dominance in the trade of luxury items, French merchants were now aggressively competing to gain a share of the lucrative international markets in sugar, textiles, fish, tobacco, coffee, indigo, rum, and inexpensive manufactures. Such efforts were spearheaded by France's growing colonial encroachments in North America, the Caribbean, Africa, and the Indian Ocean—

Breton… (London, 1746); John Campbell, *The Present State of Europe…* (London, 1750); Henry McCulloh, *A Miscellaneous Essay Concerning the Course Pursued by Great Britain…* (London, 1755); Malachy Postlethwayt, *A Short State of the Progress of the French Trade and Navigation* (London, 1756); Edmund Burke, *An Account of the European Settlements in America*, 2 vols. (London, 1757).

[68] For early warnings of France's growing commercial ambitions, see "Sally Fisher," *Britain's Golden Mines Discover'd…* (London, 1720), esp. 6-8; Dobbs, *Trade and Improvement of Ireland*, 7; Phillip Peck, *Some Observations for Improvement of Trade…* (London, 1732), 7-9; Bennet, *Two Letters on the Sugar Colonies*, 3-9; Bennet, *The National Merchant*, 89-106. By 1750, the chorus of concern had reached the point where one author decided to write a fictional account of how historians in a hundred years would explain Britain's spectacular collapse at the hands of a regenerated France. The piece aptly captures both the growing critique of British imperial policy and the begrudging admiration for French measures. The essay was printed in the *Westminster Journal*, 10 February 1750; and reprinted in *The Boston Weekly News-Letter*, 17 May 1750.

developments that were widely discussed in the British popular press.[70] Moreover, their ambitious program of naval ship-building raised deep anxieties over the gathering threat posed by resurgent French power.[71] In terms of creating a mercantile empire, many contemporaries would probably have agreed with the assessment of one authority when he complained that the French "are *out-doing* and *supplanting* us."[72]

Of particular concern was the French government's innovative use of science to advance their larger imperial ambitions. "The French Court are much to be extolled," one colonial writer opined, "for encouraging and promoting useful Discoveries." The author specifically admired the improvements in French observational astronomy, hydrography, and cartography that gave them a decided advantage in matters of trade and colonial defense.[73] Malachy Postlethwayt agreed, warning that France had become "particularly zealous for the advancement of geography, in order to extend their commerce and

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[69] Quoted in Harris, *Politics and the Nation*, 241.

[70] See *op cit.* 68. For press coverage, see Jeremy Black, *America or Europe? British Foreign Policy, 1739-63* (London, 1998), ch. 4 & 9; Harris, *Politics and the Nation*, 118-22; Wilson, 165-91. Malachy Postlethwayt, in particular, was one of the most vocal and widely read advocates of the need to combat France's new "commercial schemes of power." His celebrated *Universal Dictionary of Trade and Commerce* (1751-5) is bristling with warnings about French commercial expansion and imperial designs in the Caribbean, North America, Africa, East Indies, and the Atlantic fisheries. See, also his *Britain's Commercial Interest Explained and Improved*, ix (quotation); Postlethwayt, *The National and Private Advantages of the African Trade Considered…* (London, 1746); and Postlethwayt, *Great-Britain's True System…* (London, 1757).

[71] William Horsley, *A Treatise on Maritime Affairs: or a Comparison between the Commerce and Naval Power of England and France…* (London, 1744); Webster, *Consequences of Trade*, 18; Postlethwayt, *Britain's Commercial Interest Explained and Improved*, iv. Contemporary anxieties, however, seem unjustified in hindsight. As the historian Stephen Conway has underscored, at no point was Britain's navy seriously in danger of being outmanned or outgunned in the eighteenth century. Indeed, the Royal Navy was larger than all of its adversaries combined at many points. But these numbers were not always clear to contemporaries, especially during times of peace, when most sailors and ships were decommissioned. See Conway, *War, State, and Society*, 281.

[72] Bennet, *The National Merchant,* 92. Arthur Dobbs argued that France's aggressive policies had "depriv'd Britain of Millions." *Trade and Improvement of Ireland*, 7.

domination first upon paper, to pave the way to do it hereafter in reality."[74] In 1746, readers of the popular *Gentleman's Magazine* learned exactly how far their rivals had progressed in this respect. According to one account, the French government had a "treasure of charts, plans, and sea journals lodged in the office of the marine." The "great number of maps, and Mss. plans, taken on the spot, and sent…by skilful engineers," encompassed "plans of all parts of the world"—including British ports and coastlines.[75] Amassing such an array of knowledge, of course, required a large contingent of trained personnel; and British observers were increasingly struck by France's growing network of schools and academies "wherein were bred up DraughtsMen, Mathematicians, Engineers, and Mechanicks." The cumulative results, according to William Horsley, were producing a quiet revolution whereby the France had begun to eclipse Great Britain's technical superiority, even in such critical fields as navigation and shipbuilding.[76]

The success of imperial botany, carried out under the watchful eyes of the French state, was an equally important development that impressed British observers. As early

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[73] William Douglass, *A Summary, Historical and Political, of the First Planting, Progressive Improvements, and Present State of the British Settlements in North America* (Boston, 1749-1752), 49; John Greene, *Remarks, in support of the New Chart of North and South America…* (London, 1753), 3-5.

[74] Postlethwayt, *Universal Dictionary of Trade and Commerce*, 1:148.

[75] *Gentleman's Magazine*, February 1746, 72-3. The degree of seriousness that surrounded such knowledge made it dangerous for foreign travelers—especially engineers—to be caught taking accurate measurements of certain areas. In 1741, for example, the press reported an ominous incident in Dunkirk in which "an Englishman has been lately hang'd there for taking the Soundings about the Harbour, and having several Mathematical Instruments in his Possession." *Boston Evening Post*, 17 Aug 1741.

[76] William Horsley, *A Treatise on Maritime Affairs: or a Comparison between the Commerce and Naval Power of England and France…* (London, 1744), 4-6. For similar concerns, see Malachy Postlethwayt, *Universal Dictionary of Trade and Commerce…*, 2 vols. (London, 1751-55), I, 183; and the ominous warnings in the translator's preface to M. Deslandes, *An Essay on Maritime Power and Commerce, Particularly those of France…* (London, 1743), iii-xii.

as 1706, an apothecary garden in Nantes had been transformed into an experimental site for acclimatizing plants—a site where incoming ships were required to deposit any foreign specimens they happened to have collected while abroad.[77] A decade later, administrators of the *Jardin du Roi* had created special greenhouses to assemble and disperse the exotic plants of the empire.[78] Their success at transplanting such lucrative commodities as coffee, pepper, cloves, nutmeg, cinnamon and cochineal underscored the considerable benefits that would accrue from placing science in the service of empire. From the East Indies to the Caribbean, naturalists and royal officials worked closely together to introduce exotic crops and transform agriculture in France's expanding orbit of overseas territories.[79] Their success at "getting the spices in their plantations" elicited a mixture of admiration and envy from one British observer, who could only hope that English administrators would follow suit, dispatching botanists "to their vast possessions in the Indies" to lay open new "branches of trade and commerce."[80] Closer to home, French scientists were busy addressing technological issues that effected domestic

[77] James E. McClellan III, *Colonialism and Science: Saint Domingue in the Old Regime* (Baltimore, Md., 1992), 148.

[78] E.C. Spary, *Utopia's Garden: French Natural History from Old Regime to Revolution* (Chicago, 2000); Chandra Mukerji, "Dominion, Demonstration, and Domination: Religious Doctrine, Territorial Politics, and French Plant Collection," in *Colonial Botany: Science, Commerce, and Politics in the Early Modern World*, ed. Londa Schiebinger and Claudia Swan (Philadelphia, 2005), 19-33.

[79] James Douglas, *Arbor Yemensis fructum Cofe ferens: or, A Description and History of the Coffee Tree* (London, 1727), esp. 16; Richard Drayton, *Nature's Government: Science, Imperial Britain, and the 'Improvement' of the World* (New Haven, 2000), 68-81; Richard H. Grove, *Green Imperialism: Colonial Expansion, Tropical Island Edens and the Origins of Environmentalism, 1600-1860* (Cambridge, 1995), ch. 5; Marie-Noëlle Bourguet, "Measurable Difference: Botany, Climate, and the Gardener's Thermometer in Eighteenth-Century France," in Shiebinger and Swan, eds., *Colonial Botany*, 270-86, esp. 73-5. For a broader discussion that situates the French merger of science and commercial expansion within a wider context of cameralist reforms sweeping the continent during this period, see Keith Tribe, *Governing Economy: The Reformation of German Economic Discourse, 1750-1840* (Cambridge, 1988). Also helpful in this respect is Lisbet Koerner, *Linnaeus: Nature and Nation* (Cambridge, 1999).

[80] Quoted in Drayton, *Nature's Government,* 79.

manufacturing and production. By the 1740s and 1750s, the pace of these endeavors accelerated quickly as the French state increased its support for science as a means of improving its commercial and imperial power.[81]

For Britons, who celebrated their leadership in science, commerce and the practical arts, it was unsettling to witness the array of French institutions and resources lining up behind a program of sustained innovation. The crown financed the work of savants at the *Académie Royale des Sciences*, the *Jardin du Roi*, the Paris *Observatoire*, the *Bureau des Géographes et des Dessinateurs*, as well as a host of special expeditions and projects which might prove useful to the nation.[82] These efforts could also rely upon the support of various administrative departments within the French state—the Ministry of Marine and Colonies, for example—which coordinated initiatives involving trade and empire. The number of such agencies appeared startling to British observers. In a rather ominous tone, one author wondered,

> I do now most earnestly recommend it to others to consider, whether the following Establishments of the French are not better fram'd and adapted for the Care and Improvement of Trade, than those which we hitherto [have] concerted amongst ourselves? And I believe this will appear sufficiently evident from the bare Specification of their Titles. For the French have their,
>
> *Conseil Royal de Commerce*
> *Bureau Pour les Affairs du Commerce*
> *Intendans du Commerce, pour le Commerce de l'interieur dur Royaume, & exterieur par Terre*
> *Intendans pour le Commerce exterieur & Maritime*
> *Deputez de Villes pour Commerce*
> *Intendans des Colonies*

[81] James E. McClellan III and Francois Regourd have gone so far as to describe these developments as the creation of a "scientifico-colonial machine." McClellan and Regourd, "The Colonial Machine: French Science and Colonization in the Ancien Régime," in *Nature and Empire: Science and the Colonial Enterprise*, ed. Roy MacLeod, special issue of *Osiris* 15 (2000), 31-50.

[82] Charles Gillispie, *Science and Polity in France at the End of the Old Regime* (Princeton, 1980).

Inspecteurs etablis dans les Generalitez & Departemens des Pays d'Etats du Royaume, pour Especes de manufactures de Draps, Fils, Aines, Coton, Soyes, &c.
Jurisdiction Consulaire [83]

Even those who could not read French certainly understood his point. Britain's rival had become an administrative juggernaut that made the tiny Board of Trade appear alarmingly quaint.[84]

Whatever might be said about French despotism or popery, many British commentators expressed genuine admiration for key elements of this new imperial regime.[85] Henry McCulloh, for example, produced several noteworthy pamphlets urging the ministry to emulate French policy in order to improve the cohesion of Britain's own imperial machinery. He explained that France's remarkable progress could actually be turned to the nation's advantage by "adopting every Scheme of theirs, which may suit our present Interests and Designs."[86] Some of his suggestions—e.g. a slush fund for colonial projects, a new chain of fortifications, or an expansion of record keeping and the royal officer corps—could fit rather easily within the existing British system. Yet McCulloh clearly hoped for a deeper transformation. In fact, what he praised most about French

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[83] Bennet, *The National Merchant*, 89-90.

[84] A small number of writers did challenge the image of France as an imperial juggernaut, arguing that its power and prowess were being overstated, especially in terms of its commercial strength. For their views, see G. Turner, *An Inquiry into the Revenue, Credit, and Commerce of France* (Dublin, 1742); 2-7; and George Burrington, *Seasonable Considerations on the Expediency of a War with France* (London, 1743), 12-21

[85] William Bollan, *The Importance and advantage of Cape Breton…* (London, 1746), 140-3, The period also witnessed a concerted effort to publish French works that would spur emulation. See, for example, *The Reports and Deputies of the Council of Trade, in France to the Royal Council…in French and English* (London, 1744).

[86] Henry McCulloh, *The Wisdom and Policy of the French…* (London, 1755), 79. See also McCulloh., *General Thought on the Construction, Use and Abuse of the Great Offices…* (London, 1754); McCulloh, *A Miscellaneous Essay Concerning the Courses Pursued by Great Britain in the Affairs of her Colonies…* (London, 1755).

imperialism was its overwhelming sense of "Order, Coherence, and Union."[87] Like other writers, McCulloh envied the rational planning and "unity of design" that appeared to permeate France's entire imperial bureaucracy—a brand of enlightened absolutism which stood in marked contrast to the "eternal Clashing and jarring of Interests" that characterized Britain's disorderly state of affairs.[88] In a revealing metaphor, he compared the structure of France's administrative system to a camera obscura, in which dispersed rays of light were focused "to its extreme Point" so that any "Object could be thereby represented in a true Light." Under the watchful eye of the King, information and intelligence could flow through centralizing channels which led directly to his circle of ministers, allowing for a kind of imperial "gaze" that accurately surveyed the state of distant realms and territories.[89] Regardless of its veracity, the belief that France's growing success hinged on its ability to maintain cohesion and order throughout its empire made a deep impression on emerging British sensibilities.

Against this backdrop, the foundations of Britain's colonial system appeared far less stable than earlier generations had presumed. The fundamental problem, as

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[87] Ibid., 5-7, 23-30, 80 (quotation); McCulloh, *Miscellaneous Essay*, 8-10, 55-6.

[88] Ibid, 82. McCulloh's writings were more than academic exercises. The newly installed head of the Board of Trade, the Earl of Halifax, held essentially the same viewpoints and was actively seeking to push through a series of reforms that would centralize the flow of information and policy within the imperial system. His efforts made such matters a topic of widespread conversation and debate among the "chattering" classes of mid-century Britain. See Steven Gregory Greiert, "The Earl of Halifax and British Colonial Policy: 1748-1756," (Ph.D. diss., Duke University, 1976), ch. 4; and John Shy, "Thomas Pownall, Henry Ellis, and the Spectrum of Possibilities, 1763-1775," in *Anlgo-American Political Relations, 1675-1775*, ed. Alison Gilbert Olson and Richard M. Brown (New Brunswick, NJ, 1970), 183-6.

[89] McCulloh, *Miscellaneous Essay*, 56. McCulloh was clearly echoing some of the contemporary attitudes towards optical perspective and "design" theories which I discuss in Chapter 4, below. He was also drawing upon the pervasive metaphor of the Sovereign's gaze, which as Jay M. Smith has documented, was a powerful idiom in French political culture. See, Smith, *The Culture of Merit: Nobility, Royal Service, and the Making of Absolute Monarchy in France, 1600-1789* (Ann Arbor, Mich., 1996)

contemporaries diagnosed it, was that the jumbled patchwork of far-flung colonies and possessions had emerged without any coherent planning or foresight. Britain's meteoric rise to imperial power, in the words of one author, "has rather happened from the Advantages of its situation, the nature of its Inhabitants, and *incidental* causes; than been effectuated by well-concerted Schemes, and proper Encouragement."[90] As a result, Britain's colonial empire contained an array of disparate communities that often competed intensely with one another. "They are composed of people of different nations, different manners, different religions, and different languages," one British traveler recorded, after having completed a tour of the North American colonies at mid-century. "Nothing," he continued, "can exceed the jealousy and emulation, which they possess in regard to each other." Indeed, this "inexhaustible source of animosity" explained why the sparsely populated French settlements were able to seriously threaten the British position in North America.[91] The interception of the "Filius Gallicae" letters in 1756—sent from a colonist to the French Ambassador in London, and purportedly revealing plans to organize an uprising among the disaffected Irish and German settlers in

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[90] Bennet, *National Merchant*, 6.

[91] Andrew Burnaby, *Travels through the Middle Settlements in North-America…* (Ithaca, NY, 1963), 112-3. As early as 1739, Martin Bladen, a member of the Board of Trade, had prepared a policy brief on the topic of imperial reform for Sir Robert Walpole and his ministry to consider. In it, Bladen warned that the North American colonies were "no less than Fifteen hundred Miles in length, in perpetual Contest with each other, upon the Subject of their Trade and Boundarys; Ruled by so many various Forms of Government; so little concerned for each others Prosperity, and as devoid of all Care for the Welfare of the whole, as if they were not the Subjects of the same Prince; a much less force, than their own, might be able to destroy them…" Greene, ed., "Bladen's Blueprint for a Colonial Union," 523. On the widespread perceptions of colonial factionalism and disunity, see Harry M. Ward, *"Unite or Die": Intercolony Relations, 1690-1763* (Port Washington, NY, 1971), 75-221; and T.H. Breen, *The Marketplace of Revolution: How Consumer Politics Shaped American Independence* (Oxford, 2004), 4-6.

America—only intensified fears that the colonies were in danger of splintering along ethnic, religious, and political lines.[92]

The true calculus of strength depended upon unity not sheer numbers. As Nathaniel Ames pointed out in his popular New England almanac, the considerable advantages which the British colonists possessed, in terms of population or wealth, counted for little in the face of endemic infighting. "Our Numbers will not avail till the Colonies are united," he complained, "for whilst divided, the Strength of the Inhabitants is broken like the petty Kingdoms in *Africa*"[93] Such sentiments were echoed by another mid-century commentator who reflected on this peculiar state of affairs,

> It is to be observed that each English colony in North America is independent of the other, and that each has its own laws and coinage, and may be looked upon in several lights as a state by itself. Hence it happens that in time of war things go on very slowly and irregularly here; for not only the opinion of one province is sometimes directly opposite to that of another, but frequently the views of the governor and those of the assembly of the same province are quite different. It has usually happened that while some provinces have been suffering from their enemies, the neighboring ones have been quiet and inactive, as if it did not in the least concern them"[94]

If the colonists did not appear so concerned, the British public became increasingly worried about the fractured nature of their colonies which, as one prominent politician warned, were inherently "divided in interest and alienated by jealousy and inveterate prejudice"[95]

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[92] Francis Jennings, *Empire of Fortune: Crowns, Colonies, and Tribes in the Sven Years War in America* (New York, 1988), 239-40; Greiert, "Halifax and British Colonial Policy," 504-8.

[93] Nathanial Ames, *An Astronomical Diary: or, An Almanack for the year…1758…* (Boston, 1757), n.p.

[94] Adolph B. Benson, ed., *Peter Kalm's Travels in North America…*, 2 vols. (New York, 1937), I, 138.

[95] Charles Townsend (c.1754) quoted in Greiert, "Halifax and British Colonial Policy," 335.

Reports from abroad often painted a disturbing picture of an imperial system incapable of maintaining order. Colonists wrote numerous pamphlets, letters, and articles complaining about the mismanagement of royal officials, attempting to fix blame for the mounting political turmoil on their lack of skill and propriety. As one gentleman explained, "America has been for many years made the hospital of Great Britain for her decayed courtiers and abandoned worn-out dependents."[96] The royal and proprietary governors, in particular, became lightning rods for criticism. "These Governors [who are] brought up to pettifogging and Contention," one colonist fumed, "have been found the heaviest Curses that ever beset the Colonies they govern'd"[97] Officials and their supporters usually fired back, accusing the colonists of disloyalty and factionalism. Yet the endemic nature of these political battles, often aired in the press, ensured that both the reading public as well as officials in Whitehall became keenly aware of the magnitude of the problem.[98]

From Georgia to Massachusetts, a series of mid-century disputes and land riots underscored the fragile nature of imperial government. In New Hampshire, for instance, Governor Benning Wentworth found it nearly impossible to work with the local assembly, which he denounced as a factious body, leaving the administrative affairs of the province to remain virtually unattended for several years. Such a situation might

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[96] Quoted in Thomas C. Barrow, "The Old Colonial System from an English Point of View," in *Anglo-American Political Relations, 1675-1775*, ed. Alison Gilbert Olson and Richard M. Brown (New Brunswick, NJ, 1970), 132-3.

[97] Lewis Evans, "A Brief Account of Pennsylvania, 1753" reprinted in *Lewis Evans*, ed. Lawrence Henry Gipson (Philadelphia, 1939), 134.

[98] Barrow, "The Old Colonial System," 125-139; Stanley Katz, *Newcastle's New York; Anglo-American Politics, 1732-1753* (Cambridge, 1968); Michael G. Kammen, "British and Imperial Interests in the Age of the American Revolution," in Olson and Brown, ed., *Anglo-American Political Relations*, esp. 144-6;

have been preferable to the colonists of North Carolina, who faced the unusual dilemma of having two rival legislatures emerge—each meeting in different locations and declaring themselves the only lawful assembly in the colony. Meanwhile, royal governors in New York, New Jersey, Virginia and Georgia were at a complete impasse with their legislative bodies. Even local officials found their authority undermined by a wave of anti-rent and anti-impressment riots that sprung up in several areas.[99] Trying to get a handle on this spiraling turmoil, the Board of Trade launched a series of investigations into the troubling state of colonial affairs. Their findings offered little comfort. As one report on New Jersey declared, "unless some speedy & effectual Measures are soon taken, His Majesty's Government, Laws & Authority not only in this but in the neighboring Provinces…will in all probability be absolutely destroy'd."[100] Governor Glen of South Carolina captured the increasingly sour mood when he described the empire as a "Rope of Sand…loose and unconnected."[101]

[99] For the details surrounding these waves of political unrest, and the deep impressions they caused in England, see Alison Gilbert Olson, *Anglo-American Politics, 1660-1775: The Relationship between Parties in England and Colonial America* (Oxford, 1973); Edward Countryman, "'Out of the Bounds of the Law': Northern Land Rioters in the Eighteenth Century," in *The American Revolution: Explorations in the History of American Radicalism*, ed. Alfred F. Young (Dekalb, Il, 1976), 37-69; A. Roger Ekirch, *"Poor Carolina": Politics and Society in Colonial North Carolina, 1729-1776* (Chapel Hill, 1981).

[100] "Board of Trade to Privy Council, June 1, 1750," reprinted in *Documents Relation to the Colonial History of the State of New Jersey*, 33 vols. (Trenton, NJ, 1974), VIII, 517-22. See also the highly critical report, completed in 1751, that examines the factional feuding in nearby New York: "Report of the Privy Council upon the State of New York" in *Documents Relative to the Colonial History of the State of New-York,* ed. John Brodhead et. al., 15 vols. (Albany, NY, 1853-87), VI, 614-703.

Politics and "Patriotism": The Growing Disillusionment with the Hanoverian Regime

The troubling developments overseas, however, could not be easily divorced from the political machinations brewing at home. The origins of this connection lay in the peculiar geography of patronage and power that structured the political culture of Hanoverian Britain.[102] The nobles and politicians who competed for high office jealously guarded the privileges of patronage that accompanied their station, using the numerous appointments at their disposal to reward friends, relatives, and loyal supporters. They showed little desire to relinquish these prerogatives to imperial officials, thereby depriving governors and other crown servants of the necessary tools they needed to build their own network of local supporters. So while a colonial governor could rightfully claim to embody the authority of the King, and to stand at the top of the political hierarchy of provincial society, real power always resided in the hands of his patrons back in London, who could recall or dismiss such subordinates at will.[103] In a climate, therefore, where one's authority was completely tied to the shifting political winds of

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[101] Quoted in Michael G. Kammen, *A Rope of Sand: The Colonial Agents, British Politics and the American Revolution* (Ithaca, NY, 1968), 307.

[102] Beginning in the 1970s, a rich body of historical literature emerged that focused on the development of patronage networks, interest group politics, and the "seamless nature of the transatlantic political web" that connected the far-flung inhabitants of the empire. In particular, my argument draws upon the following scholarship: Olson and Brown, eds., *Anglo American Political Relations*; Olson, *Anglo-American Politics: The Relationship between Parties in England and America*; Katz, *Newcastle's New York: Anglo-American Politics*; Greiert, "Halifax and British Colonial Policy"; Kammen, *A Rope of Sand: The Colonial Agents*; Michael G. Kammen, *Empire and Interest: The American Colonies and the Politics of Mercantilism* (Philadelphia, 1970); Thomas C. Barrow, *Trade and Empire: The British Customs Service in Colonial America, 1660-1775* (Cambridge, Ma., 1967); James A. Henretta, *"Salutary Neglect": Colonial Administration under the Duke of Newcastle* (Princeton, 1972); and more recently, Alison Gilbert Olson, *Making the Empire Work: London and American Interest Groups, 1690-1790* (Cambridge, 1992); Patricia U. Bonomi, *The Lord Cornbury Scandal: The Politics of Reputation in British America* (Chapel Hill, 1998).

[103] See, Richard Brown, "The Anglo-American Political System, 1675-1775: A Behavioral Analysis"; Stanley N. Katz, "Between Scylla and Charybdis: James DeLancey and Anglo-American Politics in Early Eighteenth-Century New York"; and Barrow, "The Old Colonial System," in Olson and Brown, eds., *Anglo-American Political Relations*,

Whitehall, many appointees found themselves vulnerable to well-connected adversaries who either opposed their policies or sought to replace them. "So long as there are Employments of all Sizes," Joseph Addison slyly observed, "there will be Murmurers of all Degrees"[104] Colonial factions were often quite adept at using their "interest" at Court to engineer the removal of crown officials they disliked, or at the very least, to cast a shadow of doubt that undermined their effectiveness.[105] Indeed, by mid-century a number of colonial politicians and royal placemen were making trips to London for the sole purpose of shoring up their standing with those who controlled the strings of patronage and preferment.[106] The result of this system, as Governor William Gooch complained, encouraged "the most unworthy, if they happen to have friends at Home, to look upon their Superiors with Disdain and bid them Defiance."[107] His colleague, Governor George Clinton, expressed the same frustrations. Despite his efforts to mollify the opposition in New York, Clinton reported that "Faction continues still boyed up with the hopes given them by the Interest which their head [James DeLancey] pretends to have with some of his Majesty's ministers." DeLancey's strong ties to Whig grandees in London, along with those of the rival Livingston faction, would ensure that New York

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20-3; 92-108; 133-6; Henretta, *Salutary Neglect*, 19-27; 345-7; Olson, *The Relationship between Parties in England and Colonial America*, ch. 3-4; Bernard Bailyn, *The Origins of American Politics* (New York, 1968).

[104] *Gentleman's Magazine*, March 1732, 665.

[105] Brown, "Anglo-American Political System," 20; Katz, "Between Scylla and Charybdis," 94-100; Katz, *Newcastle's New York*; ch. 2-3; Olson, *The Relationship between Parties in England and Colonial America*, ch.5; Bonomi, *The Lord Corbury Scandal*, 77-98, 166-85.

[106] Katz, "Between Scylla and Charybdis," 95-6.

[107] Quoted in Barrow, "The Old Colonial System," 134.

politics remained a contentious battleground for several decades.[108] And these same dynamics were at work throughout much of the Anglo-American world, leading the noted author and imperial theorist, Thomas Pownall, to despair that “there can be no government, properly so called, but merely the predominance of one faction or the other, acting under the mask of government”[109]

Developments in English politics, moreover, helped fuel this system of transatlantic factionalism. As contemporaries knew all too well, the increasing rancor of colonial politics was intimately tied to the growing climate of political instability that followed the collapse of Sir Robert Walpole’s oligarchic regime in 1742. The fall of England’s longest serving prime minister, along with the steady erosion of his Whig coalition, sparked an intense scramble for office in the middle decades of the eighteenth century.[110] The political climate became increasingly tense in the 1740s, as the “patriot” opposition, encompassing both Tories and disgruntled Whigs, began to mount a vociferous campaign against the old guard Whigs.[111] The growing divisions even extended to the monarchy itself, where Frederick, the Prince of Wales, broke publicly

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[108] Quoted in Katz, “Between Scylla and Charybdis,” 105; Katz, *Newcastle’s New York*; ch. 3-4.

[109] Pownall, *The Administration of the Colonies* 2nd ed. (London, 1765), 32.

[110] For an analysis of the political jockeying that followed the collapse of Walpole’s “Robinocracy,” see: M.M Goldsmith, “Faction Detected: Ideological Consequences of Robert Walpole’s Decline and Fall” *History* (1979), 1-19; John B. Owen *The Rise of the Pelhems* (London, 1957); H.T. Dickinson, *The Politics of the People in Eighteenth-Century Britain* (1994); Harris, *Politics and the Nation*, ch. 1; J.C.D. Clark, *The Dynamics of Change: The Crisis of the 1750s and the English Party System* (Cambridge, 1982); Langford, *A Polite and Commercial People*, ch. 5.

[111] On the earlier roots of “patriot” opposition, see Isaac Kramnick, *Bolingbroke and his Circle: The Politics of Nostalgia in the Age of Walpole* (Cambridge, 1968), and Christine Gerrard, *The Patriot Opposition to Walpole: Politics, Poetry and National Myth, 1725-1742* (Oxford, 1994). The growing coalition that assembled under the banner of “patriotism” in the 1740s is discussed in Wilson, *Sense of the People*, ch. 2-4; Nicholas Rogers, “The Urban Opposition to Whig Oligarchy,” in *The Origins of Anglo-American Radicalism*, ed. Margaret Jacob and James Jacob (London, 1984), 132-48; and Linda Colley, *In Defiance of Oligarchy: The Tory Party, 1714-60* (Cambridge, 1982).

with his father, George II, establishing his own oppositional court in-waiting.[112] Encouraged by the public's rising frustration with the conduct of foreign policy and internal taxation, the opposition parties managed to render precarious the successive administrations of Lord Carteret, Henry Pelham, the Duke of Newcastle, and the Duke of Devonshire.[113] Unable to maintain a strong and lasting coalition, these ministries began to resemble a game of musical chairs, in which leading politicians shuffled in and out of the cabinet depending upon the political calculations of the moment. The fact that vocal critics were often given a seat in the cabinet in order to silence their opposition, only added to the complexity and volatility of the political climate.[114] And these developments reverberated throughout the imperial system, as colonists and bureaucrats watched successive patrons come and go with astonishing fluidity. At the Board of Trade, to cite just one example, nine new presidents were appointed in the span of ten years, underscoring the tumultuous political climate that encouraged groups to pursue their own

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[112] Aubrey Newman, "Leicester House Politics, 1748-1751," *English Historical Review* 76 (1961), 577-89; Harris, *Politics and the Nation*, ch 1.

[113] For the growing public opposition to the old corps Whigs and its destabilizing effects on the various ministries, see Rogers, "Urban Opposition to Whig Oligarchy," 132-48; Rogers, *Whigs and Cities*, ch. 5; Wilson, "Empire, Trade, and Popular Politics" 74-109; Owen, *The Rise of the Pelhems*; Harris, *A Patriot Press*, ch. 2-3; Clark, *The Dynamics of Change*. The constellation of mounting concerns over continental entanglements, taxes, the national debt, and the neglect of the colonies is well captured in [Anon.], *A Detection of the Views of those Who Would, in the present Crisis, Engage an Incumber'd Trading Nation, as Principals, in a Ruinous Expensive Land-War* (London, 1746). [Anon.], *A Plain Answer to the Plain Reasoner…* (London, 1745).

[114] The ministries' "broad-bottom" strategy of poaching independent Tories, "honest" Whigs, and leading opposition figures—such as William Pulteney, the Earl of Halifax, and William Pitt—led to both conspicuous tensions and constant reshuffling within the administration. The effects of this volatility are discussed in Langford, *A Polite and Commercial People*, ch. 5; Clark, *The Dynamics of Change*, ch. 1; Greiert, "Halifax and British Colonial Policy," ch. 4.

interests, even if these happened to conflict with the wishes of those temporarily in office.[115]

The mid-century kaleidoscope of political factions and maneuvering also undermined any real prospect that Parliament, or the administrative branches of the government, might address the mounting concerns over the state of imperial affairs. Ministers recognized that matters of imperial trade and governance were potentially explosive issues since the opposition would have liked nothing better than to have an opportunity to air their grievances on such matters. Critics of the government, in fact, felt confident that they could undermine the ministry and probably force a realignment of the cabinet by channeling the public's growing frustration with George II's continental entanglements, the sky-rocketing debt that accompanied them, or the ministry's perceived neglect of maritime commerce.[116] Put simply, matters of trade and empire offered the opposition a powerful weapon to wield against the ministry. For precisely this reason, those within Whitehall went out of their way to ensure that such topics rarely appeared before Parliament.[117] The Duke of Newcastle's famed policy of "salutary neglect"—essentially adopting a hands-off stance towards the colonies—was a political strategy of necessity, not a deliberate philosophy of governance. Like many of his colleagues, Newcastle actually believed in the need for systematic reform of the imperial structure, but he also recognized that the issue was a political minefield likely to shatter any

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[115] Olson, *Making the Empire Work*, 141-2.

[116] Wilson, *A Sense of the People*, ch. 3; Olson, *Relationship between Parties in England and Colonial America*, ch. 4-5; Rogers, "Urban Opposition to Whig Oligarchy," 132-48; Jeremy Black, *A System of Ambition: British Foreign Policy, 1660-1793* (London, 1991), ch. 10; Harris, *Politics and the Nation*, ch. 2-3.

ministry that attempted to pursue it. Members of the cabinet, the Privy Council, and the government's supporters within the House of Commons all agreed on the necessity of keeping such issues out of the political spotlight.[118] Oppositional figures who threatened to push imperial matters to the forefront of debate—politicians such as the Earl of Halifax or William Pitt—were typically brought into the ministry and given posts that would focus their attention elsewhere.[119] Those who would successfully navigate the troubled waters of mid-century politics knew that the issue of imperial governance was a shoal to be avoided at all cost.

Yet, statesmen did pay a price in terms of the widespread frustration and disillusionment with the political system that emerged during this period. Denunciations of factionalism and the "rage of party" suffused the newspapers, pamphlets and sermons of the era. Regardless of where one stood on particular matters of policy, many seemed to agree that the political system was essentially broken, preventing the nation from pursuing any meaningful course of action that would address the rising challenges it faced.[120] Assembling under the banner of "patriotism," a diverse array of groups began

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[117] Olson, *Making the Empire Work*, esp. 118-25.

[118] Ibid., ch. 4-5; T.R. Clayton, "The Duke of Newcastle, the Earl of Halifax, and the American Origins of the Seven Years War," *Historical Journal* 24 (1981), 571-603; Henretta, *Salutary Neglect*; Shy, "Pownall, Ellis, and the Spectrum of Possibilities," 183-6.

[119] Olson, *Making the Empire Work*, 147-8; Greiert, "Halifax and British Colonial Policy," 567.

[120] See, for example, *The Westminster Journal*, 16 March 1743; [Anon.], *Old Enlgand's Te Deum…* (London, 1743); Robert Hargreaves, *Unanimity and Public Spirit, Recommended in Two Sermons…* (London, 1746), [Anon.], *The Country Gentleman's Advice to his Son…with Regard to his Political Conduct* (London, 1755); Richard King, *A Sermon Preached before the Several Associations of the Laudable Order of Anti-Gallicans…* (London, 1751), [Anon], *An Address to the Friends of Great Britain* (London, 1753), Robert Gilbert, *The Terms of National Happiness Stated and Recommended…* (London, 1756), [Anon.], *The True National Evil* (London, 1756); John Brown, *An Estimate of the Manners and Principles of the Times* (London, 1757); *Country Gentleman, The Political Free-Thinker…*, 2nd ed. (London, 1745).

to call for a new kind of politics—one that would rise above the cynical machinations of office-seekers and their limited concerns.[121] Some placed their hopes in the idea of a "Patriot King" whose leadership would bring unity and dignity to political life by pursuing only the national interest, rather than manipulating party divisions to achieve narrow goals. This ideology grew out of the hostility towards George II's foreign and domestic policies, which many believed were driven by a sole desire to protect the interests of his native Hanover, not those of Britain. The abstract ideal of a patriot ruler found promising embodiment in Frederick, the Prince of Wales, who assiduously cultivated this image among his followers and the larger public.[122] Other segments of the political nation looked instead to the leaders of the "patriot" opposition, who also promised to overturn the corrupting Hanoverian interests and factional maneuvering that had led to such widespread discontent. While these movements managed to galvanize popular support for a time, they eventually collapsed by the beginning of the 1750s with the premature death of Prince Frederick and the "betrayal" of prominent opposition leaders, who one by one accepted offices in the ministry and changed their tune. A profound sense of alienation, even anger, swept many parts of the country, a mood that was punctuated by depressing news of British military defeats, stagnating trade, and

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[121] For a more in depth analysis of the various ideological strands and social groupings that comprised the "patriot" movement, see Gerard, *The Patriot Opposition*, ch. 6-7; Rogers, *Whigs and Cities*, ch. 3; Wilson, "Empire of Virtue," 128-64; Harris, *A Patriot Press*, 13-86; Harris, *Politics and the Nation*, 22-147.

[122] For a sample of the patriot discourse surrounding Prince Frederick, see "To his Royal Highness the Prince of Wales an Ode by Mr. Thomson" *Gentleman's Magazine*, November 1737. Yet, some Tories may well have looked to Prince Charles, the exiled Stuart "pretender" to the throne, to serve as the Patriot King. For the ambiguity, yet power, of these ideals, see David Armitage, "A Patriot for Whom?: The Afterlives of Bolingbroke's Patriot King," *Journal of British Studies* 36 (997), 397-418.

French invasion scares.[123] In the minds of many contemporaries, "the Whig oligarchy appeared to be not just irresponsible and corrupt, but inept as well."[124]

The dwindling confidence in the British State came at a very bad time. In addition to the growing threat of French encroachments and the internal divisions both at home and abroad, observers began to warn about increasing cracks within the mercantilist framework that had provided the very foundation of British power and prosperity. While politicians and merchants praised the navigation acts of the previous century for establishing a system of orderly commerce which bound the empire together, mounting evidence suggested that lax enforcement and changing circumstances required urgent reform. In particular, widely publicized reports of colonial smuggling and illicit trade with wartime enemies provoked popular indignation, highlighting the need for more oversight and administrative vigor.[125] "England cannot have too vigilant an eye over her other dominions in this respect," noted the worried Malachy Postlethwayt, since the navigation acts served as the "bulwark" of the entire mercantilist empire.[126] Such concerns had prompted the Board of Trade to launch a full-scale investigation of the matter in 1757 which concluded, rather ominously, that the old colonial system had become largely ineffective. But like other reports of this nature, the Board's findings led

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[123] Goldsmith, "Faction Detected," 1-19; Rogers, *Whigs and Cities*, 87-132, 347-89; Gerald Jordan and Nicholas Rogers, "Admirals as Heroes: Patriotism and Liberty in Hanoverian England," *Journal of British Studies* 28 (1989), 201-224; Wilson, *A Sense of the People*, 165-91, 209-10.

[124] Harris, *Politics and Nation*, 35.

[125] Josiah Child, *A New Discourse of Trade*, 4th ed. (London, 1745), 230-2; Peter Kalm's *Travels in North America*, 139; George L. Beer, *British Colonial Policy, 1754-1765* (New York, 1907),72-131; Barrow, *Trade and Empire: The British Customs Service*.

[126] Postelthwayt, *Britain's Commercial Interest Explained*, 144, 485-9.

to no immediate government action or reform.[127] Observers also fretted over the possibilities of commercial competition within the empire. The prospect of colonists setting up their own manufactures became a recurring specter to English contemporaries who maintained that such a development would spell utter disaster for Britain's economy.[128] Already by mid-century, John Mitchell was brooding over the tensions caused by this looming threat. "The thing that breeds a jealousy between Britain and her colonies," he confessed, "is not power, but manufactures, in which they interfere with one another"[129] Such problems could be avoided by wise legislation or timely intervention, but many contemporaries began to doubt whether the British state was capable of either.

The growing concern with competition and colonial markets was accentuated by a new set of challenges effecting Britain's commercial relationship with Europe. A rising tide of aggressive mercantilism on the continent, combined with the effects of intermittent war, had made access to both raw materials and consumer markets increasingly precarious. Several European nations had begun to raise tariffs, threatening to constrict key branches of Britain's foreign trade, while at the same time, encouraging domestic industries to compete with English textiles, woolens, agricultural products, and

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[127] Barrow, "The Old Colonial System," 129-30; Greiert, "Halifax and British Colonial Policy," 543.

[128] Benjamin Franklin to William Shipley, 27 November 1755, *Benjamin Franklin Papers*, 6:276; Parrott, *Reflections on Subjects Relating to Arts and Commerce*, 48-50; Postlethwayt, *Britain's Commercial Interest Explained*, 143-54. On the tentative efforts at American manufacturing, and the British response, see Neil Longley York, *Mechanical Metamorphosis: Technological Change in Revolutionary America* (Westport, Ct., 1985), 15-18.

[129] [John Mitchell], *The Contest in America between Great Britain and France, with its Consequences and Importance…* (London, 1757). 13. See also Sir Mathew Decker's growing concern in his widely read *An Essay on the Causes of the Decline of the Foreign Trade…* (London, 1744), 106-8.

manufactures.[130] "The spirit of industry and commerce raised in most countries in Europe," noted Edmund Burke, had made the reliance on colonial markets all the more crucial. The fact that Britain had not witnessed a conspicuous "decline in our commerce upon the whole," he continued, "can only be explained by the extending of our own colonies, which increases the general demand" for British goods.[131] In other words, Britain would have to look increasingly to its colonial markets in order to keep the economy afloat. Against this backdrop came a variety of calls and proposals to assert greater control over the commercial direction of the empire. Writers identified a number of commodities and branches of trade that should be encouraged so as to increase the efficiency, profit, and sustainability of Britain's mercantile system. Indeed, free market ideas found little sympathy among contemporaries who insisted that the neglect of proper planning and statecraft had left the imperial economy far too vulnerable.[132]

Thus, as Britons surveyed the imperial terrain of the 1740s and 1750s, they encountered a number of disturbing trends that raised doubts about the ability of the nation to sustain its position in an increasingly hostile world. The aggressive policies of France, the lack of order and cohesion within the British colonies, the disillusionment

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[130] For the mounting despair over closing markets, increased competition, and the "decay of trade", see: John Smith, *Chronicon Rusticum-Commerciale; or, Memoirs of Wool…*, 2 vols. (London, 1747); George-Andrew-Patrick Briton, *Some Impartial Thoughts on the Wollen Manufacturies…* (London, 1742); Coade, *Letter Wherein the Grand Concern of Trade is Asserted*, esp. 89-92; David Bindon, *A Letter from a Merchant who has left off Trade…* (London, 1753); [Anon.], *A Constituent' Answer to the Reflexions of a Member of Parliament upon the Present State of Affairs…* (London, 1755); and [Anon.], *A Detection of the Views of those who would, in the Present Crisis, Engage an Incumber'd Trading Nation…* (London, 1746)

[131] Burke, *Account of the European Settlements in America*, 1:308.

[132] Michael Jubb, "Economic Policy and Economic Development," in *Britain in the Age of Walpole: Problems in Focus*, ed. Jeremy Black (London, 1984), 121-44; Maxine Berg, "From Imitation to Invention: Creating Commodities in Eighteenth-Century Britain," *Economic History Review* 55 (2002), 1-30.

with political life, and the mounting commercial pressures of mid-century all converged to create a popular sense of anxiety that informed the period. This bundle of sentiments and concerns, moreover, provided a lens through which contemporaries interpreted the meaning of military campaigns, continental politics, the Jacobite rebellion of 1745, and perhaps most importantly, their own civic affairs. For, as imperialist sensibilities took shape—focusing on the need to instill greater order, rationality, and cohesion throughout the imperial polity—they intersected with growing movements that sought to enlist private initiative to achieve these ends. If the formal institutions of political life and the state offered little hope of addressing such issues, contemporaries could focus on the realm of civil society, where a new kind of politics "out of doors" might prove more fruitful.

The World of Projects & Imperial Reform

While the middle decades of the eighteenth century witnessed mounting frustration over the course of imperial and domestic affairs, many Britons responded in creative ways by joining in a series of popular campaigns which sought to reverse the declining fortunes of the empire. Disillusioned with traditional politics, a growing number of individuals began turning to the world of civil society and voluntary associations as a means of revitalizing the moral and material well-being of the nation. In a relatively short span of time, what emerged was a rather dense network of clubs, organizations, and informal groups committed to improving society at home while strengthening the empire abroad. Although the state might lend its support and encouragement, the public's focus increasingly shifted to the world of private enterprise where the prospects of meaningful reform appeared more likely.

The novelty of such a politics "out of doors" was not lost on contemporaries. Jonas Hanway, a merchant deeply involved in many of these improving endeavors, felt compelled to defend such popular initiatives against the charge of impropriety.[133] He recalled that some gentlemen had objected to these activities, noting that private societies were steadily encroaching upon the rightful prerogatives of the government. As one individual explained to Hanway, "Tho' the end proposed…is undeniably good…it is a public affair, and it should be supported by the public." "If we countenance private Societies," he continued, "it will be a diminution of the honor of the Legislature." Hanway responded to such concerns by pointing out that while "the government and the public are distinct objects…they operate to one and the same end." Members of the public, therefore, had both the right and obligation to promote the nation's interests as much as Parliament or the King's ministers. Private groups should therefore be encouraged to advance "the welfare of as many of their fellow-subjects as their abilities will extend to." This notion was especially true given the ominous challenges facing Britain. After all, "the Imputation of novelty" counted for little "since it is evident that only new measures can save us from the ruin which hangs over our Heads"[134]

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[133] For Hanway's involvement in various organizations and schemes for improvement, see Chapter 2.

[134] Jonas Hanway, *A Letter from a Member of the Marine Society…*, 4th ed. (London, 1757), 57-60; 32-33. See also, Jonas Hanway, *Thoughts on the Duty of a Good Citizen* (London, 1759). Kathleen Wilson has explored aspects of this emerging civic culture, with its array of clubs, societies, and projects "that were meant both to compensate for the inactivity of the state and to be inviolable to partisan and sectarian antagonisms." See Wilson, *A Sense of the People*, 61-80; Wilson, "Urban Culture and Political Activism in Hanoverian England: The Example of Voluntary Hospitals," in *The Transformation of Political Culture in Late Eighteenth Century England and Germany*, ed. Eckhart Hellmuth (Oxford, 1989), 165-84.

Such arguments and proposals began to dominate the pages of influential journals like the *Gentleman's Magazine* which circulated throughout the empire.[135] Writing in the tense climate of 1743, the magazine's editor noted how "it has been for many years lamented…that the Struggles of opposite Parties have engrossed the Attention of the Publick, and that all Subjects of Conversation, and all Kinds of Learning have given Way to Politicks." While it was only natural for such political debates to capture the limelight—especially in a nation where almost everyone considered themselves "a secondary Legislator"—the editor pointed out that other fields such as "morality, commerce, and philosophy" actually contributed more "to the publick Happiness" than the political realm.[136] Accordingly, many fashionable journals like the *Gentleman's Magazine* began to eschew party polemics in favor of publishing letters, essays, and extracts that would contribute useful knowledge to their audiences. These periodicals, in particular, became clearinghouses for various proposals, discoveries or practical hints that readers could adopt to improve their own situation and that of society at large. In Newcastle, for example, the editors of the newly created *General Magazine* boasted that they would carry "Essays from our Country Correspondents, on any useful Branch of Art and Science" as well as extracts "made from the *Philosophical Transactions*, and from such other Books or Pamphlets, Foreign, *British*, or *Irish*, as may best deserve the Notice

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[135] Founded in 1732 by Edward Cave, the *Gentleman's Magazine* became a model for other similar periodicals and miscellanies that began to appear over the course of the mid-eighteenth century. Cave's provincial background, his ties to printers and the post office, and his connections to practical tradesmen and experimenters, all helped him build up an extensive circulation throughout the British provinces and even the empire, far exceeding the previous efforts of gentlemanly journals. See, John Feather, *A History of British Publishing* (London, 1988), 110-1.

[136] *Gentleman's Magazine*, January 1743, 8:1.

of the Publick"[137] Mid-century readers increasingly encountered a barrage of such articles on everything from road building projects and river improvements to suggestions for treating cattle diseases, establishing infirmaries, or planting valuable trees. Anyone with a useful project was encouraged to submit their ideas directly to the reading public, who would judge for themselves the practicality and utility of their proposals. One such author, "Civicus", explained why this emerging public sphere could experiment with innovative schemes when political institutions could not:

> There are many affairs which engross the legislators attention…the hurry and anxiety of their hourly employments, leave the officers of state, very little leisure or spirit, to engage in schemes out of track, which require much time to methodize, and, what is equally, if not more discouraging, a fund unengaged to defray the expence…this offers some excuse for the inactivity of our ministers, who, probably, may project many designs, which they dare not undertake, and with many advantages to the community, which they never attempt to procure; but if these embarrassing obstructions can be removed, if any useful design can be formed, by private hands, and means found of executing it by private purses, it may reasonably be presumed, that their wishes will then be put in action, and their concurrence and sanction will not be refused.[138]

"Civicus" joined a growing chorus of writers and organizers who believed that revitalizing the nation's fortunes depended upon the work of "private hands" and "private purses."

The deep-seated desire for innovation—for experimenting with "schemes out of track" as "Civicus" put it —spawned an incredible array of new projects and programs at mid-century. Various groups worked, for example, to improve roads and transportation, establish hospitals, spur agriculture, encourage fisheries, and promote better development of manufacturing and commerce. There were patriotic clubs, as well, which raised money to support military widows, destitute sailors, and decommissioned troops. In a similar

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[137] *Newcastle General Magazine*, January 1747.

vein, subscription campaigns provided much needed funding to purchase supplies for the military and local militias, pay for recruitment bounties, and establish navigational schools for the training of future seamen. The period also witnessed a proliferation of distinct movements aimed at restoring the nation's manners and morals, focusing particularly on the need to curb vice, propagate religion, and instill discipline in the laboring classes. Issues of philanthropy and "police" merged imperceptibly in the minds of many contemporaries who placed their faith for a better-ordered society in workhouses, schools, and asylums.[139]

Without minimizing the important differences that distinguished these various projects, and the kinds of individuals they attracted, one can discern several common themes worth emphasizing. First, these public endeavors were almost never organized along party or sectarian lines, representing a significant departure from the past. In fact, contemporaries often stressed the need to encompass individuals of various political and

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[138] *Gentleman's Magazine*, July 1748, 18:293.

[139] My comments in this paragraph, and the proceeding one, are based upon an extensive reading of the periodical and pamphlet literature of mid-century. A number of these larger projects and schemes have been analyzed by historians interested in a variety of overlapping issues. Some of the works that deal most directly with the themes I explore include: Eric Pawson, *Transport and Economy: The Turnpike Roads of Eighteenth-Century Britain* (London, 1977); Pamela Horn, "The Contribution of the Propagandist to Eighteenth-Century Agricultural Improvement," *Historical Journal* 25 (1982), 313-329; Peter Clark, *British Clubs and Societies, 1580-1800: The Origins of an Associational World* (Oxford, 2000), and *Sociability and Urbanity: Clubs and Societies in the Eighteenth Century* (Leicester, Eng., 2000); Croxson, "The Public and Private Faces of Eighteenth-Century London Dispensary Charity." *Medical History* 41 (1997), 127-49; Roy Porter, "The Gift Relation: Philanthropy and Provincial Hospitals in Eighteenth-Century England," in *The Hospital in History*, ed. Lindsay Granshaw and Roy Porter (London, 1989), 149-78; *John* Gascoigne, *Science in the Service of Empire: Joseph Banks, the British State and the Uses of Science in the Age of Revolution* (Cambridge, 1998); Roy Porter, *The Creation of the Modern World: The Untold Story of the British Enlightenment* (New York, 2000); Langford, *A Polite and Commercial People*; Peter Borsay, *The English Urban Renaissance: Culture and Society in the Provincial Town, 1660-1770* (Oxford, 1989); Harris, *Politics and the Nation*; Maxine Berg, *The Age of Manufactures: Industry, Innovation, and Work in Britain, 1700-1820* (Oxford, 1985); A.E. Musson and Eric Robinson, *Science and Technology in the Industrial Revolution* (Manchester, 1969); David McElroy, *Scotland's Age of Improvement* (Pullman, Wash., 1969); and Donna T. Andrew, *Philanthropy and Police: London Charity in the Eighteenth Century* (Princeton, 1989).

religious affiliations so as to heal the dangerous rifts threatening the body politic.[140] Second, the social composition of these movements tended to mirror the growing divide in Georgian society between the polite and respectable classes, on the one hand, and the laboring poor, on the other.[141] The mid-century campaigns included a spectrum of people from the former camp, ranging from aristocrats and wealthy merchants all the way down to struggling artisans with the proper education and deportment. As historians have shown, the "middling ranks" took a particular interest in these reforming enterprises—a tendency that helped solidify their position as members of polite society despite their lack of the traditional attributes of land, title, or wealth.[142] A third, albeit related, theme was the fusion of personal and public improvement which characterized so much of this activity. Individuals made the most of their opportunities to forge social connections, gain useful skills, polish their character, and in some cases turn a profit; all the while making a positive contribution to society, as they saw it. Finally, it would be difficult to overstate the profound desire for cohesion and order which permeated the various civic movements of mid-century. Rooted in a constellation of perceptions and anxieties over

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[140] In fact, most societies and clubs continued to have rules of decorum preventing political or religious topics from being discussed so as to create an atmosphere conducive to diverse groups. Wilson, *A Sense of the People*, 61-80; Wilson, "Urban Culture and Political Activism," 165-84; Porter, "The Gift Relation," 149-78; Clark, *British Clubs and Societies*, 194-233.

[141] As Roy Porter noted, rather provocatively, "the key polarity in Georgian England…was not that between patrician and plebian, or rich and poor, but between those swimming in the metropolitan culture pool ... and those excluded." *Creation of the Modern World*, 76. On the growing polarity between the polite classes and popular culture, see also: See also Borsay, *The English Urban Renaissance*, ch. 11; Borsay, "'All the town's a stage': Urban Ritual and Ceremony, 1660-1800," in *English Provincial Towns, 1600-1800*, ed. Peter Clark (1984), 246-52; Langford, *A Polite and Commercial People*, esp. 76; Harry Payne, "Elite versus Popular Mentality in the Eighteenth Century," *Studies in Eighteenth-Century Culture* 8 (1979), 3-32.

[142] Langford, A Polite and Commercial People, 61-79; Jonathan Barry, "Bourgeois Collectivism? Urban Association and the Middling Sort," in *The Middling Sort of People*, ed. Jonathan Barry and C.W. Brooks (London, 1994), 84-112; Newmann, *The Rise of English Nationalism*, ch. 4.

the fragile nature of imperial society—a vulnerability underscored by war, rebellion, and factionalism—this underlying concern shaped the tone and tenor of popular campaigns that, on the surface, addressed a bewildering array of issues.

Within this vibrant culture, the world of public science emerged as a crucial arena for those interested in strengthening the commercial and imperial ties that bound Britons together. As chapter one revealed, natural philosophy had become woven into the fabric of public life in the first half of the eighteenth century. Its promotion of useful knowledge and civic collaboration animated early campaigns for societal improvement. While some of this energy was certainly directed towards matters of trade and empire, a notable shift occurred in the late 1730s and 1740s in which the application of science to imperial affairs gained far greater currency. Not only did the issues of a commercial empire loom larger in the minds of the scientific community, but the potential benefits of scientific knowledge appeared increasingly central to the challenges facing gentlemen throughout the empire. Tied together by an extensive network of institutions, correspondence and exchange, the sphere of science expanded dramatically in the middle decades of the century, providing a collaborative framework that encompassed improving groups from around the empire.[143] The realm of public science, in other words, provided the organizational resources and economy of knowledge which allowed people to begin the concrete task of building a more prosperous and unified society.

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[143] Richard Drayton and John Gascoigne are the two historians who have arguably pursued this theme in the most detail. See Drayton, *Nature's Empire*; Drayton, "Knowledge and Empire," in P.J. Marshall, ed., *The Eighteenth Century*, vol. 2 of *The Oxford History of the British Empire* (Oxford, 1998), 231-52; Gascoigne, *Joseph Banks and the English Enlightenment*; and Gascoigne, *Science in the Service of Empire: Joseph Banks, the British State and the Uses of Science in the Age of Revolution* (Cambridge, 1998).

Intersecting with broader movements, the world of science fostered what might best be described as a politics of imperial consolidation. At one level, this project involved a series of loosely overlapping campaigns which sought to harness the benefits of science to expand commercial opportunities and create a more integrated mercantilist economy. Through careful experimentation and the diffusion of useful knowledge, patriotic groups aimed to stimulate the production of exotic crops, new commodities, and vital industries, making the empire a more profitable and self-sustaining affair.[144] In the hands of enterprising groups, then, science held out the promise of implementing exactly the kind of rational improvements and orderly progress that would tighten the bonds of the imperial polity.

At the same time, the very act of participating in these cooperative endeavors was seen as an important step in healing the fractured nature of society. By focusing squarely on public improvement—a goal capable of attracting all parties and creeds—science provided a common meeting ground where individuals could associate, discover shared interests, and work together for the nation's good. Unlike the divisive world of politics, contemporaries insisted, the practical endeavors of science would help foster

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[144] One can discern a noticeable shift in mercantilist thinking by the 1740s, wherein writers began to question the heavy reliance upon outright prohibitions and tariffs in favor of encouraging experimental import substitutions—i.e. promoting fledgling domestic industries to deal with the problems of competition and the balance of trade. Malachy Postlethwayt provides a good example of this changing outlook. He began to argue that "we judge it most nationally beneficial to prevent the importation of all foreign commodities, as much as possible, but not by acts of parliament, such restraints, perhaps, being no good to commerce in general; it is therefore we recommend the raising such goods ourselves, so cheap as to make it impossible for other nations to find their account in bringing them to us: as this is the only natural and effectual prohibition of such things…so I wish every nation in the world would do the like." Postelthwayt, along with other merchants and gentlemen, began to worry increasingly about the dangers of escalating tariffs and artificial barriers. But these were not calls for free trade so much as a shift in focus towards financing research, premiums, bounties, and experimental schemes to promote new and cheaper domestic industries—a kind of enlightened mercantilism that was less about statecraft and more interested in spurring private enterprise. *Universal Dictionary of Trade and Commerce*, 1:145; Postelthwayts, *Britain's Commercial Interest Explained*, 160-1.

collaborative relationships and civic trust, providing a much needed outlet for the patriotic desires of an increasingly frustrated public. In light of the growing challenges, both at home and abroad, a sustained campaign of popular science promised to unleash the collective resources of society in ways that would strengthen and consolidate the imperial project.

CHAPTER FOUR

Scientific Networks & Imperial Reform: The Career of Henry Ellis

> Should I mention the new Inventions and Improvements in Navigation, Husbandry, and Manufactures which have been already communicated to us they would perhaps exceed your belief. I make no doubt but your plan [for a] Correspondence Carried on with ours and many other Societies in Great Brittain would occasion such a Circulation of most useful and Beneficial Knowledge as might exceed our warmest Expectations.
>
> —William Shipley to Benjamin Franklin

> You will greatly oblige me by the Communication of the Inventions and Improvements you mention. And as it is a Maxim in Commerce, That there is no Trade without Returns, I shall be always endeavouring to ballance Accounts with you, tho' probably never able to accomplish it.
>
> —Franklin to Shipley

Few things moved randomly throughout the Atlantic world of the eighteenth century. Whether one looks at shipping and commerce or the migration of people and plants, everything tended to flow along particular channels that reflected underlying *relationships* between various communities and places. Information proved to be no different. The circulation of news, gossip, or philosophical ideas followed the web of connections that bound various people and institutions into meaningful patterns of interdependence—what scholars today would call *networks*. And while almost any phenomenon can be analyzed as a network—whether it be traffic patterns or the spread of contagious disease—focusing on this particular dimension of eighteenth-century science offers unique insights into the nature and consequences of its dramatic growth. As this chapter will show, the expansion of scientific networks during mid-century not only changed the accumulation and flow of useful knowledge throughout the British empire, but also provided new levels of social and political capital that underwrote the period's dynamic movements for improving projects and imperial reform.

Not all networks, of course, are created equal. As social scientists have demonstrated, the dynamics of a particular system are determined by a variety of factors ranging from the relative positioning and centralization of the social actors (nodes) to the strength and resilience of their relationships (ties). Mapping out a network's morphology involves locating the center and periphery of the system, identifying the position and clustering of nodes, and assessing the hierarchy and reach of its ties. These characteristics typically reveal how a given network shapes the interactions and outcomes among its participants. And while historians might object to some of the specialized terminology of the field or its reliance on seemingly mechanical models, network analysis focuses on three key features that should appeal to any historian.

First, it is deeply contextual. Rather than prioritizing the sovereign individual, historical actors appear as fully immersed in a web of particular social relations that are themselves a primary source of investigation and analysis. Thinking in terms of networks provides a nuanced tool for interrogating these dynamic links between action and context. Second, it offers an organic way of thinking about social structures, power and agency, shedding light on why certain actors and groups are in a better position to achieve their goals. To be sure, the decisions and actions of individuals matter. But the particular dynamics of a network help explain why some outcomes are more likely than others, since each set of structural relations help determine what is possible and probable for certain actors. Viewed from this perspective, power becomes less about formal attributes and more about the ability to mobilize one's relationships and available resources within a social network—providing a more organic understanding of authority, agency, and social capital. Finally, focusing on networks tends to avoid the static qualities associated with other forms of structural analysis. Eventual outcomes within a network are the result of an ongoing *process*—one as fluid and dynamic as the social relations that form its core.

Eighteenth-century Britons certainly understood the centrality of personal ties to the fabric of their everyday life. In a world structured by patron-client relations and complex patterns of kinship, servitude and dependency, the primary attributes of an individual were often determined by their position within these distinct but overlapping webs of human relations. Such connections played a large role in delineating one's status and identity, rights and obligations, even behavior and deportment. Against this backdrop, the peculiar features of scientific culture come into sharper focus. As chapter one explained, the proponents of the new philosophy consciously sought to create new modes of collaboration and authority that would distinguish it from other forms of public or private life. Participating in a philosophical society or attending a polite lecture therefore involved entirely different social bonds and ways of interacting. Indeed, the production and exchange of factual knowledge required a rather unique set of human relationships—one characterized by epistemological modesty, sociability, and collaborative exchange. It also rested upon new spaces and institutional venues for incorporating broader segments of society into its improving endeavors. And here, the development of philosophical clubs and academies were crucial since they provided a cultural blueprint for effectively mobilizing social relations in a distinct way that ensured the efficient flow of information. Organizations like the Royal Society and its many imitators worked diligently to create broad networks of correspondence and exchange that could amass large amounts of knowledge, turning the assembly rooms and coffee houses of Georgian Britain into vibrant "centers of calculation."[1] This dramatic flow of specimens, records, observations, and technologies moved along meaningful paths that reflected the particular configuration of social ties sustaining the world of eighteenth-century science.

Accumulating such intellectual capital, however, required the ability to draw upon hundreds if not sometimes thousands of scientific observers, amateur experimentalists, and willing correspondents. Viewed from this perspective, the story of the "popularization" of natural philosophy during this period takes on a slightly different meaning. Rather than focusing on how lay audiences understood and appropriated scientific ideas, the emphasis shifts to examining how popular participation itself changed the structure and flow of social networks, building dense webs of personal connections and interdependencies that altered the scientific community and society, at large.

Such a process unfolded slowly and in many different settings. In colonial New York, to take just one example, a local surveyor decided to launch a small scientific campaign in the 1740s that would provide a source of entertainment and friendly cooperation among local residents. The surveyor, James Alexander, had become

[1] Larry Stewart, "Other Centres of Calculation, or Where the Royal Society didn't count: Commerce, Coffee-houses and Natural Philosophy in Early Modern London," *British Journal for the History of Science* 32 (1999), 133-54; Andrea Rusnock, "Correspondence Networks and the Royal Society, 1700-1750," *British Journal for the History of Science* 32 (1999), 155-69.

interested in the issue of magnetic variation—why compass readings tended to veer erratically from "true north" in different locations. He read about such topics in journals like the *Philosophical Transactions*, and had probably heard of contemporary movements to collect accurate records of magnetic variation. By the winter of 1744—only months before Dr. Hamilton would embark upon his noted tour of the colonies—Alexander decided to begin assembling his own observations. And in a pattern repeated throughout the eighteenth century, he reached out to a number of acquaintances, encouraging them to join in this particular endeavor that would be entertaining, edifying, and possibly useful. "I should be glad [if] you make Some Observations at the Same time," he wrote to Cadwallader Colden, "in order to See what variation of the variation is betwixt your place and this." But his plans did not stop here. As he went on to suggest, "I should be glad that you would put Mr. Clinton upon doing the Same & that you would Exchange Compasses with him. I think of directing [the] Deputies in Jersey all to do it & to Send their Observations, and also those nearest to Exchange Compasses with one another."[2] This impulse to recruit neighbors and correspondents into the ranks of the "curious", to build new connections on the basis of shared activities and interests, led to a substantial increase in both the size and nature of scientific networks. In Britain and throughout the colonies, people's entrée into the world of natural philosophy and improvement often came in such quotidian forms: recording the variance in a compass or keeping records of the weather or exchanging local seeds.

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[2] James Alexander to Cadwallader Colden, 22 January 1744, in *The Letters and Papers of Cadwallader Colden…*, 9 vols. (New York, 1918-37), III, 46-7.

And yet, these seemingly mundane activities often established new social ties between people, or transformed the nature of existing connections. In the case of James Alexander, for instance, it is crucial to note that he was not simply interested in convincing people to collect information, or even to send him the data directly. Rather, he sought to forge ties *among* the various participants, trying to put Colden in touch with Clinton, or the "deputies" in contact with each another. Scientific networking, in fact, tended to focus on the establishment of numerous horizontal ties between actors, rather than hierarchical flows of information and exchange through central nodes. Whether or not this decentralized configuration supports the image of a "republic of science", it certainly represented both a deliberate and distinct feature of these social networks.

Correspondence from the period underscores the importance of this issue within the scientific community. Naturalists were constantly trying to build personal connections among their various friends and acquaintances, going out of their way to bring different people into contact. They wrote letters of introduction, arranged meetings, organized sociable events, and encouraged their colleagues to exchange letters and specimens. Indeed, the extensive scientific correspondence of figures like Benjamin Franklin, Peter Collinson, or Sir Hans Sloane, seem to devote as much time and energy towards bringing people together as they do to actual scientific topics. [3] And over time, such activities created decentralized patterns of exchange and reciprocity. Whether individuals followed Benjamin Franklin in adopting the market metaphor of "balancing accounts", or whether they used the more common language of "gifts" and friendly "obligations", the social interaction between fellow *virtuosi* entailed very specific expectations about the imperatives of sharing information and material as well as the need to return in kind. So when the backcountry botanist, John Bartram, for example, sent a collection of sea shells to Sir Hans Sloane in the summer of 1741, the accompanying letter conveyed Bartram's hopes that "these [specimens] may find acceptance; so as to introduce a further correspondence" between the two men who had never met before. More than simply an exchange of scientific information, such a gesture also provided "a fuller demonstration that I am thy vigilant and industrious friend", as Bartram put it. Following the protocols of polite exchange, Sloane sent a letter to Bartram acknowledging the generosity and value of these items, and sought to reciprocate by including a copy of his *Natural History of Jamaica*, one of his newer plant catalogues, and the blanket invitation to accept any requests "wherein I can be useful to you." Sloane further cemented a future relationship with Bartram by expressing his fervent desire "to have some seeds, or samples of your plants, for my collections of dried herbs, fruits, &c."[4] These small steps—repeated by countless correspondents and projectors around the Atlantic—generated the dense webs of interdependency that allowed for both the efficient circulation of knowledge among participants and the ability of those individuals to summon the collective resources of so many others. Put another way, the unique configuration of these personal networks provided the social and

[3] Charles M. Andrews and Frances G. Davenport, *Guide to the Manuscript Materials for the History of the United States to 1785 in the British Museum, in Minor London Archives…* (1908), 50-71.

[4] John Bartram to Sir Hans Sloane, 22 July 1741; Sloane to Bartram, 16 January 1742, in *Memorials of John Bartram and Humphry Marshall* p.302-3

intellectual capital that sustained the expanding realms of science and collaborative improvement.

The culture of networking and sociability no doubt appealed to many eighteenth-century Britons who were eager to build connections and make a name for themselves, while at the same time, participating in an uplifting pursuit. The allure of scientific projecting became even stronger in the turbulent decades of mid-century, when mounting crises at home and abroad underscored the need for patriotic reform of the empire. As the previous chapter discussed, the emerging politics of imperial consolidation focused the energy of many enterprising groups on the need to strengthen and renew the ties that held the faltering Anglo-Atlantic empire together. And while much of this enthusiasm was channeled into a variety of new organizations like the Society for the Encouragement of Arts, Manufactures and Commerce (1754), most individuals found themselves gravitating towards less formal settings, participating in one of the many, often overlapping, networks of popular science. The instructive career of Henry Ellis—a provincial Irishman who rose to prominence within this world—offers a revealing window onto the growing networks of scientific improvement that channeled the flow of information and practical projects throughout the British Empire at mid-century. Born in Monaghan, Ireland, in 1721, Ellis set out to sea at a young age, gaining a practical apprenticeship in matters of trade and navigation. By the 1740s, Ellis was working closely with a variety of friends and patrons to enlist useful knowledge and discoveries in the service of empire. His broad-ranging interests would eventually take him to various locales throughout the Anglo-Atlantic, ranging from Africa to Hudson's Bay to Georgia, where he became the royal governor in 1756. Although Ellis rose to even higher prominence in the 1760s and 1770s, becoming a key advisor to the government on imperial affairs, his earlier career is more interesting from our perspective because it illuminates the world of mid-century improvers who sought to fuse scientific knowledge, practical innovation, and imperial reform.[5] By tracing his activities and connections, this chapter seeks to reveal the dynamic contours of the informal networks that merged science and imperial consolidation at mid-century.

Irish Roots: The Imperatives of Provincial Improvement

Ellis' particular brand of enlightened imperialism was no doubt rooted in the changing climate of his native Ireland, where popular campaigns for improvement had garnered wide-spread attention during his formative years. Much of this activity revolved around Ireland's charismatic Surveyor-General, Arthur Dobbs, who would eventually become one of Ellis' chief patrons. A zealous supporter of imperial commerce, Dobbs had written an influential study mapping out "the means of improving our country and Trade, so as to increase our Wealth, and add considerably to the Power of the *British* Empire." Brimming with statistics, detailed analysis, and a variety of proposed schemes, the work was a veritable manifesto of gentlemanly improvement. But Dobbs was the first to admit that no single person possessed the "extensive knowledge" to solve all of Ireland's problems, and so he insisted that "every one should contribute according to his

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[5] For Ellis' biographical details, see Tom Waller, "Henry Ellis, Enlightened Gentleman," *Georgia Historical Quarterly* 64 (1979), 364-76; Edward J. Cashin, *Governor Henry Ellis and the Transformation of British North America* (Athens, 1994).

ability, that something may arise from the whole, of use in the improvement of our country."[6] In the 1720s, Dobbs had begun to assemble his own network of landowners, merchants and officials who shared his vision of an Ireland regenerated by experimental agriculture, large-scale reclamation projects, canals, new machinery, improved mining, and practical research into key industries like linen manufacturing or deep-sea fishing. These groups argued that Ireland's political and commercial fate hinged upon replicating metropolitan programs of improvement and developing closer commercial ties with Britain.[7]

Such views found institutional expression with the creation of the Dublin Society for Improving Husbandry, Manufactures, and other Useful Arts and Sciences, in 1731. The "Dublin Society", as it was commonly known, sought to spur economic development through a coordinated campaign of premiums, subsidized experiments, and the dissemination of useful discoveries. Comprised of dues-paying members as well as a broader network of correspondents, the organization attempted to collect almost any useful knowledge that would "encourage the Spirit of Improvement" among the Irish

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[6] Arthur Dobbs, *Essay on the Trade and Improvement of Ireland*, iii, 16. One of Dobbs' goals, as he stressed throughout the essay, was to "rectify the Mistakes" that had led some parties in both Ireland and Britain to view the two kingdoms as "rivals in trade." Dobbs was a forceful proponent of a broader imperial perspective, seeking to establish closer ties to England while insisting that the improvement of trade in both countries were mutually intertwined (146).

[7] Some of the activities and proposals of these groups are included in Gerard Boate, *A Natural History of Ireland in Thee Parts. By Several Hands…* (Dublin, 1726); Thomas Prior, *A List of the Absentees of Ireland, and the Yearly Value of their Estates and Incomes…* (Dublin, 1729); Samuel Madden, *Reflections and Resolutions proper for the Gentlemen of Ireland, As to their Conduct for the Service of their Country…* (Dublin, 1738); Charles Smith, *The Antient and Present State of the County of Down. Containing a Chorographical Description…* (Dublin, 1744). See also, Desmond Clarke, *Arthur Dobbs Esquire, 1689-1765: Surveyor-General of Ireland, Prospector and Governor of North Carolina* (Chapel Hill, 1957); Jacqueline Hill, *From Patriots to Unionists: Dublin Civic Politics and Irish Protestant Patriotism, 1660-1840* (Oxford, 1997).

public.[8] Accordingly, their headquarters became a central clearinghouse for tracts, pamphlets, and letters that communicated new techniques from various parts of Ireland, Britain, and even Holland. Members circulated information on such diverse fields as hydraulics, soil composition, bee keeping, industrial chemicals, road construction, forestry, and the cultivation of flax.[9] The society also created a botanical garden which served to supplement the wide-ranging agricultural experiments it encouraged through monetary premiums and awards. Moreover, the society set up a special room in the Parliament-House where it displayed "the newest Instruments and Engines" to curious spectators.[10] As both contemporaries and historians have noted, the Dublin Society demonstrated a shrewd grasp of how to publicize its program of experimental innovation. In addition to orchestrating public trials of machinery and methods, the group was "one of the first bodies in Irish society to exploit systematically the growing power of the press."[11] The society, in fact, appointed its own official printer, Aaron Rhames, who was responsible for both publishing and publicizing its efforts to wider audiences.[12] Working

[8] *A List of the Members of the Dublin-Society…For the Year 1733* (Dublin, 1734), 13. Henry F. Berry discusses the origins and workings of the Society in his *A History of the Royal Dublin Society* (London, 1915), 1-74.

[9] For their wide ranging interests, see T*he Dublin Society's Weekly Observations* (Dublin, 1739); Thomas Prior, T*he Advantages Which may Arise…by Raising of Flax and Flax-seed…* (Dublin, 1732); *Instructions for Managing Bees. Drawn up and Published by Order of the Dublin Society* (Dublin, 1733); *Instructions for Planting and Managing Hops, and for Raising Hop-Poles, Drawn up and Published by Order of the Dublin Society* (Dublin, 1733); *An Account of Saffron: The Manner of its Culture and Saving for Use, With the Advantages it will be of to this Kingdom…* (Dublin, 1732); *Essays and Observations on the Following Subjects. Viz. On Trade…* (Dublin & London, 1740); Samuel Madden, *A Letter to the Dublin-Society, on their Improving Fund: and the Manufactures, Tillage, &c. in Ireland* (Dublin, 1739).

[10] *List of the Members of the Dublin-Society*, 13.

[11] Harris, *Politics and the Nation*, 204. See also, *The Dublin Society's Weekly Observations*, 5-7;

[12] In addition to local newspapers and handbills, Rhames was also adept at getting extracts of the society's work included in wider publications such as the *Gentleman's Magazine*, almanacs, and Anglo-American newspapers.

in tandem with local clubs, newspaper editors and public officials, the Dublin Society thus helped set the terms of a popular agenda focusing on the scientific advancement of agriculture, transportation, manufacturing, and public health. Practical knowledge, in the hands of enlightened patriots, was increasingly seen as crucial to the revival of the kingdom's stagnant fortunes and its successful integration within the imperial fold.[13]

As Henry Ellis would later discover, the work of the Dublin Society had a far reaching impact that went well beyond the shores of Ireland. In America, for instance, the colonial press often reported various aspects of the societies' program in admiring detail. The front page of the *Boston Weekly Post-Boy,* in the fall of 1735, described two recent "trials" that had been successfully conducted on the society's behalf. One experiment involved a "Carr furnished with Friction Wheels, after a new Manner" that doubled the load which a horse could pull. The second entailed a new "screw-pump," which the society had modeled after Dutch versions, and which "emptied a Pond of Water, containing one thousand Hogsheads in less than four Hours."[14] Many newspapers chose to print the annual premium lists of the Dublin Society, which outlined the cash awards that would be given to "him who manures the greatest Quantity of Land with a due Proportion of Marle, £10", "to him who raises the greatest Quantity of Wheat on one Acre, £10", and so forth.[15] While colonial Americans were unlikely to be the beneficiaries of such awards, they were expected to take note of what enterprising groups

[13] See, Madden, *Reflections and Resolutions proper for the Gentlemen of Ireland*; 23-41.

[14] *Boston Weekly Post-Boy*, 20 October 1735; For a discussion of the Dublin Society's work in encouraging the growth of Flax and the linen industry, see *American Weekly Mercury* 1 August 1745.

[15] *New-York Weekly Journal*, 18 January 1741; *Boston Post-Boy*, 23 January 1749.

were achieving in Ireland, and by extension, what they should be striving towards at home. One striking example of this impulse to emulate occurred in Boston in 1751 when local inhabitants formed the Society for Encouraging Industry and Employing the Poor.[16] Explicitly modeled after the efforts of the Dublin Society to promote linen manufacturing, the Boston organization attempted to create its own domestic industry that would achieve the twin goals of poor relief and mercantilist reform. Pointing out the large sums which New Englanders spent on foreign linens from Germany and Holland, the proponents argued that the creation of a public society to encourage local manufacturing would help strengthen the mercantile bonds of the empire while providing employment for widows, orphans, and the recently destitute. Although none of the members had any experience in producing linens—the subscription rolls indicate that most participants came from the ranks of Boston's civic elite—the society felt confident that it could import the necessary technical knowledge via the printed word.[17] Members, for example, circulated the Dublin Societies' *Essays and Observations on the Linen Manufactory* (1740) while employing a local printer to publish a lengthy manuscript on the subject which the Irish experimenter, Sir Richard Cox, had sent them.[18] Better

[16] B*oston Evening Post*, 9 July 1750. Gary Nash discusses certain aspects of this organization in *The Urban Crucible: Social Change, Political Consciousness and the Origins of the American Revolution* (Cambridge, Ma., 1979), 190-5.

[17] *Rules of Incorporation for the Society for Encouraging Industry and Employing the Poor* (Boston, 1754), 2-4, 7-12; Samuel Cooper, Industry and Frugality Proposed… (Boston, 1753).

[18] *A Letter from Sir Richard Cox, Bart., to Thomas Prior Esq. Showing from Experience a Sure Method to Establish the Linen Manufacture…* (Boston, 1750). Interestingly enough, the preface to this publication emphasized the similar contexts facing improvers in both Ireland and America. While historians have often focused on the shared "provincialism" of Scotland and America—particularly the ways in which the Enlightenment and its culture of useful knowledge evolved along parallel lines—far less attention has been paid to the role of Ireland in this respect. And as I mentioned above, Benjamin Franklin consciously looked to the Dublin Society as a model for the American Philosophical Society in 1743.

channels of communication and aggressive outreach had made it possible for civic groups on both sides of the Atlantic to exchange ideas about their schemes for improvement.

Henry Ellis' own entrée into this world of scientific improvers came in 1746, when Arthur Dobbs and his circle of associates recruited the young Irishman to participate in a voyage of discovery to Hudson's Bay. Only twenty-five years old, Ellis had recently arrived in London after completing several cruises in the Mediterranean and West Indies. His experiences at sea, as one biographer noted, "were partly a lesson in geography and partly an introduction to the heady game of empire building."[19] Both came together in Dobbs' ambitious project to open new avenues of trade in the North Atlantic by exploring Hudson's Bay and searching for the elusive Northwest Passage. Ellis was appointed to serve as the official "hydrographer" of the expedition, while also acting as an informal agent for Dobbs and his financial backers.[20] Like Sir Joseph Banks or James Cook, whose scientific expertise would make them important contributors to later voyages of discovery, Ellis was expected to record as much detailed information as possible about the geography, climate, topography, and "natural productions" of the region.[21] In May, he set sail aboard the aptly named *Dobbs Galley*, bound for the northern most reaches of the British Empire.

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[19] Cashin, *Governor Henry Ellis*, 10.

[20] Henry Ellis recounts how he became involved in the project in *A Voyage to Hudson's-Bay, by the Dobbs Galley and California, in the years 1746 and 1747, for Discovering a North West Passage…* (Dublin, 1749), 49-50.

[21] Ibid., 50. For the later fusion of science and imperial exploration—exemplified by Banks, Cook, and others—see, Gascoigne, *Joseph Banks and the English Enlightenment*; and David Mackay, *In the Wake of Cook: Exploration, Science, and Empire, 1780-1801* (London, 1985).

Enterprise and Exploration: Developing the "Northern Indies"

The mission Ellis embarked upon certainly reflected the changing atmosphere of the 1740s and 1750s. The *Dobbs Galley*, and its companion ship the *California*, had been purchased and outfitted by the North-West Committee, a group of gentlemanly investors led by Arthur Dobbs. The Committee included a large portion of Anglo-Irish backers, a fact that not only exhibited Dobbs' personal influence, but also the projects potential benefits to Irish trading interests in the North Atlantic. [22] The main goal of the expedition, and the aspect which garnered public attention, was the search for a Northwest Passage that would allow traders to navigate to the Pacific Ocean via a direct northerly route. If such hopes seem almost quixotic with the benefits of hindsight, contemporaries believed it was precisely the kind of bold initiative the nation sorely needed. With the intense commercial pressures wrought by closing markets in Europe and aggressive competition abroad, Britons had to begin actively searching for any and every opportunity to open new branches of trade.[23] Such concerns fed into a growing perception that the nation had lost its appetite for discovery—a view that expressed itself in a pervasive nostalgia for the adventurous exploits of the Elizabethan age. Indeed, mid-century writings on trade and empire often included a kind of secular jeremiad, calling on Britons to recover the enterprising spirits of their predecessors. As a result, the period

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[22] For the activities and membership of the North-West Committee, see *Articles of Agreement for Carrying on an Expedition by Hudson's Straights for the Discovery of a North-West Passage…* (London, 1745); Ellis, *Voyage to Hudson's-Bay*, 48-9; [Dobbs], *A Short Narrative and Justification of the Proceedings of the Committee…* (London, 1749). For the broader context surrounding interest in the Northwest passage, see Glyndwr Williams, *The British Search for the Northwest Passage in the Eighteenth Century* (London, 1962).

[23] H.V. Bowen has examined how the expansionary trends of the eighteenth-century British empire were not the product of government policy, but were instead driven by the growing "enterprise culture" among merchants, investors

witnessed a proliferation of ambitious schemes which championed exploration as a way to extend the frontiers of both knowledge and imperial trade. The excitement even swept Parliament which, in 1745, issued a £20,000 reward to anyone that discovered a Northwest Passage.[24] Modeled after the famed Longitude bill, Parliament's conspicuous action seemed to vindicate the aspirations of scientific projectors like Ellis and Dobbs.

Nor were they alone, in this respect. Other groups were busy forming their own companies to finance expeditions to the artic during this period. In the American colonies, for example, Benjamin Franklin helped organize a subscription campaign in Philadelphia, Boston, and New York to send a schooner, the *Argo*, in search of a northern passage in 1753.[25] Comparing the initiative to the recently created academies and hospitals, he explained to one correspondent how the voyage reflected the growing "public spirit of this people."[26] Like a competing scheme, backed by the Maryland cleric James Sterling, Franklin's expedition also encompassed a reconnaissance of the Labrador coast, hoping to discover potential commercial opportunities in fishing, whaling, mineral

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and projectors who were eager to open up new avenues of trade, speculation, and even settlement overseas. *Elites and Enterprise*, 40-44, 69, 171-93. See also, Jubb, "Economic Policy and Economic Development," 121-44.

[24] 18 George II. c. 17. A printed version of the Bill was released to the public as *An Act for Giving a Publick Reward to such Person or Persons…as shall Discover a North West Passage through Hudson's Streights…* (London, 1745). For the growing enthusiasm surrounding these measures, see also *Journal of the House of Commons* (London, 1797--), XXIV, 762; *Gentlemen's Magazine* 15 (1745), 51. Henry Beaufoy, F.R.S., who was a confidant of several leading MPs and other involved parties, emphasized how interwoven were the strands of scientific, commercial, and imperial motives underlying this and other legislation "for northern discoveries." See his recollections printed in *Annals of Philosophy, Or, Magazine of Chemistry, Mineralogy, Mechanics…*, 10 (1817), 424-5. Parliament also issued a later reward of £5,000 pounds, in 1775, for anyone reaching the North Pole or discovering an artic passage to the Pacific (i.e. above the Hudson's Bay), see *Journal of the House of Commons*, 35:283.

[25] The goals and details of the voyage were covered in lengthy pieces in the *Pennsylvania Gazette*, 10 May 1753; 15 November 1753; 29 November 1753. For other colonial explorers interested in the artic and the northwest passage, see, Howard Eavenson, *Map Makers and Indian Traders: An Account of John Patten: Trader, Artic Explorer, and Map Maker; Charles Swaine: Author, Trader, Public Official, and Artic Explorer; Theodorus Swaine Drage: Clerk, Trader and Anglican Priest* (Pittsburgh, 1949).

[26] Franklin to Jared Eliot, 19 December 1752, *Papers of Benjamin Franklin*, 4:389.

extraction, or trade with the indigenous population.[27] Yet, such a project was not entered into lightly. For one thing, the mission required nearly fifteen hundred pounds, a considerable sum to wager on an uncertain voyage.[28] But intellectual capital proved equally important to the endeavor. Franklin and his associates had to gather as much detailed information as possible in order to make their project viable—acquiring a number of maps, sea charts, and traveler's accounts. The Library Company of Philadelphia soon began to act as a kind of scientific repository for the growing collection of sources that had been carefully culled from book dealers, map-makers and correspondents, including material that Henry Ellis had produced on his 1746 voyage.[29] The mobilization of these transatlantic information networks turned Philadelphia into a "center of calculation" where knowledge about distant places could be transcribed and aggregated in ways that encouraged scientific projecting.[30] And when the *Argo* returned

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[27] Captain Swaine, who headed the expedition, records that a "Draughtsman & Mineralist" was included as part of the crew, but unfortunately the extant documents do not name this scientific observer. An account of the voyage's observations of the Labrador coast was reprinted in [Anon.], *The Great Possibility of a North West Passage…* (London, 1768), 154-76. Swaine's expedition actually encountered 7 other ships in the artic waters on its short voyage, revealing the growing number of vessels either exploring for the northwest passage or scouting out possible territory for whaling—a commercial field that was attracting considerable attention among imperial boosters in England, Scotland and Ireland. In fact, organizations such as the Society of Arts and the Royal Society were sponsoring research into harpoon engines and other trials to encourage British whalers, part of the larger movement to promote fisheries which I discuss below.

[28] Franklin to Cadwallader Colden, 28 February 1753, *Papers of Benjamin Franklin*, 4:463-5. The same day that Franklin was writing letters about the upcoming voyage he was also busy mailing copies of instructions on observing the Transit of Mercury which he had recently printed. He asked his correspondents to distribute them among their friends since accurate observations of this phenomenon would promote "the improvement of Geography and Astronomy." Franklin to James Bowdoin, 28 February 1753; and Bowdoin to Franklin, March 1753, Ibid., 446, 461.

[29] James Logan to Franklin, 7 November & 9 November 1748; Franklin to Jared Eliot, 19 December 1752, 12 April 1753, *Papers of Benjamin Franklin*, 3:325, 329; 4:387-89; 4:465; Franklin was also asking his colleagues to send "any queries to make concerning that Country, its Productions, &c. or would have any particular observations made there" which he would pass along to the Captain and crew (Ibid., 3:389). *Charter, Laws, and Catalogue of Books of the Library Company of Philadelphia* (Philadelphia, 1770).

[30] Bruno Latour, *Science in Action: How to Follow Scientists and Engineer through Society* (Cambridge, Ma., 1987), ch. 6.

after failing to discover a Northwest route to the Pacific, Franklin and his associates could at least take comfort in the fact that its crew managed to create “a very good Chart, and have a better Account of the Country, its Soil, Produce, &c than has hitherto been published.”[31] Not surprisingly, this material became part of the Library Company’s growing collection, which Franklin promised to dutifully transmit to other scientists and gentlemen back in England.[32] This emerging economy of knowledge helped fuel the growing confidence of explorers and merchant adventurers who turned the period into a veritable second “age of discovery.”

Henry Ellis’ expedition to Hudson’s Bay, furthermore, grew out of widespread criticisms over the lack of energetic leadership in certain areas of the empire. Private monopolies, such as the East India, the Royal Africa, the Levant, and the Hudson’s Bay companies, faced a barrage of attacks at mid-century, as writers complained about their wasteful management of the territories and trade which were entrusted to them.[33] Portrayed as corrupt and inept, these chartered corporations were legally entitled to exert a stranglehold over large portions of the empire, suffocated the potentially lucrative commerce that Britain desperately needed to develop. Ellis’ patron, Arthur Dobbs, represented one of the staunchest critics of the Hudson’s Bay Company for precisely this

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[31] *Pennsylvania Gazette*, 15 November 1753; Franklin to Richard Jackson, 6 December 1753, *Papers of Benjamin Franklin*, 4: 148.

[32] Peter Collinson to Benjamin Franklin, 26 January 1754; Franklin to Sir John Pringle, in *Franklin Papers*, 5:190-3; 14:352

[33] Josiah Tucker, *A Brief Essay on the Advantages and Disadvantages which Respectively Attend France and Great Britain, with Regard to Trade. ...*, 2nd ed. (London, 1750), 21-2, 40-2, 65-85;William Burke, *An Account of the European Settlements in America…*, 2 vols., 2nd ed. (London, 1758), II, 288-90. “Fisher,” *Britain’s Golden Mines*, 24-5. Jubb, “Economic Policy and Economic Development,” 121-44.

reason. In several pamphlets he listed the myriad ways in which it had utterly failed to encourage settlement, explore the region, stimulate local markets, and foster trade.[34] It would be fair to say that a major reason why the North-West Committee was able to raise an impressive £10,000 in public subscriptions—including a £100 share purchased by Ellis, himself—lies in the growing desire among its supporters to demonstrate the true potentials of the region. Ellis' role, in this respect, was seen as crucial. As the scientific observer and designated agent for the committee, he was charged with making detailed maps, tidal records, and meteorological observations as well as an analysis of "the different natures of the soil." More importantly, the sponsors wanted Ellis to spare no effort in collecting "metals, minerals, and all kinds of natural curiosities."[35] Thus, even if the *Dobbs Galley* and the *California* did not find the elusive northwest passage, they might still discover valuable evidence of the untapped resources waiting to be cultivated by private enterprise. In fact, the popular campaign to divest the Hudson's Bay Company of its monopoly privileges reached its zenith only two years after the ships returned in the summer of 1747. Responding to an outburst of merchant petitions, which stressed the

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[34] Arthur Dobbs. *An Account of the Countries Adjoining to Hudson's Bay, in the North-West Part of America...* (London, 1744). Dobbs also released a concise handbill that listed these points for the public. [Dobbs], *A Short View of the Countries and Trade Carried on by the Company in Hudson's-Bay; Shewing the Prejudice of that Exclusive Trade, and Benefit which will Accrue to Great-Britain, by Opening and Extending that Trade and Settling those Countries* [London, 1748?]. See also, Louis Joseph Plumard de Dangeul, *Remarks on the advantages and disadvantages of France and of Great-Britain with respect to commerce,* **...** London, 1754), 149-177; *[Anon.], A short state of the countries and trade of North America. Claimed by the Hudson's Bay Company, under pretence of a charter for ever, ... London, 1749, 3-24*; William Burke, a respected authority on these matters, noted how the indolence of the Hudson Bay Company "has been often and loudly complained of." In his view, it was simply "astonishing that this trade has not hitherto been laid open" by Parliament. See, Burke, *Account of European Settlements*, 288-90.

[35] Henry Ellis, *A Voyage to Hudson's-Bay*, 50

need to open the imperial playing field to worthy improvers, Parliament ordered a full-scale investigation of the whole matter.[36]

While the expedition failed to gain eternal fame by locating a passage to the South Sea, Ellis managed to achieve considerable recognition and reward for his efforts. Upon arriving in London, he discovered that many of England's leading figures were anxious to meet with him, hoping to discuss his voyage and impressions of the region. Ellis was also elected a fellow of the Royal Society, opening the door to a larger world of well-connected statesmen and scientists. His certificate of membership proclaimed him "a Gentleman of merit of great curiosity and an uncommon zeal for the making of discoveries and promoting Natural History, Geography and navigation and who will therefore we doubt not be a useful and valuable member of the Society."[37] Ellis' growing reputation was no doubt solidified when he published a detailed account of the mission and its wider purpose, accompanied by a new map of the region which he personally constructed. *A Voyage to Hudson's-Bay* (1748) became a commercial success, generating multiple editions, foreign translations, and popular excerpts in the press.[38] Blending vivid narrative with scientific descriptions, the work laid out the compelling

[36] This investigation, in 1749, was part of a series of critical evaluations in which the Royal Africa and Levant Companies lost their legal monopolies while the Hudson Bay and East India Companies narrowly escaped a similar fate. For the special committee assigned to investigate the affairs of the Hudson Bay Company, see *Gentlemen's Magazine*, 19 (1749), 100; *Journals of the House of Commons*, 25:845.

[37] Quoted in Cashin, *Governor Henry Ellis*, 36.

[38] The first London edition was released in 1748, followed by a Dublin edition the following year, and then translations in French, German, and Dutch. The account was also reprinted in: *The World Displayed; or, a Curious Collection of Voyages and Travels…* 20 vols (London, 1759-61), X, 228-84; John Barrow, *A collection of authentic, useful, and entertaining voyages and discoveries, digested in a chronological series…*, 3 vols. (London, 1765), III, 193-231. Edward Drake, *A New Universal Collection of Authentic and Entertaining Voyages and Travels…* (London, 1768), 359-76; Benjamin Franklin acquired a copy immediately and was busy loaning it out to friends. See, James Logan to Benjamin Franklin, 9 November 1748, *Papers of Franklin*, 37:325.

need for an energetic program of discovery and imperial renewal—one that would "surely awaken us from that slothful and drowsy State into which…we are visibly fallen."[39] Only a public campaign of new exploration and overseas development could provide the means by which "the Exportation of our commodities and Manufactures may be vastly increased, that several branches of Foreign Trade may be highly improved, that Navigation in general…be greatly extended, and our Shipping increased."[40] To skeptics who doubted the commercial opportunities of the icy North Atlantic, Ellis responded that a similar lack of vision could be found in earlier periods, when naysayers belittled the possible benefits of colonization in warmer climes. Experience had proven them wrong. And as Ellis declared rather provocatively, with the proper encouragement, Britons would one day celebrate the great wealth and power generated by "these Northern Indies."[41]

Ellis' forceful stance only fueled the growing suspicion of the Hudson's Bay Company and whetted the public's appetite for more information about the region's true potential. In reality, very few people had reliable intelligence about the climate, soil, or geography of the area.[42] When Ellis wrote therefore about the need for "*Public Information*…to set this Matter in it's true Light", he was tapping into a deep vein of

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[39] Ellis, *Voyage to Hudson's Bay*, x.

[40] Ibid., vii.

[41] Ibid., ix. These calls were also echoed in Henry Ellis, *Considerations on the Great Advantages which would Arise from the Discovery of the North West Passage* (London, 1750); [Arthur Dobbs], *Reasons to Shew, that there is a Great Probability of a Navigable Passage to the Western American Ocean…* (London, 1749).

[42] Capt. Christopher Middleton, who had participated in an earlier voyage to explore Hudson's Bay sponsored by Dobbs and the Admiralty, found that his weather tables and other observations were in high demand. See the

curiosity about what the territories and trade of the Hudson's Bay Company actually comprised.[43] Knowing that it had many enemies, the company's directors had tried to keep a tight lid on such information. As critics never tired of pointing out, the Company insisted on absolute secrecy among its employees, preventing anyone from keeping personal records, journals, maps, or the like. No wonder, then, detractors could easily cast doubts upon the veracity of popular conceptions of the region, which imagined a frozen landscape devoid of little potential aside from the fur trade. As one anonymous author complained, the Company officials "say and pretend, that the Countries adjoining Hudson's Bay are in so inhospitable of a Climate, and so excessively cold, that no Persons can be induced to inhabit it; that no Kind of Grain can grow there", that frozen rivers prevent the development of "trade in the inland Countries." But how could such accounts be trusted when the same officials "prevent their Captains and Servants from publishing any Journals or Charts...or Discoveries…or Descriptions of these Countries, or Knowledge of the Climates and inland Parts of that Country"? The author immediately seized upon Henry Ellis' weather journal to suggest that the directors had vastly understated the potential of these northern climes.[44] Another writer decided to address the same issues in verse, creating a lengthy poem extolling the untapped possibilities of

Philosophical Transactions 40 (1738), 310-11; *Philosophical Transactions* 42 (1742), 157-71; *Gentleman's Magazine*, March 1743, 143.

[43] Ellis, *Voyage to Hudson's-Bay*, 47 (emphasis in original). Aspects of this debate are explored in Glyndwr William, "The Hudson's Bay Company and Its Critics in the Eighteenth Century," *Transactions of the Royal Historical Society*, 5th Ser., 20 (1970), 149-171.

[44] Anon.] *A Short State of the Countries and Trade of North America Claimed by the Hudson's Bay Company* (London, 1749), 5, 9-10, 28-43.

Hudson's Bay:

> Declare what Treasures Snow-sunk Rocks produce
> How dreary Desarts howl for human Use
> Tell Industry; 'twill find, while Ocean rolls,
> Branda, Sainte Barbe, and Guinea in the Poles
> Do Eastern Barriers cramp a Briton's Soul
> Is West deny'd then elevate the Pole!
> Subdue th' astonish'd Globe! 'tis God's Command
> Who never made unvistable Land!
> Bid utmost North his Treasury display
> Bask in the Warmth of semi-annual Day[45]

The poem went on to praise the efforts of the Dobbs-Ellis circle for focusing the nation's attention on such pressing matters. Indeed, Ellis' published account—along with a similar pamphlet in which he repeated the call for more scientific and commercial exploration—helped persuade a number of influential people that the northern fringes of the British Empire deserved far greater attention than they had received in the past.[46]

Ellis' blend of science and imperial improvement found a receptive audience among his emerging circle of associates and patrons in London. In the late 1740s and early 1750s, the young explorer began to establish close ties with the coalition of individuals who gathered around Frederick, the Prince of Wales.[47] Meeting at Leicester

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[45] James Sterling, *An Epistle to the Hon. Arthur Dobbs, Esq; in Europe. From a Clergyman in America* (London, 1752), 27-8

[46] Ellis, *Considerations on the Great Advantages from the Discovery of the North West Passage,* 1-7.

[47] Ellis dedicated his published account of the expedition to the Prince of Wales, noting the meetings which "you were pleased to allow me, soon after my Return from this Voyage; the many judicious Questions you were pleased to ask, and the Generous Care you expressed." Ellis, *Voyage to Hudson's Bay*, iv. Arthur Dobbs no doubt was instrumental in introducing Ellis to the Prince of Wales and his circle of advisors. Dobbs had close ties to Leicester house and was actively encouraging the Prince's followers to support a program of private expansion into the North Atlantic. One of his policy briefs written for Prince Frederick still survives in the Hunter Manuscripts at the University of Glasgow. Yet, the Prince of Wales, had a number of strong ties to the scientific community ranging from his gentleman of the bedchamber (Lord Charles Cavendish) to a series of chaplains (particularly, John Theophilus Desaguliers and Thomas Rutherforth) to the likes of Stephen Hales, Phillip Carteret Webb, and John Ellis. See "Frederick Louis, Prince of Wales," *DNB* 7:675-78; E.G.R. Taylor, *Mathematical Practitioners of Hanoverian England, 1714-1840* (Cambridge, 1966), 10, 135-36.

House, the prince's residence, this coterie of politicians, noblemen, scientists and literati had spearheaded much of the "patriot" opposition to Walpole and the Whig regime. Although the group lacked an explicit party platform, it was held together by a bundle of related concerns and priorities dealing with the need for a dramatic shift in the direction of the nation. One key area of agreement involved matters of trade and empire. The ministry, they insisted, had severely neglected these pillars of British strength, investing far more attention and resources to continental affairs and domestic politics. By the time Henry Ellis joined these circles, the emphasis on strenuous opposition had begun to fade as prominent members accepted positions in the new government led by Henry Pelham. But if the Leicester set appeared to be loosing some of its political focus, the group remained equally committed to fostering a more robust and enlightened brand of imperialism. Ellis discussed such issues with the likes of William Pitt, Lord Barrington, Lord Halifax, George Lyttelton, Lord Egmont, Philip Carteret Webb, James Oglethorpe, Robert Nugent, John Ellis, and Dr. Stephen Hales—all members of this tightly-knit circle. Ellis could be particularly helpful since the group had set its sights on a series of enterprising designs involving the recently acquired territory of Nova Scotia, and more importantly, its potentials for commercial fisheries. Combined with similar interests in deep-sea fishing off the Scottish coast, the group's wide-ranging endeavors aimed to cultivate opportunities in the northern reaches of the empire that had been too often overlooked.[48] Ellis' "Northern Indies" would become part of a an improving arc that

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[48] On the Leicester groups heavy involvement in the movement for commercial fisheries, see Bob Harris, "Patriotic Commerce and National Revival: The Free British Fishery Society and British Politics, c. 1749-58," *English Historical Review* 114 (1999), 285-313. Greiert, "Halifax and British Colonial Policy," ch. 4.

stretched from the North Sea all the way to the coast of Maine—a project that would bring order, prosperity and cohesion to the rather precarious territories of Britain's northern empire.

Imperial Industries: Developing a Knowledge Economy

The encouragement of commercial fishing was a widely popular endeavor at mid-century, reflecting strands of patriotic, imperialist, and scientific thought that were increasingly woven together. Gentlemanly improvers—including Ellis and his patrons—argued that Britain had failed to use its maritime resources to effectively exploit this most beneficial of trades.[49] Arthur Dobbs spoke for many concerned observers when he complained that "our exports upon this article are small to a shameful Degree, and a lasting Reproach on the Nation."[50] He proposed the creation of large-scale fisheries off the coast of Scotland, Ireland, Labrador, Nova Scotia—indeed, wherever cod or herring could be found.[51] Rather than scold his audience, another writer opted to paint a luring picture of the untold wealth simply waiting to be raised up from the ocean's depths. Fisheries, he explained, were "true mines, of greater value, as well as cheaper wrought,

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[49] See, for example, [Anon], *The Wealth of Great Britain in the Ocean Exemplified…* (1749); [Anon.], *England's Path to Wealth and Honour…* (London, 1750); [Anon.], *The Vast Importance of the Herring Fishery to these Kingdoms* (London, 1749); [Anon.], *Some Considerations on the British Fisheries…* (Dublin, 1750); Edward Vernon, *Considerations upon the White Herring and Cod Fisheries…* (London, 1749).

[50] Dobbs, *An Essay on Trade and Improvement*, 28; William Doyle, *A Letter to every Well-Wisher of Trade and Navigation…* (Dublin, 1739), 1-2. For another jeremiad that captures well the tenor and tone of public discussions on this issue, see the fictional dialogue between an Englishmen and a Dutchmen in *The Old England Journal*, 17 August and 21 September 1745.

[51] Dobbs, *A Friend in Need is a Friend in Deed…* (Dublin, 1737)

than those of Mexico and Peru"[52] Such rhetoric, which pervaded the newspapers and popular literature of the day, appeared entirely credible in light of contemporary estimates that placed the total value of Europe's deep-sea fishing industry at £10,000,000 sterling per year.[53] While increasing Britain's share of this lucrative trade had long been a matter of general interest, it soon crystallized into a movement for concerted action at the end of the War of Austrian Succession in 1748. Hoping to make the most of a fragile peace, Britons formed numerous patriotic societies and projects to encourage commercial fishing throughout the North Atlantic—schemes that would bolster the mercantile power of the empire while finding timely employment for the hordes of decommissioned sailors and troops appearing at the war's end.[54]

Yet, if wresting control of the lucrative cod and herring trade from Britain's rivals was an appealing prospect, contemporaries recognized that its success would depend upon technical abilities that had proven elusive in the past. As boosters of deep-sea fishing readily conceded, Britain's natural advantages in terms of its geographic position, numerous harbors, and large maritime community had never really translated into concrete gains before. Some writers pointed to the lack of sufficient funding and organization that had traditionally hampered the fisheries—a complaint which fed logically into the growing call for new companies based upon large public subscriptions.

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[52] Douglass, *A Summary, Historical and Political*, 6. The comparison of the fisheries to gold/sliver mines—often in the New World—was a common trope repeated throughout the press and pamphlet literature of the day.

[53] "Fisher," *Britain's' Golden Mines*, 16; Francis Cawood, *An Essay: Or, Scheme: Towards Establishing and Improving the Fisheries…* (London, 1721), 14, 42. These Calculations were based on the work of Simon Smith, a political arithmetician.

But most authorities also agreed that the problem went deeper, emphasizing how the lack of technical knowledge regarding salt production and the curing process were to blame for Britain's disappointing role in the North Atlantic fisheries.[55] As one observer noted, calls for expanding commercial fishing would remain idle talk "unless we cou'd shew, that we were as capable of curing, as we are of catching the Fish, which is a thing impossible without Salt proper for the Purpose."[56] And manufacturing large quantities of the appropriate curing salt was a complicated affair. Ordinary white salt—which British producers had made for centuries from salt-brines located in regions like Cheshire—was simply unfit for the job.[57] Indeed, this domestic salt had proven so inadequate as a curing agent that Parliament had legally discouraged its use in the fisheries since the early eighteenth century, hoping to thereby improve the quality and reputation of British exports in competitive world markets.[58] Such a policy, however, meant that the nation

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[54] Harris, "Patriotic Commerce and National Revival, 285-313. Contemporary viewpoints are distilled nicely in James Ogelthorpe's report to the House of Commons on these matters in 1748, *Journal of the House of Commons*, 25:871.

[55] John Chamberlayne, *Magnæ Britanniæ Notitia: or, the Present state of Great Britain ...* (London, 1735), 362-3; Dobbs, *An Essay on Trade and Improvement*, 123-4; Cawood, *An Essay towards Improving the Fishery*, 38; Peck, *Observations for Improvement of Trade*, 42; Doyle, *Letter to every Well-Wisher of Trade*, 8, 11-15; *Wealth of Great Britain in the Ocean*; 53; George Beatty, *A Scheme Humbly Offer'd…in order to Rectify the Many Abuses Committed in the Fishing-Trade of North-Britain* (London?, c. 1730), n.pag.

[56] John Knightley, *Essay toward Proving the Advantages which may Arise from Improvements on Salt Works…* (Dublin, 1733?), n.pag. See also the discussion in *Read's Weekly Journal or British Gazetteer*, 27 October 1750.

[57] Curing Salts was one of the few items that could be imported directly from Europe to the colonies: See the Navigation Acts, Act 12 *Car. II.* ch. 18; Act 15 *Car. II.*, ch. 7; Act 13 *Geo. I.* ch 5 & 7. At the beginning of the century, the Scottish Parliament tried to overcome these problems by creating a domestic refining industry. The process—known at the time as "making salt upon salt"—involved importing foreign rock salt that would then be mixed with local brine and boiled down to an appropriate curing salt. Apparently the Scots and other British experimenters encountered little success. *Draught of an act anent coal and salt* (Edinburgh, [1701]), 2.

[58] For a contemporary discussion of the legal and technical issues surrounding the use of salt in the fisheries, see the House of Common's special committee report of 1717, "Salt used in curing fish. Petition of merchants and dealers on the coast of Fife concerning…the laws and policy surrounding domestic versus foreign salt for fisheries," *Journals of the House of Commons*, vol. 18, p. 607; *A Collection of Such Statutes Relating to his Majesty's Customs, and Duties*

was forced into the unenviable position of having to buy this key product from rival kingdoms—chiefly, the French, Spanish, and Portuguese who produced the more powerful "bay-salts" that were capable of curing fish.[59] Not only did this reliance on foreign salt upset the balance of trade and threaten shortages during times of war, but it also added a considerable surcharge that put British fishers at a competitive disadvantage. To overcome such obstacles, gentlemen and scientists collaborated in a program of experimental research which sought to transform the domestic salt industry, thereby freeing Britain from its harmful dependence on continental sources.[60] The tools of science, in the hands of enlightened projectors, thus helped underpin the burgeoning confidence of patriotic groups who believed they could solve the commercial predicaments facing the empire.

Given his connections and interests, Ellis was probably well aware of the new attention being paid to salt. The topic had become something of a critical issue which members of the Royal Society and other scientific organizations sought to quickly

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upon Salt **...** (Edinburgh, 1734). For its part, the Dutch government took these issues so seriously that it passed dozens of laws regulating the production and application of salt in the curing of fish. Doyle, *Letter to every Well-Wisher of Trade*, 14.

[59] For growing recognition of this dangerous dependence, see *A Third Collection of Scarce and Valuable Tracts…* (London, 1751), 353-4; Ephraim Chambers, *Cyclopaedia: Or, an Universal Dictionary of Arts and Sciences…*, 7th ed. (London, 1751-2), n.pag. "Salt"; *Journals of the House of Commons*, 25:1033-7.

[60] There was also a parallel movement to improve internal navigation so that domestic salt-works could ship their materials directly to coastal fisheries without facing the prohibitive costs of overland transportation (i.e. the traditional pack horse trains) while gaining access to the enormous supplies of coal needed to fuel their open pan furnaces. The most noteworthy of these efforts centered on clearing a 21 mile stretch of the River Weaver that ran through the historic salt beds of the Cheshire basin—the traditional center of British salt making since Roman times. With the backing of Liverpool merchants, who were deeply involved in the salt trade, Parliament passed legislation that incorporated a group of public subscribers to manage the project (Act 7 *Geo. I*, ch. 10; further extended by Act 7 Geo. II, ch. 28). Although it took 11 years to complete, the Weaver Navigation helped spur both salt manufacturing and later chemical industries in the region. For Parliamentary debate, see "Salt trade and the Weaver navigation," *Journals of the House of Commons*, 19:227. On public campaigns to improve harbors as part of the larger effort to promote fisheries, see *Gentlemen's Magazine* 18 (1748), 294; Wyndham.. *Lex Mercatoria Rediviva*, 150, 160-1,

address. "The making and refining of Salt," as one contributor to the *Philosophical Transactions* emphasized in 1748, "must certainly be considered as one of the mechanic Arts…which is a necessary Part of that Knowledge, that true Science of Nature, which is not taken up in vain and fruitless Speculations, but effectually labours to relieve the Necessities of human Life."[61] In Dublin, this "mechanic art" was encouraged through a campaign of premiums awarded to individuals or companies that could produce the greatest amount of curing salts for use in the fisheries. Irish newspapers carried stories about several of these public trials, suggesting that the research into salt production was on the verge of discovering new techniques that would end the monopoly of continental producers.[62] Not to be outdone, private groups in Scotland—led by the Society for Improvers in the Knowledge of Agriculture of Scotland and the Board of Trustees for Fisheries, Manufactures, and Improvements in Scotland—had begun to develop their own program of scientific research and practical experimentation with different forms of rock, brine, and bay-salts.[63] In London, meanwhile, much of the focus revolved around the work of Thomas Lowndes, a Cheshire gentleman who invented a new process for refining domestic brine-salt that supporters claimed rivaled the best salts from France or

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[61] *Philosophical Transactions* 45 (1748), 372; Sir John Pringle's "Some Experiments on Substances Resisting Putrefaction," *Philosophical Transactions* 46 (1749), 480-88. The Royal Society had received a number of papers on salt during its early years and some members, like John Houghton, continued to solicit any information or discoveries on the topic that might lead to improvements among domestic producers, see John Houghton, *A Collection for the Improvement of Husbandry and Trade…* (London, 1727-8), 74-106. For early eighteenth-century campaigns to investigate salt production, see L.G.M. Bass-Becking, "Historical Notes on Salt and Salt-Manufacture," *The Scientific Monthly* 32 (1931), 434-46.

[62] Berry, *A History of the Royal Dublin Society*, 61-2.

[63] These efforts are reviewed in Archibald Cochrane, Earl of Dundonald, *The Present State of the Manufacture of Salt Explained…* (London, 1785), 43-76; McElroy, *Scotland's Age of Improvement*, 134-7. For contemporary praise of Scottish efforts to advance salt refining techniques, see Postlethwayt, *Britain's Commercial Interest Explained*, 59.

Portugal.[64] Contemporaries took the matter so seriously that Parliament convened several committee hearings to investigate the matter, ordering a series of public experiments to be conducted in the summer of 1745. Declaring that "the improving of the Brine Salt of this kingdom would be a great Advantage to the Trade and Navigation of this Country," Parliament authorized a surprising £7,000 reward to Lowndes if his method proved effective, reliable, and affordable.[65]

Like so many other gentlemanly improvers, Lowndes' career straddled the worlds of science, mercantilism, and imperial reform. The heir to a comfortable estate, Lowndes had the time and resources to pursue a variety of different projects over the course of his lifetime. He was particularly interested in matters of imperial trade and expansion, an outlook that probably grew out of his early position as the provost-marshal of South Carolina. While he never visited the colony, Lowndes became an anxious observer of French and Spanish activities in America, offering countless policy proposals to encourage the ministry to adopt a more robust imperial posture. He pushed for the large-scale settlement of foreign Protestants in South Carolina, promoted exotic agricultural crops for the region, and tried to establish a colonial pot-ash industry that would both diversify the economy of South Carolina while weaning Britain of its reliance on Baltic

[64] Thomas Lowndes, *Brine-Salt Improved: Or, The Method of Making Salt from Brine, that Shall be as Good or Better than French Bay-Salt* (London, 1746); Lowndes, *A Seasonable Hint for our Pilchard and Coast Fisheries…* (London, 1748); "Petition of T. Lowndes," *Journals of the House of Commons,* 25:163; *Gentleman's Magazine*, November 1746; *Whitehall Evening Post* 26 April 1748; Joshua Dixon, *The Literary Life of William Brownrigg…* (London, 1801), 34.

[65] *Journals of the House of Commons*, 25:163.

producers.[66] His focus on the salt industry, therefore, represented a natural outgrowth of his underlying concerns with consolidating the imperial system.[67] To pursue these goals, Lowndes combined research into the chemical structure of salt crystals with detailed observations of production methods in France, Holland, and England. He also corresponded with doctors, chemists, victuallers, salt-dealers, and naturalists about the peculiar qualities of salt that affected its curative powers. After experimenting with "many trials of acid preparations and minerals," Lowndes settled upon Alum as the key chemical additive that would yield the hard salt crystals—shaped like pyramids—that made French bay-salt such a successful curing agent.[68] As part of his arrangement with Parliament, Lowndes drew up detailed explanations of his process that were quickly circulated in published form, especially by naval officials. And while his discoveries did not resolve every problem facing British salt-makers, his improvements were recognized as significant enough to garner wide-spread adoption and the large Parliamentary award that had been promised.[69]

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[66] The encouragement of colonial pot-ash and pearl-ash industries became a dominant concern of imperial boosters and scientific improvers during this period. The Royal Society, the Society of Arts, and other groups tried to publicize the best methods for producing these chemicals while also judging the purity of samples sent from North America.

[67] The basic details of Lowndes' life and activities are sketched out in J. A. Cramb, 'Lowndes, Thomas (*bap.* 1692, *d.* 1748)', *Dictionary of National Biography*. Upon his death, one newspaper described Lowndes as an "eminent and successful Projector"—a title he would have no doubt embraced. *London Evening Post,* 12 May 1748.

[68] Lowndes, *Brine-Salt improved*, 16. Lowndes claims to have spent almost ten years experimenting with salt production and traveling to foreign sites to observe different methods.

[69] For the navy's adoption and promotion of Lowndes' technique, see the letters reprinted in Lowndes, *Brine-Salt Improved*, 2-11; *The Public Advertiser*, 6 August 1753; *London Evening Post*, 11 May 1754; *London Gazette*, 11 March 1755. Fittingly enough, Lowndes used his Parliamentary award to endow a chair in Astronomy at Cambridge University (*Journal of the House of Commons*, 28:435).

Yet, arguably the most influential research was carried out by William Brownrigg, a noted physician and chemist with close ties to Henry Ellis and many of the individuals leading the fisheries movement.[70] Brownrigg's chief patron, Sir James Lowther, helped found the Free British Fishery Society in 1749 and was a frequent visitor to Leicester House. In many respects, Lowther personified the improving land-magnates of the era. Praised for his vast "knowledge of philosophical and commercial subjects," Lowther invested heavily, for example, in steam engines and other technology to extract coal from his northern estates. He also financed the construction of a laboratory near his mines so that Brownrigg could study the causes and effects of "fire-damps"—the combustible gases that claimed the lives of so many colliers.[71] Brownrigg put aside this work, however, to begin investigating the chemical and technical challenges facing British salt makers. In 1748, he published *The Art of Making Common Salt* which offered an exhaustive analysis of the different equipment, procedures, and chemical properties affecting the production of salt throughout Western Europe. Since English rock salt mined from quarries lacked the necessary preservative qualities, Brownrigg focused on the techniques of producing stronger salts from a combination of brine water and rock salt—a process known by contemporaries as "salt-upon-salt." Only the Dutch had mastered this particular method, and it was widely understood as the secret to their

[70] Dixon, *The Literary Life of William Brownrigg*, 31-51. Well into the nineteenth century, British scientists and salt manufacturers continued to treat Brownrigg's study as a definitive source on such matters.

[71] [Anon.], Some Thoughts on Building and Planting, to Sir James Lowther… (London, 1755), 26. J.V. Beckett, "Dr. William Brownrigg, F.R.S.: Physician, Chemist and Country Gentleman," *Notes and Records of the Royal Society of London* 31 (1977), 255-71; Harris, "Patriot Commerce and National Revival," 285-313; Larry Stewart, *The Rise of Public Science: Rhetoric, Technology, and Natural Philosophy in Newtonian Britain, 1660-1750* (Cambridge, 1992), 163-4; 232-3, 359.

continuing dominance of the commercial fishing industry.[72] Hoping to break this monopoly, and thereby promote the British fisheries, Brownrigg explored why domestic efforts had proved so disappointing in the past. What he discovered, through careful experimentation and correspondence, was that English refiners had unknowingly allowed "muriatic salts" (hydrochloric acids) to impregnate the crystals, rendering their product unfit for curing provisions.[73] Brownrigg's analysis focused on how a reduction in the temperature of the salt pans, along with several chemical additives, could improve the surface tension of the brine and the purity of the crystals that would form along its crust. These key insights were supplemented by a host of other suggestions for better equipment and extractive techniques that appeared throughout the text, including detailed engravings to illustrate different aspects of the process.[74]

Brownrigg also devoted considerable attention to explaining how Britons, throughout the empire, could "be supplied with bay-salt of their own manufacture."[75] Since few areas outside of England possessed large salt deposits or brine springs, he proposed that British subjects in Ireland, Scotland, the Caribbean, and the North American mainland should follow the example of the French, who extracted "bay" or sea salt through a carefully constructed system of canals and holding ponds in which brackish

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[72] Brownrigg, *The Art of Making Common Salt…* (London, 1748), iii-ix, 3-7, 45-52, 165-71. See also, John Campbell, *An Exact and Authentic Account of the Greatest White-Herring-Fishery In Scotland, Carried on Yearly in the Island of Zetland, by the Dutch only…* (London, 1750)

[73] Ibid., 29-32, 125, 220-92.

[74] Ibid., 57-72, 103-119, 171-219. John Campbell noted that many of these "Great Improvements" had been incorporated into the "Management of these [Salt] Works" by the late 1760s. Campbell, *A Political Survey of Britain*, 2 vols. (London, 1774), I, 78.

[75] Ibid., 219.

tidal waters were allowed to evaporate. While such ideas had been floated before, Brownrigg argued that the changing imperial climate and the need to bolster the Atlantic fisheries had made these projects a timely necessity. And to counter the potential skepticism of the public, who might be inclined to believe that the production of bay-salt could only occur in the peculiar environment of the Mediterranean, Brownrigg gathered an array of evidence that indicated otherwise. Working with colleagues and correspondents, he produced tables calculating the annual precipitation and evaporation rates of various locales, which combined with an analysis of water salinity, implied that bay-salt could be manufactured throughout much of the British dominions.[76] His writings not only described how to construct and operate such coastal salt-works, but also listed new "improvements" that would make British refineries more profitable than their rivals. In particular, Brownrigg insisted that the use of cement lining, hydraulic engines, covered cisterns, and retractable tarps would allow producers to double the amount of salt rendered by the traditional methods. To many observers, it appeared that an imperial salt industry was within the nation's grasp.[77]

[76] Ibid, 171-209. Recorded observations on rain fall and evaporation rates could prove useful in a variety of different contexts. Alexander Blackwell, an agricultural improver, used many of the same sources as Brownrigg to inform his theories about the best methods of drainage in certain regions. Over the course of the eighteenth century, the expanding networks of correspondence and publishing helped ensure that such information would be more widely available to groups throughout the empire. Blackwell, *A New Method of Improving Cold, Wet, and Barren Lands…* (London, 1741), 14.

[77] Ibid, 226-44. The Society of Arts offered several large awards for anyone who could produce domestic salt "which will answer the Purposes of Bay Salt", noting that "the Method of making Bay Salt, and the Practicability of doing it to Advantage in England, may be seen in Doctor Brownrigg's Treatise on that Subject" *Premiums by the Society, Established in London…* (London, 1764), 18-9. For growing explanations of salt-manufacturing, often reprinting sections of Brownrigg's work, accompanied by calls for public experimentation, see Postlethwayt, *Universal Dictionary of Trade and Commerce*; 2:765-73; Chambers, *Cyclopaedia*, n.pag "Salt"; *A New and Complete Dictionary…Comprehending all the Branches of Useful Knowledge… By a Society of Gentlemen*, 4 vols. (London, 1760), IV, 2793-99. Brownrigg's work also circulated widely throughout the American colonies, appearing in book sellers advertisements, catalogues of subscription libraries, and correspondence. Yet, as far as I have discovered, there was only one serious attempt to establish a large-scale salt manufactory, involving Robert Hunter Morris in the 1750s.

Henry Ellis would have heard such matters being widely discussed at meetings of the Royal Society and private gatherings throughout London. His colleagues, in fact, deemed Brownrigg's work so significant that the Royal Society took the unusual step of publishing a lengthy abstract of the work in its *Philosophical Transactions*. William Watson assumed the job of drafting a comprehensive review of Brownrigg's findings, a task justified by the growing recognition that salt production held the key to improving Britain's "Fisheries, and its Navies and Commerce, and many of its richest Colonies."[78] While the review pointed out many of Brownrigg's contributions, it also underscored the collaborative nature of such research. The incredible array of "Facts referred to in these Disquistions," Watson emphasized to his audience, came largely from "the Observations of judicious Salt-Officers, daily conversant in these Matters, or of curious and inquisitive Navigators, Merchants, Travellers, and Naturalists; or, the Experiments of many learned Physicians, Chemists, and Philosophers."[79] William Brownrigg, in fact, stood at the center of a vast information network that spanned the empire, encompassing correspondents of all types ranging from practical tradesmen to bureaucrats and gentlemanly scientists. His colleague, Henry Ellis, figured prominently within these circles by virtue of his connections to the Royal Society, the fisheries movement, and his newly appointed post as a deputy commissary general of His Majesty's stores. Offered by the Earl of Halifax as a reward for his recent service on the Hudson's Bay expedition,

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The details are presented in a 1758 Parliamentary report and David Hume's, *A History of England…Continued to the Death of George the Second by T. Smollett*, 13 vols. (London, 1825), XII, 347.

[78] Watson, "An Account of a Treatise by Wm. Brownrigg…Abstracted by W. Watson," *Philosophical Transactions* 45 (1748), 353.

[79] Ibid., 371.

the job made Ellis responsible for overseeing the supply of military provisions.[80] The army and navy were probably the largest purchasers of salt and cured victuals at the time; and military officials expressed considerable frustration at having to rely upon foreign, particularly French, salt to meet their needs. Like other groups, these administrators followed closely the improving schemes that emanated from the assembly rooms, coffee-houses, and private studies of mid-century London.[81]

Currents of Change: Information Networks & Experimental Projects

The members of the Royal Society, which included both active scientists and worldly gentleman, became increasingly focused on such practical endeavors. Although later scholars would often bemoan the neglect of pure science within the eighteenth-century institution, contemporaries held a rather different perspective.[82] Under the leadership of presidents like Sir Hans Sloane, Martin Folkes and Sir John Pringle, the Royal Society embraced its role as a vibrant clearinghouse for useful information and projects. The pragmatic spirit could even be seen in the new compilations of the *Philosophical Transactions*, which began to translate Latin articles into English for the "general Use of the Public, and…the Perusal of all Mathematicians, Artificers,

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[80] See Rory T. Cornish, "Henry Ellis (1721-1806)" in *Dictionary of National Biography*.

[81] William Thompson recounts these efforts in his, *An Appeal to the Public in Vindication of Truth and Matters of Fact: Setting Forth, Among other Particulars, an Infallible Method to Prevent, for the Future, the Navy of England being Supplied with Pernicious Provisions…* (London, 1761).

[82] Charles Babbage helped set the tone for the disparaging view of the eighteenth-century Royal Society in his *Reflections on the Decline of Science in England…* (London, 1830). For a discussion of how modern historians have appraised the subject, see David Miller, "'Into the Valley of Darkness': Reflections on the Royal Society in the Eighteenth Century," *History of Science* 27 (1989), 155-66; and the collection of essays in "Did the Royal Society

Tradesmen, &c, for their improvement in various Branches of Business"[83] One of the promising schemes which attracted considerable attention while Ellis was attending meetings of the society in London involved the use of ventilating machines created by his friend, Dr. Stephen Hales. Responding to a deadly outbreak of typhus in the Royal navy, Hales designed a mechanical contraption that relied upon bellows and a network of pipes to circulate fresh air aboard ships.[84] The Royal Society received a flood of papers on the subject and supported a series of public experiments to gauge the potential benefits of the machine in a variety of applications.[85]

Ellis participated in one such trial in 1751, when he installed a large ventilator aboard his ship, *The Earl of Halifax*, traveling to the west coast of Africa. Ellis had developed close ties to Lord Halifax in the preceding years, connections that were forged both at the Royal Society and Leicester House, the Prince of Wales' residence. With Halifax's support, Ellis assumed command of a Bristol vessel about to embark on a slave trading voyage.[86] Because of the notoriously high rates of disease and death associated with the African trade, especially among slave ships, the cruise offered a conspicuous

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Matter in the Eighteenth Century?" a special volume of the *British Journal for the History of Science* 32, no. 2 (1999), 130-221.

[83] Most individuals who read the *Philosophical Transactions* in the British provinces or colonial settlements did so through compiled editions such as Benjamin Baddam's *Memoirs of the Royal Society; Being a New Abridgment of the Philosophical Transactions…*, 10 vols. (London, 1738-41), i (quotation). One of the things that is striking about Baddam's compilations, and other later imitators, is the enormous emphasis placed on useful knowledge in the preface, notes, translation and even selection of articles, which probably shaped how contemporaries looked upon the Society's work.

[84] Hales discusses the background of his research and experimentation with ventilators in *A Description of Ventilators: Whereby Great Quantities of Fresh Air May with Ease be Conveyed into Mines, Goals, Hospitals, Work-Houses and Ships…* (London, 1743).

[85] The activities and excitement surrounding Hale's ventilators is discussed in D.G.C. Allan and Robert E. Schofield, *Stephen Hales: Scientist and Philanthropist* (London, 1980), ch. 4.

testing ground for Hales' ventilators. So while Ellis expected to earn a profit from his human cargo, he also considered the voyage an important experiment in the application of imperial science. Accordingly, he transmitted detailed reports of his observations which were circulated among Lord Halifax, Dr. Stephen Hales, and other members of the Royal Society, eventually being published in the *Philosophical Transactions*.[87] Writing from Cape Mount, in present-day Liberia, Ellis described the effects of the ventilator on everything from the acoustic vibrations of bells to the speed with which candles burned. In terms of practicality, however, the most relevant portions of Ellis' reports centered on his observations of the general health of slaves and sailors as well as the large cargo of guns that showed no signs of rust or deterioration that typically occurred in the damp holds of ships. Indeed, the fact that only 6 of the 350 slaves died on the trip to Jamaica appeared to offer compelling proof of the machine's potentials.[88]

Ellis' experiments were part of a larger effort to apply the technology of ventilators to solve a host of pressing concerns. The Royal Society and its members, for example, helped direct the instillation of ventilating machines in dozens of hospitals, prisons, underground mines, and storage facilities. Even the chambers of Parliament were equipped with new ventilators. Both the navy and army purchased a variety of

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[86] Cashin, *Governor Henry Ellis*, 39.

[87] "A Letter to the Rev. Dr. Hales, F.R.S. from Captain Henry Ellis, F.R.S. dated January 7, 1750-1 at Cape Monte, Africa, Ship Earl of Halifax," *Philosophical Transactions* 47 (1752), 211-14.

[88] Ibid. See also Ellis' later letter to Hale reprinted in Hales' *An Account of a Useful Discovery to Distill Double the Quantity of Sea-Water…* (London, 1756), 42-5.

models as well, hoping to improve health aboard ships and within field hospitals.[89] Lord Halifax was so taken with the potential benefits—calculating that mortality rates were 12 times lower on ventilated ships—that he used his authority as President of the Board of Trade to ensure that all transport vessels bound for the new colony of Nova Scotia were equipped with the contraptions.[90] Supporters also claimed that ventilators dramatically improved the quality of foodstuffs, agricultural commodities, and metal wares that filled the cargo holds of Britain's maritime fleet.[91]

Yet, there were other groups equally interested in exploring the industrial applications of the device. Hales, himself, worked closely with a team of mechanics and experimenters to determine if the machines could prove useful in distilling liquids.[92] By forcing currents of pressurized air through distillation stills, Hales showed that the process could be achieved with significantly less fuel, cost, and time. The new techniques of ventilated distillation opened up a variety of innovative uses.[93] William Brownrigg applied the basic idea to conduct experiments on the effects of forced air in

[89] Hales, *A Description of Ventilators*, 6-45, 67-93; Stephen Hales, *A Treatise on Ventilators. Wherein an Account is Given of the Happy Effects of the Several Trials…* (London, 1758), 13-18; 26-81, 132-35.

[90] On Halifax's calculation, see Hales, *Treatise on Ventilators*, 96; and Greiert, "Halifax and British Colonial Policy," 87-89; James Ogelthorpe appears to have adopted a similar policy regarding the instillation of ventilators on transport ships heading to Georgia at the end of the proprietary period. See, *Gentleman's Magazine***,** 16 (1746), 494.

[91] *Treatise on Ventilators*, 88, 120, 162, 228,

[92] Stephen Hales, *Account of a Useful Discovery to Distill*; Hales, *Treatise on Ventilators*, 318. In particular, Hales collaborated with Thomas Yeoman, a millwright who would become one of the leading civil engineers in the decade to come. Yeoman also had a close working relationship with the editor of the *Gentleman's Magazine*, Edward Cave, which helps to explain why stories about ventilators seem to appear in issue after issue.

[93] Keane Fitzgerald, "Experiments on Applying the Rev. Dr Hale's Method…to the Steam Engine," *Philosophical Transactions*, Vol. 50 (1757), 53-7; 370-3. Not surprisingly, Hales thought it could be used to help in the production of curing salts. Hales, *Treatise on Ventilators*, 277-9.

both the production of bay-salt and the efficiency of steam engines.[94] The same principles launched analogous efforts which sought to harness the potential of ventilators to combat the problem of moisture in certain key commodities. Powered by wind and water mills, Hales' device was used to dry a range of products from gun powder to grain.[95] Discussed frequently by the press and by enterprising circles, such efforts revealed the emergence of collaborative networks organized around the benefits of practical knowledge and enlightened improvement.[96]

During this period, Henry Ellis was also involved in a variety of scientific pursuits focusing on the advancement of navigation. Working with George Adams—a prominent instrument maker and fellow member of the Royal Society—Ellis created a reflecting device that would allow mariners to determine latitude in poor weather. Under the existing methods, sailors often found it difficult to use octants or quadrants that required a person to train their sights on the distant skyline—a task nearly impossible when clouds and rain obscured the horizon. George Adam's new quadrant, combined with Ellis' technique of using a glass-mercury speculum as a mirrored aid, promised to solve this problem by eliminating the need to "sight" a horizon in order to calculate one's position at sea.[97] On his own voyages, Ellis also began to collect detailed observations on the

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[94] William Brownrigg, "Thoughts on the Reverend Dr. Hale's New Method of Distillation by the United Force of Air and Fire" *Philosophical Transactions* 49 (1755-6), 534-543.

[95] *Gentleman's Magazine*, 16 (1746), 315-8; Hales, *Treatise on Ventilators*, 258-82.

[96] An elaborate description of how to construct several ventilators, accompanied by illustrations, appeared in *A New and Complete Dictionary of Arts and Sciences Comprehending all the Branches of Useful Knowledge*, 4 vols (London, 1754-55), IV, 3269-2371, Plate CCXCIV.

[97] For a description of Ellis' "floating Mirrour," see George Adams, *The Description and Use of a New Sea Quandrant, for Taking the Altitude of the Sun…* (London, 1748), 36-40.

temperature of the ocean at different depths. Using a special contraption made by his friend, Dr. Stephen Hales, he lowered an insulated vessel containing a thermometer and a controlled door which could be opened to collect samples of water from as deep as 500 feet. Ellis' meticulous records were duly transmitted to the Royal Society which published the findings as part of a broader campaign to collect this sort of useful information.[98] The period, in fact, witnessed considerable interest in the possibility of using such records to discover scientific laws governing the ocean's currents. Accordingly, public-spirited gentleman encouraged travelers, mariners and their fellow *virtuosi* to collect valuable data, which in the near future might allow Britain to gain an even greater mastery of the sea. Already, there were growing speculations about the existence and nature of a "Gulph-stream", about which, Ellis' observations were quickly applied.[99]

The same principles inspired similar campaigns to assemble careful observations in the name of science, navigation, and imperial improvement. One of the most impressive efforts, in this respect, involved the systematic collection of recorded variances in magnetic compass readings taken from around the globe. By 1757, the

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[98] "Letter to the Rev. Dr. Hales from Captain Henry Ellis," 211-14. Ellis also kept detailed meteorological records on his various sea voyages; although these journals are no longer extant. See, *Philosophical Transactions* 50 (1758), 755-6.

[99] Joseph Mead, *An Essay on Currents at Sea…* (London, 1757), v-viii, 17-39; Benjamin Franklin to Sir John Pringle, 27 May 1762, *Papers of Benjamin Franklin*, 10:85-100; Thomas Pownall, who traveled extensively throughout the colonies, was also exploring these issues in the late 1750s and early 1760s, although his work would not be published for a couple of decades. More importantly, Pownall discussed these matters regularly with the circle of merchants, navigators, and gentleman he associated with, demonstrating how such topics were becoming increasingly significant to wider groups. See Pownall, *Hydraulic and Nautical Observations on the Currents in the Atlantic Ocean Forming an Hypothetical Theorem for Investigation…* (London, 1787); and John A. Schutz, *Thomas Pownall, British Defender of American Liberty: A Study of Anglo-American Relations in the Eighteenth Century* (Glendale, Calif., 1951), 155.

Royal Society had received nearly 50,000 such observations, illuminating just how vast its network of knowledge gatherers had become.[100] Ellis, himself, had carefully recorded such information during his expedition to the Hudson's Bay. And contemporaries recognized that the puzzle of magnetic variation had significant bearing on Britain's ability to successfully navigate its imperial waters, especially those of the northern Atlantic. The traditional methods of determining course based upon a plane chart became increasingly useless as one moved farther from the equator. Since two-dimensional maps can never accurately delineate the spherical nature of the earth, most nautical charts contained growing levels of distortion as they moved from the equator to the poles. These cartographic projections were drafted as if lines of longitude and latitude were equidistant—a visible grid that was basically accurate along the equator but unreliable to sailors navigating either the northern or southern portions of the globe. Even the famed Mercator projection—a geometric formula developed by Gerardus Mercator and Edward Wright at the end of the sixteenth century—could only resolve these problems of distortion below the latitude of 60º, leaving much of Ellis' "northern Indies" in a kind of navigational haze.[101] And while newer mapping techniques would emerge in the eighteenth century to address some of these issues, plotting a reliable course still depended upon magnetic compass bearings which demonstrated a bewildering tendency

[100] Royal Society Journal Book (RSJB), 10 November 1757. On the broader interest in understanding magnetism, see Patricia Fara, *Sympathetic Attractions: Magnetic Practices, Beliefs, and Symbolism in Eighteenth-Century England* (Princeton, 1996)

[101] The longstanding concern with navigating the northern waters of the Atlantic, and the peculiar challenges it presented, is explored in Amir Alexander, "Harriot and Dee on Exploration and Mathematics: Did Scientific Imagery Make for New Scientific Practice?" in *The Heirs of Archimedes: Science and the Art of War Through the Age of Enlightenment*, ed. Brett D. Steele and Tamera Dorland (Cambridge, Ma., 2005), 189-93.

to fluctuate in various locales. If enough data was collected, transcribed and accumulated, contemporaries hoped to develop a working model of the magnetic globe that would make such navigation far more reliable. So like the attempts to solve the puzzle of longitude or the laws governing the oceans' currents, British gentleman believed that the key to improving the maritime sinews of the empire lay in a public campaign of record keeping and collaborative research.

Ellis not only participated in such campaigns, but his rising stature also allowed him to become a genteel patron of knowledge in his own right. Like many of his associates, he helped to finance the work of marine cartographers who relied upon subscriptions to produce an increasing array of charts and maps for the benefit of the public at mid-century.[102] One of the most interesting examples involved the work of Lewis Morris, a self-taught hydrographer and surveyor from Wales. With the financial backing of Ellis and other subscribers, Morris published his *Plans of Harbours, Bars, Bays and Roads* in 1748.[103] Based upon more than a decade of work, Morris' collection of sea charts and harbor plans offered a highly accurate picture of the Welch coastline, an area infamous for its treacherous shoals and "melancholy Accounts of Shipwrecks, and Losses." Yet, detailed maps were only one part of Morris' text. Accompanying each chart of a Harbor or coastline, Morris included a lengthy discussion of projects that

[102] Not only was financial support important. But as most of the prefaces and appendixes to contemporary maps make clear, cartographers relied heavily upon a network of correspondents to supply the data and details for their work. See, for example, Lewis Evans, *Geographical, Historical, Political, Philosophical and Mechanical Essays. The First Containing an Analysis of the General Map of the Middle British Colonies…* (Philadelphia, 1755); and Greene, *Remarks, in support of the New Chart of North and South America*, 1-46.

[103] For Ellis' subscription, see Morris, *Plans of Harbours, Bars, Bays and Roads in St. George's Channel, lately Survey'd…* (London, 1748), 8.

groups should pursue in order to improve the local economy. Almost every section, in fact, followed a set formula under the headings: “Description”, “Improvements”, and “Natural Commodities and Trade.” While some of the improvements that Morris called for seem perfectly in keeping with a work of this nature—such as plans for building piers, dredging new channels, or establishing lighthouses—he often strayed farther a field, proposing the creation of canals, new manufactures, and even technological changes in the mining industry.[104] Such projects would provide a “Means to raise the Spirit of Trade in many Places, where the Inhabitants are now utter Strangers to it.”[105] Like other aspiring provincials throughout the empire, Morris hoped to launch a civic campaign that would incorporate Wales more closely into Britain’s dynamic economy and its culture of public improvement.

The New Brand of Enlightened Imperialism

Given all of Henry Ellis’ connections and interests, contemporaries were probably not surprised when he was appointed to serve as the royal governor of Georgia in 1756. The colony, itself, had been the product of many of the same attitudes and individuals that shaped the world in which Ellis operated. The private trustees who founded Georgia—nearly a third of whom were members of the Royal Society—had aimed to make the colony a model settlement that would prove the benefits of orderly planning and

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[104] Ibid., 39-56.

[105] Ibid., 14. Many contemporaries, especially those outside of the maritime community, seemed to be more impressed by Morris’ programs for improvements than they were by the actual charts and surveys. See, for example, Josiah Tucker’s comments in his *Instructions for Travelers…* (London, 1757), 12.

rational imperialism.[106] Conceived as a bulwark against Spanish aggression emanating from Florida, as well as a cure to poverty back home, the province was designed to be an enlightened city upon a hill. The trustees pursued an innovative scheme that would combine orderly compact settlements with a heavy emphasis on botanical experimentation and the promotion of exotic staples. They paid for naturalists to collect potential crops in the Caribbean and Latin America—plants that would be housed in a special ten-acre botanical garden established in Savannah.[107] Here, the colonists could experiment with exotic spices, fruits, and commodities that Britain had to purchase from its imperial rivals. Over time, a steady stream of foreign plants arrived in the colony: new varieties of mulberry trees, grape vines, cotton plants, coffee trees, tea shrubs, hemp and flax seeds, Neopolitan chestnuts, olive trees, madder and hops roots, orange trees, rhubarb, and even kale from Egypt.[108]

As part of this program, the trustees spent a considerable amount of resources to foster a local silk industry, hiring foreign experts and erecting a public filature. Engineers like William Gerard DeBrahm were sent over to handle a variety of public projects ranging from the creation of a series of fortifications to the building of wharves

[106] Raymond Phineas Stearns, *Science in the British Colonies of America* (Urbana, Il, 1970), 326-7; Kenneth Coleman, *Colonial Georgia: A History* (New York, 1976). An older but still very useful work is Leslie Frederic Church's *Oglethorpe: A Study of Philanthropy in England and Georgia* (London, 1932).

[107] Stearns, *Science in the British Colonies,* 327-33; James W. Holland, "The Trustees Garden in Georgia," *Agricultural History* 12 (1938), 271-77; Edith Duncan Johnston, "Dr. William Houstoun, Botanist," *Georgia Historical Quarterly* 25 (1941), 325-39.

[108] Coleman, *Colonial Georgia,* 112; Joyce E. Chaplin, *An Anxious Pursuit: Agricultural Innovation and Modernity in the Lower South, 1730-1815* (Chapel Hill, 1993), ch. 5.

and lighthouses.[109] In the hands of gentlemanly trustees—men such as Dr. Stephen Hales, Sir James Lowther, James Oglethorpe, and the Earl of Egmont—the colony exemplified the growing convergence of scientific interests and imperial planning that flowered at mid-century. Although the crown assumed control of Georgia in 1752, the prime architect of royal policy at the Board of Trade, the Earl of Halifax, shared the same fundamental vision as the trustees, who were mostly his friends from the Royal Society and the Leicester circle.[110] Ellis, therefore, represented a logical choice to those groups seeking to continue the imperial experiment in Georgia, despite his young age and lack of any significant political experience.

Ellis' appointment, moreover, reflected a broader pattern discernable in Halifax's approach to imperial governance in the 1750s. Hoping to quell the mounting turmoil within the colonies, Halifax increasingly turned to gentlemanly scientists whom he selected to fill vacancies in several royal governorships. While he often had to battle the Duke of Newcastle over the control of patronage and imperial appointments, Halifax managed to install more than a few governors who fit the mold he was looking for. Arthur Dobbs, for instance, was selected to serve as the royal governor of North Carolina in 1754, dispatched to the colony that had witnessed such political instability with its dueling assemblies. Thomas Pownall, another figure who moved extensively through these circles, became the governor of Massachusetts in 1757. Like Dobbs and Ellis,

[109] Coleman, *Colonial Georgia*, 20-38, 93, 99-105, 115 180; E. Merton Coulter, ed., *Journal of William Stephens*, 2 vols. (Athens, Ga., 1958-9), I, 2-4. The long-serving provincial secretary, William Stephens, had a background in matters of surveying and engineering himself. In fact, before he arrived in Georgia, he had been working for the York Building Company which was one of the most active employers of steam engines and technological projects. On the York Building Company, see Stewart, *Rise of Public Science*, ch. 11.

Pownall had worked closely with scientists, map-makers, and enterprising merchants to pursue a variety of improving projects that brought him to the attention of Halifax and William Pitt. He corresponded with colonists about agricultural experiments, topography, promoting exotic crops like tea or silk, and various schemes for establishing model colonies in the Ohio territory.[111] Such an outlook was also shared by Virginia's new governor, Francis Fauqier, who had actually studied under Isaac Newton and was a leading light of the Royal Society when he departed in 1758. His residence in the colonial capital of Williamsburg became a familiar meeting place for those interested in science and useful knowledge. Thomas Jefferson would later recall with fondness the time he spent in the company of Faquier and his circle of *literati*, which included figures like the natural philosopher William Small. The Governor also helped establish a local club modeled upon the philosophical societies of London and Edinburgh.[112] For Halifax and his colleagues, then, individuals like Faquier, Pownall, Dobbs and Ellis represented ideal choices for posts overseas since they all shared a commitment to imperial consolidation, innovative projects, and a collaborative temperament. They embodied, in

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[110] Greiert, "Halifax and British Colonial Policy," ch. 6.

[111] For Pownall's scientific activity and various projects, much of it only published later in his life when he returned to Britain, see Pownall, *Hydraulic and Nautical Observations*; Pownall, *A Memoir, Entitled Drainage and Navigation But One United Work…* (London, 1775); Pownall, *A Topographical Description of such parts of North America as are Contained in the Map of the middle British Colonies…* (London, 1776); Pownall, *Political Arithmetic: Containing Observations on the Present State of Great Britain and the Principles of her Policy in the Encouragement of Agriculture…* (London, 1774); Lewis Evans, *Geographical, Historical, Political , Philosophical and Mechanical Essays* (Philadelphia, 1755), 4; John A. Schutz, *Thomas Pownall, British Defender of American Liberty: A Study of Anglo-American Relations in the Eighteenth Century* (Glendale, Calif., 1951), 26-7, 35, 43-7, 51-3, 88-90, 153-5

[112] "Francis Faquier (1704?-1768)" *Dictionary of National Biography*, 6:1113-4; Brook Hindle, *The Pursuit of Science in Revolutionary America, 1735-1789* (Chapel Hill, 1956), 31, 91, 119.

other words, the dynamic culture of scientific improvers that had been steadily expanding for the previous decade.

As royal governor, Ellis did not disappoint his circle of patrons and associates. While his predecessor, John Reynolds, had been unable to accomplish anything in the face of heated opposition, Ellis worked to ease the tense atmosphere by recruiting colonial leaders, of all parties, into a campaign of science and civic improvement.[113] He mobilized broad support, for example, to launch a renewed effort to make raw silk a viable commodity for export. Using his connections back home, Ellis convinced the Society for the Promotion of Arts, Manufactures, and Commerce to offer a promising bounty on colonial silk—an incentive that certainly helped revive interest in the matter. By 1760, Georgia produced a record 1,200 pounds of raw silk for export, causing colonists throughout America to take a second look at an industry which had been largely forgotten in the wake of previous failed attempts.[114] Indeed, enterprising groups led by Benjamin Franklin and Jared Eliot launched silk campaigns of their own in Pennsylvania and Connecticut, respectively.[115]

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[113] On the endemic factionalism of early Georgia and Ellis' success at diffusing the situation, see Cashin, *Governor Henry Ellis*, ch. 5; and W.W. Abbot, *The Royal Governors of Georgia, 1754-1775* (Chapel Hill, 1959), 34-83.

[114] "On the Raising of Silk Worms," *American Magazine* 1 (1769), 117-151, 183-5, 214-6; Benjamin Franklin, for instance, wrote to the secretary of the Society of Arts in 1763, noting that "In my Journey from Philadelphia hither [Boston], I have had the Pleasure of meeting with sundry Persons in different Places, who are attempting the Produce of Silk" in light of the encouragement from the Society's bounty and Georgia's success. *Papers of Benjamin Franklin*, 10:321.

[115] *Papers of Benjamin Franklin*, 16:178-179, 198-201; 17:296; 18:159, 188, 245-6, 254; 19:68 . *The Pennsylvania Gazette*, July 29, 1772 Franklin even argued that Silk production could become a major household industry and provide the remittances colonists sorely needed to pay for British consumer goods. See, *Poor Richard Improved* (Philadelphia, 1765), and *The Interests of Great Britain Considered* (London, 1760).

In Georgia, Ellis was busy promoting a broad agenda in which the silk industry was only one aspect. He devoted considerable time and energy towards expanding the ranks of the newly-formed Georgia Society, an organization modeled explicitly after the Royal Society of London and the Society of Arts. Committed to the gentlemanly goals of advancing trade, knowledge, and mutual respect, the Georgia Society offered the perfect forum in which the energies of colonial planters, merchants, and tradesmen could be channeled into what they saw as the productive pursuits of improvement.[116] James Habersham, a local member, confessed that while he was not entirely sure what skills he could bring to the efforts, "I must own I revere and esteem Men who act out of the narrow sphere of self and communicate knowledge for useful improvements for the Public good."[117] To encourage such dispositions, Ellis also made sure that he forwarded the names of local gentleman to his correspondents back in England, so that these groups would be able to exchange plants, seeds, and useful discoveries amongst each other. He introduced several individuals, in particular, to his friend and namesake John Ellis, who was arguably one of the most active scientists in terms of dispersing experimental crops and specimens throughout the British Empire. A zealous promoter of the Royal Society, the Society of Arts, and any civic groups interested in cultivating useful knowledge, John Ellis was as eager to open up avenues of exchange with colonists in Georgia as he was

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[116] On the Georgia Society, see *South Carolina Gazette*, 25 October 1760, and Harold E. Davis, The Fledgling Province: Social and Cultural Life in Colonial Georgia, 1733-1776 (Chapel Hill, 1976), 173.

[117] Quoted in Cashin, *Governor Henry Ellis*, 117.

with individuals in the Carolinas, Florida, and throughout the Caribbean.[118] In time, the links between members of the Georgia Society and those in England had became so extensive that one critic wondered whether the club had begun to eclipse the local assembly in terms of its influence and clout in London.[119]

Having calmed the political waters and galvanized support for a program of civic improvement, Ellis was appointed to the governorship of Nova Scotia in 1760, charged with leading the other colony that Lord Halifax desired to make an imperial success. Ellis, however, chose to decline the position and return to London where he continued to participate in matters of science and imperial reform. While in later years he achieved even more influence among policy makers and statesmen, his early career highlights the range of activities and collaborative networks that emerged from the fusion of science and imperial projects. Although these schemes often failed to realize the heady dreams of promoters, they slowly altered the contours of public life by creating new arenas that invited certain groups to participate in forms of collective action which could be trumpeted as both patriotic and profitable. The creation of a more prosperous and cohesive empire, as Ellis' associates believed, would depend on the ability of public-spirited groups to apply the knowledge and organizing techniques of an enlightened age to the array of problems facing the imperial nation. Recruiting Britons into the expanding world of practical science, both at home and abroad, became central to this vision of

[118] With introductions from Gov. Ellis, John Ellis was soon corresponding with a number of colonists in Georgia such as William De Brahm, Henry Yonge, Pickering Robinson, Joseph Ottolenghe, William Clifton, and James Habersham. See Roy A. Rauschenberg, "John Ellis, F.R.S.: Eighteenth Century Naturalist and Royal Agent to West Florida," *Notes and Records of the Royal Society of London* 32 (1978), 149-64; Stearns, *Science in the British Colonies*, 334.

imperial consolidation that arose in the tumultuous decades of the mid-eighteenth century.

[119] Cashin, *Governor Henry Ellis*, 116.

CHAPTER FIVE

Projecting Knowledge:
Drawing, Design, and the Visual Culture of Improvement

> The Province of *Geometry* is almost infinite: Few of our Ideas, but may be represented to the Imagination by Lines upon which they straight become of *Geometrical* Consideration. Astronomy, Music, Mechanics, and, in a Word…all the precise and accurate Sciences, may be refer'd to *Geometry*…being render'd sensible by Lines, they become permanent Objects, constantly exposed to a rigorous Attention and Examination
>
> —Ephraim Chambers, *Cyclæpedia*

Few words could match the importance of "project" in the lexicon of eighteenth-century Britain. Often hailed as the "age of projects", Hanoverian society was awash with various schemes for improvement that made "projectors" a cultural icon of the age.[1] And as the previous chapters discussed, an expanding network of groups and institutions coalesced around the conviction that scientific projects held the key to regenerating and consolidating the British empire. But the term had another meaning—one that carried considerable weight with eighteenth-century contemporaries. As a verb, "to project" also meant to delineate or draw an object onto a flat plane. The science of "projection", a branch of geometry and optics, involved the complex task of rendering three dimensional objects onto a two-dimensional surface.[2] While it may be tempting to marginalize this

[1] Daniel Defoe, *Essay on Projects* (London, 1697); [William Hunt], *The Projectors. A Comedy…* (London, 1739); *Adventurer* 16 October 1753. For scholarly analysis of projects and projectors, see: Larry R. Stewart, *The Rise of Public Science: Rhetoric, Technology, and Natural Philosophy in Newtonian Britain, 1660-1750* (Cambridge, 1992); A.J.G Cummings and Larry Stewart, "The Case of the Eighteenth-Century Projector: Entrepreneurs, Engineers, and Legitimacy at the Hanoverian Court in Britain," in *Patronage and Institutions: Science, Technology, and Medicine at the European Court, 1500-1750*, ed. Bruce T. Moran (Rochester, NY, 1991), 235-61; Christine MacLeod, *Heroes of Invention: Technology, Liberalism and British Identity, 1750-1914* (Cambridge, 2008), ch. 2.

[2] See, for example, John Harris, *Lexicon Technicum: or, an Universal Dictionary of Arts and Sciences…*, 3rd. ed. (London, 1716), n.pag., "Projection"; Samuel Johnson, *A Dictionary of the English Language…*, 2 vols, 2nd ed.

second definition as an arcane branch of knowledge—one perhaps restricted to mathematicians or specialists—the evidence from eighteenth-century sources suggest that projective drawing assumed critical importance to contemporaries who understood its centrality to a host of practical fields ranging from surveying to architecture to manufacturing.[3]

A working knowledge of scientific draughtsmanship and design was increasingly seen as a necessary skill for gentlemen, military officers, professionals, and artisans of all stripes. Indeed, the eighteenth century witnessed a conspicuous outpouring of manuals, special instruments, and drawing schools that aimed to equip segments of the public with the ability to create and interpret *projected* knowledge. As a result, many Britons' entrée into the world of science, and their practical experience with useful projects, often flowed from this highly structured form of visual culture. It provided a kind of universal "grammar"—as the mathematician Brook Taylor pointed out—that conditioned how people understood and attempted to improve the material world around them.[4]

(London, 1755-56), II, n. pag., "Project" and "Projection"; Ephraim Chambers' *Cyclopædia, or, an Universal Dictionary of Arts and Sciences…*, 2 vols. (London, 1728), II, 794-97; Malachy Postlethwayt, *The Universal Dictionary of Trade and Commerce…*, 2 vols. (London, 1751-55), I, 145-6, 180-3; Humphry Ditton, *A Treatise of Perspective Demonstrative and Practical…* (London, 1712), William Emerson, *The Projection of the Sphere, Orthographic, Stereographic, and Gnomonical…* (London, 1749), i-xvi. .

[3] Bernard Lens, an instructor at Christ's Hospital, expressed the growing consensus surrounding the importance of technical drawing when he declared that "there is scarce any Art or Profession which receives not some Assistance from Drawing and Projection; without her Help, no Design or Models can be well executed; to her the Mathematician, Architect and Navigator is continually indebted; no Station of Life is exempted form the Practice of it, from the General at the Head of an Army, to the Mechanic, who subsists by his Handicraft." Lens, *For the curious young gentlemen and ladies…* (London, 1751), i. For a sampling of contemporary literature that emphasized the wide ranging applications of projective drawing, see also, Postlethwayt, *Universal Dictionary of Trade and Commerce*, 180-3; Edward Wells, *The Young Gentleman's Mechanicks…* (London, 1713). 164-171; Jean Dubreuil, *The Practice of Perspective: or, an Easy Method of Representing Natural Objects…*, trans. Ephraim Chambers (London, 1726); Batty Langley, *The Young Builder's Rudiments: or the Principles of Geometry, Mechanicks, Mensuration and Perspective, Geometrically Demonstrated…* (London, 1730); Bernard Lens, .

[4] Brook Taylor, *New Principles of Linear Perspective: or the Art of Designing on a Plane…* (London, 1749), vii.

To appreciate the breadth and impact of this popular branch of science, one might look at the early career of George Washington. Born into a minor branch of the Virginia gentry, Washington received almost no formal education in his formative years. He therefore lacked many of the traditional attributes of genteel culture such as the ability to read classical languages, speak French, or be conversant with the liberal arts and sciences. Few contemporaries, and even fewer historians, would describe Washington as "bookish." And for precisely this reason, he rarely appears in scholarly accounts of the Enlightenment, let alone surveys of eighteenth-century science. But upon closer inspection, Washington's early attempts to compensate for his educational deficiencies reveal the significant role that geometry and mathematical drawing could play in the quest to achieve respectability and advancement in the world.

At the age of 14, Washington began to assemble a series of "school copy books" in which he recorded a variety of useful lessons that could serve as a curriculum for self-improvement.[5] Scholars have typically focused on the last of these books, which began with practical forms of writing—such as how to draft bills of exchange, promissory notes, or other legal instruments—and concluded with Washington's famed "Rules of Civility and Decent Behaviour in Company and Conversation", a collection of 110 maxims copied from a renaissance etiquette manual. Relying upon these sources, historians have emphasized Washington's conservative temperament, his attempt to imitate the courtly ethos that supposedly infused the squirearchy of Britain, and by

[5] The three surviving copy books, dating from 1745-48, are housed in the Manuscript Division of the Library of Congress, George Washington Papers (GWP), Series 1: Exercise Books, Diaries, and Surveys, 1741-99, Subseries A. Only the section pertaining to "Rules of Civility" has ever been published.

example, the colonies.[6] Yet the first two copy books offer a different picture of Washington. In these extant volumes, written in a careful hand, the young Washington transcribed a course of mathematics beginning with basic arithmetic and progressing through geometry, plane and spherical trigonometry, logarithms, surveying, and various forms of mensuration. The sections on geometry, trigonometry and surveying are replete with hundreds of drawings intended to illustrate and resolve various problems ranging from the simple—"how to construct a perpendicular line"—to more advanced endeavors such as drawing accurate survey plats or changing their scale (see Figure 1).[7] The text vividly illustrates how Washington learned to use mathematical principles and projective drawing to reduce complex three dimensional problems into precise lines on paper, rendering them accessible to the kind of "rigorous attention and examination" that enlightenment figures like Ephraim Chambers stressed as the key to comprehending the natural world.

While the pursuit of such knowledge may seem only natural for a young colonist interested in becoming a surveyor, the basic skills Washington acquired had a much

[6] See, for instance, Gordon Wood, *The Radicalism of the American Revolution* (New York, 1992), 197-8; Richard L. Bushman, *The Refinement of America: Persons, Houses, Cities* (New York, 1992), ch. 2; Paul K. Longmore, *The Invention of George Washington* (Berkeley, Ca., 1988), 1-16. Washington's pre-occupation with manners and genteel civility has made him a prominent figure in the scholarly reappraisal of colonial culture, much of which has been inspired by Norbert Elias' work on the "civilizing process" that emanated from the courtly world of the Renaissance. Elias, *The History of Manners*, Volume 1: *The Civilizing Process*, trans. Edmund Jephcott (New York, 1978); and Volume 2: *The Court Society*, trans. Edmund Jephcott (New York, 1983).

[7] Robert Dodsley, a popular authority on educational matters at the time, noted that the teaching of geometry and precision drawing often went hand and hand. Rather than memorizing theorems, students were encouraged to learn geometry by delineating lines, figures, and problems on paper—an approach that seemed to dominate contemporary instructional manuals which often intertwined the study of mathematics with drawing. And like Brook Taylor, Dodsley argued that geometric principles served as the "grammar" underpinning accurate draughtsmanship. See, *The Preceptor: Containing a General Course of Education…*, 2nd ed., 2 vols. (London, 1754), I, 450-1.

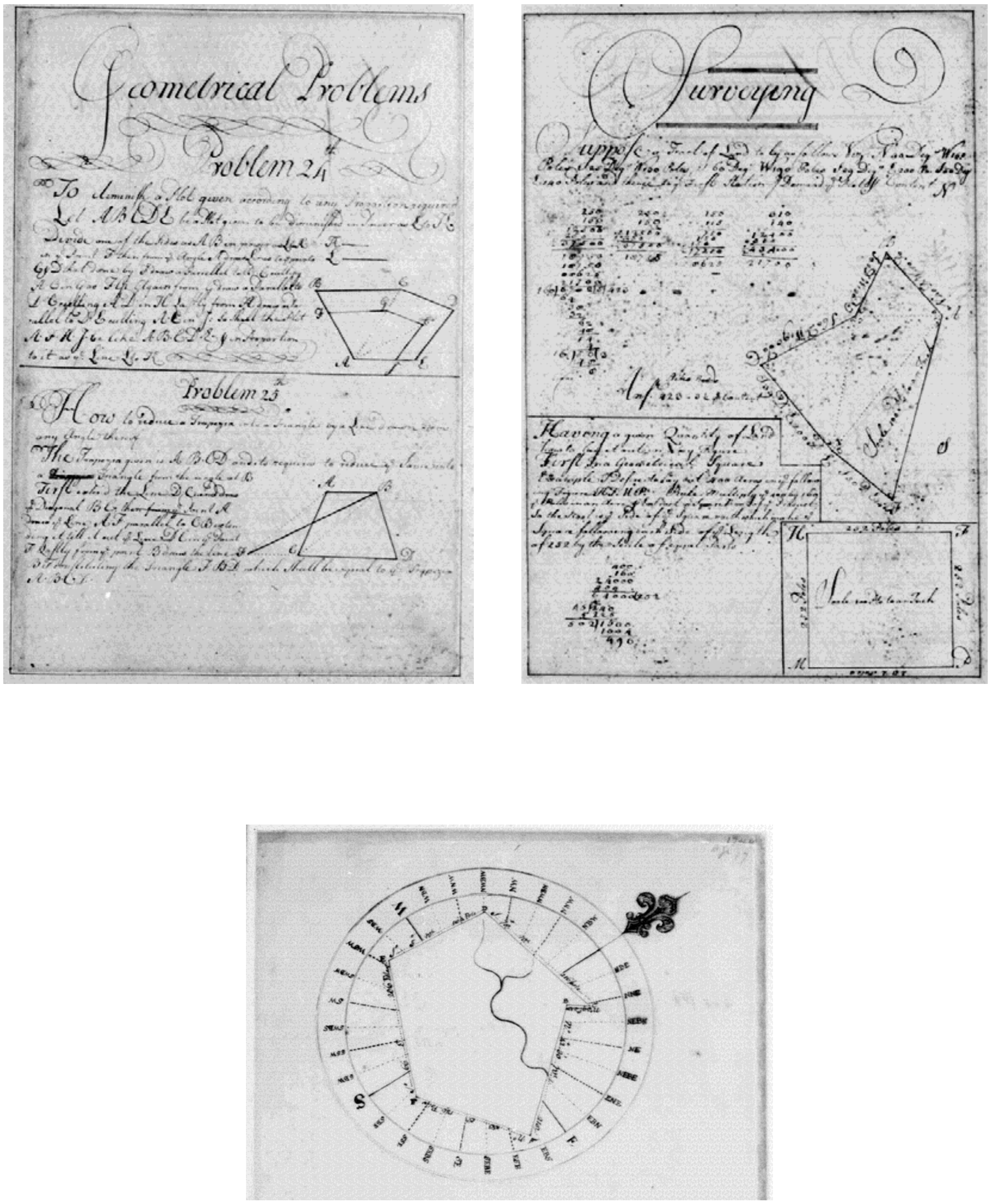

Figure 1. Pages from George Washington's School Copy Books (Manuscript Division of the Library of Congress). The projective drawings that illustrate these texts demonstrate not only a basic understanding of geometrical draughtsmanship, but also Washington's growing ability to use mathematical tools such as a compass, protractor, t-square, parallel rule, and possibly a sector.

growing necessity for individuals who wanted to succeed in military service, commercial endeavors, or even the management of large estates. Putting aside Washington's early career as a surveyor for the crown, what is perhaps most striking about his mathematical training is the extent to which he relied upon these skills in a variety of different contexts throughout his life. His rapid rise to high command in the colonial militia was made possible not only by strong patrons, but also by his reputed talent for cartography, military engineering, and topography.[8] Upon his early "retirement" to Mount Vernon in 1758, Washington employed his projecting skills in the service of improving his estate. He acquired several detailed plans of a new seed drill, for example, using these English drawings to successfully build his own versions.[9] Like other improving landowners, Washington relied heavily upon technical drawings to transmit information about a variety of potential agricultural devices and mills.[10] Moreover, his construction of detailed survey plats enabled Washington to divide his nearly 5,000 acre plantations into precise fields where he could perform controlled experiments with new crops, fertilizers,

[8] Washington's correspondence from this period included a number of fortification plans and maps which he communicated to fellow officers, patrons, and royal officials. See, for example, "Instructions for Captain Peter Hogg, 21 July 1756," in *The Writings of George Washington*, ed. John C. Fitzpatrick,39 vols. (Washington, D.C., 1931-1944), I, 309-402; George Washington to Thomas Waggoner, 13 July 1756, 21 July 1756, GWP, Series 2; William Fairfax to George Washington, July 10, 1756, GWP, Series 4; Donald Jackson and Dorothy Twohig, ed., *The Diaries of George Washington, 1748-1799*, 6 vols. (Charlottesville, Va., 1976-79), I, 191. Many of Washington's extant maps and topographic surveys are covered in Lawrence Martin, ed., *The George Washington Atlas* (Washington, D.C., 1932).

[9] Paul Leland Hayworth, *George Washington: Farmer…* (Boston, 1915), 107. Hayworth's account reproduces a number of drawings and scaled plans relating to Washington's agricultural experiments and interest in machines.

[10] Some of the extant drawings that Washington either constructed or received can be found in: *Diaries of Washington*, I: xxix ; Samuel Powel to George Washington, 10 May 1786, GWP, Series 4; "George Washington, October 28, 1792, Plan for a Barn," GWP, Series 4; Arthur Young to George Washington, February 1, 1787, Series 4. Like other agricultural improvers, Washington also relied heavily upon the detailed engravings that increasingly dominated agricultural treatises—something which distinguished eighteenth-century works from their predecessors. Hayworth, *George Washington: Farmer*, 126; *Diaries of Washington*, I:xxvi-xxxiv.

and tools.[11] When Washington lent out some of his "plotting instruments" to a neighbor, he stressed the need for their quick return, "as I measure all my Fields, and I am now Inclosing a new one, and do not know where to lay the Rails that are to Fence it, till I find how much of the Field will give me the quantity of Land I want to Inclose."[12] More than simple fastidiousness, Washington's construction of plats and delineated fields underpinned his almost obsessive tendency to reduce everything on his plantations to mathematical calculations—from the exact yield of wheat that could be harvested per acre to the amount of time it would take to plow fields of a specific dimension—always with an eye towards designing more efficient outcomes.[13] Everything seemed to hinge, in fact, on Washington's ability to reduce the complex and messy realities of agricultural life into abstract lines and quantities, delineating a world on paper that could be more easily grasped and managed. It is probably no accident, therefore, that Washington's greatest frustration as a planter involved the growing of tobacco, an intricate plant whose unpredictable nature consistently defied his attempts to project a kind of rational order onto the landscape.[14]

[11] Through several purchases, Washington roughly tripled the size of his Mount Vernon estate by the 1780s, creating an enormous tract of land that was impossible to observe and manage *in person*. See, "The Growth of Mount Vernon, 1754-86," *Diaries of Washington*, 1:240-42. Several of his surviving estate plats are located in the Manuscript Division of the Library of Congress, while one survey—a detailed estate plan he sent to the agronomist, Arthur Young—was eventually published in *Letters from His Excellency George Washington to Arthur Young…* (London, 1801).

[12] George Washington to George William Fairfax, 19 January 1774, *Writings of George Washington*, 3:108-9. For Washington's early purchase of various drawing and mathematical tools, see, the orders placed with his English factor, Robert Cary & Company, in *Writings of George Washington*, 2:330-4; 354; 436, 463.

[13] *Diaries of Washington*, 1:260, 264, 293-4; 2:81. In many respects, the growing visual delineation of the land—in the form of accurate survey plats and estate plans—laid the foundation for enterprising landlords to adopt a variety of "improving" techniques ranging from drainage projects to enclosures to double-entry bookkeeping.

[14] On the peculiar requirements of tobacco culture, and Washington's frustrations with the crop, see T.H. Breen, *Tobacco Culture: The Mentality of the Great Tidewater Planters on the Eve of Revolution* (Princeton, 1985), ch. 2.

This outlook also helps to explain Washington's involvement in a variety of engineering projects and schemes for improvement that occupied much of his free time. In particular, Washington became a leader of several private ventures that sought to build canals, clear river ways, or drain large wastelands. He took a prominent role, for instance, in directing the affairs of the James River Company, the Potomac Company, and the Dismal Swamp Land Company—the latter of which involved a heady scheme, beginning in 1763, to reclaim nearly 40,000 acres of swampland while building a drainage canal that would connect the waters of the Chesapeake Bay and Albemarle Sound.[15] Managing such projects required a proficient understanding of technical drawings, mapping, and principles of design, even if Washington and his associates relied upon hired specialists as they often did. In a similar vein, Washington evaluated the potential of new machines or engines based upon detailed plans, often a necessity when inventors and investors lived hundreds, if not thousands, of miles away (see Figure 2).[16] So while Washington frequently felt excluded from the cosmopolitan "republic of letters" because he lacked the traditional requisites of a liberal education, his technical literacy ensured that he could participate quite effectively within the growing culture of gentlemanly improvement. And in many ways, it was this graphic language of projection which helped sustain the burgeoning confidence and fascination with "projects" throughout the empire.

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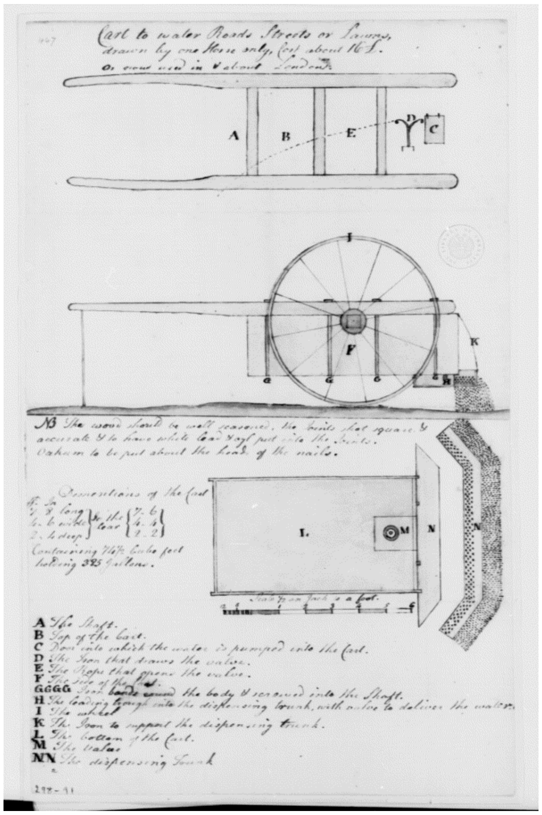
[15] George Washington to Governor Benjamin Harrison, 10 October 1784, *Writings of George Washington*, 27: 471-80; George Washington to Edmund Randolph, September 16, 1785; George Washington to John Fitzgerald and George Gilpin, 31 March 31 1786, GWP, Series 2.; Wayland F. Dunaway, *History of the James River and Kanawha Company* (Richmond, Va., 1922), ch. 1-2; John Pickell, *A New Chapter in the Early Life of Washington in Connection with the Narrative History of the Potomac Company* (New York, 1856); Charles Royster, *The Fabulous History of the Dismal Swamp Company: A Story of George Washington's Times* (New York, 1999).

[16] See, for example, the projective drawing: "Lawrence Talliaferro, 1757, Plan for a Rolling Mill," GWP, Series 4.



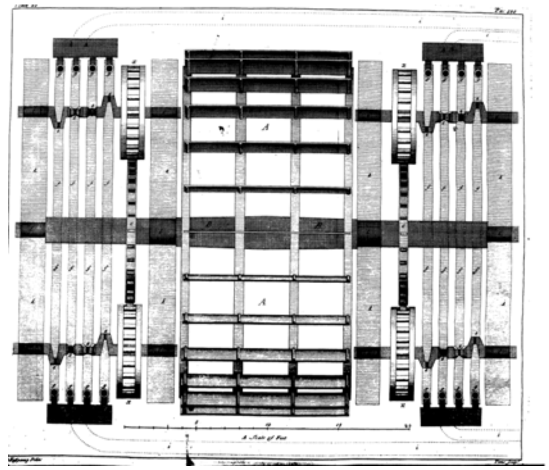


Figure 2: Drawings & Plans Acquired by George Washington

(Left): "Drawing of a Watering Cart," (Manuscript Division of the Library of Congress, GWP, Series 4).

(Right): "Plan of Hydraulic Engine and Water Pumps, London", plate 20 of Steven Switzer, *An Introduction to a General System of Hydrostaticks and Hydraulicks, Philosophical and Practical…*, 2 vols. [London, 1729]). Switzer's text was one of a number of books that Washington purchased for the lavishly engraved drawings, plans, and elevations of contemporary machines.

Fittingly enough, this aspect of the Enlightenment took center stage in Ephraim Chambers' renowned *Cyclopædia*, whose lavish frontispiece captured in arresting detail the visual culture underpinning the world of eighteenth-century science (see Figure 3).

Figure 3: Frontispiece to Ephraim Chambers' *Cyclopædia, or, an universal dictionary of arts and sciences…*, 2 vols. (London, 1728). Chambers' dictionary proved to be one of the most celebrated and widely reprinted texts in the Enlightenment cannon. Indeed, Diderot and d'Alemebert's monumental *Encyclopédie* began as an attempt to translate Chambers' work into French.

When readers opened this popular work, they encountered a full folio-page engraving that sought to illustrate the pursuit of knowledge. Echoing Raphael's *School of Athens* (1511), the engraving depicts a bustling academy filled with groups who are discussing and demonstrating the various branches of philosophy.[17] For readers familiar with the ideas of Francis Bacon, the frontispiece almost certainly conveyed a lucid message about the proper foundations upon which true knowledge should be built.[18] All of the activities, for example, involve the empirical study of nature or the useful arts. Books, along with the scholastic culture they embody, are relegated to a solitary library in the background, where the inscription "Theologia" indicates they belong.[19] Everywhere else, individuals are actively working together to investigate the material world, invoking allusions to Bacon's imaginary "Solomon's House" or the various learned academies that attempted to translate his ideals into practice. But while the engraving underscores the Baconian imperative to study things not words, it also presents a striking image of the tools and techniques that should guide such endeavors. In the foreground, an array of optical, mathematical and drafting instruments lie on the steps of the academy, reminding viewers that the construction of natural knowledge depended upon the accurate delineation of the world. To their right, individuals teach the fundamental disciplines of geometry and linear projection, reinforcing the centrality of visualized knowledge to the scientific enterprise (see Figure 4). The composition of the engraving—which at first glance seems to present a hodgepodge of disparate groups and activities—actually focuses the viewer's attention on the large circle of people gathered in the entrance to the Academy, individuals who busily pour over maps, globes, and drawings of all sorts. Surrounded by

[17] Chambers—who had served an apprenticeship under John Senex, the prominent map and globe-maker—relied upon John Sturt to engrave this frontispiece. Chambers had already collaborated with Sturt in the production of an English translation of Sebastien Leclerc's *Treatise of Architecture* (1714).

[18] See Chapter 1.

[19] Richard Yeo analyzes Chambers' ambivalent attitude towards libraries, books, and traditional learned culture in *Encyclopaedic Visions: Scientific Dictionaries and Enlightenment Culture* (Cambridge, 2001), ch. 5.

the tools of their trade, one finds astronomers, cartographers, engineers, architects, geographers, opticians and craftsmen, all of whom appear to share a similar concern with transcribing natural knowledge into visual form. Indeed, the prevalence of geometric

Figure 4: Enlarged section of Chambers' frontispiece. Note the individual in the front-center who is studying the principles of linear perspective. He is surrounded by various groups of "mathematical practitioners" and artisans actively employed in the visualization of knowledge.

figures and drawings, which appear even on the floors and columns of the academy, convey an almost platonic message about the mathematical order underpinning the material world, albeit one that emphasizes the pragmatic uses of such knowledge. Here, one finds the graphic embodiment of Chambers' claim that all the arts and sciences could be "refer'd to Geometry", that precision and insight would follow from the accurate delineation of natural phenomenon into lines and figures on the drawn page.[20] Chambers' frontispiece, in fact, offered an interpretive vision that situated drawing and projected knowledge at the heart of the Enlightenment program. It was a conception of science and useful knowledge that many contemporaries, George Washington among them, would have certainly understood.

This chapter explores how the principles of scientific drawing and design came to assume such a prominent role within the Anglo-American enlightenment, emerging as a critical issue for those who sought to participate in the popular campaigns for improvement that proliferated at mid-century. As we shall see, both fields lay at the intersection of contemporary concerns regarding how scientific knowledge should be constructed, how information could be transmitted effectively, what procedures would encourage innovation within the realm of production, and how groups could exercise greater control over their increasingly ambitious projects for improvement. And like other branches of science, technical drawing began to assume greater import in the highly charged atmosphere of mid-century, when the intense rivalry with France and fears of imperial decline fueled calls for a popular campaign to cultivate the skills of draughtsmanship and design. Viewed as a means of revitalizing the commercial and technological state of the nation, these fields received the support of scientists and

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[20] Chambers, *Cyclopædia*, 1:141-4. Chambers, of course, recognized the potential pitfalls of assuming that all natural phenomenons could be perfectly "abstracted" into "*Geometrical* lines and circles." But he repeatedly stressed the insights that could be acquired from projected knowledge, which used mathematical principles to approximate nature in ways that could serve the practical needs of individuals (142). In this respect, he was well within the mainstream of Enlightenment thinking. See, James Franklin, "Artifice and the Natural World: Mathematics, Logic, Technology," in *The Cambridge History of Eighteenth-Century Philosophy*, ed. Knud Haakonssen (Cambridge, 2006), 818.

politicians who argued that they provided the necessary foundation for material progress in all the useful arts and sciences.[21] Indeed, a growing chorus of observers called for the establishment of public drawing schools and design academies as an essential prerequisite for reversing the nation's declining fortunes at home and abroad.[22]

At a deeper level, an analysis of graphic techniques helps to illuminate some of the core principles that motivated and sustained the *economy of knowledge* in the Anglo-Atlantic world. Without diminishing the importance of print culture or other avenues of exchange, it is important to recognize that the realms of science and public improvement continued to face a variety of obstacles to their program of encouraging systematic innovation, collaboration, and the dissemination of useful discoveries. Like the empire itself, these networks had to span not only vast geographic distances, but also had to encompass disparate peoples and knowledge-making practices that were deeply rooted in their own localized contexts.[23] Projectors often complained about the parochialism they encountered—people who showed little inclination to veer from the time-honored paths of local custom or craft traditions—while recognizing the considerable difficulties in

[21] While no historians have examined this popular campaign in detail, scholars interested in the origins of design culture and material production/consumption have focused on this period as a critical moment in their fields. See, for example, Charles Saumarez Smith, *Eighteenth-Century Decoration: Design and the Domestic Interior in England* (London, 1993); Jules Lubbock, *The Tyranny of Taste: The Politics of Architecture and Design in Britain, 1550-1960* (New Haven, 1995); John Styles, "Manufacturing, Consumption and Design in Eighteenth-Century England," in *Consumption and the Wold of Goods*, ed. John Brewer and Roy Porter (London, 1993), 523-554; David Irwin, "Art versus Design: The Debate, 1760-1860" *Journal of Design History*, 4 (1991), 219-32; and the articles in "Eighteenth-Century Markets and Manufactures in England and France," a special volume of the *Journal of Design* 12, no. 3 (1999).

[22] Matthew Craske, "Plan and Control: Design and the Competitive Spirit in Early and Mid-Eighteenth-Century England," *Journal of Design History* 12 (1999), 187-216.

[23] David Wade Chambers and Richard Gillespie, "Locality in the History of Science: Colonial Science, Technoscience, and Indigenous Knowledge" *Osiris* 15 (2000), 221-240; David N. Livingstone, *Putting Science in Its Place: Geographies of Scientific Knowledge* (Chicago, 2003); Bruno Latour, *Science in Action: How to Follow Scientists and Engineers through Society* (Cambridge, Ma., 1987), esp. ch. 6.

transferring a particular technique or discovery from one context to another. Scientific draughtsmanship held out the hope of creating a more uniform system of information exchange whereby "thick" knowledge could be disentangled from its local setting and transmitted across cultural and geographic boundaries.[24] A new kind of graphic literacy, proponents argued, would increase the ability of groups to communicate information reliably, and in the process, ensure the sorts of collaborative relationships that could bridge potential divides. Meanwhile, the closely related field of design aimed to employ draughtsmanship as a tool of innovation, encouraging individuals to exert greater ingenuity and control over the conceptual production of everything from furniture and luxury goods to complicated machinery.[25] Mathematical principles would elevate the power of the imagination by turning abstract notions into visible lines that could be honed with scientific rigor.

In reality, neither field ever achieved the grandiose claims that some ardent promoters had put forward. But the techniques of projected knowledge, and the public campaigns that arose in support of them, certainly helped to condition the popular embrace of scientific improvement throughout the British Empire. The expanding appeal of technical drawing and principles of design encouraged individuals to view the world through a particular lens, privileging an orderly conception of nature that invited rational

[24] Ken Alder, "Making Things the Same: Representation, Tolerance and the End of the *Ancien Regime* in France," *Social Studies of Science* 28 (1998), 499-545; Bruno Latour, "Drawing Things Together," in *Representations in Scientific Practice*, ed. Michael Lynch and Steve Woolgar (Cambridge, Ma., 1990), 20-69. Eugene Ferguson, *Engineering and the Mind's Eye* (Cambridge, Ma., 1992).

[25] Mathew Decker, *An Essay on the Causes of the Decline of the Foreign Trade…* (London, 1744), 43, 109-10; John Gwynn, *An Essay on Design: Including Proposals for Erecting a Public Academy to be Supported by Voluntary Subscription…* (London, 1749); *Monthly Review*, June 1749, pp 89-91, 162-71; *Gentleman's Magazine*, July 1749, pp. 318-19; *Westminster Journal*, July 8 1749.

control and improvement. The Enlightenment vision of progress, in other words, depended on a particular way of seeing the material world—one that was rooted in new techniques of graphic representation and analysis. Scientific drawing, as both George Washington and Ephraim Chambers understood, was not simply about creating a more *realistic* depiction of nature; but rather, creating a discernible image that could be analyzed, transmitted, and improved by those who understood the rules of this visual game.

Windows onto the World: Creating a Graphic Language

The historical roots of visual projection—learning to draw objects according to the rules of mathematical perspective—lie in the work of Renaissance "artisan-engineers" who developed new techniques for representing space and the objects within it.[26] Inspired by the recovery of classical texts such as Euclid's *Elements*, *Optics*, and Ptolemy's *Cosmographia* in the late Middle Ages, humanists began to incorporate the principles of optical geometry into their study of ancient architecture, painting, science, and engineering. Hoping to revive the achievements of antiquity, early Renaissance practitioners like Brucelleschi, Giotto, and Uccello experimented with applying Euclid's notion of a "visual cone" to their artistic and architectural projects.[27] Both Euclid and Ptolemy held that light moved in a rectilinear fashion, conceptualizing vision as the

[26] The term "artisan-engineer"—meant to capture the peculiar quality of Renaissance practitioners like Brucelleschi, Uccello, Da Vinci, Galileo, and others who came from craft backgrounds and combined a working interest in the visual arts, technology, and engineering—comes from Lynn White, Jr., "The Flavor of Early Renaissance Technology," in *Developments in the Early Renaissance*, ed. B.S. Levy (Albany, NY, 1972).

[27] For these early experiments, see especially Samuel Y. Edgerton, Jr. *The Heritage of Giotto's Geometry: Art and Science on the Eve of the Scientific Revolution* (Ithaca, NY, 1991), 23-147.

convergence of these straight rays into the optical cortex. While classical authors were unsure as to whether the eye projected these rays or received them directly from objects, their main concern was in developing a theory of vision in which light could be understood as reticulated lines connecting the eye to the sensory world.[28] This theory, moreover, suggested that graphic representations could be treated as mathematical problems. Since a two dimensional drawing was essentially a flat picture plane that stood between the viewer and the object, the principles of solid geometry could be applied to analyze the effects of this plane intersecting the visual cone (see Figure 5). By carefully

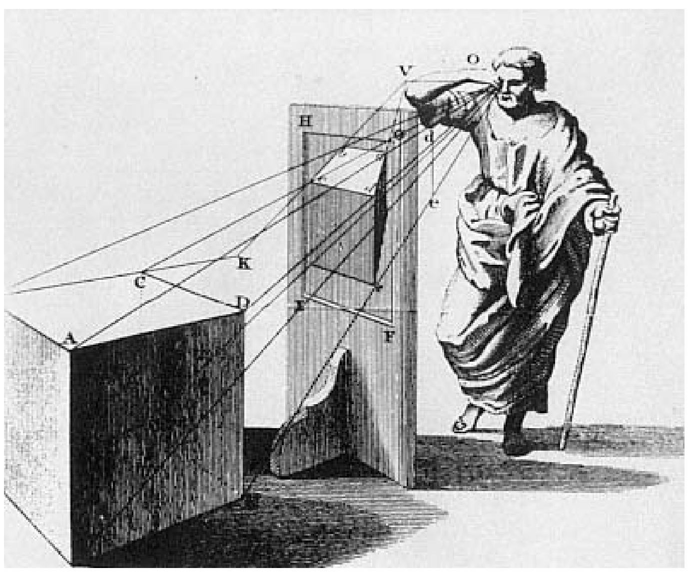
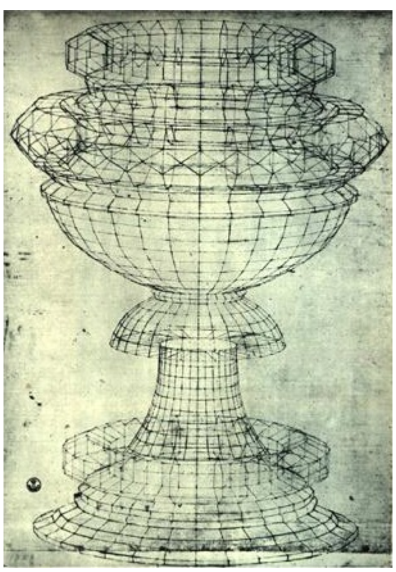


Figure 5: Wood-cut image showing the principles of linear perspective in which a transparent window or picture plane intersects the converging rays of the visual "pyramid" that connects the eye of the viewer to the various points on an object. A Diagram of this sort was often one of the first images in perspective manuals. (Source: Brook Taylor, *New Principles of Linear Perspective*, 3rd ed. [London, 1749]).

[28] David C. Lindberg, *Theories of Vision from Al-Kindi to Kepler* (Chicago, 1976); ch. 8; Sven Dupre, "Visualization in Renaissance Optics: The Function of Geometrical Diagrams and Pictures in the Transmission of Practical Knowledge," in *Transmitting Knowledge: Words, Images, and Instruments in Early Modern Europe*, ed. Sachiko Kusukawa and Ian Maclean (Oxford, 2006), 11-39.

diagramming the horizon line, and then the diagonal rays that connected points on an object to the converging point within the mind's eye, artists could produce a structured representation of space in which the size, shape, and relative relationship of objects could be drawn as they appear to a fixed observer in real life. In other words, one could reliably incorporate the illusions of depth, shadow, and dimensionality onto a flat surface. Seeking to apply these principles to their own work, artisan-engineers in Italy began to experiment with forms of linear perspective that might imbue their projects with the same geometric order and proportion underlying nature (see Figures 6 & 7). In fields such as painting, architecture, cartography and fortifications, Renaissance practitioners employed



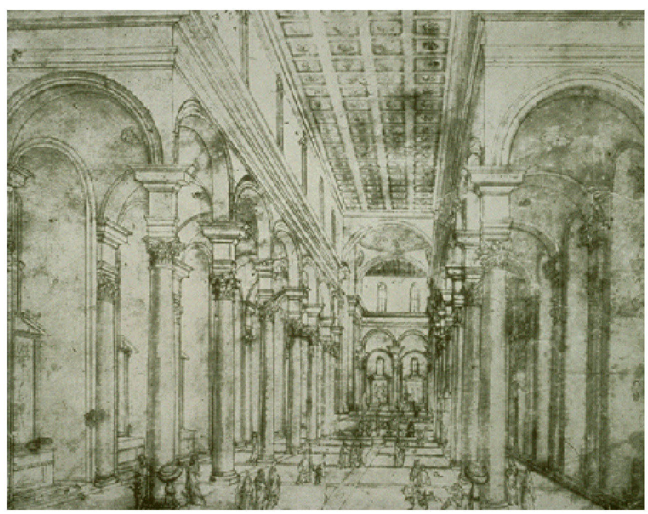


Figure 6 (left): Paolo Uccello's perspective drawing of a Chalice, c. 1450 (Uffizzi Gallery, Florence)
Figure 7 (right): Filippo Brunelleschi's perspective drawing, "The Centre Nave in St. Lorenzo," (early 15th century)

the science of *perspectiva* to provide a new framework that would guide their practical endeavors.[29]

By the fifteenth century, a rich body of literature had begun to emerge explicating the theory of mathematical perspective and its various applications.[30] Leon Battista Alberti's *De picture* and *Elementa picturae* (1435-6) offered some of the first attempts to organize these ideas in a systematic fashion. Alberti argued that graphic representations should be understood as transparent planes or "windows" through which an observer views the outside world from a fixed vantage point. Modifying Euclid's visual "cone" into a "pyramid", he noted that each diagonal ray of light, which converges on the eye from an object, intersects this perpendicular plane and determines the precise location of that point on the picture. In an oft-repeated experiment, Alberti described how one could create this ideal window by hanging "a veil of loosely woven fine thread…divided up by thicker threads into as many parallel square sections as you like, and stretched on a frame" between the viewer and the chosen object (see Figure 8).[31] Not only did this perspective grid make it easier to delineate figures by revealing the size, spatial relationship and foreshortening needed to give a realistic impression of a particular scene; but more importantly, it transformed three dimensional objects into coordinates on a grid

[29] On the Renaissance development of mathematical perspective and projective drawing, see Lawrence Wright, *Perspective in Perspective* (London, 1983); Erwin Panofsky, *Perspective as Symbolic Form*, trans. Christopher S. Wood (Cambridge, Ma., 1991) Samuel Y. Edgerton, Jr., *The Renaissance Rediscovery of Linear Perspective* (New York, 1975); Thomas E. French and Carl L. Svenson, *Mechanical Drawing* (New York, 1948); Martin Kemp, *The Science of Art: Optical Themes in Western Art from Brunelleschi to Seurat* (New Haven, 1990); Kemp, "Geometrical Perspective from Brunelleschi to Desargues," *Proceedings of the British Academy* 70 (1984), 89-132; Martin Jay, *Downcast Eyes: The Denigration of Vision in Twentieth-Century French Thought* (Berkeley, Calif., 1993).

[30] For an analysis of the growing body of manuals and manuscripts from fifteenth to the early sixteenth century, see the collection of essays in *The Treatise on Perspective: Published and Unpublished*, ed. Lyle Massey (Washington, D.C., 2003).

[31] Alberti, *De picture* quoted in Wright, *Perspective in Perspective*, 64.

that could be analyzed in mathematical terms. Using the Euclidean doctrine of similar triangles, Piero della Francesca showed how artists could transpose such coordinates from perspective to *plan* and *elevation*, or vice versa. This procedure allowed one to construct accurate mathematical representations of the most complex objects from vaults and architectural capitals to the human body "which Piero geometricized with meridians and parallels, almost as if it were the terrestrial globe," in the words of one historian.[32]

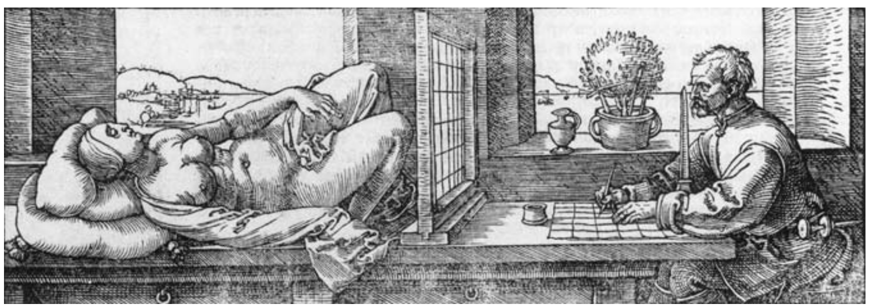


Figure 8: This wood-cut shows an artist demonstrating the basic principle of Alberti's *sportello* or reticulated window which serves as both the picture plane and grid for constructing an accurate drawing in linear perspective. (Source: Albrecht Dürer, *Underweisung der Messung*, 1525)

In the work of humanists like Piero, Leonardo da Vinci, Sebastiano Serlio, and Albrecht Dürer, these principles would be further refined by the application of more advanced branches of geometry and trigonometry. They were interested in the study of various curvatures and how to incorporate them into projective drawing, examining ways in which points on a sphere, cylinder, ellipse, or helix could be translated into coordinates on a two dimensional plane as well as the reverse.[33] These more advanced forms of

[32] Filippo Camerota, "Renaissance Descriptive Geometry: The Codification of Drawing Methods," in *Picturing Machines, 1400-1700*, ed. Wolfgang Lefevre (Cambridge, Ma., 2004), 179-80.

[33] See, Camerota, "Renaissance Descriptive Geometry," Wolfgang Lefevre, "The Emergence of Combined Orthographic Projections," and Jeanne Peiffer, "Projection Embodied in Technical Drawings: Dürer and His Followers," in *Picturing Machines, 1400-1700*, ed. Wolfgang Lefevre (Cambridge, Ma., 2004), 175-208, 209-44; 245-

stereographic projection were useful for those interested in transferring a painting to a curved dome, for example, or for those trying to construct maps, planispheres, sundials, armillary spheres and certain challenging architectural features.[34] By the sixteenth-century, artisan-engineers were also developing rules for *orthographic* projections—a form of mathematical perspective in which the lines connecting the points of an object to the drawing plane meet at right angles, instead of converging on a focal point as in linear perspective. While this approach yields an image that does not look as realistic to the eye, because the illusion of depth associated with a vanishing point is completely absent, it does create a representation that preserves true angles and true measurements, making it more useful for scaled plans, elevations, or sections intended to serve as working designs. Armed with a compass, rule and grid, individuals could therefore rely increasingly upon different sorts of projection techniques to construct mathematical drawings that suited their various needs.

Judging the import and cohesion of this Renaissance work has proven a thorny issue for modern scholarship. On the one hand, individuals developed a wide array of techniques that often differed noticeably from the approach of one another. Identifying a single theory of mathematical perspective, therefore, runs the risk of oversimplifying

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75; Edgerton, *The Renaissance Rediscovery of Linear Perspective*; Kemp, "Geometrical Perspective from Brunelleschi to Desargues," 89-132.

[34] Throughout this chapter, I try to consciously employ the vocabulary that eighteenth-century practitioners and the public used to describe these different methods of perspective and projection. Specifically, I use the framework that became rather conventional by that time period which distinguished between "linear" perspective, "sceneographic" perspective, "aerial" perspective, "specular" perspective, "sceneographic" projection, "orthographic" projection, and "stereographic" projection. I am fully aware that some of these terms carry a different meaning today, or even in earlier periods, but I hope that my discussions of the techniques will be clear enough to avoid confusion.

what in reality was an evolving web of loosely related methods and priorities.[35] Many authors were not always clear about the rationale or underlying connections between these different practices, leading one scholar to remark that some material "looks like a book of recipes rather than a theoretical text."[36] Nowhere were these ambiguities more apparent than when one examines how perspective drawing actually functioned in practice. Often the confident claims about mathematical theory and optical certainty were abandoned by pragmatic architects, engineers, or draughtsmen who had to deal with the complexities of real life situations. Furthermore, historians who have analyzed many of the era's projective drawings have tended to emphasize the ways in which the social context—particularly the intended audience—could have as much of an impact on these illustrations as the dictates of mathematical theory. Hoping to communicate promising machines or architectural plans to courtly patrons, artisan-engineers were more than willing to abandon the principles of a unified viewpoint or to employ artistic license if it rendered their images more enticing to a lay audience.[37] On the other hand, a number of scholars have been struck by the seemingly revolutionary import of linear perspective, which they argue provided a kind of totalizing conception of space as isotropic, governed by mathematical principles, and perceived from discernable vantage points. One historian, for example, has claimed that the emergence of this new visual culture, which

[35] Many of these ambiguities, tensions, and contingencies are traced out by the various essays in Massey, ed., *Treatise on Perspective: Published and Unpublished*. Ken Baynes and Francis Pugh also accentuate what they see as the lack of consistent and stable drawing conventions in their survey *The Art of the Engineer* (Woodstock, NY, 1981).

[36] Lefevre, "The Emergence of Combined Orthographic Projections," 226.

[37] Marcus Popplow, "Why Draw Pictures of Machines? The Social Context of Early Modern Machine Drawing"; Rainer Leng, "Social Character, Pictorial Style, and the Grammar of Technical Illustration in Draughtsmen's Manuscripts in the Late Middle Ages"; Mary Henninger-Voss, "Measures of Success: Military Engineering and the Architectonic Understanding of Design," all in *Picturing Machines, 1400-1700*, 53-84, 85-114; 143-172.

posited a notion of "homogenous space uniformly subject to geometrization according to Euclid's principles", laid the essential foundation for the scientific and technological outpouring of the early modern era.[38] According to another scholar, the development of linear perspective was "one of the most fateful innovations in Western culture…an epochal achievement" that marked the beginning of modernity in Western society.[39] While such dramatic claims may not be sustainable in terms of the vast majority of early modern people—many of whom probably never saw or encountered the ideas of mathematical perspective—it does seem safe to conclude that these new techniques had a considerable impact among the network of artists, scientists, and technicians who increasingly relied upon them.[40]

Both these ambiguities and transformative possibilities unfolded as the Renaissance science of *perspectiva* became more widely adopted in northern Europe during the sixteenth and seventeenth centuries. In places like France, the Netherlands and Germany, the field of mathematical perspective became an important part of the humanist cannon as well as a growing resource in the hands of surveyors, cartographers, architects, astronomers, painters and military engineers.[41] The field, in fact, straddled the worlds of natural philosophy and *technè*. For it was considered an essential branch of optics and

[38] Edgerton, *The Heritage of Giotto's Geometry*, 16. See also, Samuel Y. Edgerton, Jr., "From Mental Matrix to 'Mappamundi' to Christian Empire: The Heritage of Ptolemaic Cartography in the Renaissance," in *Art and Cartography: Six Historical Essays*, ed. David Woodward (Chicago, 1987).

[39] Jay, *Downcast Eyes*, 44. See also, Panofsky, *Perspective as Symbolic Form*.

[40] For a balanced appraisal, see A. Mark Smith, "Getting the Big Picture in Perspetivist Optics," *Isis* 72 (1981), 568-89, and J.A. Bennett, "Practical Geometry and Operative Knowledge," *Configurations* 6 (1998), 195-222.

[41] Wright, *Perspective in Perspective*, ch. 5-7; Kemp, "Geometrical Perspective from Brunelleschi to Desargues," 89-132 Mary G. Winkler and Albert van Helden, "Johannes Hevelius and the Visual Language of Astronomy," in *Renaissance and Revolution: Humanists, Scholars, Craftsmen and Natural Philosophers in Early Modern Europe*, ed. J.V.Field (Cambridge, 1993), 73-96.

geometry—two of the architectonic sciences of early modern Europe—while also providing essential methods for a variety of practitioners who needed to create accurate representations of the material world. As Albrecht Dürer pointed out, an author exploring geometric perspective addressed a surprisingly diverse range of audiences from philosophers all the way to "goldsmiths, sculptors, stonemasons, woodworkers, and others who base their art on the correctness of the drawing."[42] This broad constituency was reflected in the growing corpus of literature on mathematical perspective, which encompassed weighty Cartesian tomes, Jesuitical texts, guide-books designed for the professions, and craft manuals that circulated among artisans.[43] By the seventeenth century, all of these genres had gradually made their way to England in either print or manuscript form.[44] Yet, most Britons who became familiar with these techniques seemed to have acquired their knowledge of technical drawing or projective geometry through hands-on experience, often serving as apprentices to map-makers, surveyors, globe-makers, opticians, engravers, architects, and the like. Within this community of "mathematical practitioners"—as the historian E.G.R. Taylor has called them—a working knowledge of draughtsmanship had already become an increasingly central aspect of their craft by the middle of the seventeenth century.[45] What would change in the following decades would be the emergence of a broader spectrum of instructional texts,

[42] Dürer, *Underweysung der Messung* (1525) quoted in Camerota, "Renaissance Descriptive Geometry," 198.

[43] Peiffer, "Projections Embodied in Technical Drawings," 245-75; Baynes and Hugh, *The Art of the Engineer*.

[44] While the *English Short Title Catalogue* captures some of these developments, particularly the publication of English or Latin translations, the collections of the Dibner and Folger Libraries in Washington D.C. contain a much larger assortment of books and manuscripts that reflect the transfer of perspective theory from the continent to England.

[45] E.G.R. Taylor, *The Mathematical Practitioners of Tudor and Stuart England* (Cambridge, 1954)

educational venues, and technical aids that sought to disseminate the principles of mathematical drawing beyond these specialist circles.

Perspective "Made Easy"

From roughly 1680 to 1740, British writers and translators began to produce an increasing number of guidebooks that focused on matters of perspective drawing "made easy."[46] By and large, these texts eschewed any claims to proffer new discoveries or dramatic insights into the theory of mathematical perspective.[47] What people sorely needed, according to Joseph Moxon, one of the first writers in this vein, was a "discourse of PRACTICAL PERSPECTIVE" that would make sense of the intricate web of ideas and techniques that defined the field. Moxon acknowledged that a variety of instructional texts were already circulating, many from respected theorists like Sebastian Serlio. But he noted that these manuals had gone through several languages and "as the generality of

[46] My analysis of the literature on perspective is based upon the following texts: Joseph Moxon, *Practical Perspective; Or Perspective Made Easie…* (London, 1670); Jean Dubreuil, *Perspective Practical. Or, A Plain and Easie Method of True and Lively Representing all Things to the Eye at a Distance...*, trans. Robert Pricke (London, 1698); Dubreuil, *The Practice of Perpective: Or, An Easy Method of Representing Natural Objects…*, trans. Ephraim Chambers (London, 1726); Willem Jacob 'sGravesande, *An Essay on Perspective…*, trans. Edmund Stone (London, 1724); William Halfpenny *Perspective Made Easy: Or, A New Method for Practical Perspective…* (London, 1731); Humphry Ditton, *A Treatise of Perspective Demonstrative and Practical* (London, 1712) John Barrow, *Dictionary Polygraphicum…* (London, 1735); John Hamilton, *Stereography: Or, A Compleat Body of Perspective…*, 2 vols. (London, 1738); John Hammond, *The Practical Surveyor…* (London, 1725); John Holwell, *Trigonometry Made Easie Fitted to the Meanest Capacity…* (London, 1685); Bernard Lamy, *A Treatise of Perspective…*, trans. A. Forbes (London, 1702); Batty Langley, *The Young Builder's Rudiments: Or, the Principles of Geometry, Mechanicks, Mensuration, and Perspective, Geometrically Demonstrated…* (London, 1730); Jacques Ozanam, *Cursus Mathematicus…* (London, 1712); Andrea Pozzo, *Rules and Examples of Perspective Proper for Painters and Architects, etc.…*, trans. John James (London, 1707); William Salmon, *Polygraphice: Or, the Arts of Drawing, Engraving, Etching, Limning, Painting…* (London, 1701); John Shuttleworth, *A Treatise of Opticks Direct…* (London, 1709); Brook Taylor, *Linear Perspective: Or, a New Method of Representing Justly all Manner of Objects…* (London, 1715), [2nd rev. ed, 1719; 3rd rev. ed, 1749].

[47] The major exception was John Hamilton's, *Stereography: Or, A Compleat Body of Perspective* (1738), which applied harmonic sets to perspective theory in a way that had never been done before. But his text was also marketed to beginners and went out of his way to explain the most basic geometric principles. For a contemporary review of his work, which noted this peculiar mix of dense mathematics and an instructional format, see *The History of the Works of the Learned, for the Year one thousand and seven hundred and thirty-eight…* (London, 1739), 161-78; and Joshua Kirby, *Dr. Brook Taylor's Method of Perspective Made Easy* (Ipswich, 1754), ii.

Ingenious Artists do with me confess, the words are translated but not the Science."[48] This tension between the ambiguity of "words", needed to convey the subject matter, and the actual "Science" of perspective drawing represented a thorny problem that had consistently plagued writers and their audiences in the past. Put simply, it proved frustratingly difficult to capture perspective drawing in words. Trying to overcome these issues, the new guidebooks that emerged in the early eighteenth century set out to systematize this body of knowledge, bringing greater clarity, precision and order to the process. Many authors compared themselves to "grammarians", developing more exacting rules and vocabulary that would allow potential students to better understand the fundamental principles and how to apply them logically in more complex situations.[49] The often mysterious diagrams and explanations that appeared in earlier texts—what one translator described as the "Confusion of occult lines"—would need to be eliminated in favor of lucid precepts that any beginning reader could grasp.[50]

The desire for greater "order and measure every where" would begin with language itself.[51] The vocabulary of popular culture contained a rich tapestry of words relating to vision, graphic images, and drawing. But as the mathematician and perspective writer Humphrey Ditton warned, the reliance on vernacular terms could lead to considerable confusion. He drew attention to words such as "appearance" or "sight" or

[48] Moxon, *Practical Perspective*, iv

[49] Ibid., x; Taylor, *Linear Perspective*, vii; 'sGravesande, *An Essay on Perspective*, xvi; Dubreuil, *The Practice of Perpective*, iii, vi; Ditton, *A Treatise of Perspective Demonstrative and Practical*, iv.

[50] Andrea Pozzo, *Rules and Examples of Perspective Proper for Painters and Architects, etc…*, trans. John Sturt (London, 1707), title page.

[51] Chambers, ed. *The Practice of Perspective: Or, An Easy Method*, viii.

even “point”, which if used “promiscuously”, would lead a person “to signifie one and the same thing” when there were actually meaningful distinctions to be made.[52] He emphasized, for example, the pitfalls in using the term “APPEARANCE” to discuss the graphic representation of an object drawn on a plane. Some authors had used this language instead of the proper term “PROJECTION.” This seemingly trivial issue of diction, he claimed, went to the heart of understanding what the science of perspective was all about. The “appearance” of a figure, i.e. how an object looks to the eye, “depends only upon *the Relation of two things* to each other, *viz*. the *Object*, and *Eye*.” Whereas, the theory of perspective also has to consider the location and position of the plane upon which the image is drawn or “projected.”[53] In other words, the “appearance” of an object never changes if the eye and the object are stationary, but its “projection” will change dramatically if the intermediary plane is moved or rotated while the other two points remain fixed. So learning to think in the three dimensional terms of perspective—how an object will change depending upon the position of the eye, the object, <u>and</u> the plane of projection—required a fastidious use of language to avoid slipping into the kind of ambiguous phrasing that could mislead beginners. Other authors echoed these concerns, demonstrating a conscious effort to incorporate greater precision and accuracy into the terminology they employed throughout their texts.[54]

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[52] Ditton, *A Treatise of Perspective Demonstrative and Practical*, iii, vii-x.

[53] Ibid., iii.

[54] Taylor, *New Principles of Linear Perspective*, esp. v-vi;. ‘sGravesande, *An Essay on Perspective*, ii-ix; Barrow, *Dictionary Polygraphicum…* (London, 1735), 578; Halfpenny *Perspective Made Easy: Or, A New Method for Practical Perspective*, 4; Hamilton, *Stereography*, i-iii. 9-12, 73.

Writers adopted a variety of strategies to sharpen the meaning of their words and communicate ideas more clearly to lay audiences. One widely used approach involved the typography of the printed text itself. Many of the perspective manuals, for example, relied upon italic, capital, and small caps typeface to visually signal that a given word was being used in a specific manner.[55] Terms such as "LINE", "POINT", "APPEARANCE" and so forth were generally set in capitals to alert the reader that these words carried a particular connotation not to be conflated with their ordinary usage. By and large, italic fonts were reserved for subsidiary terms which evolved from these principle definitions. So in a work like Ephraim Chambers' *The Practice of Perspective*, a general "POINT" was set apart from "*Points of Sight*", "*Points of Distance*," or "*Accidental Points*" by the italic typeface.[56] Over time, these conventions evolved into a relatively stable system in which caps and italics linked defined words in a kind of hierarchy of specified meaning—capital fonts indicating a principle term, italics marking a more particular derivative of it, and both signaling that the phrases were not to be confused with everyday parlance.[57] In all likelihood, such practices drew their inspiration from the work of technical dictionaries and compendia of the period, which had developed a similar typographic schema to organize their web of defined terms.[58] But regardless of its origins, by the

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[55] Fittingly enough, geometric projection played a key role in typography where type designers relied upon mathematical drawing to create the precise contours of letter forms, face contrast, proportionality, and spacing within the fonts they created.

[56] Chambers, ed. *The Practice of Perspective: Or, An Easy Method*, vi.

[57] Brook Taylor, Humphrey Ditton, Ephraim Chambers, Batty Langley, John Shuttleworth, Willem Jacob 'sGravesande, and John Hamilton all adopted this approach, albeit with varying degrees of consistency throughout their texts.

[58] Several of the translators and authors of these perspective manuals also produced dictionaries at the time, so it would seem likely that they transferred these techniques from one context to another. Moreover, most of the authors

1720s, one can discern a conspicuous pattern among instructional drawing manuals which employed typographical conventions to provide more structure to the meaning of words.

The practices of defining terms also became more systematic as these guidebooks competed to offer accessible tracts to the reading public. Even at the beginning of the eighteenth century, it was common for instructional texts to offer definitions of key words as a kind of preliminary discussion to the methods of perspective drawing. But an increasing number of guidebooks began to include organized glossaries to explicate all of the major terms relating to the field. Some authors chose to alphabetize these sections, while others preferred to move in a logical fashion, starting with the basic definitions of geometric figures and progressing towards the more advanced lexicon of orthographic, stereographic, and scenographic projection. And while certain texts presumed a working knowledge of Euclidean geometry, most instructional manuals felt obliged to explain all terms and concepts in considerable detail.[59] There were good reasons for doing so. Some words, such as "orthographic", carried a very different connotation among architects, military engineers, and *literati*.[60] So clarity of ideas required that authors spell out the precise meaning of words.

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acknowledged that they had consulted works such as John Harris' *Lexicon Technicum*, Ephraim Chambers' *Cyclopaedia*, or various mathematical dictionaries, so they certainly were familiar with this emerging practice.

[59] Willem Jacob 'sGravesande, for example, noted that he expected his readers to be conversant with the principles in Euclid's *Elements*. Any axioms drawn from more advanced or specialized texts he put into italic font, to alert the reader accordingly. But as I mentioned above, most authors tried to assume little prior geometric knowledge amongst their audience.

[60] Taylor *New Principles of Linear Perspective*, 4. See also, Chambers, *Cyclopaedia*, n.pag. "Orthography"; Harris, *Lexicon-Technicum*, n.pag. "Orthographic".

Not surprisingly, perspective manuals demonstrated an even greater concern with systematizing the rules of this science. All authors agreed on the basic conception of the field. "Perspective teaches us the Manner of Delineating by Mathematical Rules," as Willem Jacob 'sGravesande explained, "how to draw geometrically upon a Plane, the Representations of Objects according to their Dimensions and different Situations."[61] Almost every text started with this basic definition which eighteenth-century writers copied from earlier perspective theorists. But the "mathematical rules" that followed proved far more difficult to explain in a clear and cohesive fashion. Indeed, once an author moved beyond the opening description of a drawing plane intersecting the visual pyramid, the specific methods as to how one should construct the numerous lines and points needed to create a diagram on that plane became increasingly complicated. Even those manuals which only aimed to teach linear perspective—essentially side-stepping the more complex branches of orthographic and stereographic projection—struggled to reduce the dizzying array of steps and rules into some kind of manageable order. Most authors tried to address this problem by organizing their precepts along axiomatic lines, drawing upon the tools of logic and the geometric proof to systematize their methods. A number of these perspective guides, for instance, adopted the structure of theorems, lemmas, and corollaries to demonstrate how the principles of mathematical drawing derived logically from certain fundamental premises. Having attempted to establish the theoretical foundations of perspective, authors then employed similar methods to show

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[61] 'sGravesande, *An Essay on Perspective*, 1.

how the practical application flowed from these general axioms: stating a "proposition" followed by a "construction" and ending with a "demonstration."

Such an approach, of course, did not make for light reading; but the advocates of perspective "made easy" insisted that systematic methods would yield the desired results. Sensing that the general public might find this axiomatic logic difficult to digest at first, Ephraim Chambers counseled patience:

> Tho' I have strain'd every Nerve to render the Science easy, I don't doubt but there are several will find some difficulty at the Beginning. But whosoever can surmount the first Difficulties, may go on assur'd, that there is nothing but he will understand, and practices; provided he takes care to master one Rule well before he turn over the Leaf to another. The truth is, they may be said, in some measure, to hang and depend on each other: And a little Trouble of this Kind at first, will be abundantly recommpens'd by the future Ease accruing from it."[62]

Another writer agreed, emphasizing that the structure of theory helped reduce the science of perspective to its "natural order, which makes it easier now to comprehend [its] greatest Difficulties in six Months, than formerly in six years"[63] Addressing workmen in the building trades, Batty Langley insisted that anyone could learn to draw in mathematical perspective "provided that they learn each Problem in its proper Order as they proceed, before they begin on the next." In a metaphor that was sure to please his readers, Langley compared the careful study of theorems and corollaries to the laying of a "good and sure Foundation…to build a strong and massy Structure."[64]

Yet, the challenge facing authors was to create the most cohesive theories which would yield the shortest as well as most reliable steps towards producing an actual

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[62] Chambers, "Preface," in Dubreuil, *The Practice of Perspective: Or, An Easy Method*, vi.

[63] Lamy, *A Treatise of Perspective*, v.

[64] Langley, *The Young Builder's Rudiments*, 77.

drawing. For while it was relatively simple to explain how one should delineate an imaginary cube or triangle, it became exceedingly complicated to trace the steps and perspective lines needed to draft a building, machine, or landscape in the real world. However much a writer like Batty Langley talked about the ease and clarity of perspective drawing if one followed the "proper order", readers found few shortcuts in terms of the process of constructing accurate visual representations. Take, for example, Langley's methods for drawing the ancient architectural orders, a task that became increasingly necessary for builders, architects and even furniture makers as neoclassicism swept England in the eighteenth century. Drafting the elegant spirals, or *volutes*, of the Ionic order required a series of over thirty calculations and steps along with nearly a hundred perspective lines to render a mathematically correct representation (see figure 9).[65] Even a figure like Willem Jacob 'sGravesande, who boasted that his work had reduced all of the useful rules of perspective into just three general theorems, admitted that draughtsmen would have to follow a course of "tedious particulars" to translate these principles into practice.[66] Yet mathematicians and perspective writers continued to pursue the idea that such tedious steps might be avoided in the future, and the whole process simplified, if a better system were developed. Such desires fueled the expanding market for perspective works, each claiming to offer a more concise and elegant approach to the complicated endeavor.

[65] Batty Langley, *The City and Country Builder's and Workman's Treasury of Designs* (London, 1741), 119-27.

[66] 'sGravesande, *An Essay on Perspective*, iv, 12, 19, 43-7.

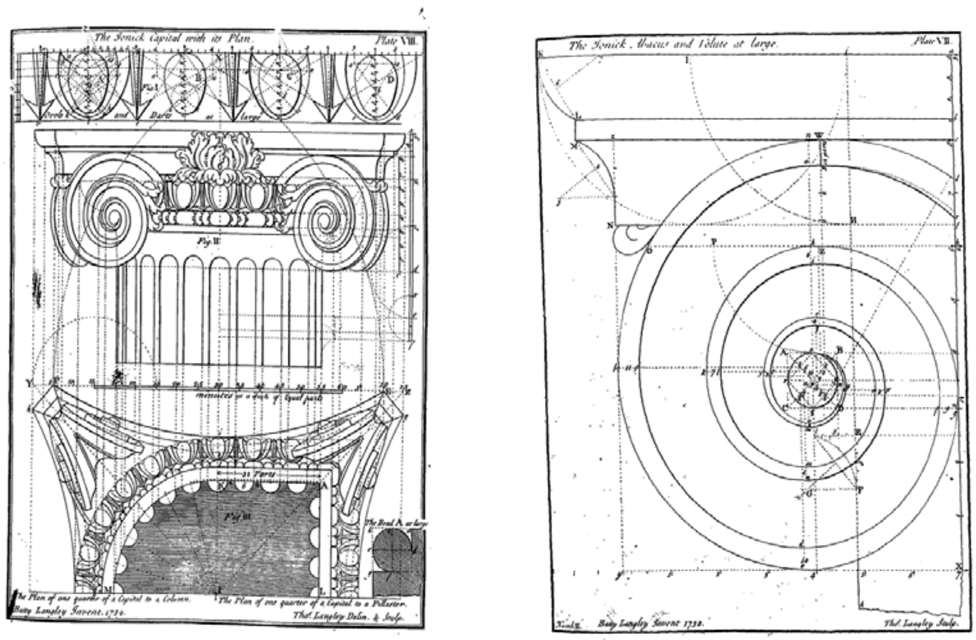


Figure 9: These illustrations of Langley's methods for drawing the Ionic order in perspective demonstrate the finished product with a handful of the major sight lines. The actual process was an extremely intricate affair, albeit one that could be replicated reliably in the hands of an attentive student. (Source: Batty Langley, *The City and Country Builder's and Workman's Treasury of Designs* [London, 1741])

In this environment, authors also competed to present the most useful and curious engravings to illustrate their texts. In the late seventeenth century, translators and commentators like Joseph Moxon or Robert Pricke included a modest number of prints into their editions on perspective. For the most part, however, these images were reproductions taken from earlier continental tracts and did not always fit well with the analysis presented in their work.[67] This tendency changed over time, as more authors either constructed their own engraved plates or hired draughtsman to execute the process

[67] Moxon, *Practical Perspective; Or Perspective Made Easie*; Dubreil, *Perspective Practical, or a Plain and Easie Method of true and lively Representing all Things…by a Religious Person of the Society of Jesus…set forth in English by Robert Pricke* (London, 1672).

for them. Popular guidebooks began advertising these features on their title pages, boasting upwards of 50 or 60 copper-plate engravings to provide guidance for unsure readers. Moreover, these images became integral parts of the textual presentation, serving to demonstrate the application and practical steps needed to resolve a specific problem, rather than ornaments designed to convey basic principles of geometry or perspective, as they were in earlier books. The mathematician, Brook Taylor, who was one of the few writers to resist this trend, noted the criticism he had received on this matter. In the second edition of his *New Principles of Linear Perspective*, Taylor expressed his discomfort with the fact "that many People object to the first Edition that I gave of these Principles because they see no Examples in it, no curious Descriptions of Figures, which other Books of Perspective are commonly so full of…and so are loathe to give themselves the trouble to read it." Taylor declined to include more illustrations in his later editions, pointing out to his readers that they would be better served by learning principles first, and then drawing practical examples for themselves, rather then relying upon engraved plates that largely indulged the "fancy."[68] Taylor may well have been correct, but the popularity of illustrations in perspective manuals proved more compelling in the long run.

Viewed as a whole, the work of early eighteenth-century perspective theorists and their guidebooks contain three distinct qualities worth underscoring. First, the genre carved out a much larger venue in which the historically specialized techniques of projection and mathematical drawing could unfold. The authors, themselves, came from

[68] Taylor, *New Principles of Linear Perspective*, vi-vii. The original edition

a broad spectrum of disciplines and crafts, ranging from architects, painters, and craftsmen to scholarly mathematicians. Even if they wanted to write solely about their own field—how to draft an architectural elevation, for example, or how to construct a landscape painting in perspective—the nature of the publishing market often required that authors address a wider constituency in order to justify the cost of printing.[69] These individuals, therefore, had to figure out how to make sense of the tangled web of practical rules, craft traditions, abstract geometrical theories, and competing techniques that had evolved in different settings over the previous centuries. Second, the growing need and desire to systematize this body of knowledge—making it accessible to a general audience—presented a number of obstacles that elicited creative responses. As we have seen, individual authors experimented with typographical conventions, new terminology, glossaries, formal logic, and new illustrations in an effort to provide greater clarity, order, and cohesion to the field. Some of these experiments were confined to a single text, while other methods garnered more widespread imitation within the community of perspective theorists. Most popularizers were quite explicit about their tendency to draw upon the ideas of predecessors or competitors when they felt a certain approach would benefit their own goals.[70] By the 1740s, the exchange of ideas, vocabulary, and methods had begun to produce a more standardized field of knowledge. This interpretive point is

[69] The main exception was the surveying text, which appeared in reasonably large numbers and addressed a specialized audience.

[70] See Chambers, *The Practice of Perspective: Or, An Easy Method of Representing Natural Objects*, xi-xiii; ‘sGravesande, *An Essay on Perspective*, i-iii; Ditton, *A Treatise of Perspective Demonstrative and Practical*, ii-v; Hamilton, *Stereography: Or, A Compleat Body of Perspective*, 9-12; Lamy, *A Treatise of Perspective*, 2; Salmon, *Polygraphice: Or, the Arts of Drawing*, 32-3.

not meant to make light of the substantive differences that distinguished one text from another. Authors certainly considered their own work unique, arguing that their particular scheme marked a significant improvement over the past. But these distinctions were beginning to take shape within an increasingly shared framework—idiomatic expressions that made sense because of a common language that most writers ascribed to. A tract from the 1680s, for instance, was likely to contain lengthy discussions about techniques for shading, coloring, composition, and the author's opinion on matters of taste or aesthetic judgment. By contrast, the perspective manuals of mid-century looked increasingly similar in their approach, laying out uniform definitions, axioms, practice problems, and schematic illustrations. Indeed, one might argue that these works possess a kind of abstractness that marked a significant decline from the richer texts of the seventeenth century, where discussions of judgment, experience, and personal skill took center stage. But the desire to create a more uniform method of draughtsmanship grew out of its own logic for greater accessibility, producing a kind of "thin" set of skills which could be widely replicated.[71] Finally, these texts reveal a growing emphasis on the centrality of mathematical instruments and drawing tools to the process of perspective "made easy." Whereas earlier writers spent more time discussing techniques of brush strokes, crayons, the use of the pen and so forth, mid-century writers focused on the t-square, compass, parallel ruler, sector and other instruments of precision. Joshua Kirby's widely popular guidebook, *Dr. Brook Taylor's Method of Perspective Made Easy*,

[71] The ways in which technical drawing sought to minimize judgment and "thick" knowledge rooted in cultural settings is explored in Alder, "Making Things the Same"499-545; Latour, "Drawing Things Together," 20-69; and Kathryn Henderson, *On Line and on Paper: Visual Representations, Visual Culture, and Computer Graphics in Design Engineering* (Cambridge, Ma., 1999), ch. 3.

actually began with a detailed explanation of these "necessary Instruments in Drawing [that] may be had at any Mathematical-Instrument-Maker's."[72] Such tools had become so important that they were discussed even before the preliminary definitions of the field were presented. For many authors, such instruments held out the tantalizing possibility of providing an easier shortcut between systematic theories and constructing drawings in practice. Instruments, it seemed, might open the world of projection to an even larger public.

Living by the Rule: Mathematical Instruments & Draughtsmanship

The eighteenth century constituted arguably the "golden age" for Britain's community of scientific instrument makers. Along London's busy Fleet Street, craftsmen and their masters produced an enormous array of mathematical, philosophical and optical instruments that were employed by an equally broad range of professions.[73] English makers like John Bird, Thomas Wright, Jonathan Sisson, Benjamin Cole, Thomas Heath, George Adams, Benjamin Martin, George Graham, and Jesse Ramsden created devices that were sought after throughout the British Empire and Western Europe. Contemporaries, in fact, often celebrated this industry as one of the leading branches of the nation's trade. The economist Josiah Tucker used it as an conspicuous example to prove that British manufacturers possessed more "skill and ingenuity" than their French

[72] Joshua Kirby, *Dr. Brook Taylor's Method of Perspective Made Easy, Both in Theory and Practice…* (Ipswich, 1754), 1; Halfpenny, *Perspective made easy: Or, a New Method for Practical Perspective*, vi.

[73] E.G.R. Taylor, *The Mathematical Practitioners of Hanoverian England, 1714-1840* (London, 1966); John Brown, *Mathematical Instrument-Makers in the Grocers' Company, 1688-1800* (London, 1979); Jim Bennett, *The Divided Circle* (London, 1987)

rivals, while John Chamberlayne waxed poetic about the profits that England received from exporting its "Barometers, Thermometers, Air-Pumps…Curious Telescopes, Microscopes, Perspectives, Mirrors, Spheres, Globes, Charts, Maps, and all sorts of Mathematical Instruments, Dials, Balances, Sea-Compasses, &c."[74] Many of the industries' leading practitioners were also elected to the Royal Society of London and considered philosophers in their own right, not simply technicians providing tools or services.[75]

Within this expansive instrument trade, mathematical tools comprised a central branch. Contemporaries usually divided scientific implements into three main categories: Mathematical, Optical, and Philosophical devices. While some of these latter instruments were employed in the service of drawing, such as the camera obscura, by far the most important tools came from the mathematical instrument makers. By the beginning of the eighteenth century, this field had already produced a wide range of implements that served the practical needs of architects, surveyors, cartographers, navigators, mechanics, military engineers, carpenters, and astronomers (see Figure 10).[76] The list proved so

[74] Josiah Tucker, *A Brief Essay on the Advantages and Disadvantages which Respectively attend France and Britain with regard to Trade…*, 2nd ed. (London, 1750), 34; John Chamberlayne, *Magnae Britanniae Notitia: Or, the Present State of Great-Briatin…*, 39th ed. (London, 1755).

[75] Richard Sorrenson, "George Graham, Visible Technician," *British Journal of the History of Science* 32 (1999), 203-221; Sorrenson, "Towards a History of the Royal Society in the Eighteenth Century," *Notes and Records of the Royal Society of London* 50 (1996), 29-46.

[76] Nicolas Bion, *The Construction and Principle Uses of Mathematical Instruments…*, trans. Edmund Stone, rev. ed. (London, 1758); Gerard L'Estrange, *Scientific Instruments, 1500-1900: An Introduction* (London, 1998); H.W. Dickenson, "A Brief History of Draughtsman's Instruments," *Transactions of the Newcomen Society* 27 (1949-50), 73-84; Baynes and Hugh, *The Art of the Engineer*; Maya Hambly, *Drawing Instruments, 1580-1980* (London, 1988);

long, according to one contemporary, that it was best not to "enumerate" the various trades and professions, since it would encompass "most of the active stations of life."[77]

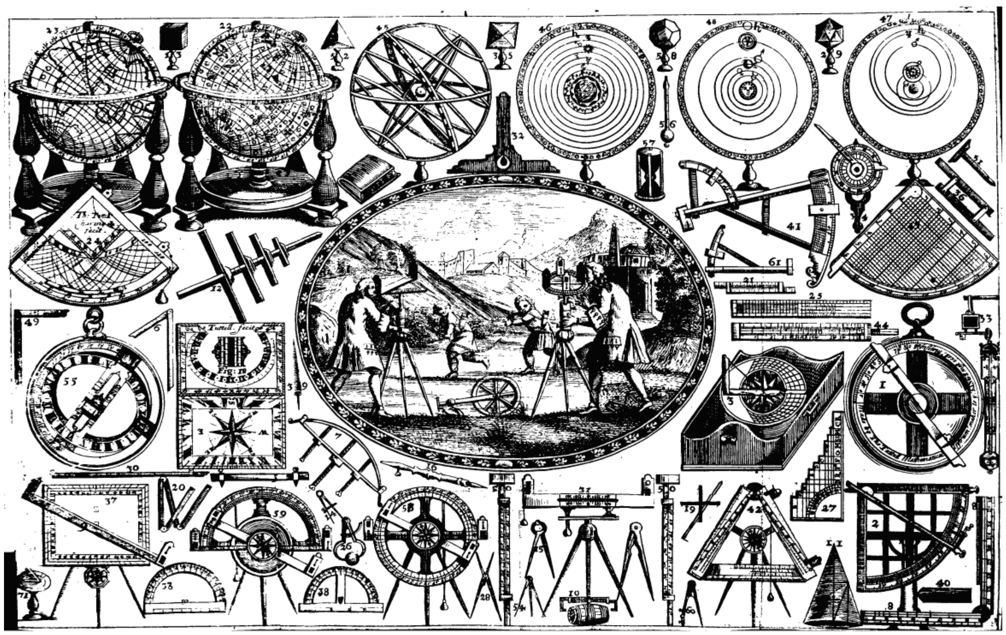


Figure 10: This illustration from 1700 displays some of the prominent mathematical instruments that were used at the beginning of the century. (Source: Joseph Moxon, *Mathematicks Made Easie, Or a Mathematical Dictionary, Explaining the Terms of Art and Difficult Phrases…* **[**London, 1700]).

Indeed, these tools proved increasingly necessary for individuals engaged in what contemporaries called "mixed mathematics." The term originated with Francis Bacon in the early seventeenth century and quickly became a widely accepted way of distinguishing between *pure* mathematics, which focuses upon magnitude in an abstract sense; and *mixed*, which examines issues of quantity and magnitude as they are manifested in actual material bodies or phenomenon. And while such an expansive

[77] John Robertson, *A Treatise of such Mathematical Instruments as are Usually Put into a Portable Case…* (London, 1757), i.

definition could include almost every branch of natural science, individuals typically confined it to applied fields such as surveying, cartography, pneumatics, navigation, architecture, hydraulics, gunnery, gauging, dialing, mensuration, and engineering.[78] And since mathematical projection played an important role in most of these endeavors, it should come as no surprise that drafting tools were a mainstay of mathematical practitioners and the instrument makers who supplied them.

Indeed, the eighteenth century witnessed a dramatic advance in the number, variety, and quality of instruments designed to facilitate mathematical drawing. Take, for example, one of the most elementary tools for graphic representation—the compass. This device has an incredibly long history, and scholars have traced significant modifications or improvements over the centuries. In early modern Europe, notable advancements occurred in terms of the invention of the wing arc compasses, the drawing compass (which had removable points to allow for the use of a pencil), and the screw compass.[79] But these developments were overshadowed by the rate of change which began in the late seventeenth century and flourished in the following decades. By mid-century, Hanoverian instrument makers were producing more specialized compasses to meet the needs of various professions and challenging tasks: the hair compass, bow compass,

[78] For contemporary discussions of this distinction as well as the various branches of mixed mathematics, see Ephraim Chambers, *Universal Dictionary of Arts and Sciences*, 2 vols. (London, 1728), I, ii; II, 509; Benjamin Martin, *Bibliotheca Technologica…* (London, 1740), 507-513; "Mixed Mathematics" in Thomas Walter, *A New Mathematical Dictionary…* (London, 1762), n.pag. It is also important to note, as the historian Lorraine Daston has underscored, that the field of mixed mathematics "dominated the discipline [of mathematics], both in prestige and proportion of published research" in the eighteenth century—essentially reversing the modern hierarchy which places pure mathematics above applied research. Daston, *Classical Probability in the Enlightenment* (Princeton, 1988), 53-56, 53.

[79] Derek J. Price, "The Manufacture of Scientific Instruments from c.1500 to c.1700," in *From the Renaissance to the Industrial Revolution c.1500 to c.1750*, vol. 3 of *The History of Technology*, ed. Charles Singer et. al. (Oxford, 1957), 530-557; Richard Sorrenson, "Towards a History of the Royal Society in the Eighteenth Century," *Notes and Records of the Royal Society of London* 50 (1996), 29-46.

German compass, triangular compass, sea-chart compass, fixed proportional compass, variable proportional compass, beam compass, elliptical compass, spherical compass, cylindrical compass, symmetrical spherical compass and new inserts for the drawing compass such as specialty ink pens, metal cutters, and ink dotted wheels (see Figure 11).[80] Other aspects of the compass underwent change as well, with instrument makers

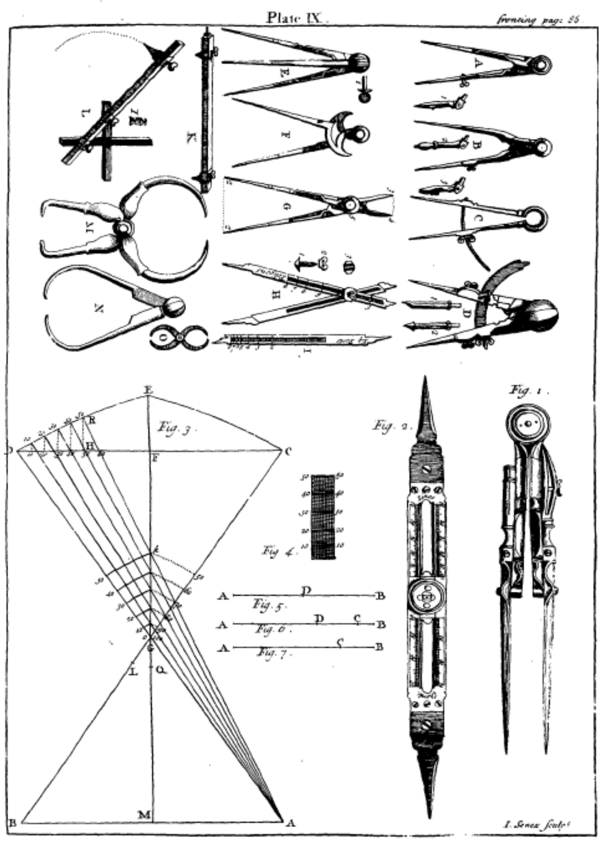


Figure 11: This engraved print, from a mid-century manual on mathematical instruments, shows the variety of innovative compasses that became available by this period. Although some were not designed for drafting, most of the compasses were intended to aid in various forms of projection and perspective (Source: Edmund Stone's revised version of Nicolas Bion's *The Construction and Principle Use of Mathematical Instruments* [London, 1758]).

[80] Stone, *Construction and Principle Uses of Mathematical Instruments*, 112-38; William Webster, *The Description and Use of a Complete Sett or Case of Pocket-Instruments…*, 2nd ed. (London, 1739), 3-9.

devising new ball, wing, screw and spring joints for greater accuracy and control. The end result for consumers was a broader range of tools that often simplified tasks or allowed them to be performed with increased confidence. Equipped with an item such as a proportional compass, for example, one could quickly change the scale of drawings without having to perform lengthy calculations. And while learning to use these tools still required the acquisition of certain knowledge and skills, they did alleviate a number of drawing challenges for those who were able to wield them effectively.[81]

Along with the compass, the rule represented one of the most fundamental drafting tools, and it too began to appear in more sophisticated guises as the eighteenth century progressed. The prior invention of the basic folding rule, slide rule, and scaled rule were taken in new directions as makers competed to offer the most useful implements for reducing time and error.[82] Some craftsmen experimented with different construction materials to prevent warping and the unreliable drawing edge it produced, while others focused their attention on developing more accurate scales for measuring, drafting, or calculating. In terms of measurement, the division of the rule into fractions of an inch required considerable mathematical skill in dividing the scale into precisely equidistant marks. In an era before machine dividers, a scale was only as precise at the mathematical practitioner who made it; and the craftsmen of eighteenth-century England demonstrated a marked improvement in this respect.[83] The addition of drawing scales on

[81] Benjamin Martin, *Description & Use of a Case of Mathematical Instruments* (London, 1771), 14-19.

[82] Hambly, *Drawing Instruments*, 105-24.

[83] Stone, *Construction and Principle Uses of Mathematical Instruments*, 38-46; Webster, *The Description and Use of Pocket-Instruments*, 11-16; Bennett, *The Divided Circle*, ch. 2.

either the face or back of a rule increased as well; a feature which allowed a person to change the ratio or proportion of a delineated object with greater ease. These were often combined with specialized logarithmic scales to enable the quick calculation of chords, secants, sines, tangents, rhumbs, and polygons for orthogonal and stereographic projections.[84] Moreover, the folding rule, which opened to a 90º angle for drawing perpendicular lines, began to appear with special scales along its sides, enabling the instrument to measure angles and to be used as a sighting device in surveying or prospective draughtsmanship. The sheer array of devices ensured that the drawing public—or at the very least, active professionals—could rely upon specific tools to address almost any drawing challenge (see Figure 12). Their widespread use in so many different trades and contexts by mid-century made a lasting impression on the French traveler, Jean Bernard Le Blanc, who noted that Britons seemed to live "by the rule and compass."[85]

These improvements in traditional drafting implements were matched by an equally striking range of new mechanical devices that sought to eliminate the laborious steps involved in creating certain graphic representations. The popular *volutes*, or spiral caps of the Ionic order, which had caused authors like Batty Langley to develop such intricate procedures for drawing them, could increasingly be drafted with ease by the volute compass or the helicograph, both of which produced mathematically accurate spiral curves. Likewise, the construction of ellipses, spherical sections, and proportional

[84] Robertson, *Treatise of Mathematical Instruments as are Put into a Portable Case*, 33-4.

[85] Jean Bernard Le Blanc, *Letters on the English and French Nations, Containing Curious and Useful Observations on their Constitutions Natural and Political…*, 2 vols. (London, 1747), 45.

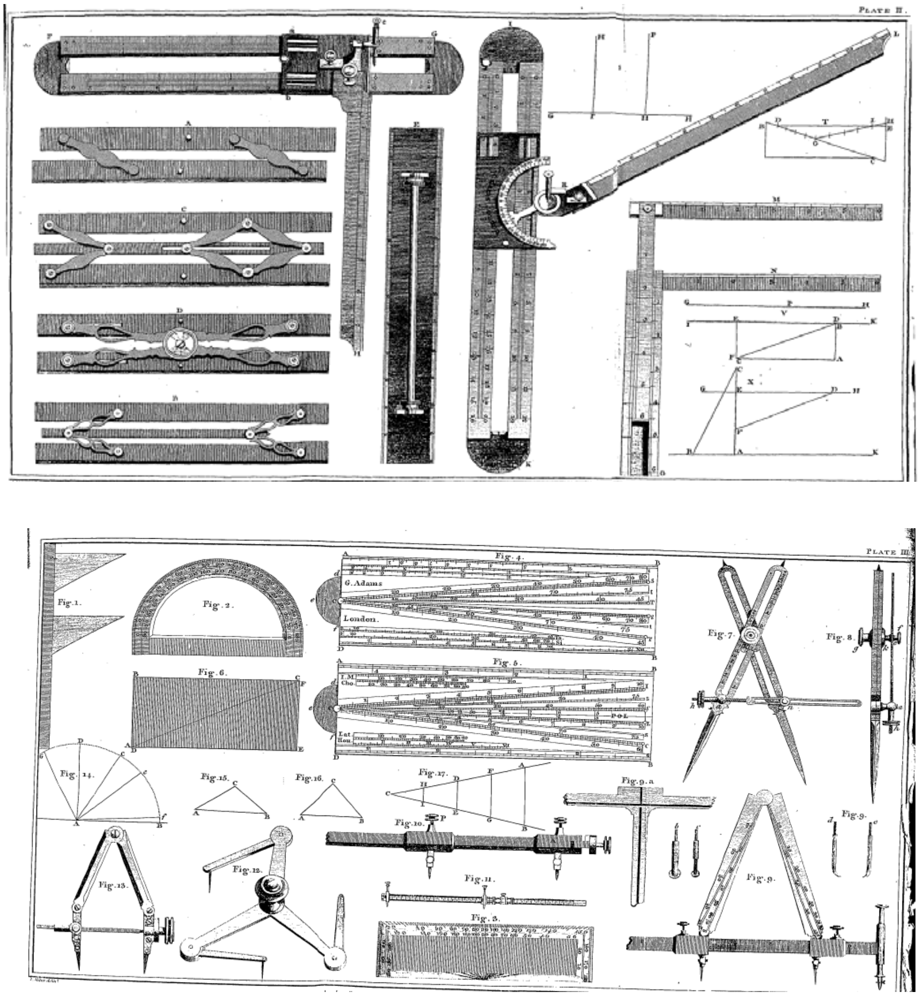


Figure 12: These two diagrams from an eighteenth-century treatise on Mathematical Instruments display some of the parallel, scaled, and folding rules that would have been used by contemporary draughtsman and individuals in a variety of trades where projective techniques were employed. (Source: George Adams, *Geometrical and Graphical Essays, Containing a Description of the Mathematical Instruments used in Geometry, Civil and Military Surveying…* [London, 1791]).

drawings were facilitated by the emergence of new elliptical trammels, cyclographs, and pantographs, respectively. Some instrument makers tried to reduce the entire science of linear perspective into a mechanical process through the creation of projective drawing devices. In the 1730s, William Halfpenny was advertising his “new-invented senographical protractor”, which combined a drawing table, sighting implement, and hinged projection plane "so easy [to use], that a Person, tho' an intire Stranger to Perspective, may, by Reading a few Lines, become Master of the Instrument, without the help of a Master."[86] Halfpenny's apparatus, however, looks quite rudimentary compared to the perspective machines invented by George Adams, James Watt, and others after mid-century (see Figures 13 & 14).[87] While the cost and reliability of such instruments prevented them from being widely adopted among the drawing public, many contemporaries expressed a growing confidence that such mathematical tools, combined with simplified theories of perspective, would render the difficult science accessible to larger segments of society.

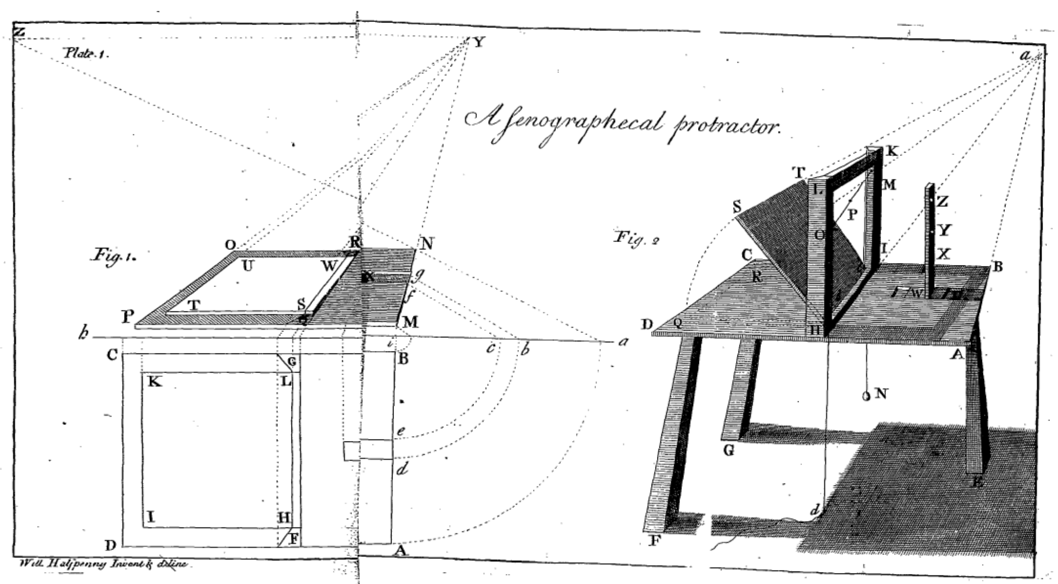


Figure 13: William Halfpenny's Senographical Protractor (Source: William Halfpenny *Perspective Made Easy: Or, A New Method for Practical Perspective…* [London, 1731]),

[86] Halfpenny, *Perspective Made Easy: Or, A New Method for Practical Perspective*, 1-3; *London Evening Post*, 12 October 1731; *General Advertiser*, 3 July 1732.

[87] George Adams, *Geometrical and Graphical Essays, Containing a Description of the Mathematical Instruments used in Geometry, Civil and Military Surveying…* (London, 1791), 211-14, 301-6.

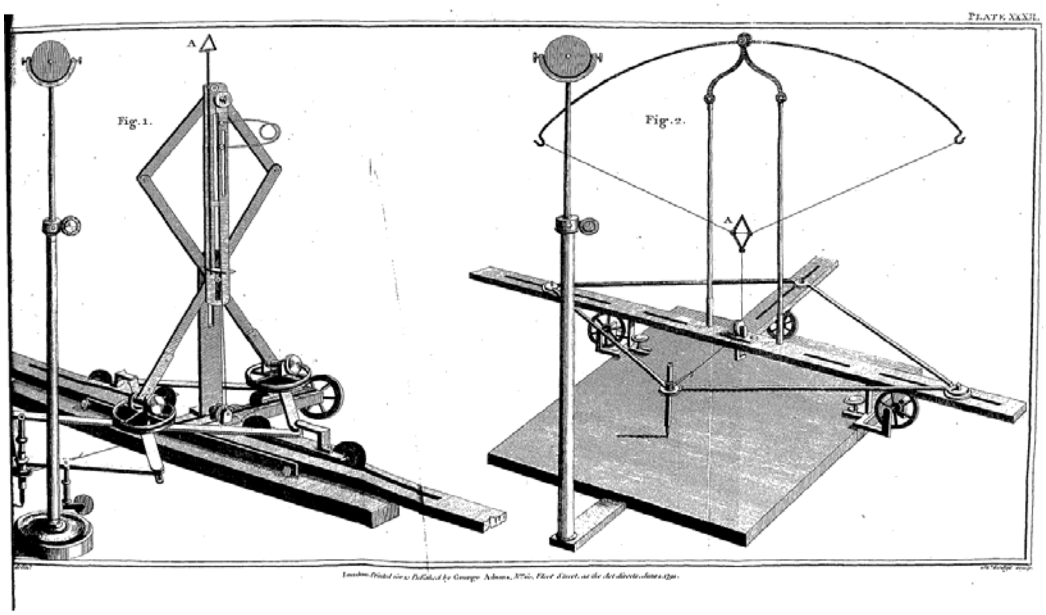


Figure 14: This plate illustrates the perspective apparatus designed by the instrument maker, George Adams, which promised to reduce the complexities of linear perspective to mechanical operations that anyone could perform. (Source: George Adams, *Geometrical and Graphical Essays, Containing a Description of the Mathematical Instruments used in Geometry, Civil and Military Surveying…* [London, 1791]).

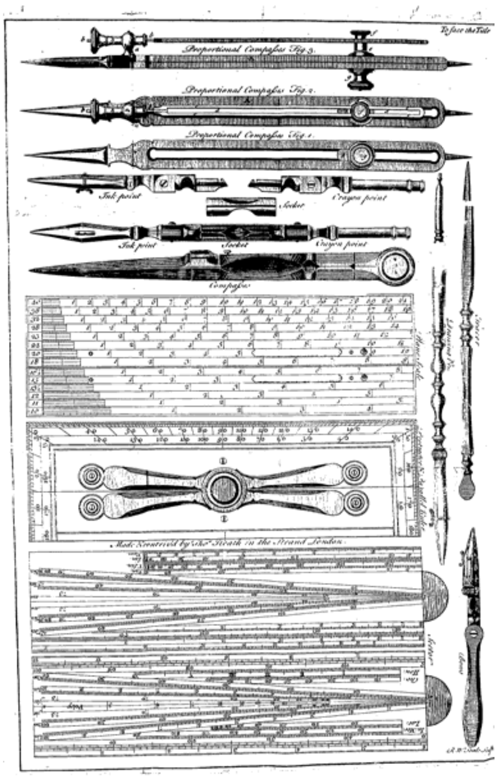
The increasing demand for affordable yet precise drafting tools led to an important change in the way instrument makers conducted their business. Whereas previous craftsmen had largely worked on commission, producing specific implements to fill a client's particular order, mid-eighteenth century workshops increasingly turned out standardized products for a general consumer marketplace. This change, it should be pointed out, did not lead to the disappearance of commission work. Nor did it herald the beginning of mass-produced items in a factory-like setting. Rather, the re-organization of the instrument trade built upon the expanding networks of credit and distribution that were transforming the larger economy during this period.[88] In terms of drawing implements, master craftsman and their workers began creating more standardized instrument "cases" that were sold *via credit* through an array of distant book stores, mercantile shops, printing houses, and dry goods vendors. Individuals could now purchase drafting tools directly from local merchants or distributors, who carried pocket-cases, box-cases, and magazine-cases.[89] In a place like Boston, for instance, "Cases of Mathematical Instruments" were sold at Jeremiah Condy's book store, Henry Knox's shop, and by other dry-goods retailers who advertised that such wares were available "on the most reasonable terms."[90]

John Robertson, a mid-century writer who studied these matters in detail, explained the emerging categories that instrument makers had developed by this time. In a typical introductory set, a "*pocket-case*', the small collection would include a pair of compasses, lead crayons, a drawing pen, and a plane scale. If one purchased a "*complete pocket-case*", they would also acquire a smaller pair of compasses, a pair of bow compasses, a lead pencil, a ruling pen tip, a protractor, a parallel rule, and a sector (see Figure 15 & 16). While different workshops might modify this list slightly or change the design of certain tools from year to year, pocket cases became a fairly fixed entity,

[88] Neil McKendrick, John Brewer, J.H. Plub, *The Birth of a Consumer Society: The Commercialization of Eighteenth-Century England* (Bloomington, Ind., 1982); Maxine Berg, *The Age of Manufactures, 1700-1820: Industry, Innovation, and Work in Britain*, 2nd ed. (London, 1994).

[89] For an example of these increasingly standardized commercial packages—in terms of pocket-cases, box-cases, and magazines—see the catalogue of advertised instruments (c. 1760): "Mathematical, Philosophical, and Optical Instruments Made and Sold by Heath and Wing," that was sewn into the back of various quarto and octavo books sold at the time. See also, William Webster, *The Description and Use of a Complete Sett or Case of Pocket-Instruments…*, 2nd ed. (London, 1739).

[90] *Boston News-Letter*, 29 April 1762; Richard Bushman "Shopping and Advertising in Colonial America," in *Of Consuming Interest: The Style of Life in the Eighteenth Century*, ed. Cary Carson, Ronald Hoffman, and Peter J. Albert (Charlottesville, Va., 1994), 251.



(Left) Figure 15: Contemporary illustration of the mathematical drawing tools included in a complete pocket-case. (Source: John Robertson, *A Treatise of Such Mathematical Instruments, as are Usually put into a Portable Case…* **[**London, 1747])

(Right) Figure 16: A complete pocket-case from the second half of the eighteenth century. This particular case came from the shop of Peter Dollond, a noted London instrument maker. (Source: Andrew Alpern Collection of Drawing Instruments, Avery Architectural & Fine Arts Library, Columbia University)

emerging as a commodity that could be reliably bought and sold throughout the empire. In a similar vein, the "*box-case*" evolved into a general product which included the aforementioned items plus a tracing point, gunner's calipers, and a pair of proportional compasses nestled within its partitioned drawers. At the pinnacle of this hierarchy stood the "*magazine-case*" which was brimming with proportional compasses, elliptical compasses, dividers, and specialized sliding rules and scales that appeared to vary somewhat depending upon the workshop which produced it.[91] By the third quarter of the eighteenth century, the enumerated lists of instruments included in the box and magazine cases had only grown, reflecting the broader trend towards a greater array of mathematical tools.[92]

The advent of more widely available tools and instruments—particularly the pocket cases that were sold throughout the provincial reaches of Anglo-America—made the techniques of projective drawing accessible to a broader range of practitioners. Designed to be durable, reliable, and above all, portable, these compact drafting sets could be carried almost anywhere, allowing individuals to delineate accurate representations of machines, estates, harbors, or other useful intelligence. A growing number of writers and commentators, in fact, stressed the need for individuals to carry such drawing cases whenever they traveled. Josiah Tucker, one of the most respected economists of the era, decided to emphasize this issue when he wrote an instructional guide for Britons touring abroad. Like other authors who wrote in this vein, Tucker insisted that travelers pay close attention to any discoveries, inventions, or useful practices which could be recorded for the benefit of themselves and the nation at large. He was particularly insistent that individuals produce "draughts of Machines or Engines…together with Descriptions of their Uses, and Calculations of their Expence both in making, and maintaining them." "Gentlemen, who travel after this manner,"

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[91] Robertson, *Treatise of Mathematical Instruments as are Put into a Portable Case*, 1-4.

[92] See George Adams, *Geometrical and Graphical Essays, Containing a Description of the Mathematical Instruments used in Geometry, Civil and Military Surveying…* (London, 1791), 10-12.

Tucker proclaimed, "will travel to great Advantage, doing an Honour to their Country when Abroad, and to themselves when they return Home."[93] One of the reasons why draughts proved so important in conveying such information was the fact that they seemed far more transparent and objective than the tangled web of words. Traveler narratives could prove unreliable on this account, Thomas Falconer explained to the naturalist Joseph Banks, "for when we judge by description we form an opinion through the medium of another man's understanding, who generally compares it with something else he has seen…What an assistance is it then to truth to have the objects delineated by one common measure [e.g. drawing] which speaks universally to all mankind." The idea that graphic representations could serve as a kind of universal language, a *lingua franca* that would transmit information across cultural barriers, underpinned the growing campaign to promote perspective drawing and more reliable drafting instruments among the public. The communication of useful knowledge would depend, in some measure, on the dissemination of drawing skills.

[93] Josiah Tucker, *Instructions for Travellers…* (London, 1757), 15. The ideal of the "improving" traveler, who carefully recorded and delineated useful knowledge while abroad, spawned an entire genre of tracts dedicated to explaining how one should record and organize such observations. Perhaps the most detailed and interesting text in this vein was Leopold Graf von Berchtold's *An Essay to Direct and Extend the Inquiries of Patriotic Travellers…*, 2 vols. (London, 1789).

CHAPTER SIX

Appropriating Useful Knowledge:
The Place of Science in a Provincial World

> In a country whose reigning character is the love of science…the opportunities of acquiring and communicating knowledge ought always to enlarge with the circle of the population. America has now outgrown the state of infancy: her strength and commerce make large advances to manhood, and science in all its branches has not only blossomed, but even ripened on the soil.
>
> --Thomas Paine, *Pennsylvania Magazine*

By the middle decades of the eighteenth century, science had become an increasingly popular endeavor among the colonists of British North America. During this period, natural philosophy went from being an esoteric branch of knowledge—one cultivated by a small cadre of intellectuals—to become a broad and accessible movement that captured the attention of gentlemen, merchants, tradesmen, and aspiring members of the "middling" ranks.[1] The uses of natural knowledge seemed to multiply as groups throughout America made it their business to promote and sustain the public's growing interest in these affairs. Lecturers, tutors and instrument makers, for example, catered to an expanding market of enlightened consumers eager to keep abreast of the latest developments in experimental philosophy and technology. In a similar vein, printers and book dealers provided a steady stream of scientific material which brought various aspects of natural philosophy directly to provincial audiences, gratifying the curiosity of

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[1] Looking back on this period, Samuel Miller argued that it "may be emphatically called the AGE OF PHYSICAL SCIENCE" in which the notable advances made in particular fields of natural philosophy were matched by an "extraordinary diffusion of knowledge" that directly shaped the "state of public opinion." Miller did not hesitate to employ the language of "revolution" to capture the dramatic changes in science and public culture that he believed were a defining aspect of the age—a time when "swarms of inquirers and experimenters [were] every where

those with the literacy and means to participate in this burgeoning realm of print. The study of the natural world received considerable support from the clergy and gentry as well—groups who largely embraced the new science as a worthy endeavor that would inculcate piety and politeness among its practitioners. Even new institutions played their part as colonists created an array of clubs, subscription libraries, and civic associations that embraced scientific knowledge as an avenue to both personal and public improvement.[2] Such efforts not only broadened the scope of colonial science, but more importantly, they made scientific knowledge an essential part of the emerging provincial culture that was transforming public life in eighteenth-century America.

While historians have noted the growing influence of natural philosophy and enlightenment culture in such colonial centers as Boston or Philadelphia, the developments of the period actually come into shaper focus when one examines the changes affecting smaller communities, such as Lancaster, Pennsylvania.[3] Located near

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abounding", making experimental knowledge and natural philosophy an integral part of public life. Miller, *A Brief Retrospect of the Eighteenth Century…*, 2 vols. (New York, 1803), II, 412-17.

[2] My thinking about the popularization of science in eighteenth-century America—and in particular, the ways in which science became a cultural commodity promoted by various groups whose motives were often as pragmatic and worldly as they were philosophical—is rooted in certain strands of Enlightenment historiography that have tended to emphasize the "business of enlightenment" and the "social history of ideas." Particularly helpful, in this regard, have been: Robert Darnton, *Mesmerism and the End of the Enlightenment in France* (Cambridge, Ma., 1968) J.H. Plumb, *The Commercialisation of Leisure in Eighteenth-Century England* (Reading, Eng., 1974); Robert Darnton, *The Literary Underground of the Old Regime* (Cambridge, 1982); John Money, *Experience and Identity: Birmingham and the West Midlands, 1760-1800* (Manchester, 1977); Peter Borsay, *The English Urban Renaissance: Culture and Society in the Provincial Town, 1660-1770* (Oxford, 1989); John Brewer and Roy Porter, eds., *Consumption and the World of Goods* (London, 1993); Margaret Jacob, *Living the Enlightenment: Freemasonry and Politics in Eighteenth-Century Europe* (Oxford, 1991); John Brewer, *The Pleasures of the Imagination: English Culture in the Eighteenth Century* (London, 1997); Roy Porter, *The Creation of the Modern World: The Untold Story of the British Enlightenment* (New York, 2000); and David Jaffee, "The Village Enlightenment in New England, 1760-1820," *William and Mary Quarterly* 47 (1990), 327-46.

[3] Some of the classic explorations of the Enlightenment's impact on America's urban centers include Carl Bridenbaugh, *Cities in Revolt: Urban Life in America, 1743-1776* (New York, 1955); Carl and Jessica Bridenbaugh, *Rebels and Gentlemen, Philadelphia in the Age of Franklin* (New York, 1942); Carl Bridenbaugh, "Philosophy Put to

the banks of the Conestoga River, some 65 miles west of Philadelphia, Lancaster emerged in the 1730s as the county seat for the frontier settlements of southeastern Pennsylvania. Like its surrounding areas, the town contained a mixed population of German, Scotch-Irish, Swiss, Welsh, and English settlers who carved out a comfortable living from commercial agriculture and trade-crafts.[4] When Thomas Pownall, an English official, visited Lancaster in 1754 he was impressed by the rapid state of progress in this colonial outpost. "Lancaster is a growing town," he recorded, "and making Money—a manufactory here of saddles and packsaddles, also of guns—it is a stage town—500 houses—2,000 inhabitants."[5] And yet the dangers that such frontier communities faced became immediately evident with the outbreak of the Seven Years' War (1754-63), which exposed the English backcountry to a wave of devastating attacks from Native American war parties allied with the French. The toll of violence was particularly severe in Lancaster County, leading one inhabitant to openly wonder "if this part of the country has breath'd its last." Writing to the provincial secretary in the bleak winter of 1756, he

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Use: Voluntary Associations for Propagating the Enlightenment in Philadelphia, 1727-1776," *Pennsylvania Magazine of History and Biography* 101 (1977), 70-88; Frederick B. Tolles, *Meeting House and Counting House; Quaker Merchants of Colonial Philadelphia, 1682-1763* (Chapel Hill, 1948), ch. 7-9; Samuel Eliot Morison, *Intellectual Life of Colonial New England* 2nd ed. (Ithaca, 1965); Michael Kraus, *Intercolonial Aspects of American Culture on the Eve of the Revolution, With Special Reference to the Northern Towns* (1928, reprint; New York, 1972); and more recently, Nina Reid-Maroney, *Philadelphia's Enlightenment, 1740-1800: Kingdom of Christ, Empire of Reason* (Westport, Ct., 2001); David S. Shields, *Civil Tongues & Polite Letters in British America* (Chapel Hill, 1997); Laura Rigal, *The American Manufactory: Art, Labor, and the World of Things in the Early Republic* (Princeton 1998). For the impact of science, in particular, see Brooke Hindle, *The Pursuit of Science in Revolutionary America, 1735-1789* (Chapel Hill, 1956); Raymond Stearns, *Science in the British Colonies of America* (Urbana, Il., 1970).

[4] Jerome H. Wood, *Conestoga Crossroads, Lancaster, Pennsylvania, 1730-1790* (Harrisburg, Pa, 1979),1-20, 159-78; Carlton Wittlinger, "Industry Comes to the Frontier," *Pennsylvania History* 21 (1954), 153-61. Carl Bridenbaugh explores the wide variety of craftsmen in Lancaster, a group highly esteemed for their "mechanical knowledge," in his *The Colonial Craftsmen* (orig. publ. 1950; New York, 1990), 115-120.

[5] "Extract from Gov. Pownall's Journal in the year 1754," printed in *Hazard's Register of Pennsylvania* 6, no. 2 (July, 1830), 29.

described a chaotic scene of “Women and Children screaming & lamenting; Men’s Hearts failing them under all the Anguish of Despair” and many people simply fleeing east for safety.[6]

Given this context, it is rather remarkable that members of the community chose to invest their precious time and resources in the creation of a subscription library for the borough and its surrounding areas in 1759. The ambitious project sought to marshal the resources of an enlightened age to address the pressing concerns of local residents. Emerging before the war had even ended, the institution became a vibrant focal point for those who aspired to rebuild the civic life of Lancaster and regenerate the sense of progress that had been sorely tested in the preceding years.[7] By examining how this project unfolded, and its broader meaning for the inhabitants who participated, we can get a better understanding of the ways in which natural philosophy and the culture of enlightened sociability spoke to the concerns and aspirations of provincial communities.

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[6] Rev. Thomas Barton to Richard Peters, February 6, 1756; reprinted in *Account of Fort Robinson*, ed. D.A. Kline and Luke Baker (Perry County, Pa., 1924), 10-11.

[7] “A Short Account of the Julian Library” in *The Charter, Laws, Catalogue of Books, List of Philosophical Instruments, &c. of the Juliana Library Company, in Lancaster* (Philadelphia, 1766), 12. The subscription library was part of a series of civic projects in Lancaster that included the creation of a manufactory for the unemployed; the formation of three volunteer fire companies; transportation improvements funded by the Conestoga Bridge Lottery (1761); and several prominent building campaigns ranging from churches to designs for a municipal reservoir. Far from being unconnected, these projects relied upon many of the same members and often worked in tandem to achieve goals. The Union fire company, for example, lent money to the library at certain points while relying upon the latter to offer guidance in terms of purchasing and repairing its hydraulic fire engine. The details of these collaborative arrangements can be found in the manuscripts included in Alfred Sanderson’s *Historical Sketch of the Union Fire Company, No. 1…from 1760-1879* (Lancaster, 1879), 9-22. On the various projects, see also: *Pennsylvania Gazette*, 10 December 1761; J. I. Mombert, *An Authentic History of Lancaster County* (Lancaster, Pa., 1869), 371; *Charter, Laws, & Catalogue of the Juliana Library*, x.

The Juliana Library and the Village Enlightenment

Despite the challenges of frontier life, the proponents of the new library company managed to attract considerable support for their project. The organizers, it should be noted, faced some potential hurdles in terms of locating the financial resources and people needed to accomplish their goals. Creating a proper library in the midst of the rural hinterlands—one intended to encompass the latest books and instruments of the day—would require not only a considerable sum of money, but also the coordinated effort of a large body of subscribers. Everyone had to agree on a host of complicated issues ranging from fiduciary matters to the rules governing membership and decision making. To meet such challenges, the proponents of the library pursued a methodical campaign which drew upon some of the resourceful techniques underpinning associational life during the eighteenth century.[8] They circulated proposals to leading members of the community, printed advertisements in the newspaper, canvassed for subscriptions, and most importantly, drafted a comprehensive "Sett of Articles or Constitutions" that would govern the affairs of the library—a kind of "social compact" writ small.[9] The fact that such methods seemed to come naturally to the inhabitants of Lancaster underscores just how widespread the patterns of enlightened mobilization had become, providing distant provincials with an effective blueprint for how to engage and

[8] Benjamin Franklin's *Autobiography* still offers one of the best windows onto the principles and techniques of organization that underpinned the expanding world of voluntary associations in colonial America. *The Autobiography of Benjamin Franklin* (Mineola, NY, 1996). See also, Peter Clark, *British Clubs and Societies, 1580-1800: The Origins of an Associational World* (Oxford, 2000), ch. 11; Carl Bridenbaugh, "Philosophy Put to Use," 70-88.

organize likeminded individuals.[10] Initially, around 60 individuals subscribed to Lancaster's new library company, raising an impressive fund of £200 sterling.[11] With such resources at their disposal, the directors not only assembled one of the premier libraries in colonial America, but they also acquired a large collection of scientific instruments and natural curiosities. Their unexpected success caught the attention of many observers, including Thomas Penn, the proprietary head of the colony, who was so pleased with their initiative that he donated several items from his personal collection and obtained a legal charter for the group. As a sign of gratitude, the members chose to be incorporated as the Juliana Library Company in honor of Penn's wife, Lady Juliana.[12]

Like other aspiring provincials, the inhabitants of Lancaster placed great stock in the benefits of making knowledge and learning more accessible.[13] Their views on this

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[9] *Charter, Laws, & Catalogue of the Juliana Library*, 12. The original articles of agreement for the library are reprinted in Charles I. Landis, "The Juliana Library Company in Lancaster," *Pennsylvania Magazine of History and Biography* 43 (1919), 25-7.

[10] Arthur Schlesinger first drew attention to the growth of voluntary associations during the middle decades of the eighteenth century in "Biography of a Nation of Joiners," *American Historical Review* 50 (1944), 3. See also, Bridenbaugh, *Cities in Revolt*, ch. 3; Bridenbaughs, *Rebels and Gentlemen*, 21-27.

[11] *Charter, Laws, & Catalogue of the Juliana Library*, 12. The membership rolls appeared to have increased steadily. By 1773, the directors announced that the "frequent applications for admission into this Company" had reached a point where the membership numbers were at the maximum level "heretofore agreed on to be admitted." *Pennsylvania Gazette*, 6 January 1773.

[12] Ibid, 12-14. Lady Penn seems to have taken a personal interest in the library, and fittingly enough, her donations suggest a familiarity and attachment to scientific subjects. She donated, for example, an orrery as well as a copy of John Harris' popular tract (*The Description and Use of the Globes and the Orrery*) which had already appeared in nine editions by this point (Ibid, 47, 55). Lady Penn would continue to send various items until the outbreak of hostilities in 1776, including a multi-volume account of James Cook's celebrated voyage to the south Pacific, a folio of which was devoted entirely to the maps, plats, and drawings from this scientific expedition. Her later gifts to the library are recorded in the list, compiled by the directors, which documents the roughly 200 additional titles acquired after the catalogue was released in 1766. This document, currently in the possession of the Historical Society of Pennsylvania, is printed in Landis, "Juliana Library Company," 229-33.

[13] Ned C. Landsmen, *From Colonials to Provincials: American Thought and Culture, 1680-1760* (New York, 1997); Bridenbaughs, *Rebels and Gentlemen*, 29-68. For revealing statements about the centrality of knowledge in a provincial setting, see the address from the Directors of the Library Company to Thomas Penn, printed in *The*

subject appeared in the library's first published catalogue, which included a precocious essay on the fate of knowledge throughout human history and the role of their own institution within this unfolding narrative.[14] The authors began by stressing that "we come into this World enveloped in a Cloud of Ignorance: Nature places almost all upon a Level, and makes no very material Difference in dispensing her Gifts." Having posited such a natural equality among mankind, they argued that it was the cultivation of learning *alone* which "raises one Part of the human Species above another" and creates the visible distinctions "not only between Individuals, but between Nations and Countries." As proof, the authors pointed to the classical world, recounting the histories of Greece, Rome, and Africa to underscore the inherent link between the state of knowledge, on the one hand, and the rise and fall of ancient civilizations, on the other. "By carrying the Sciences to Perfection," they claimed, these societies had achieved "a Pitch of Glory and Reputation" that transformed them into "Masters of the World." But as soon as learning

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Pennsylvania Gazette, 31 May 1733; *The American Magazine and Historical Chronicle* (Jan., 1744), 210-11; [Benjamin Franklin], *Proposals relating to the Education of Youth in Pennsylvania* (Philadelphia, 1749); *New-York Mercury*, 14 October 1754; and the concluding remarks found in Nathanial Ames, *An Astronomical Diary: or, An Almanack for the year of our Lord Christ, 1758…* (Boston, 1757), n. pag.

[14] The library's catalogue was clearly intended for a public audience, designed to convey the immense pride and ambition that permeated the institution. It begins with a rather elaborate title page, replete with learned quotations and lavish typography—a feature that runs throughout the text, indicating that no expense was spared in terms of print composition. Contemporaries would have also taken notice of the size of the catalogue—a quarto—which was both a costly and impressive format for a provincial library to adopt. In fact, I know of only one other colonial library that printed a catalogue in quarto: the Charlestown Library Society in 1770. And given the costs of printing in such a format, it is all the more striking that the text is filled with a lengthy preface, a dedication, a history of the company, an account of its "friends and benefactors", and perhaps most surprisingly, the complete citations of all the books (some titles running upwards of a hundred words) rather than the "short title" or abbreviated format that most libraries employed. The work, therefore, projects a rather conspicuous claim to respectability and authority by appropriating the mantle of learned culture. And in all likelihood, the members intended to send volumes as gifts to benefactors, potential patrons, and other similar institutions—just as philosophical organizations of the time exchanged their printed journals to develop ties of reciprocity and good will.

was neglected, they "shrunk back again into a poor petty State; so that Science and Empire fell together."[15]

Such lessons, however, were not confined to antiquity. In more recent times, one could look to the meteoric rise of Britain or the late progress in Russia to see how schools, libraries, and philosophical academies had spread the "most useful Arts and Sciences"—laying the foundation for increasing prosperity and power.[16] Indeed, the impact of learning was even greater in modern times, the library's spokesmen declared, because the advent of print technology and inexpensive books had made "the Avenues to Knowledge smooth and easy to all." Now, "even the Husbandman and Mechanic, without neglecting their necessary Callings, may taste the Fruits of literary Leisure." This growing accessibility of knowledge, combined with the example set by the mother country, had encouraged the colonists to establish similar institutions throughout America. The authors surveyed the "Promotion of Useful Knowledge" in several of the neighboring colonies and trumpeted the success of their own province "in this glorious contest." After all, Pennsylvanians had created public institutions to cultivate the arts and sciences "in almost every Town of Note." What made Lancaster's own library unique was the fact that it brought "the Means of Knowledge…the nearest Westwardly, of any

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[15] Charter, Laws, & Catalogue of the Juliana Library, i-iii. See also, Ephraim Chambers, *Cyclopaedia, or an Universal Dictionary of Arts and Sciences*, 2 vols. (London, 1728), I, "Preface".

[16] The authors placed considerable emphasis on Russia's transformation under Peter the Great (1672-1725)—a figure who achieved near mythical status in British texts of the period for his efforts to not only promote enlightened institutions, such as libraries and academies, but also his willingness to personally observe and learn several trades while touring Europe so as to gain useful knowledge that could be applied back in Russia. Indeed, the celebration of Peter the Great as the archetype of enlightened kingship probably set the stage for George III's later apotheosis as an improving monarch willing to study the humble arts of husbandry and mechanics for the good of his kingdom.

that we know of." Situated on the very edge of English settlement, the Juliana Library Company symbolized the importation of knowledge and refinement to the outer fringes of the British Empire.[17]

Yet, the notion that access to learning would help establish civility and progress on the frontier should not obscure the fact that it was a particular kind of knowledge which Lancastrians prized in their new library company.[18] In all likelihood, the library's collection would have appeared quite different had it emerged earlier in the century. The preceding decades, in fact, had witnessed fundamental changes in both the intellectual world and the material realities of the transatlantic book trade, altering the kinds of knowledge that were produced and available by mid-century. Whereas previous libraries, whether public or private, had been dominated by a narrow range of religious and devotional literature, the books chosen by the Juliana Company highlight the changing landscape of eighteenth-century priorities.[19] Ordering from the finest book shops in

[17] Ibid, ii, vi-ix. For the broader historical context surrounding the emergence of social libraries and other efforts to promote useful knowledge, see Jesse H. Shera, *Foundations of the Public Library: The Origins of the Public Library Movement in New England, 1629-1855* (Chicago, 1949); James Raven, "Social Libraries and Library Societies in Eighteenth-Century North America," in *Institutions of Reading: The Social Life of Libraries in the United States*, ed. Thomas Augst and Kenneth Carpenter (Boston, 2007), 24-52; and Paul Kaufman, "The Community Library: A Chapter in English Social History," *Transactions of the American Philosophical Society*, n.s. 57 (1967), 3-67. For contemporary analysis on the spread of provincial libraries "to these remote Corners of the World," see the address printed in *The Pennsylvania Journal,* 24 November 1763. The founders of the Union Library Company, in neighboring Hatboro, were even starker in their portrayal of libraries as outposts of civility amidst the "Black and Dark Ignorance" that "did about this time greatly prevail in these parts…with all the Horrid Concomitants that Generally Accompany or flow from it." These comments, along with other portions of the library's minute book, are reprinted in Chester T. Hallenbeck, "A Colonial Reading List from the Union Library of Hatboro, Pennsylvania," *Pennsylvania Magazine of History and Biography* 56 (1932), 290.

[18] Richard Bushman captures some of the major elements which converged in the early eighteenth century to make the pursuit of civility and refinement such cultural imperatives among aspiring provincials in his *The Refinement of America: Persons, Houses, Cities* (New York, 1992), 3-99.

[19] On the changing nature of the book trade and colonial reading habits, see David D. Hall, "Introduction: The Uses of Literacy in New England, 1600-1850," and Stephen Botein, "The Anglo-American Book Trade before 1776:

England, the directors chose the latest works in history, literature, philosophy, commerce, and the arts. They carefully selected authors who were defining the agenda of the British Enlightenment that was unfolding back home. Members could consult major works by John Locke, Joseph Addison, Richard Steele, Alexander Pope, Samuel Johnson, David Hume, Lord Kames, Josiah Tucker, and Malachy Postlethwayt. The library included continental figures as well—*literati* such as Voltaire, Montesquieu, Puffendorf, Vattel, and Fontenelle.[20] The new sensibilities of the Enlightenment also permeated the popular magazines and journals which the directors acquired. The pages of the *Spectator, Tatler*, *Guardian*, and *Gentlemen's Magazine* offered distant provincials an appealing entrée into this cosmopolitan world, engaging readers with witty essays that were meant to entertain as well as edify.[21] It would be hard to overstate the appeal and influence of such

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Personnel and Strategies," in *Printing and Society in Early America*, ed. William L. Joyce et. al (Worcester, Ma., 1983), 1-131; David Hall, "Readers and Writers in Early New England," and Ross W. Beales and James N. Green, "Libraries and their Users," in *The Colonial Book in the Atlantic World*, ed. Hugh Amory and David D. Hall (Cambridge, 2000), 117-151, 399-404. Edwin Wolf probably examined more catalogues and book collections than any other historian of eighteenth-century America. For his conclusions on the changing priorities of colonial readers, see in particular his early article "Franklin and His Friends Choose Their Books," *Pennsylvania Magazine of History and Biography* 80 (1956), 11-36; and his later *The Book Culture of a Colonial American City: Philadelphia Books, Bookmen, and Booksellers* (Oxford, 1988).

[20] David Lundberg and Henry May examined a number of early American libraries and book-sellers lists, attempting to reveal statistically the preferences of the "enlightened reader." Their first sample group consisted of ninety-two catalogues, seventy-four of which came from the period between 1750 and 1775, offering a nice snap-shot of "mid-century tastes." Their findings suggest that the Juliana libraries' selections mirrored broader trends in terms of the contemporary titles they chose. Lundberg and May, "The Enlightened Reader in America," *American Quarterly*, 28 (1976), 262-93, 267. See also, Wolf's discussion of the mid-century trends among colonial libraries in "Franklin and his Friends," 12-16. I have also relied upon two popular contemporary guides to situate the libraries' collection in broader perspective: John Clarke's influential *An Essay upon Study, Wherein Directions are given for the due Conduct thereof, and the Collection of a Library*... (London, 1731), and Samuel Johnson's *An Introduction to the Study of Philosophy Exhibiting a General View of all the Arts and Sciences, for the use of Pupils…* (New London, Ct., 1743).

[21] Indeed, a quotation from Addison's *Spectator* adorned the title page of the library's published catalogue. On the central role these periodicals played in espousing Enlightenment ideas and sensibilities, see Lawrence E. Klein, *Shaftesbury and the Culture of Politeness: Moral Discourse and Cultural Politics in early Eighteenth-Century England* (Cambridge, 1994); Porter, *The Creation of the Modern World*, esp. 194-203. On the provincial popularity of these journals, see Landsman, *From Colonials to Provincials*, 38-42; Henry F. May, *The Enlightenment in America* (New York, 1976), 36-7. While the original periodicals had achieved quite impressive print runs, ranging from nearly 4,000

periodicals, which often served as cultural touchstones for aspiring readers who modeled their own notions of taste, judgment, and polite conversation upon them. Indeed, the directors of the nearby Library Company of Philadelphia were forced to replace their copies of the *Spectator*, *Tatler*, and *Guardian* because the originals had been “read to tatters” by enthusiastic members.[22]

But the most striking aspect of the Juliana library was the enormous attention given to scientific and technical literature. Of the roughly five hundred books purchased between 1760 and 1763, nearly a fifth of all works fell into this category. Members and their guests could draw upon a vast array of sources covering almost every field of scientific inquiry.[23] At one end of the spectrum, the library contained a number of accessible guidebooks which promised to explain the complexities of natural philosophy to a lay audience. The notion of science “made easy”—a reassuring phrase often displayed prominently on the title page of such works—had proven so popular among readers that an entirely new genre of literature had emerged under this banner by the

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copies per issue in the case of the early *Spectator* to a more modest 500 copies for some of its imitators, later publishers paid lavish sums to acquire the copyrights which would allow them to reprint these journals in bound editions for the larger public. Indeed, periodicals such as the *Spectator* and *Tatler* had some of the most valued and jealously guarded copyrights in the English language. See, Donald F. Bond, ed. *The Spectator*, 5 vols. (Oxford, 1965), I, xx-xxvii.

[22] Wolf, “Franklin and His Friends,” 21. Such periodicals were by no means absent from more formal educational settings. The Trustees of the neighboring Academy of Philadelphia assigned “*Spectators*, *Ramblers*, and monthly Magazines for the Improvement of Style and Knowledge of Life” to all incoming freshman. See the detailed curriculum printed in the *Pennsylvania Gazette*, 12 August 1756.

[23] G.S. Rousseau surveys the terrain of eighteenth-century scientific publications, including an appendix of scientific books contained in the libraries of some prominent contemporaries, in “Science Books and their Readers in the Eighteenth Century,” in *Books and their Readers in Eighteenth-Century England*, ed. Isabel Rivers (New York, 1982), 197-255.

middle of the eighteenth century.[24] Not surprisingly, the most popular expositors of Newtonian science, writers such as William Whiston, Samuel Clarke, William Derham, Isaac Barrow, Benjamin Martin and John Keill, figured prominently in the library's collections. In a similar vein, the directors acquired a variety of mathematical texts designed to introduce beginners to the relevant branches of algebra, geometry, trigonometry, and analysis. For those who already possessed the necessary skills and background, the library also offered highly specialized works in physics and astronomy, such as Isaac Newton's *Principia Mathematica* or Edmund Halley's *Regii Tabulae Astronomicae*. The decision to purchase such challenging texts suggests that certain members, at least, were interested in exploring the highest branches of natural science.

Yet the overwhelming majority of the library's collections were geared towards more accessible disciplines, including mechanics, agronomy, optics, chemistry, botany, and natural history. Of particular interest, in this regard, was the large body of literature devoted to "mixed mathematics" which encompassed such important fields as surveying, cartography, pneumatics, navigation, architecture, hydraulics, military engineering, gunnery, gauging, and dialing—all of which were represented in the catalogue.[25] In addition to this impressive array of technical works, the library contained essential resources like Ephraim Chamber's *Cyclopaedia* as well as a nineteen volume set of the

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[24] For the advent of "polite" texts designed to instruct beginners, see Mary Terrall, "Natural Philosophy for Fashionable Readers," in *Books and the Sciences in History*, ed Marina Frasca-Spada and Nick Jardine (Cambridge, 2000), 239-54; and Alice N. Walters, "Conversation Pieces: Science and Politeness in Eighteenth-Century England," *History of Science* 35 (1997), 123-35.

[25] On the concept of mixed mathematics, see Chapter 5.

compiled *Philosophical Transactions* of the Royal Society. Even the potential interests of children were addressed. They could read works like Antoine Pluche's *Spectacle de la Nature: or, Nature Displayed*, which introduced boys and girls to the curious world of natural philosophy through imaginary dialogues and vivid illustrations.[26] The depth and scope of the library's scientific holdings would appear to speak volumes about the appetite for natural knowledge within provincial communities, even those far removed from the metropolitan centers of learning.

Other aspects of the Juliana Library Company, particularly its large assortment of scientific instruments, further underscore this point. In just a few years, the directors managed to assemble a panoply of "philosophical instruments" that included most of the key devices associated with the new experimental science. The libraries inventory reveals that the company had acquired an orrery, two pairs of globes, a solar microscope, a camera obscura, a thermometer, a barometer, an artificial magnet, two of the latest "catoptric" or reflecting telescopes, Hadley's improved sea-quadrant, a fore staff, a nocturnal, Everard's sliding rule, a chemical balance, and "a large and curious sett of Mathematical Instruments, in a shagreen case."[27] Perhaps the only conspicuous items

[26] Pluche's work, in particular, was quite striking in that he purposely aimed to equip young people with *both* a working knowledge of science and an ability to engage in the art of polite conversation amongst mixed company. For Pluche's views on the connections between curiosity, conversation, and the exercise of the rational faculties, see, *Spectacle de la Nature: or, Nature Displayed…*, trans. Samuel Humphreys, 7 vols. (London, 1739), I, vii-xix. For an analysis of the growing market for children's scientific books, see James A. Secord, "Newton in the Nursery: Tom Telescope and the Philosophy of Tops and Balls, 1761-1838," *British Journal for the History of Science* 23 (1985), 127-51;

[27] *Charter, Laws, and Catalogue of the Juliana Library*, 55-56. For context as to the range of contemporary instruments that were popular at the time, see Robertson, *A Treatise of such Mathematical Instruments as are Usually Put into a Portable Case…* (London, 1757), 1-4; George Adams, *Geometrical and Graphical Essays, Containing a Description of the Mathematical Instruments used in Geometry, Civil and Military Surveying…* (London, 1791), 10-12.

missing from their collection were an air pump and the increasingly popular "electrical machine"; the latter of which, the directors assured, "will be added as soon as possible."[28] Given the considerable cost of purchasing such an extensive array of instruments, the Juliana Company clearly placed a high priority on making the practical tools of science available to its members, implements that most individuals could probably not afford to purchase on their own. Yet as subscribers, each person could borrow these items for up to two weeks, giving them ample time and opportunity to experiment with them.[29]

The library also helped to make these devices more accessible by purchasing one of the most comprehensive guides to scientific instruments available at the time, an English translation of Nicholas Bion's famed *Instruments de Mathématique*.[30] This impressive folio, complete with 30 lavish copper-plate engravings, offered an encyclopedic survey of how to construct, repair, and most importantly, utilize the vast

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[28] Ibid, 56. G.L'E. Turner provides an insightful overview of the growing standardization of scientific instrument collections among eighteenth-century libraries, philosophical societies, colleges, and private connoisseurs in "Eighteenth-Century Scientific Instruments and Their Makers" in *The Cambridge History of Science* 8 vols. (Cambridge, 2003), IV, esp. 513-22. From the library's account book, it appears that the directors managed to acquire an electrical machine by 1768, and it may very well have been built locally. See the secretary's financial accounts printed in Landis, "Juliana Library Company," 35.

[29] Article 19 of the company's by-laws establishes the rules governing the use of the library's philosophical instruments. Some items required the permission of the directors to be checked out, while others could be borrowed at any time. Ibid, 26.

[30] Nicholas Bion, whose success with producing globes and mathematical instruments earned him the title *Ingénieur du Roi* to Louis XIV, published *Instruments de Mathématique* in 1709. Bion's text went through numerous translations and editions; in fact, his book is still in print today. The first English edition, which appeared in 1723, was translated by Edmund Stone in collaboration with John Senex, who handled the elaborate engravings and publishing. The Juliana Library purchased the second edition that appeared in 1758, published by Joseph Richardson, whose background in fashionable literature would suggest that he saw a potentially broad (and profitable) audience for the work. For a glowing contemporary review of this edition, and the potential audiences that it would serve, see the *Critical Review*, IX. See also, Clark, *An Essay upon Study*, 309. On Richardson's trade, see Thomas Mortimor, *The Universal Director…* (London, 1763), 169. For his business connections to American book sellers, see Elizabeth Carroll Rielly, "The Wages of Piety: The Boston Book Trade of Jeremy Condy," in *Printing and Society in Early America*, 88-89, 96.

array of devices associated with natural philosophy and mixed mathematics. The translator, Edmund Stone, had gone to great lengths to incorporate numerous changes and additions to Bion's text, providing a more user-friendly work that would appeal to "almost every Gentleman" as well as "Men of Action and Business."[31] A reader could find clear yet detailed instructions on how to use everything from a basic ruler and compass to the most advanced theodolite. Stone's personal background made him the perfect candidate for such a task. Although he eventually became a member of the Royal Society and one of the most respected mathematicians of his day, Stone had grown up without any formal education, working as a common gardener on a nobleman's estate. His own entrée into the world of science came when he spent time with a group of visiting masons who were kind enough to patiently explain the various mathematical tools they were using to build a structure on the property. The young gardener became so captivated with this subject that he spent the next few years teaching himself how to read mathematical and philosophical texts in English, Latin, and French.[32] In his latter career,

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[31] Nicholas Bion, *The Construction and Principal Uses of Mathematical Instruments translated from the French of M. Bion, …*, trans. Edmund Stone, 2nd ed. (London, 1758), v. In essence, Stone used Bion's text as a foundation for creating his own treatise, adding entirely new chapters on over 20 English instruments or recent devices that Bion did not address; revising other sections that he felt were either unclear or misleading; incorporating an extensive glossary to explain all terms to beginners; and commissioning John Senex—the premier scientific engraver of the period—to execute the various illustrations. In addition to its accessible format, the actual cost of this folio would suggest that Stone and Richardson were serious about reaching a fairly broad audience including artisans, tradesmen, and the like. While savants and gentlemen could purchase ornately bound editions that went for a £1 or more from various booksellers and catalogues, those with more limited means could still purchase the folio sewed "in sheets" for as little as 4 shillings, a veritable bargain for an illustrated folio of its kind. For the unbound versions, see "Books printed for J. Richardson in Pater-Noster Row" (1760). The firm of Robinson and Roberts were advertising bound copies in 1768 for £1.5.0 ("Books printed for Robinson and Roberts, in Pater-noster-Row" [1768]), while Benjamin Franklin paid the firm of Wilson and Nicol £1.1.0 for his "full calf" bound edition in 1769 (see, Edwin Wolf II and Kevin J. Hayes, *The Library of Benjamin Franklin* [Philadelphia, 2006], 132).

[32] The details surrounding Stone's background and his rise to prominence as a self-taught mathematician are discussed in *The Dictionary of National Biography* and *The Dictionary of Scientific Biography*. By the beginning of the nineteenth century, Stone had become an almost iconic figure, embodying the centrality of self-taught knowledge to

Stone focused heavily on creating mathematical dictionaries, textbooks, and annotated translations that would render the fields of mathematics and natural philosophy more accessible to lay audiences.[33] Nor was he alone in this respect. A number of authors vied to produce the clearest guidebooks that would explain the theoretical and practical aspects of scientific instruments to an expanding audience that ranged from curious gentlemen to aspiring tradesmen. Such works made it possible for literate men and women, like those who participated in the Juliana Library, to engage in scientific pursuits despite the growing specialization of both tools and techniques that was beginning to define certain fields by the eighteenth century.

The library also began to acquire natural curiosities that were intended for the edification and study of its members. Unfortunately, the extant records do not describe these items in much detail, but they appear to have been largely comprised of "curious Mines, Minerals and Fossils" gathered from the region and elsewhere.[34] With the growing importance of mining and metallurgy to the economy of western Pennsylvania, these items probably spoke to the pragmatic concerns of some members who were

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social mobility. Indeed, he was lionized in self-help works and popular literature as a kind of English version of Benjamin Franklin.

[33] In addition to his widely esteemed translation of Bion's text on mathematical instruments, Stone had considerable success with his own work, *The Description, Nature, and General Use of the Sector and Plain-Scale,* which appeared in 4 successive editions. His large-scale compilation, *A New Mathematical Dictionary*, was also well received and was published in two editions during his lifetime. But equally important was his work in the realm of translating and updating various texts on natural philosophy and mathematics. He produced accessible English editions—often replete with numerous annotations and illustrations—of such weighty tomes as Isaac Barrow's geometrical lectures, Gravesande's lectures on Newtonian philosophy, the Marquis L'Hospital's works on calculus and conic sections, David Gregory's prized Latin edition of Euclid's geometry, and Gregory's treatise on astronomy. Stone also translated more practical works such as Henri Pitot's French text on navigation or Gravesande's essay on the uses of mathematical perspective.

interested in developing the area's potential resources.[35] One of the library's directors, Thomas Barton, was particularly active in promoting the useful benefits that would flow from this particular branch of natural history. As his son later recalled, Barton's "fine collection of North American minerals" was unrivalled at the time, consisting of valuable salts, marls, ores, fossils, and crystals.[36] Some of these specimens were given to the Juliana Library while others were included in the large "box of natural Productions" that Thomas Barton sent dutifully to the Penn family in England.[37] Since these items could reveal the scope of the region's mineral deposits and natural resources, they possessed a special relevance to the colony's proprietors as well as the library's membership. That "great advantage" could be gleaned from such collections had already prompted John Bartram, a nearby naturalist, to propose an ambitious "scheme" for executing a more

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[34] *Charter, Laws, & Catalogue of the Juliana Library*, 56. These items were provided by Rev. Thomas Barton, who was a principle figure in the founding of the library and one of its earliest directors. On his interest in such matters, see Charles W. Rutschky, "Thomas Barton's Collection of Minerals," *Pa History* 8 (1941), 148-50.

[35] By 1750, the American colonies, with Pennsylvania in the lead, were producing roughly 1/8 of the world's pig iron. Richard Middleton, *Colonial America: A History, 1565-1776*, 3rd ed. (Oxford, 1996) 209; Adolph B. Benson, ed., *Peter Kalm's Travels in North America…* (New York, 1937), 159; Arthur C. Binning, *Pennsylvania Iron Manufacture in the Eighteenth Century*, 2nd ed. (Harrisburg, Pa., 1973); James Swank, *Introduction to a History of Ironmaking and Coal Mining in Pennsylvania* (Philadelphia, 1878), 17-33Lancaster County had not only several iron mines and forges, but also copper and lead works by this time as well as rich limestone deposits. On the geological resources of the area, see J. I. Mombert, *An Authentic History of Lancaster County* (Lancaster, Pa., 1869), 346, 605-10. On the interest in metal trades in Lancaster, see Bridenbaugh, *Colonial Craftsman*, 117-20. In this context, the libraries purchase of an English assaying instrument for testing the purity and composition of alloys is all the more suggestive.

[36] Rutschky, "Barton's Collection of Minerals," 148-9. While Benjamin Smith Barton's assessment no doubt reflects a bit of filial pride, his eventual status as one of America's leading naturalists certainly adds weight to his assessment. Thomas Barton, himself, taught at the Academy of Philadelphia and corresponded with a number of important scientific and political figures, including Linnaeus. On Barton's career, see especially M.F. Russell, "Thomas Barton and Pennsylvania's Colonial Frontier," *Pennsylvania History* 46 (1979), 313-34; and Kerby A. Miller et. al., eds., *Irish Immigrants in the Land of Canaan: Letters and Memoirs from Colonial and Revolutionary America, 1675-1815* (Oxford, 2003), 487-99.

[37] Ibid, 149. The Penn family had already begun to quietly arrange some surveying parties for the backcountry which were instructed to gather and examine mineral deposits among other useful "intelligence." The details are related in Lawrence Henry Gipson, *Lewis Evans, to which is added Evans' A Brief Account of Pennsylvania…* (Philadelphia, 1939), 33-38.

systematic geological survey of the colonies. Bartram's project, which epitomized the fusion of scientific knowledge and public improvement, envisioned a network of gentlemanly volunteers who would use special augers "to bore the ground to great depths, in all the different soils in the several provinces." By carefully documenting "the contents of the bit, every time the augur is drawn out…and the particular depth of every *stratum* they bore through", these attentive virtuosi could begin to compile a "subterranean map" that would reveal the untapped resources lying beneath their very own feet.[38] In addition to the various minerals and ores that might be discovered for commercial purposes, Bartram emphasized the range of practical benefits that would flow from such geological knowledge: rich beds of marl that could serve as much-needed manure, salt deposits that would free communities from costly imports, peat or coal that would supply energy, and subterranean water that might be extracted for irrigation.[39] While it is doubtful that the members of the Juliana Library Company entertained such grandiose plans, they did share a similar utilitarian faith in the ultimate benefits that would accrue from the diligent

[38] John Bartram to Dr. Alexander Garden, 14 March 1756, printed in *Memorials of John Bartram and Humphrey Marshall…* (Philadelphia, 1849), 392-3.

[39] Ibid, 393. Another contemporary who shared Bartram's interest in the possibilities of a geological survey was Lewis Evans, a well-known and well-connected Pennsylvanian geographer. Evans, who was a close associate of one of the library's directors, Edward Shippen, had produced a highly praised map of the middle colonies that was accompanied by an analysis of the natural history of the region. Evans had apparently collected a wide range of geological information, intending to create a series of new, three-dimensional maps that would include a "perpendicular [cross] Section" showing not only "the Elevations, Depressions, outer Appearances and Names of places" but more importantly, "the Nature of the Soil, Substrata and particular Fossils" beneath the surface. And like Bartram, he was particularly interested in the practical uses that could be gained by locating beds of minerals, salts, and marls. See, Evans, *Historical, Political, Philosophical, and Mechanical Essays* (Philadelphia, 1755), 1-4; Gipson, *Lewis Evans, 8,* 95-7, 104-7. Martin J.S. Rudwick explores the evolution of geological mapping, and in particular, the attempts to visually render three dimensional knowledge onto paper in his, "The Emergence of a Visual Language for Geological Science, 1760-1840," *History of Science* 14 (1976), 149-95.

study of nature's artifacts.[40]

Yet, as was true with other philosophical organizations of the time, the acquisition of such "cabinets of curiosity" also reflected broader cultural desires to foster the appropriate taste and discernment among individuals, making them enlightened connoisseurs of the natural world.[41] Curiosity, after all, represented one of the defining attributes that distinguished the eighteenth-century *cognoscenti* from the rest of society, making the study of such objects an exercise in the kind of inquisitive ethos that the members of the Juliana Library were hoping to cultivate.[42] At a time when many embraced John Locke's view of the mind as a *tabula rasa*, learning to engage the world in an attentive and observant manner was crucial to the proper development of the intellect. Empiricism, in this respect, encompassed a whole range of cultural practices and attitudes, not just a narrow set of epistemological propositions about how knowledge

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[40] The interest in studying geological specimens seemed to extend beyond the library company. When Johann David Schöpf traveled trough Lancaster in 1783, hunting for plants and *materia medica*, he was impressed by the Rev. Henry E. Muhlenberg's "cabinet of home minerals" that he considered one of the finest in America. One of Thomas Barton's sons, Matthias, also diligently pursued geology in his free time. A prominent lawyer and local politician, Matthias Barton assembled a "large collection of the mineral productions of Pennsylvania" including "many specimens of the ores and clays of his native State." See, Mombert, *Authentic History of Lancaster*, 373; Alexander Harris, *A Biographical History of Lancaster County…* (Lancaster, Pa., 1872), 30.

[41] Silvio A. Bedini, "The Evolution of Science Museums," *Technology and Culture* 6 (1965), 1-29; Joel J. Orosz, *Curators and Culture: The Museum Movement in America, 1740-1870* (Tuscaloosa, Alab., 1990). On the evolution of cabinets of curiosity in Britain, see the essays by Arthur MacGregor, "The Cabinet of Curiosities in Seventeenth-Century Britain," and Michael Hunter, "The Cabinet Institutionalized: The Royal Society's 'Repository' and Its Background," both in *The Origins of Museums: The Cabinet of Curiosity in Sixteenth- and Seventeenth-Century Euorpe*, ed. Arthur MacGregor and Olivery Impey (Oxford, 1985), 147-58, 159-68; and R.G.W. Anderson et. al., eds., *Enlightening the British: Knowledge, Discovery and the Museum in the Eighteenth Century* (London, 2003).

[42] Barbara M. Benedict has examined the important shift that took place by mid-eighteenth century in the cultural meaning attached to such activities as collecting, connoisseurship, and curiosity, itself. The older critiques of curiosity, ranging from the charge of indulgent credulity to subversive questioning, largely faded away as new groups of writers and cultural arbiters made the investigation of curious objects into a prestigious marker of respectability and discernment. See both Benedict, *Curiosity: A Cultural History of Early Modern Inquiry* (Chicago, 2001), ch. 4, and Peter Harrison, "Curiosity, Forbidden Knowledge, and the Reformation of Natural Philosophy in Early Modern England," *Isis* 92 (2001), 265-90.

worked. Accordingly, one had to learn how to observe phenomenon carefully: to sharpen the senses, to ask the right questions, to draw perceptive conclusions, and to evaluate their merits in the give-and-take atmosphere of conversation with others. In short, individuals had to school themselves in the *art* of curiosity, developing those traits which exemplified how a sentient person should interact with the material world surrounding them.[43]

For precisely this reason, many of the social libraries of the period had begun to assemble their own displays of natural specimens and rarities, a trend that was mirrored in private homes and studies as well.[44] Such curiosities, which were intended to spark questions and lead to elevated conversation, served ultimately to connect the growing interest in the natural world to the emerging culture of refinement and polite sociability that made institutions like the library company so appealing.[45] Indeed, Benjamin Franklin argued that students enrolled in the new academy in Philadelphia should be

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[43] See, for example, the witty analysis of curious culture and collecting in *The Connoisseur: By Mr. Town, Critic and Censor-General*, no. 2, 7 February 1754. Jessica Riskin explores some of the broader intellectual, cultural, and even political implications of empiricism in *Science in the Age of Sensibility: The Sentimental Empiricists of the French Enlightenment* (Chicago, 2002).

[44] The nearby Library Company of Philadelphia had assembled so many specimens and curiosities by 1739, that they were forced to move the entire library to a larger space in the newly completed State House (now Independence Hall). See, Edwin Wolf II, *At the Insistence of Benjamin Franklin: A Brief History of the Library…* (13-15). A description of their collection can be found in *The Charter, Laws, and Catalogue of…the Library Company of Philadelphia* (Philadelphia, 1770), 4-8. For the widespread popularity of these collections, particularly among social libraries of the time, see Raven, *London Booksellers and American Customers*, 48, 64-7, 166-70; Paul M. Rea, "A Contribution to Early Museum History in America," *Proceedings of the American Association of Museums* 9 (1915), 53-65. For philosophical organizations, see Whitfield J. Bell Jr., "The Cabinet of the American Philosophical Society," in *A Cabinet of Curiosities: Five Episodes in the Evolution of American Museums,* ed. Whitfield J. Bell Jr., et al. (Charlottesville, Va., 1967), 1-34. These trends also reflected the growing popularity of natural history, a field which had began to recover from a period of neglect caused by the dominance of mathematics and experimental philosophy. On the resurging interest in natural history and the new-found respect accorded to the examination of specimens, see John Gascoigne, *Joseph Banks and the English Enlightenment: Useful Knowledge and Polite Culture* (Cambridge, 1994), 73-117; and *A Supplement to Mr. Chamber's Cyclopaedia: or, Universal Dictionary of Arts and Sciences* 2 vols. (London, 1753), ii.

[45] Bushman, *The Refinement of America*, ch. 2; Riskin, *Science in the Age of Sensibility*.

thoroughly immersed in the discipline of natural history precisely because it would improve their powers of observation, judgment, and discourse. "The Conversation of all will be improved by it," he pointed out, "as Occasions frequently occur of making Natural Observations, which are instructive, agreeable, and entertaining in almost all Companies."[46] Increasingly, contemporaries invested considerable value in the attentive study of nature, expecting that it would pay "instructive" dividends in various aspects of life ranging from health to business to the pleasures of agreeable conversation.

The Juliana Library's heavy emphasis on science and useful knowledge was central to a vision of personal improvement that spoke to the library's diverse membership. While the cost of joining the organization (40 shillings) was well beyond the reach of many struggling families, the subscription lists reveal that members came from a variety of different backgrounds and stations. As one might expect, the library company included many of the prominent individuals in local society—namely, merchants, lawyers, clergymen, doctors and political officials. But their numbers were balanced by an equally large share of well-to-do farmers, artisans, metal workers, shopkeepers, and the like, who played a significant role in shaping the distinctive

[46] [Franklin], *Proposals Relating to Education*, 25-7. Franklin suggested, in particular, that students read works such as John Ray's *Wisdom of God*, William Derham's *Physico-Theology* and Pluche's *Spectacle de la Nature*. To get a sense of just how far these new values and prescriptive norms had evolved—trumpeting curiosity, conversation, and an attentive observation of the natural world—one might compare Antoine Pluche's encouraging address to children in *Spectacle de la Nature* with one of the more traditional guidebooks for Anglo-American youth, Eleazar Moody's *The School of Good Manners. Or Rules for Children's Behavior…* 5th ed. (New London, 1754), which focuses on the stern control of the tongue and any inquisitive impulses. C. Dallet Hemphill, among others, has drawn attention to the changing social and class dynamics that were embedded in the shifting emphasis of eighteenth-century conduct manuals, which began to articulate a new way of conceiving and presenting the self that differed from the aristocratic codes of self-discipline that dominated the preceding period. See: Hemphill, "Manners and Class in the Revolutionary Era: A Transatlantic Comparison," *William and Mary Quarterly* 63 (2006), 345-72.

character of the region as well as its library.[47] Creating an appropriate venue for such diverse groups—one where different individuals could coalesce around a common yet purposeful set of activities—represented a civic imperative for the inhabitants of Lancaster as well as other provincial communities at mid-century. The motto of the town's new voluntary fire company, "In Union there is Strength," captured the sentiments of many who embraced the emerging clubs and civic associations as a means to bridge the sectarian and partisan divides of the past.[48] Drawn from a spectrum of ethnic and religious persuasions—including the town's small Jewish community—the members of the library hoped to capitalize on the opportunities for both personal and public improvement which the institution promised.[49] And as the directors noted, the practical bent of the library's holdings would serve the "particular Genius for *Agriculture* and the *Mechanic Arts*" that was a source of pride among local residents. In true Baconian fashion, the study of experimental knowledge and innovation would stimulate improvements in all branches of life, leading to a steady advance in both the moral and

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[47] By 1770, tradesmen and artisans made up 66% of the Lancaster's tax rolls and they played a large role in the social and political life of the community. See Bridenbaugh, *Colonial Craftsmen*, 120; Wood, *Conestoga Crossroads*, 32-9.

[48] Sanderson, *Historical Sketch of the Union Fire Company*, v. The Rev. Richard Peters, who served as the provincial secretary, expressed this growing sense of enthusiasm for the variety of civic "projects" which not only succeeded in contributing some material improvement to society, but also brought together groups that had been increasingly hostile because of religious and political strife. Like many observers, he was struck by the fact that these schemes were carried out by "a Sett of private men" without any aid or direction from the government. See his revealing remarks in Peters, *Sermon on Education, Wherein some Account is given of the Academy, Preach'd at the Opening thereof…* (Philadelphia, 1751), 22-24.

[49] One of the library's directors, Rev. Thomas Barton, captured the striking religious diversity of the local community when he explained to the secretary of the SPG that the Anglican community was a tiny minority compared to the "German Lutherans, Calvinists, Mennonists, Moravians, New Born, Dunkars, Presbyterians, Seceders, New Lights, Covenanters, Mountain Men, Brownists, Independents, Papists, Quakers, Jews, etc." Thomas Barton to SPG Secretary, 16 November 1764, printed in *Historical Collections Relating to the American Colonial Church*, ed. William Stevens Perry, 4 vols. (Hartford, 1870-78), II, 366-72. For modern assessments, see Rodger C. Henderson,

material well being of its practitioners.[50] In contrast to the traditional subjects of genteel learning—fields such as classical literature or poetry that were only suitable for the leisured classes—the pursuit of useful knowledge could appeal to a much broader constituency which the library served. "An application of this Kind," the directors explained, "far from being useless or improper to the industrious *Husbandman*, or ingenious *Artist*, will sweeten his Toil, and repay him with Pleasure and Profit."[51]

If modern observers are tempted to dismiss such notions as rhetorical fancy, there is considerable evidence that Lancaster's craftsmen and farmers actually pursued the study of science as a means to both "pleasure and profit." The local gunsmith and shop-keeper William Henry, for instance, made good use of the library's collections to conduct wide-ranging experiments in chemistry, metallurgy, electricity, and steam engines. While Henry took care of his business during the day, as a family member later recalled, "his evenings and mornings were devoted to the laboratory." Yet, it would be a mistake to interpret his interest in science as an isolated pursuit, something divorced from his daily interactions with friends, acquaintances, and practical concerns. Even at work, Henry's propensity to "discourse upon the subjects of science" shaped the atmosphere of his store, turning it into a kind of rural *salon* for those who shared his interests. Like the library's

"Demographic Patterns and Family Structure in Eighteenth-Century Lancaster County, Pennsylvania," *PMHB* 114 (1990), 353. On the eclectic background of the library's membership, see also Wood, *Conestoga Crossroads*, 227.

[50] Catalogue, ix. Like the followers of Bacon in England, who aimed to compile and disseminate useful discoveries under the rubric of an all-encompassing "history of trades", the directors of the Juliana Library emphasized the potential benefits that would accrue from having access to a repository filled with such books. Here, they pointed out, the reader "may view the Schemes of Millions that have gone before him in the same Art, compare them with his own, and put in Practice *that* which he thinks best." Ibid, x.

quarters, Henry's shop provided a sociable space where different groups could mingle to discuss scientific matters, curious topics, or their own schemes for improvement. Accordingly, it served as a "popular resort of mechanical men" and a favorite haunt for those who "possessed the little science of the town and neighbouring country."[52]

While it may be impossible for historians to discover who exactly these "mechanical men" were that gathered in such enlightened haunts, we do know about some of the local inhabitants who participated because of their eventual rise to prominence.[53] Both Robert Fulton and David Rittenhouse, for example, launched their careers as celebrated scientists and inventors by capitalizing on the resources of the Juliana Library. A formal education was simply beyond the reach of both men who came from modest families.[54] The prospect, therefore, of gaining access to such an extensive collection of books and instruments made the institution a prized resource among aspiring tradesmen in search of educational opportunities and personal advancement. Another

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[51] *Catalogue,* x. For similar arguments about the "Solidity and Use of Natural Philosophy and Mathematics" among farmers, traders, and mechanics, see the essay on education in the *Boston Evening Post* 4 June 1753.

[52] The descriptions of William Henry and his shop come from an account written by his son, John Joseph Henry, and are quoted in Whitfield J. Bell Jr., *Patriot-Improvers: Biographical Sketches of Members of the American Philosophical Society*, 2 vols. (Philadelphia, 1997), I, 352.

[53] In addition to Fulton and Rittenhouse, whom I discuss here, other individuals who were known to frequent either the Juliana Library or similar scientific sites in Lancaster include Benjamin West (the painter), John Fitch (the steam boat experimenter), Joseph Priestley, Tom Paine, and Adam Kuhn. See Francis Jordon, *Life of William Henry*, 50-55.

[54] Robert Fulton Sr. was a respected tailor and farmer, who participated in local civic projects like the Juliana Library and the Union Fire Company. He struggled with debt, however, and would not have been able to pay for any formal education for his son (the future inventor), who was accordingly apprenticed to a silversmith. For the younger Fulton's background and his time spent at Henry's shop, see Cynthia Owen Philip, *Robert Fulton: A Biography* (New York, 1985), 3-8. On David Rittenhouse's background—that was likewise considered respectable but very "modest"—and his connections to Thomas Barton and the Juliana library, see William Barton, *Memoirs of the Life of David Rittenhouse…* (Philadelphia, 1813), 115-22; Brooke Hindle, *David Rittenhouse* (New York, 1980), 11-31. By the time of the library's creation, Rittenhouse was already an established clockmaker, working out of a shop he had built on his father's farm.

well documented case involved William Henry Stiegel, a German immigrant who arrived in Lancaster County after having worked for a few years as a clerk in Philadelphia. Stiegel found employment at the nearby Elizabeth Furnace where he managed to rise quickly, assembling a partnership that acquired the forge in just a few years. Stiegel's work in iron mongering, furnace design, and eventually glass production benefited from his ability to consult the technical literature of the Juliana library as well as the knowledge of its members. By the 1770s, the newly proclaimed "Baron" Stiegel was busy managing an industrial fiefdom worth thousands of pounds and was making his own contributions to the scientific community by manufacturing glass vials and philosophical instruments for the growing domestic market.[55] At a time when Britain's high quality glass was seen as crucial to maintaining the empire's lead in optical, navigational, and commercial technologies, and when Parliament had legally prohibited the export of such unfinished glass to other countries, the success of Stiegel's "American Flint Glass Manufactory" attracted considerable attention throughout the colonies.[56]

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[55] *Pennsylvania Gazette*, 23 March, 1769; 20 June 1771. Stiegel's glass works even received the endorsement of the American Philosophical Society, which had set up a special committee to inspect and evaluate his products. Stiegel's glass attracted special attention because he was the first in America to use lead oxide to produce flint glass—the highest form of glass that we today refer to as "leaded" or "crystal" glass—prized for its clarity, weight, and brilliance. Yet flint glass also contained certain properties, particularly its high dispersion and refractive index, which made it ideal for achromatic lenses, prisms, and other optical uses. See, APS Minutes, 21 June 1771; *Pennsylvania Gazette*, 27 June 1771. Stiegel's production of scientific instruments is also discussed in Barton, *Memoirs of David Rittenhouse*, 206-7. For perspective on the scope and worth of Stiegel's iron forges and glass works, see George L. Heiges, *Henry William Stiegel: The Life Story of a Famous American Glass-Maker* (Manheim, Pa., 1937), 33-39. The enormous array of glass items required for a functioning scientific laboratory is illustrated by Harvard's 1779 inventory of its "Philosophical Apparatus", which contained well over a hundred glass jars, vials, capillary tubes, globes, lenses, prisms, and the like. See I. Bernard Cohen, *Some Early Tools of American Science…in Harvard University* (Cambridge, Ma., 1950), Appendix II, 145-151.

[56] One measure of public recognition was the fact that the Pennsylvania Assembly granted Stiegel a sizable cash reward for his success. *Colonial Records of Pennsylvania*, 16 vols. (Harrisburg, Pa., 1838-53), X, 54. The production of glass was one of the most heavily regulated of British industries because of its commercial importance and because of the heavy excise taxes applied to both flint and crown glass (as opposed to the inferior categories of plate, broad, and

To be sure, most of the library's members did not go on to make a name for themselves as renowned scientists, inventors, or industrialists. Both then and now, figures like Rittenhouse or Fulton stood out for the depth of their interest and abilities. Indeed, the very notion of science as a profession would have been largely foreign to eighteenth-century colonists, who understood natural philosophy to be an essential part of polite learning, not a distinct vocation for specialists.[57] This point is worth underscoring because the goal of the Juliana Library Company, and other similar organizations of the period, was not to train dedicated scientists who would produce "path-breaking" research. Rather, they functioned as mutual improvement societies, offering members the educational tools and resources they needed to better themselves, their community, and their position in the world.[58] In this respect, the Juliana Library reflected a much larger movement that swept the provincial regions of Britain and her empire during this period. From Birmingham to Edinburgh to Charleston, provincial inhabitants flocked to

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bottle glass that were untaxed). On Britain's lead in glass production, optical technologies, and Parliament's prohibitions against their export, see Guy Miege, *The Present State of Great Britain, and Ireland…*, 11th ed. (London, 1748), 145; John Chamberlayne, *Magnae Britanniae notitia: or, the Present State of Great Britain…* (London, 1741), 34-5. Myles W. Jackson, *Spectrum of Belief: Joseph von Fraunhofer and the Craft of Precision Optics* (Cambridge, Ma., 2000), ch. 5. Various departments of the British state also had a vested interest in the manufacturing of high quality glass and lenses, which were necessary for a wide range of surveying, navigational, and military instruments. See Richard Sorrenson, "The State's Demand for Accurate Astronomical and Navigational Instruments in Eighteenth-Century Britain," in *The Consumption of Culture, 1600-1800: Image, Object, Text*, ed. Ann Bermingham and John Brewer (London, 1995), 263-71. The broad range of scientific and consumer items that depended on high quality flint glass can be seen in John Cuff's hand-bill advertisement *John Cuff, Optician, Spectacle, and Microscope Maker…* (London, [1745?]).

[57] Roy Porter, "Science, Provincial Culture and Public Opinion in Enlightenment England," *British Journal for Eighteenth-Century Studies* 3 (1980), 20-46.

[58] Dorothy F. Grimm, "Franklin's Scientific Institution," *Pennsylvania History* 23 (1956), 437-62. The image of library companies as essential civic institutions was a favorite theme of provincial newspapers. And as the historian John Smolenski has documented, the press' coverage of such voluntary associations often helped shape the broader public's conception of what active citizenship entailed. See, Smolenski, "'Incorporated…into a Body Politic': Clubs, Print, and the Gendering of the Civic Subject in Eighteenth-Century Pennsylvania," in *Periodical Literature in Eighteenth-Century America*, ed. Mark L. Kamrath and Sharon M. Harris (Knoxville, 2005), 54-9.

enlightened clubs and organizations that aimed to improve both the individual and society, hoping in the process to participate more fully in the vibrant world of metropolitan culture. This dimension of the Enlightenment, as historians have increasingly discovered, found tremendous support within provincial communities where groups avidly embraced the latest forms of learning, sociability, and civic engagement.[59] And as the case of Lancaster suggests, science figured prominently in these efforts because it addressed the everyday concerns of inhabitants who believed that it would bring both refinement and material prosperity to their communities. Such knowledge, in the words of the library's spokesmen, transformed people "into different creatures," making them enlightened Britons worthy of membership in an empire "now renowned and revered throughout the World, for her Wisdom, Policy, Leaning, and Arts."[60]

Situated within this broader context, the example of the Juliana Library Company invites historians to reconsider the complex role that science played in helping colonists negotiate the dynamic forces changing their world at mid-century. Although previous

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[59] John Clive and Bernard Bailyn, "England's Cultural Provinces: Scotland and America," *William and Mary Quarterly* 11 (1954), 200-213; Davis Dunbar McElroy, *Scotland's Age of Improvement: A Survey of Eighteenth-Century Literary Clubs and Societies* (Pullman, Wash., 1969); Nicholas Phillipson, "The Scottish Enlightenment," in *The Enlightenment in National Context* (Cambridge, 1981), 19-40; Bridenbaugh, *Cities in Revolt*, ch. 5 & 8; Joyce E. Chaplin, *An Anxious Pursuit: Agricultural Innovation and Modernity in the Lower South, 1730-1815* (Chapel Hill, 1993), ch. 5; Money, *Experience and Identity*, ch. 4-6; Porter, "Science, Provincial Culture, and Public Opinion,"; Porter, *Creation of the Modern World*, 11-14, 36-46, 232-55; Borsay, *The English Urban Renaissance*, ch. 10; Kathleen Wilson, *The Sense of the People: Politics, Culture and Imperialism in England, 1715-1785* (Cambridge, 1995), ch. 1; and Gascoigne, *Joseph Banks and the English Enlightenment*, ch. 5. One of the most striking manifestos of the provincial Enlightenment, in this respect, was penned by Samuel Madden—an Irishman and a vocal supporter of the Dublin Society. See his: *Reflections and Resolutions proper for the Gentlemen of Ireland, As to their Conduct for the Service of their Country…* (Dublin, 1738).

[60] *Charter, Laws, and Catalogue of the Juliana Library*, i. On the ways in which Americans increasingly trumpeted the links between natural knowledge and societal progress during this period, see Hindle, *Pursuit of Science in Revolutionary America*, 190-215; J.R. Pole, "Enlightenment and the Politics of American Nature," in *The Enlightenment in National Context* , ed. Roy Porter and Mikulas Teich (Cambridge, 1981), 192-214; and Chaplin, *An Anxious Pursuit*, 131-276.

generations certainly had to contend with outside developments that intruded upon their local affairs, nothing compared to the dramatic affects of sustained imperial warfare, commercialization, ethnic migration, and Anglicization that swept the British Atlantic in the course of the eighteenth century.[61] As the inhabitants of Lancaster knew all too well, provincial communities faced an increasing range of challenges and opportunities as the imperatives of both empire and market began to exert a powerful influence on their daily lives.[62] This context is crucial in understanding how and why colonists chose to invest their limited time and resources in the pursuit of science. For as we shall see, the growing appeal of "useful knowledge" was directly tied to the emergence of new networks of communication, commercial expansion, patterns of consumption, forms of sociability, and modes of public life that were transforming the very fabric of provincial

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[61] Ian K. Steele, *The English Atlantic, 1675-1740: An Exploration of Communication and Community* (Oxford, 1986). On the sense of provincial isolation at the beginning of the century, see Landsmen, *From Colonials to Provincials*, esp. 31; Herbert L. Osgood, *The American Colonies in the Seventeenth Century*, 3 vols. (New York, 1904), II, 433-42, III, 507-21; J.M Sosin, *English America and Imperial Inconstancy: The Rise of Provincial Autonomy, 1696-1715* (Lincoln, Neb., 1985), esp. 233-35; Kraus, *Intercolonial Aspects of American Culture*, introduction & ch. 2. The cultural impact of this isolation is provocatively explored in Richard D. Brown, *Knowledge is Power: The Diffusion of Information in Early America, 1700-1865* (Oxford, 1989), ch. 1-2. Bradford J. Wood has written thoughtfully about the need for historians to investigate how the new eighteenth-century trends of Anglicization and "transatlantic integration" fit into more traditional patterns of localism as well as the newly emerging regional cultures and social networks that began to distinguish the late colonial period. Wood, "'For Want of a Social Set': Networks and Social Interaction in the Lower Cape Fear Region of North Carolina, 1725-1775," in *Cultures and Identities in Colonial British America,* ed. Robert Olwell and Alan Tully (Baltimore, 2006), 45-69.

[62] Historians have tended to agree that the middle decades of the eighteenth century marked a dynamic period of economic, demographic, and cultural change which shattered the previous patterns of isolation and "persistent localism" that had characterized colonial American society in the past. The larger interpretive meaning of this change, however, has provoked disagreement among scholars, with some emphasizing the theme of Anglicization, others prioritizing the framework of modernization, and still others pointing to the tensions and anxieties caused by the turbulent growth. See, T.H. Breen, *The Marketplace of Revolution: How Consumer Politics Shaped American Independence* (Oxford, 2004), 33-192; T.H. Breen and Timothy Hall, "Structuring Provincial Imagination: The Rhetoric and Experience of Social Change in Eighteenth-Century New England," *American Historical Review* 103 (1998), 1411-1439; Jon Butler, *Becoming America: The Revolution before 1776* (Cambridge, Ma., 2000); Bridenbaugh, *Cities in Revolt, passim*; Gordon S. Wood, *The Radicalism of the American Revolution* (New York, 1992), 124-168; Jack P. Greene, "Search for Identity: An Interpretation of the Meaning of Selected Patterns of Social Response in Eighteenth-Century America," *Journal of Social History* 3 (1969), 189-220.

society throughout the empire.[63] By embracing science, the citizens of Lancaster sought to channel these forces into a concerted campaign of improvement—one that spoke directly to their shared anxieties and aspirations. The activities of this frontier library, like a host of similar endeavors in Scotland, Ireland and America, represented a conscious attempt to appropriate the most dynamic aspects of metropolitan culture to address the pressing concerns of provincial life. Indeed, the growing appeal of science went to the heart of what one historian has called the peculiarly "cosmopolitan form of provinciality" that defined American society during the late colonial period.[64]

The remainder of this chapter examines how science came to assume such a role in provincial society, emerging as an endeavor that was both meaningful and accessible to significant numbers of literate colonists. It traces the web of people, institutions, and historical developments that led to the creation of an indigenous scientific community—one capable of sustaining the broader public's interest in useful knowledge. Whereas previous chapters focused largely on Britain or the empire, highlighting the evolving relationship between the world of science and the culture of improvement, the following

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[63] In addition to the work by Carl Bridenbaugh, Ned Landsman, and David Shields, see Michael Kammen's perceptive analsysis of the dramatic mid-century changes in New York's intellectual and cultural life in *Colonial New York: A History* (New York, 1975), 242-77, as well as Trevor Burnard's portrayal of the aspiring provincial elites of mid-century Maryland in *Creole Gentlemen: The Maryland Elite, 1691-1776* (New York, 2002), ch. 7.

[64] Landsman, *From Colonials to Provincials*, 63. See also, Ned C. Landsman, "The Provinces and the Empire: Scotland, the American Colonies, and the Development of Provincial Identity," In *An Imperial State at War: Britain from 1689 to 1815* ed. Lawrence Stone (New York, 1994), 258-87. Carla Mulford has likewise raised the point that science provided a key arena in which colonists could both adopt the latest forms of European culture while also addressing their own experiences, concerns, and priorities. But I disagree with her conclusions that the growing interest in science around mid-century led to a "creole" identity that "functioned as a putative nationalism" distancing colonial elites from England and Europe. See Mulford, "New Science and the Question of Identity in Eighteenth-Century British America," in *Finding Colonial Americas: Essays Honoring J.A. Leo Lemay*, ed. Carla Mulford and David S. Shields (Newark, Del., 2001), 79-103, 80.

discussion turns attention squarely to the American context, exploring how colonists acquired the tools and cultural literacy to participate in these emerging movements. After all, the efforts to develop a trans-Atlantic network of improvers would have floundered if provincial communities did not have the requisite training and resources to support such enlightened aspirations. The fact that the inhabitants of a remote community like Lancaster were able to assemble and utilize such an impressive scientific collection suggests that provincial society already possessed a far-reaching economy of knowledge by 1760, providing the requisite infrastructure that fueled the growing popularity of science on both sides of the Atlantic.

Science and the World of Print

The diffusion of science in colonial America was intimately tied to one of the most striking characteristics of the eighteenth century—the dramatic expansion of print culture. Contemporaries, themselves, were often quick to highlight this point, claiming that the emergence of new forms of knowledge and their rapid spread throughout the cosmopolitan "republic of letters" rested upon the increasing accessibility of the printed word.[65] Such claims seemed indisputable to Samuel Miller, a New York clergyman and amateur historian, whose survey of intellectual life in the eighteenth century radiates with the enthusiastic outlook of the age. Indeed, Miller found it difficult to constrain his excitement over the consequences that arose from this "stupendous" growth in printed

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[65] Lorrain J. Daston, "The Ideal and Reality of the Republic of Letters in the Enlightenment," *Science in Context* 4 (1991), 367-86;

material, which in his estimation, had increased "a *thousand fold*" above the previous century. Drawing upon the popular mechanical imagery of the day, he likened this expansion of print to a "great moral and political engine" that efficiently circulated information among a broad "public"—an entity whose very existence depended upon print's unique ability to circumvent the traditional boundaries based upon ethnicity, class, or creed.[66] Although modern historians might shy away from the overtly whiggish tone of Miller's perspective, many scholars have pursed these core themes examining in intricate detail how a virtual "revolution" in print culture reconfigured the intellectual and cultural terrain of the Anglo-Atlantic world. Debate still continues over the exact depth and scope of this transformation. But there is little doubt that significant portions of American society witnessed a dramatic change as the proliferation of printed material began to reach individuals and communities that had remained largely isolated in the past.[67]

As both a printer and an insatiable reader, Benjamin Franklin (b. 1706) was acutely aware of the changes he witnessed over the course of his lifetime. In his *Autobiography*, Franklin painted a vivid picture of colonial society in the early decades of

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[66] Miller, *A Brief Retrospect*, 2:417-9.

[67] Paul J. Korshin, ed., *The Widening Circle: Essays on the Circulation of Literature in Eighteenth-Century Europe* (Philadelphia, 1976); John Feather, "The Commerce of Letters: The Study of the Eighteenth-Century Book Trade," *Eighteenth-Century Studies* 17 (1984), 405-24; Michael Warner, *The Letters of the Republic: Publication and the Public Sphere in Eighteenth-Century America* (Cambridge, Ma., 1990); Jurgen Habermas, *The Structural Transformation of the Public Sphere: An Inquiry into a Category of Bourgeois Society*, trans. Thomas Burger (Cambridge, 1989); William L. Joyce, David D. Hall, and Richard Brown, eds, *Printing and Society in Early America* (Worcester, Ma., 1983); Hugh Armory and David D. Hall, eds., *The Colonial Book in the Atlantic World* (Cambridge, 2000); Charles E. Clark, *The Public Prints: The Newspaper in Anglo-American Culture, 1665-1740* (New York, 1994); Janine Barchas, "Before Print Culture: Mary, Lady Chudleigh, and the Assimilation of the Book," in *Eighteenth-Century Genre and Culture: Serious Reflection on Occasional Forms: Essays in Honor of J. Paul Hunter*, ed. Dennis Todd and Cynthia Wall (Newark, Del., 2001), 15-35.

the eighteenth century, when books and other forms of print were still quite scarce. While Franklin might have been exceptional in terms of his childhood “thirst for knowledge,” his inability to gain access to suitable reading material was an all too common experience that most people shared.[68] Before his apprenticeship began, Franklin had to remain content pouring over the same handful of books in his father’s home, mostly works of “polemical divinity” and chap books that he found largely uninspiring. His search for “more proper books” seems to have been a major preoccupation of his early years in Boston, where his autobiography recounts in considerable detail how his time, money, and friendships all revolved around the determined quest to gain access to such material. But when Franklin left Massachusetts in the 1720s, he discovered that the availability of print was even more limited in other communities. “There was not a good Bookseller’s Shop in any of the Colonies to the Southward of Boston,” he complained, and the few printing houses that he encountered were equally discouraging since they were mostly “Stationers” trafficking in paper supplies, account ledgers, almanacs and the like. Always resourceful, Franklin tried to overcome these shortcomings by suggesting that his close friends, who met in a weekly club known as the “Junto”, should pool their small collections together to create a common library. As he quickly discovered, however, members were hesitant to part with such precious commodities and his scheme faded away after a year. Books were simply too rare and valuable to be relinquished lightly. In such an environment, one can appreciate why a passenger, who had fallen

[68] *The Autobiography of Benjamin Franklin*, ed. Philip Smith (London, 1996), 3.

overboard and almost drowned on one of Franklin's early trips, seemed more concerned with drying out and preserving his copy of *Pilgrims Progress* than reflecting on his near demise.[69]

The genuine reverence accorded such items was a product not only of their scarcity, but also reflected the particular nature of the literature circulating at this time. Because of the cost of books—the majority of which was determined by the expense of paper itself—merchants adopted a conservative strategy, stocking only a narrow selection of popular titles that had literally proven their weight in the past.[70] These "steady sellers" consisted largely of religious works such as bibles, psalmbooks, devotional texts, primers and catechisms.[71] Such staples could command a guaranteed audience because they spoke to the daily concerns of people who relied heavily upon them as they grappled with the rites and passages of Christian living. Individuals and families would read such items repeatedly, often memorizing entire sections, while drawing intimate connections to their own experiences with conversion, grace, afflictions, or the specter of death. This emotionally charged form of literacy, as one scholar has documented, created "an intense relationship between the book and reader" that structured the dynamics of early print culture.[72] It was not an accident, therefore, that the passenger whom Franklin helped

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[69] Ibid. 9, 60, 17.

[70] On paper and the cost of books, see *Colonial Book in the Atlantic World*, 52; Jon Feather, *A History of British Publishing* (London, 1988), 164-6.

[71] The term "steady sellers" comes from David Hall's "The Uses of Literacy," in *Printing and Society in Early America*, 28-32.

[72] David D. Hall, "The Uses of Literacy in New England," in *Colonial Book in the Atlantic World*, 34.

rescue from the Long Island Sound happened to be carrying a copy of *Pilgrims Progress* in his coat pocket. John Bunyan's devotional text epitomized the kind of steady seller that dominated the colonial market throughout the seventeenth and early eighteenth centuries. As Franklin himself declared, "it has been more generally read than any other book, except perhaps the Bible."[73] Even the non-religious material that Franklin encountered in his early years—ballads, chapbooks, or almanacs—addressed many of the same themes and were drawn from an equally narrow pool of conventional texts. Without disputing the richness or import of this popular canon, it is worth pointing out that one of the defining characteristics of early American print culture was the limited range of subject matters and genres available well into the eighteenth century.[74]

To be sure, there were some gentlemen who possessed the wealth and inclination to purchase a broader assortment of reading material from abroad, assembling their own diverse libraries. Bibliophiles like Cotton Mather, James Logan, or William Byrd managed to build impressive collections at the beginning of the eighteenth century by assiduously developing contacts with book dealers and correspondents throughout Europe.[75] But this aspect of learned culture was clearly the domain of a small circle of elites, a fact underscored by the numerous times when Franklin caught the attention of

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[73] Franklin, *Autobiography*, 17

[74] Charles Francis Adams famously referred to the period from the mid-seventeenth century to the mid-eighteenth century as the "glacial period" in New England's cultural and intellectual life: *Massachusetts: Its Historians and its History, An Object Lesson* (Boston, 1893), 108. While such a view certainly devalues the complexities and developments of the period, it continues to inform the broader currents of scholarship because of the sheer depth of change that seemed to occur by the 1730s and 1740s.

[75] Kevin J. Hayes, *The Library of William Byrd of Westover* (Madison, Wisc., 1997); Edwin Wolf, *The Library of James Logan of Philadelphia, 1674-1751* (Philadelphia, 1974),

high-ranking gentlemen simply because of his books. Describing one such encounter, Franklin wrote:

> The then governor of New York, Burnet (son of Bishop Burnet), hearing from the captain that a young man, one of his passengers, had a great many books, desir'd he would bring me to see him. I waited upon him accordingly…The gov'r. treated me with great civility, show'd me his library, which was a very large one, and we had a good deal of conversation about books and authors. This was the second governor who had done me the honor to take notice of me, which to a poor boy like me, was very pleasing.[76]

In the hierarchical world of the early eighteenth century, such *condescension* reflected the anxious desire of gentlemen to acquaint themselves with any fellow virtuosi, regardless of their age or social status.[77] That an individual traveling with many books became "news", and that a colonial governor would respond to it by arranging a personal audience, only serves to delineate just how circumscribed the sphere of learned culture actually was in provincial society during this period.[78]

Modern scholarship appears to confirm Franklin's early impressions and reveal the magnitude of the change that emerged as the century progressed. Although the complexities of the book trade and printing industries make it difficult to assemble precise numbers, historians agree that the era witnessed a dramatic increase in the production, distribution and consumption of the printed word. The figures from the

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[76] Franklin, *Autobiography*, 25. Burnet's massive collection, which he shipped from England when he assumed the governorship of New York, was apparently large enough to impress even the perpetually dour Doctor William Douglass, who confessed that the experience of browsing "the Governor's library has not a little turned my head." Douglass to Cadwallader Colden, 14 July 1729, *Colden Papers* 1:308. See also, Esther Singleton, *Social New York Under the Georges: 1714-1776…* (New York, 1902), 61-3. Burnet was tutored by Newton and ascertained the latitude of Boston and New York (sending this information to the Royal Society in 1724).

[77] Gordon Wood provides a lucid discussion of the hierarchal nature of colonial society and the workings of patronage, deference and condescension within this culture in *Radicalism of the American Revolution*.

[78] For a discussion of how news, gossip, and print intersected in the tightly-knit communities of early America—especially with regards to how elites functioned as important nodes within these communication networks—see

English customs ledgers, which recorded the transatlantic shipment of books and periodicals by hundredweight, indicate that the level of exports to America rose steadily from the beginning of the century, punctuated by a sharp acceleration that started in the late 1740s.[79] During this critical period, described by scholars as a veritable "book import boom", the amount of printed material arriving in North America increased fourfold in just two decades, so that by 1770 the colonial market accounted for more than half of the entire English trade in exported books worldwide.[80] Having shown little interest in the American market for years, London's publishing houses and wholesalers appeared to discover the untapped potential of colonial consumers around mid-century, aggressively developing new ties to provincial retailers as well as catalogues and advertisements for their goods.[81] What makes these trends even more striking is the fact that they were matched by equally significant gains in the amount of material printed locally within the colonies. Statistical information derived from the North American Imprint Program (NAIP)—a database that incorporates the revised bibliographic information from Shipton and Mooney's *National Index of American Imprints* (1969)—shows a nearly identical pattern to the transatlantic book trade, in which colonial publications rise gradually until mid-century when the rate of growth begins to climb

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Richard D. Brown, *Knowledge is Power: The Diffusion of Information in Early America, 1700-1865* (New York, 1989), 16-41.

[79] On the outpouring of print culture from the 1740s on, throughout the British provincial world, see Hall, "The Uses of Literacy," 45-6; Raven, ; Ian Steele, *The English Atlantic 1675-1740: An Exploration in Communication and Community* (New York, 1986), 260 Thomas Munck, *The Enlightenment: A Comparative Social History, 1721-1794* (2000), 91-2; Feather, *Eighteenth-Century Provincial Book Trade*, ch. 3.

[80] Raven, "The Importation of Books," 196.

considerably.[82] In terms of sheer volume, therefore, provincial inhabitants found themselves living in a world that was increasingly characterized by the widespread availability of print, both from home and abroad.

Yet such numbers only tell part of the story. Important questions remain as to the causes and timing surrounding this proliferation of eighteenth-century print. How, for example, does one account for the dramatic expansion of print culture when such likely explanations as rising literacy rates or technological improvements in production appeared to play a negligible role in the process? On the American side, where a historically large proportion of white men could already read, literacy rates among adults did not change significantly in the first three quarters of the eighteenth century, although noticeable trends certainly appeared among particular regions or social groups.[83] But

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[81] Raven, London Booksellers and American Customers, 87.

[82] Hugh Amory provides a revealing series of statistical graphs based upon the NAIP database as well as a discussion of the methodological issues surrounding this material in "Appendix One: A Note on Statistics" *The Colonial Book in the Atlantic World*, 504-518. My characterizations of the domestic and import trades are based upon Graphs 1B & 7B (pp. 506, 514).

[83] In his pioneering study, *Literacy in Colonial New England*, Kenneth Lockridge argued that literacy rates among New England males increased sizably from 70% to 90% over the course of the *entire* eighteenth century. But subsequent research has complicated many aspects of this growth trajectory, while all agreeing that literacy rates were remarkably high throughout the period and experienced some growth in the last quarter of the century. See, for example, Alan Tully's analysis of Chester and Lancaster counties, Pennsylvania, ("Literacy Levels and Educational Development in Rural Pennsylvania, 1729-1775," *Pennsylvania History* 39 (1972), 302-12), which found minimal growth in the levels of literacy over this time while also discovering higher female rates than Lockridge's work would suggest. Likewise, Ross W. Beales Jr.'s detailed study of Grafton, Massachusetts ("Studying Literacy at the Community Level: A Research Note," *Journal of Interdisciplinary History* 9 (1982), 83-102) and Ian K. Steele's survey (*The English Atlantic, 1675-1740: An Exploration of Communication and Community* [Oxford, 1986] , 265-66, 270) drew more complicated conclusions that questioned the model of steadily rising literacy rates. F.W. Grubb provides an excellent analysis of the voluminous research on colonial literacy, including useful tables that summarize the percentage rates and sample sizes of various studies, in "Growth of Literacy in Colonial America: Longitudinal Patterns, Economic Models, and the Direction of Future Research" *Social Science History* 13 (1990), 451-482, esp. 453-4. Grub concludes that literacy in colonial America was defined by three major characteristics: 1.) It was remarkably high from the beginning, with most communities possessing rates over 70%. 2.) Compared to Europe, the literacy rates were distributed much more evenly among geographic regions and social classes. 3.) Literacy often underwent cyclical growth, meaning that the high literacy rates of the first generation of new settlers in a region were not passed on to their children, but these rates usually recovered by the third generation.

compared to the developments in continental Europe at this time, historians would be hard pressed to link the growth of print to the emergence of large, newly-literate segments of the population. In a similar vein, the material aspects of production remained fairly constant throughout this period. Improvements in typeface or engraving techniques should not obscure the fact that Anglo-American printers, paper-makers, bookbinders, and other artisans pursued their craft in much the same way as their seventeenth-century predecessors.[84] Moreover, the particular timing involved—namely, the sharp acceleration of growth at mid-century that occurred on both sides of the Atlantic—raises questions as to the various factors that shaped this rather peculiar trajectory.

While examining such issues might seem more appropriate to specialists dealing with the "history of the book", these topics actually point to a central dimension of eighteenth-century science that is easy to overlook. Among the many valuable contributions made by the literature investigating print culture, perhaps the most striking insight involves the detailed reconstruction of the *social context* that has profoundly shaped the production, distribution, and consumption of the printed word.[85] Scholars have been quite successful in situating the world of print within this broader historical context, revealing how the complicated interaction between people and texts is embedded

[84] James Raven, "The Book Trades," in *Books and their Readers in the Eighteenth-Century England: New Essays*, ed. Isabel Rivers (Leicester, UK, 1982), 5-9.

[85] Robert Darnton, in particular, has written quite forcefully about the need to situate print within the complex social "circuits" of communication that shaped the flow and meaning of information throughout society. See: Darnton, "What is the History of the Book?" and "First Steps Toward a History of Reading" in *The Kiss of Lamourette:*

within larger frameworks of meaning and social relationships. Like attentive ethnographers, historians have explored how such complex dynamics structure the actual experience of activities like authorship or reading, whose import has varied significantly in different historical settings. They have also drawn attention to the fact that print, as a cultural medium, exists along side other forms of oral and visual communication which often influence the uses of print, itself. Seen from this perspective, one can begin to ask new questions about how the growth of eighteenth-century publishing, and scientific material in particular, intersected with broader social currents. Unlike the approach of bibliographers or intellectual historians, who have tended to focus on the diffusion of texts and ideas; an analysis that prioritizes the social dimensions of literacy traces the actual *evolution* of printed material from beginning to end, focusing on the web of people and practices that shaped how contemporaries interacted with the medium of print. And if one examines the evolution of scientific texts in the eighteenth century—the complex ways in which they were produced, financed, distributed, acquired, and used—a rather unique picture of the period emerges. The expansion of both science and print culture, it turns out, was based heavily upon the development of intricate social networks that both propelled and mediated the flow of information throughout the Anglo-Atlantic world.[86]

Reflections in Cultural History (New York, 1990), 107-35, 154-87. For a highly successful application of this approach to the American context, see Brown, *Knowledge is Power*.

[86] Although rooted in a very different time period and set of technologies, Carolyn Marvin's analysis of the emergence of electric communications in the nineteenth century offers a thought-provoking account of how continuity, change, and patterns of social relations were woven together with the introduction of new media forms. Her research, in particular, spotlights how the introduction of electrical lighting, telegraphs, and telephones did not so much revolutionize the way people interacted as provide a series of new arenas in which interested parties could rework older patterns of social order. Such an emphasis not only recognizes the complex continuities which often persist through periods of dramatic technological change, but also puts more focus on actual people and how their intentions shaped the social implications of new technology and media. See, *When Old Technologies were New: Thinking about Electric*

Without diminishing the importance of ideas, or the need to trace their dissemination through the realm of print, it is crucial to recognize that such developments rested upon equally significant transformations in the social sphere.

Communication in the Late Nineteenth Century (New York, 1988). "series of arenas for negotiating issues crucial to the conduct of social life"

EPILOGUE

The Civic Awakening

> The Curious have observ'd that the Progress of Science (like the Sun) is from the East to the West; thus has it travelled thro' *Asia* and *Europe*, and now is arrived at the Eastern Shore of *America*. As the Cœlestial Light of the Gospel was directed here by the Finger of GOD…so Arts and Sciences will change the Face of Nature in their Tour from Hence over the Appalachian Mountains to the Western Ocean.
>
> —*Astronomical Diary & Almanack* (1758)

By 1760, the growing popularity of science and practical improvement had altered the cultural landscape of the British Empire. Patterns of scientific exchange and innovation, which had emerged first in metropolitan Britain in the early decades of the eighteenth century, had begun to take firm root within the far-flung communities of the British periphery—a diverse array of societies ranging from the provincial regions of England, Wales and Scotland to the Kingdom of Ireland and the American colonies. This expanding culture of scientific improvement, moreover, provided an important link connecting Britons throughout the Atlantic world. Individuals corresponded about agricultural experiments and new fertilizers; irrigation systems and navigational projects; surveying techniques and weather records. Enterprising groups published both detailed accounts and drawings of new technologies for the benefit of the reading public. In a similar vein, countless books and magazine articles appeared, explaining the latest discoveries pertaining to drainage, canals, road-building, mills, or manufacturing processes. To encourage this improving spirit, gentlemanly societies throughout the empire offered premiums and awards to promote the advancement of useful knowledge in all its manifold forms. And over time, this steady flow of letters, books, seeds, specimens, drawings, plants, tools, and machines testified to the vast web of interconnections that had emerged from the realm of popular science. With its enticing vision of collaboration, experimentation, and patriotic improvement, eighteenth-century science provided an ideal set of practices that resonated with the concerns of a wide-spectrum of Britons throughout the empire. Indeed, as one historian has noted, scientific improvement became the "dominant faith" of polite society, "much as evangelicism was to be after 1780."[1]

Few contemporaries appreciated this almost quasi-religious "faith" in science and progress better than Nathaniel Ames (1708-1764), a Massachusetts almanac-maker whose career corresponds almost perfectly with the time frame of this dissertation. Born into a respectable Puritan family, Ames appears to have inherited his father's interest in astronomy, mathematics, and medicine from an early age. And while he served as a practicing physician in Dedham throughout his life, Ames was best known for producing the *Astronomical Diary; or, Almanack*, which was the first annual almanac in American history when it began appearing in 1725. Almost immediately, his work became widely popular throughout New England, selling upwards of 50,000-60,000 copies a year and spawning numerous imitators, including Franklin's *Poor Richard's Almanack*. And like Franklin, Ames embellished his text with aphorisms, poetry, polite literature, and discussions of useful knowledge—all designed to entertain as well as edify audiences. But in his 1758 edition of the *Astronomical Diary*, Ames decided to add an entirely new

[1] C.A. Bayly, *Imperial Meridian: The British Empire and the World, 1780-1830* (London, 1989), 80.

section that would address a pressing topic. "America," he explained to his readership, "is a Subject which daily becomes more and more interesting:—I shall therefore fill these Pages with a Word upon its Past, Present and Future State." His commentaries on the fate of the North American continent came at a critical moment in time, when the outcome of the Seven Year's War and the imperial struggle with France still hung in the balance. The stakes involved in this conflict, he explained, could not have been higher. Both France and England were battling for control of a "fertile country between Canada and the Mississippi that is of larger Extent than all [of] France, Germany, and Poland." The interior stretches of the continent were truly "the Garden of the World!" And while there had been a time in the past, when "we might have been possess'd of it," Britain's imperial designs had never been well-coordinated or energetic enough to take advantage of the situation. Indeed, Ames' description of the "present state of North America" was filled with the kinds of imperialist anxieties that earlier chapters of this study examined—namely, the apprehension over factionalism, disunity, and poor management.[2] Yet, remarkably enough, this pessimistic tone disappeared completely when Ames turned to his speculations on the "future state" of the American continent. Here, he expressed a buoyant faith in the power of science to unleash the natural and human potential of British America—a timely vision that spoke to the concerns of his generation.[3]

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[2] Nathaniel Ames, *An Astronomical Diary; or, an Almanack for…1758* (Boston, 1758), 14-16. On Nathaniel Ames, and his son, Nathaniel Ames III, who was also an almanac-maker and scientist, see Marion Barber Stowell, *Early American Almanacs; the Colonial Weekday Bible* , 72-6. For publication figures, see *The Papers of the Bibliographical Society of America*, 73 (1979), 42.

[3] Ibid, 16.

Ames's musings have a strong providential—even millennial—tone that captures the optimistic creed of scientific improvers. God intended mankind to utilize the works of His creation; and the providential discovery of North America had revealed "a vast Stock of proper Materials for the Art and Ingenuity of Man to work upon." And just as the "Light of the Gospel" was beginning to "drive the long! Long! Night of Heathenish Darkness from *America*", so too would the light of science "march thro' the vast Desert" transforming the howling wilderness into a lush garden. With his imagery of heathen darkness, howling deserts, and a providential mission to improve, Ames was skillfully combining the Puritan sense of a divine "errand into the wilderness" with the enlightenment vision of scientific progress.[4] The result was a heady mix that portended a boundless future:

> The residence of wild Bests will be broken up, and their obscene Howl cease for ever;—Instead of which, the Stones and Trees will dance together at the Music of Orpheus—the Rocks will disclose their hidden Gems,—Huge Mountains of Iron Ore are already discovered; and vast Stores are reserved for future Generations; This Metal more useful than Gold and Silver, will imploy Millions of Hands, not only to form the martial Sword, and peaceful Share, alternately; but an Infinity of Utensils improved in the Exercise of Art, and Handicraft amongst Men. Nature thro' all her Works has stamp'd Authority on this Law, namely, "That all fit Matter shall be improved to its best Purposes."—*O! Ye unborn Inhabitants of America! Should this Page escape its destin'd Conflagrations at the Year's End,—when your Eyes behold the Sun after it has rolled the Seasons round for two or three Centuries more, you will know that in* Anno Domini 1758, *we dream'd of your Times!*[5]

Written at a trying moment, when Britain's prospects were particularly bleak because of costly military defeats in 1757, Ames' faith in science and practical improvement

[4] Ibid, 16; Perry Miller, *Errand into the Wilderness* (Cambridge, 1956); William Cronon, *Changes in the Land: Indians, Colonists, and the Ecology of New England* (New York, 1983). At the same time, his son was reflecting on the transit of science and civilization, with the same evangelical fervor in his diary in September of 1758. See "Diary of Dr. Nathaniel Ameis," *Dedham Historical Register* 1 (1890), 10-11.

sustained his overriding belief in societal *progress*—a concept that was as central to the worldview of the Enlightenment as *grace* was to the evangelical Christianity of the era.[6] And like the more famous evangelical movements, the culture of scientific improvement was a genuinely transatlantic phenomenon that changed the fabric of communities, generated new identities and new social connections, altered the tenor of public life, and most importantly, spoke to the pressing concerns of Britons who were trying to make sense of a rapidly changing world. Historians have long explored these aspects of the "Great Awakening", trying to understand the complex social, intellectual, and even political ramifications of the evangelical revivals that swept the Anglo-Atlantic world.[7] This dissertation has tried to show how an equally complex set of transformations resulted from the expansion of popular science throughout the British Empire—a movement that put forward its own system of values and way of life every bit as encompassing as evangelical Christianity. It would make sense, therefore, to conceptualize the broader ramifications of popular science and the culture of improvement as constituting its own *civic* awakening.

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[5] Ibid, 16.

[6] For a more elaborate analysis of the eighteenth-century concept of progress, see David Spadafora, *The Idea of Progress in Eighteenth-Century Britain* (New Haven, 1990), and Roy Porter, *The Creation of the Modern World: The Untold Story of the British Enlightenment* (New York, 2000), ch. 19.

[7] Alan Heimert, *Religion and the American Mind: From the Great Awakening to the Revolution* (Cambridge, Ma., 1966); Patricia Bonomi, *Under the Cope of Heaven: Religion, Society, and Politics in Colonial America* (New York, 1986); Rhys Issac, *The Transformation of Virginia, 1740-1790* (Chapel Hill, 1982); Frank Lambert, *"Pedlar in Divinity": George Whitefield and the Transatlantic Revivals, 1737-1770* (Princeton, 1994); Timothy Hall, *Contested Boundaries: Itinerancy and the Reshaping of the Colonial American Religious World* (Durham, NC, 1994); Susan O'Brien, "A Transatlantic Community of Saints: The Great Awakening and the First Evangelical Network, 1735-1755," *American Historical Review* 91 (1986), 811-32; and T.H. Breen and Timothy Hall, "Structuring Provincial Imagination: the Rhetoric and Experience of Social Change in Eighteenth-Century New England," *American Historical Review* 103 (1998), 1411-39.

This dissertation has attempted to reconstruct the essential elements and social dynamics at the heart of this transatlantic movement. The preceding chapters have explored the origins of this civic awakening in the nexus of science, practical improvement, and public anxieties that arose during the turbulent decades of mid-century. And while individuals had a variety of personal reasons for participating in the world of science, the end result of the expanding popularity of natural philosophy was a significant change in the civic culture throughout much of Anglo-America. It did so in at least four principle ways.

First, science offered an attractive way of reconciling private interests with a commitment to the public good of the nation. Individuals looking to climb the social ladder or to improve the profitability of their estate or simply to find a pleasurable diversion could participate in the world of science, while still feeling that their pursuits were benefiting the larger community. The culture of natural philosophy, in other words, merged personal and public improvement, creating an appealing avenue for ambitious provincials and other aspiring Britons.

Second, science provided a well-tested model of public sociability that allowed individuals from different backgrounds to participate in a collaborative enterprise that was pleasurable yet purposeful. The sectarian, political and ethnic divisions of the eighteenth century made such cooperative endeavors potentially explosive. This lesson would be learned by many well-intentioned groups, such as the trustees of the newly created King's College in New York, who discovered that denominational and party rivalries could easily threaten to destroy the most innocuous of civic projects. Since the end of the eighteenth century, science had developed social conventions and unique institutional spaces designed to foster trust and collaboration among disparate groups. Gentlemanly improvers relied upon these cultural resources in their efforts to carve out new civic arenas from which to pursue their increasingly ambitious projects for bettering society.

Third, the realm of popular science changed the nature of personal relationships—and by extension, the capacity for collective action—by creating extensive social networks devoted to the exchange of ideas, material, and support. Scientists and improvers were constantly looking to share information, discoveries, tools, machines, suggestions, models—any useful knowledge that could assist their endeavors. Indeed, these groups demonstrated an almost evangelical urge to recruit new members into the community of science, offering premiums and rewards, sending instruments or exotic specimens to potential recruits, trying to strike up new correspondence, and the like. This mindset was summed up by the Scottish agriculturalist, Robert Maxwell, when he declared that "Improvers are a communicative sort of people."[8] As a result, the world of natural philosophy created a dense web of social connections among its participants, allowing members to access a broad range of knowledge and support. In other words, the expansion of science created thousands of reciprocal ties and relationships, generating a level of human capital that changed the dynamics of civic life.

Finally, popular science helped disseminate an ideology of progress that expanded the civic horizons of eighteenth-century Britons. Natural philosophy—at both a theoretical level and in its everyday practices—offered the most powerful testimony of the Enlightenment's claim that the world was capable of being studied, understood, and above all, improved. As Nathaniel Ames's explained to his almanac readers, the central "Law" of nature and nature's god was "That all fit Matter shall be improved to its best Purposes." Those who participated in eighteenth-century science, and the campaigns for promoting useful knowledge, became conditioned to look upon the natural and social worlds as essentially malleable, open to rational analysis and endless improvement at the hands of enterprising projectors. Not only did these experiences seem to suggest an empowering conception of change and progress, but they also led to a new ideal of active citizenship. All too often, accounts of the Enlightenment suggest that it fostered a kind of spectatorial politics, in which citizens thought about, wrote about, and critically debated the major public issues of the day. And there is certainly considerable merit to this interpretive point. Yet there is also a danger in overlooking the equally powerful imperative to direct action—a different side of the Enlightenment that was rooted in the culture of natural science. With its array of clubs, associations, and practical projects, eighteenth-century science offered a program of concerted *action*—i.e. collecting plants, building drainage ditches, erecting hospitals, installing ventilators, and hundreds of seemingly prosaic activities that invited people to participate in the worldly business of improvement. Here was a distinct vision of progress—one rooted in the lived experiences of everyday scientific pursuits—that fired the imagination of many

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[8] Robert Maxwell, *Select Transactions of the Honourable The Society of Improvers In the Knowledge of Agriculture in Scotland…* (Edinburgh, 1743), ix.

eighteenth-century Britons and steadily altered the contours of both public and private life.