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Michael J. Braddick, *God's Fury, England's Fire: A New History of the  
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# The British Atlantic World, 1500–1800

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A dramatic story has often been told that links Europeans' landfall in the Americas to the origins of modern science. By this view, Atlantic colonization helped bring about a revolution in the way science was practised. The Americas' surprising existence undermined the authority of the Bible and the teachings of Aristotle, both of which had been ignorant of the New World. The shock of discovery unsettled long-rooted trust in what these precious books said about the world, its peoples, and the God who had created them. But it wasn't just the content of knowledge that the Americas changed. The very ways by which Europeans claimed to understand nature's processes were transformed. Scriptural and Aristotelian teachings were not simply incomplete or corrupt; more dramatically, their fallibility suggested that trust in words passed down across generations was in fact the wrong basis for making sense of the natural world. Experience, experiment, eye-witnessing, empiricism – a variety of labels became linked to the ideal of directly interrogating nature as a utilitarian enterprise. This modern epistemological break is, moreover, often portrayed as an especially English story. Francis Bacon is cited as the leading champion of the 'new science', who called for the reformation of knowledge based on experience rather than trust, and inspired the chartering of the Royal Society of London in 1660, whose motto was *nullius in verba* – nothing in words.<sup>1</sup>

Recent histories of the natural sciences, however, have seriously challenged this account. One central issue is mediation. Consider the example of early modern travel writings that aimed to

describe and catalogue the natural history of exotic regions like the Americas. Oceanic distance magnified problems of trust: how could readers in Europe come to believe in the reality of phenomena they would never witness themselves? Such texts claimed to be accurate first-hand accounts of waterways, landscapes, flora, fauna and foreign peoples. Remote eye-witnessing could only be conveyed, however, through words or images that were the mediating products of human art. Even in those most empirical-seeming spaces – the botanic gardens sown with transplanted seeds and the wonder-cabinets stuffed with curiosities – the identities and properties of such things were not self-evident but dependent on the webs of spoken and written testimony in which they were embedded. Direct access to nature may have been the ideal, but it was never the reality.

While there was no decisive rupture between textual trust and authoritative experience, a rhetoric of useful matters of fact did gradually supplant earlier languages of wonders, marvels and curiosities. Phenomena previously seen as providential actions or inexplicable marvels became described in terms of regularity and predictability, suggesting their susceptibility to human discipline and control. But were they? Paradoxically, as matters of fact became more authoritative, they also became more controversial. One influential model of knowledge-making stresses the translation of local phenomena into universally standardized languages and measures to enable recognition, systematization and exploitation.<sup>2</sup> Finding standard names for flora and fauna, or aggregating local geographical knowledge into a uniformly calibrated map of the world, are merely two of the most striking examples of techniques for converting the local into the universal. In this respect, metropolitan projects of knowledge and empire were analogous, if not coterminous; each depended on networks of reliable travelers, informants and laborers. An Atlantic perspective, however, forces us to move beyond metrocentric narratives, to examine what kinds of social relationships sustained such networks across arduous early modern oceanic and cultural distance. This chapter investigates what went on inside the networks that circulated a variety of natural knowledges around the British Atlantic world, exploring the tension between metropolitan commercial imperialism and Creole-American self-fashioning. The reckoning of the world's resources crucially required a reckoning of its peoples, too. The chapter concludes, therefore, by suggesting the necessity of relating accounts of the natural world to debates and contests,

particularly concerning African slavery, over who was fit to make that accounting.

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Early English encounters in Atlantic colonies were very often governed by belief in the reality of wonders and magic instead of sober matters of fact, a language later transferred to the study of nature from legal practices and evidentiary discourse. Error itself played a decisive role. Columbus's original 'Indian' landfall was the accidental result of a quest for new trade routes to the East, made with difficulty in the absence of accurate Longitude readings (impossible before the later eighteenth century). The accounts of lands and peoples sixteenth-century English travelers encountered on ensuing journeys – many of them privateering missions in bitter rivalry with Spain, and hoping to emulate Spanish American fortunes in gold and silver – were not self-evidently accurate reports but wordy compounds of reportage, rumor, and delusion. Wonders and monsters abounded. While searching for the mythical golden city of El Dorado in Guiana, for example, the knightly privateer Walter Raleigh confirmed the existence of the 'Ewaipanoma ... reported to have eyes in their shoulders, and their mouths in the middle of their breasts'.<sup>3</sup> Although he had not seen them for himself, relying on Spanish and indigenous testimony instead, he nevertheless affirmed their existence since, in his view, the discovery of the Indies had shown many apparent fables to be true.

Even that most seemingly utilitarian exercise, the gathering of plant specimens, was governed by ancient belief systems. To many learned commentators, America was not the object of a modern fact-seeking curiosity, but a baroque collection of secrets whose occult signs could only be decoded by the magus. In that eminently practical space, the Renaissance botanical garden, plants were understood to possess magical sympathies and virtues. Their gathering together was a redemptive recreation of the Garden of Eden, and thus an act of intense religious value.<sup>4</sup> Alchemy, which involved the experimental transmutation of organic materials, and was also understood as the alchemist's quest for spiritual illumination, provided a longstanding tradition of practice that saw nature in at once occult and practical terms, and thus a ready metaphor for American discovery. John Dee, an advisor on geography and navigation to Elizabeth I and imperial promoter, was both a

devout Christian and practitioner of alchemy and astrology. As Shakespeare's tale of Prospero's dominion over the monstrous slave Caliban in *The Tempest* (1610–11) suggested, New World mastery depended on divining nature's secret spells.<sup>5</sup>

Two principal contexts informed the articulation of programs for reforming knowledge in the early seventeenth century: challenges to Aristotelian cosmology and threats to the very survival of the English state. The astronomical observations of Tycho Brahe in Denmark and Galileo Galilei in Italy had already raised questions about the accuracy of Aristotelian dicta. The Scholastic teachings dominant in the universities emphasized the heavens' changeless physical perfection, situating the earth at the center of a universe consisting not of empty space but concentric crystalline spheres. Tycho's observations of a comet traveling through space, and Galileo's of sun-spots and undiscovered moons orbiting Jupiter, lent credence to heterodox notions that the earth was neither encased in solid spheres nor located at the universe's center. Astonishingly, it seemed that the Aristotelian view of creation, supported by the Catholic Church, might be wrong, and the truth about nature might now lie in ingenious instruments like telescopes and the practice of experiment. Since the early sixteenth century, meanwhile, the Spanish had grown rich on American bullion, and founded new institutions, notably the *Casa de la Contratación*, for organizing their new navigational and botanical knowledge of the Americas.

Francis Bacon responded to both crises. He was no abstract philosopher but a gentleman-courtier, council member of the fledgling Virginia Company and promoter of American colonization, who became James I's Lord Chancellor in 1618. Trained in the humanist tradition, he was also a devout and learned Protestant. Where Spain plundered, England would 'plant' colonies in America and bring true faith in place of idolatrous rapacity. 'Those twin objects, human Knowledge and human Power, do really meet in one', he declared.<sup>6</sup> Practical mastery of nature was fundamental to the English state, economy and Protestant mission.

In 1620, Bacon published *The Great Instauration*. Its title page depicted ships passing beyond the Pillars of Hercules – the limits of the known world – and bore the legend *multi pertransibunt et augebitur scientia*: many traveled to and forth and knowledge was increased. The Pillars of Hercules had long been used by the Holy Roman Emperor Charles V as an emblem of Spanish ambition, but the legend, which referred to the Book of Daniel's eschatological

prophecies, signaled a zealous Protestant twist. Maritime commerce and private trading initiatives would not only bring English knowledge and power, but realize a Protestant Millennium as well. Laboring to recover true knowledge, lost since the Fall, would both improve man's estate on earth and bring redemption. 'Nor can the place of this labour and search and worldwide perambulation be supplied by any genius or meditation or argumentation',<sup>7</sup> Bacon warned. The arduous work of travel was necessary to replace Aristotelian pieties with useful facts. His solution involved a hierarchical division of labor that seemed to map neatly onto the Atlantic world. What he called the 'merchants of light' in the *New Atlantis* (1627) would serve the 'interpreters of nature'.<sup>8</sup> Travelers and colonizers would gather the facts of natural history that described the world, and send them back in obedient service to the mother state, to institutions like Salomon's House (the fictional academy in the *New Atlantis*), where natural philosophers would frame causal explanations of natural processes. Although this might seem like an exclusively utilitarian, empirical and statist program, it was in fact the millennial vision of a man who still invoked biblical and ancient authorities, believed in the efficacy of natural magic and was profoundly committed to private commercial endeavor.

The reality of early English colonization was disastrous, however, resulting in failure to find significant quantities of bullion or a northern passage to Asia, and the extinction of the Roanoke colony on the American mainland. Three challenges confronted subsequent colonizers: climate, access to food, and relations with indigenous peoples. The English did not arrive as conquerors but depended for their survival on negotiating with Amerindians for foodstuffs like corn and instruction in agricultural technique. Although made wary by the absorption of English settlers by their Gaelic subjects in Ireland in previous centuries, Virginia's colonizers initially relied on assistance from the Powhatan confederacy, and evinced 'admiration' for the ingenious 'artes' by which these Algonquian peoples demonstrated mastery of natural resources through farming, archery, healing, fishing, and even conjuring.<sup>9</sup> The *Briefe and True Report* on Roanoke published in 1588 by Thomas Hariot, a mathematician who had joined the expedition, was preoccupied with a strategic assessment of Algonquian skills. Rather than casting them as irredeemably barbarous, his inclusion of images of the ancient Picts suggested an indigenous capacity for civil and Christian improvement, such as the English themselves had undergone.<sup>10</sup> While the

spectacle of native idolatry – witness their tattooed bodies and talismanic *manitou* – made the colonizers wary, their own vulnerability obliged them to a grateful wonder at the skills by which they themselves might prosper.

The English were anxious to align nature on the side of colonization, and overcome fears of exotic climates that would accelerate the humoral degeneration of their temperate bodies in the torrid and frigid zones of the Americas. By the mid-seventeenth century, both the demographic balance of power and cultural perceptions had shifted relations between the two peoples. Unaccounted for by biblical genealogy, Amerindians fascinated European observers as a challenge to orthodox Christian belief in monogenesis: the single act of creation by God, from which a unified family of man had descended. Increasingly, acquiring Algonquian objects as curiosities – Powhatan's mantle is to this day displayed in Oxford's Ashmolean Museum – betokened historical curiosity rather than strategic interest in admirable tools, as English musketry superseded native archery. Successful settlement in the Chesapeake and New England, built on the tobacco trade and family migration respectively, coupled with the decimation of Indian populations by diseases like smallpox, enabled settlers to see their bodies as uniquely suited to inhabit the landscape. From child-rearing to war, Amerindian arts now seemed artificial bulwarks against a natural destiny of decline. Contrasts between the different peoples' explanations of matter and spirit also sharpened in the later seventeenth century. The new 'mechanical philosophy' focused accounts of physical phenomena on atoms of matter in motion, rejecting as unintelligibly 'occult' the Aristotelian, magical and heathen notions that purpose was inherent in matter, and that matter could act where it was not ('action at a distance'). Christian mechanists insisted that matter could only act through direct physical contact, and that spirit did not inhere in matter but existed hierarchically above it. Native *manitou*, always suspect, now assumed by comparison the aspect of an odious fetishism and the nadir of Indian ignorance. Tellingly, exponents of the mechanical philosophy were also active proponents of right religion. Thus, the wealthy Irish Protestant Robert Boyle was both the Royal Society's leading advocate of experiment for demonstrating nature's mechanical ways, and also governor of the New England Company, funding missionary travel, the translation of the Bible into Massachusett, and the Boyle Lectures for the global promulgation of the faith.<sup>11</sup>

For New England's Puritan colonists, however, matter and spirit often seemed inseparable. Clearing woodlands for agriculture was an act of spiritual gardening and moral self-improvement, eminently pleasing to God. Nature's utility was divine by design. 'Feeble man, I am a Remedy, which our gracious Maker has provided for thy Feebleness', cried the plants themselves in Cotton Mather's *Christian Philosopher* (1721), 'take me, know me, use me, thou art welcome to all the Good that is to be found in me!'<sup>12</sup> The high level of education, literacy and religious commitment of these settlers drove their philosophical studies of nature as a form of Christian devotion with an intensity unmatched elsewhere in the British Atlantic world. Harvard College came to possess the best collection of scientific instruments in all the colonies, and an active local community of astronomers, which included the Boston Philosophical Society (a short-lived club of natural philosophers), emerged to serve both local and global purposes. Thomas Brattle sent observations of a comet that Isaac Newton later incorporated in his epochal *Principia Mathematica* (1687), while ministers distributed almanacs featuring Copernican astronomy to combat folk belief in judicial astrology. In the 1720s, Isaac Greenwood, a former student of Cotton Mather's who trained in England under the leading Newtonian John T. Desaguliers, became the first to use experimental apparatus in public demonstrations of Newtonian mechanics in British America.<sup>13</sup>

For both the learned and the folk, New England's was a Providentialist culture. God's word was written in the books of scripture and nature equally, with phenomena such as meteors or failed harvests often read as portents of divine intervention, clues that might reveal whether election or damnation beckoned. Nature was lawful only on divine pleasure, and filled with meaningful surprises. John Josselyn's account of his 1630s New England travels repeatedly discussed the existence of monsters. In the same decade, the 'monstrous births' endured by the prophetess and clerical critic Anne Hutchinson and others made sense to Governor John Winthrop and his associates as the progeny of traffic with the devil. The Salem witchcraft scare of 1692 demonstrated the persistent credibility of invisible agents intervening in the visible world, to the learned and lay alike, although the clergy were split over the authority of the spectral evidence used to condemn the guilty. Such episodes suggested that belief in wonder-working could dangerously destabilize the social order by authorizing prosecutions based on the uncertain art of reading natural signs.<sup>14</sup>

In late-seventeenth-century England, prodigious wonders and portents smacked precisely of vulgar credulity and social danger. The Royal Society's avoidance of metaphysical questions in its Boylean experimental program was in part a political response to the deep religious conflicts of the Civil Wars. When they spoke of nature, therefore, Puritan natural philosophers in New England were thus confronted by multiple Atlantic publics that espoused different codes of epistemological decorum. Increase Mather's *Essay for the Recording of Illustrious Providences* (1684) collected accounts of singular phenomena, such as lightning strikes, fusing naturalistic description with theological interpretation. While supplying London savants with useful descriptions, and seeming to defer to their prerogative of final interpretation, Mather also counseled local audiences that such phenomena were divine pronouncements targeted with specific moral purpose at the faithful in New England. His son Cotton Mather, who became a Fellow of the Royal Society, sought to reconcile his Calvinist faith with Newton's physical laws of motion, which to some suggested nature might be a wholly mechanical system. His response was ambiguous. The universe did indeed resemble a well-designed machine, he agreed, although one maintained by an immanent God who could suspend its operations if he wished (privately, Mather continued to believe in portents and prodigies). Both Mathers were zealous Creoles who balked at the redefinition of wonders from prodigies to regularities offered by moderate English advocates of 'physico-theology'. Yet, engaging both local and transatlantic publics remained essential if they were to maintain their faith in the intellectual harmony between knowledge and devotion.<sup>15</sup>

From an imperial perspective, the resources and profits to be had from Ireland, Africa, and the West Indies dwarfed those of New England. Metropolitan institutions now enacted linked programs of disciplined curiosity – Thomas Sprat envisioned the Royal Society and Royal Africa Company as sister enterprises<sup>16</sup> – better to organize the flow of labor, resources and information to serve English interests. Economic botany, political arithmetic, coordinated systems of trade and enslaved African labor laid the foundations for a mercantilist complex of gentleman-projectors who used long-range intelligence networks and maritime power to make fortunes on plantation crops like sugar and tobacco. Natural history and botany united a pious understanding of the natural order with profitable taxonomic techniques for identifying and cultivating the foodstuffs and drugs that began pouring from the Americas into

English nurseries like Chelsea Physick Garden and, later, Kew Gardens. Old systems of taxonomy, exploded by the vast quantity of new specimens, were largely replaced by the second quarter of the eighteenth century with Carolus Linnaeus's utilitarian scheme, which employed binomial labels to classify plants according to their sexual characteristics. Trained observation and visual representation thus became essential attributes of the profiteering botanist, as did techniques for preserving seeds and specimens to endure long-distance shipping.<sup>17</sup>

Systematic curiosity was also the objective of colonial administrators inspired by Baconian reformism, in particular William Petty. An admirer of Bacon's and a member of the circle of Samuel Hartlib, a group of learned Protestants who sought to realize the Lord Chancellor's millennial plan, Petty was an anatomist and charter member of the Royal Society who had taken a leading role in orchestrating the Down Survey (1652), which assessed the value of Irish lands conquered under Oliver Cromwell. This administrative work directly informed Petty's strenuous advocacy of what became known as 'political arithmetic': a project in rational governmentality that proposed exact mathematical calculation as an objective basis for policy-making. In works like *The Political Anatomy of Ireland* (1672), he computed the value of Irish laborers and lands in numerical and financial terms. As Boyle had done for ship captains and travelers, Petty also drew up questionnaires to evaluate the potential for investment in new American plantations like Pennsylvania.<sup>18</sup> Devices for disciplined and trustworthy assessments of exotic resources took material form as well. Before the slave trade, the Guinea coast was important to England as a source of ivory and gold. The value of gold varied, however, due to Akan traders' ability to pass off adulterated specimens, and also because of clippers who circulated debased coin in London. In response, natural philosophers mobilized mechanical ingenuity and state authority as technologies of stabilization. Boyle advocated the use of hydrostatic balances, rather than judgment alone, better to identify debased gold through lost density. Newton, meanwhile, as Master of the Mint, secured passage of laws for executing counterfeiters during the economically turbulent 1690s. The value of gold, English currency and the economic credibility of the Protestant succession of the Glorious Revolution might all be upheld by artificial machines to establish trustworthy values for nature's commodities.<sup>19</sup> The character and effectiveness of such disciplinary measures was limited, however; its methods often met resistance

and failed. Caribbean planters, for example, repeatedly ignored the Board of Trade's requests for information. Policy-makers were extremely slow to adopt Petty's principles of government by systematic knowledge-gathering. Parliament was a great agglomeration of private interests, and typically supportive of entrepreneurial rapacity rather than hostile to it, as its naval campaigns against piracy and deregulation of the slave trade in the early eighteenth century show.<sup>20</sup>

No one enacted the complex of disciplined curiosity and colonial investment more than the naturalist and collector Hans Sloane. Sloane trained in chemistry and medicine before serving as physician to the Duke of Albemarle on a voyage to Jamaica in 1687. Although he failed to keep his dissolute master alive, he successfully transported 800 plant specimens, detailed in his *Natural History of Jamaica* (1707), whose title page repeated the Baconian mantra about travel increasing knowledge. The voyage brought financial rewards as well, including marriage to the widow of a major planter. This match made Sloane a direct participant in Atlantic slavery. He received Jamaican sugar from South Sea Company ships that transported slaves from Africa to the West Indies; developed friendships with significant investors like the Duke of Chandos; and advised the Royal Africa Company on botanical projects in Guinea. Although often praised as a self-made man, Sloane made himself the hub of a global network by absorbing an astonishing range of official appointments and associations with powerful trading companies. He became President of the Royal Society; President of the Royal College of Physicians; Physician to Christ's Hospital, Queen Anne, George II and the Army; and was made a baronet. Income from his medical practice, his wife's plantations, property in Chelsea and medical recipes such as milk chocolate and Peruvian bark (quinine), allowed him to pursue his ambitions as a collector. Sloane's collections, among the greatest of any individual in the period, comprised specimens, books, prints, manuscripts and artificial curiosities, swelled by a constantly expanding cadre of suppliers including East India Company agents, American planters and travelers like Mark Catesby (whose American voyage he sponsored). These collections reflected the connoisseur's strategic curiosity in the materials and craftsmanship of the world's peoples, and were ultimately turned to a global reckoning of human skill. The British Museum, created in 1753 as the world's first national public museum, dramatically concretized stadiad narratives that now placed Britain at the center of a global history of progress by

displaying its mastery of the world's artefacts. Its purpose was 'to prevent our falling back again into a state of ignorance and barbarism', stated one early guide, and 'see the Progress of Art in the different Ages of the World'.<sup>21</sup>

There were few if any social limits to Sloane's suppliers: female naturalists like Maria Sybilla Merian, who traveled to Surinam; Ayuba Suleiman Diallo (also known as Job Ben Solomon), a former slave from Senegal; and privateers like William Dampier, who sailed the South Seas.<sup>22</sup> Gathering facts for the metropolis also depended heavily on the labor and goodwill of American Creoles. The knowledge networks of the Atlantic world were thus inextricable from the politics of empire. Creole aspirations were both recognized and frustrated. When in 1709 he asked Sloane to send mineral samples to Virginia for comparison with local specimens, the wealthy planter William Byrd II, was told to send *his* to London for metropolitan evaluation instead. Doomed by his provincial situation to the status of supplier rather than interpreter, Byrd responded through satire. He wrote multiple accounts of the running of the line to demarcate the Virginia–North Carolina boundary: an official report for English readers, and 'secret' and 'general' histories for Creoles, ridiculing English efforts at charting American marshlands.<sup>23</sup> At the same time, involvement in such projects promised recognition in the republic of letters, commercial opportunity and occasionally patronage. The lynchpin of the North Atlantic naturalist network was Peter Collinson, a Fellow of the Royal Society and Quaker merchant based in London, who boasted a remarkable collection of American clients, including John Bartram, John Mitchell, Cadwallader Colden, and Benjamin Franklin, connecting them to naturalists throughout Europe, and ensuring a plentiful flow of New World seeds into European nurseries and taxonomies. Colonial botany made pious worship of nature and agricultural profiteering into a dynamic combination.<sup>24</sup> When the Scottish-trained Virginian Mitchell moved to London in the 1740s, he was prized and patronized as a key informant on American flora, while the devout Quaker Bartram supplied thousands of specimens to England from his Pennsylvania garden, earning a rare pension as King's Botanist after 1765.<sup>25</sup> In reality, Creole labor was as often a story of cosmopolitan recognition and imperial collaboration as of frustration and patriotic resistance.

Experiments with electricity epitomized the vibrant public culture of natural science increasingly affluent urban Creoles now brought into being. Itinerant demonstrators provided the stimulus.

In 1743, the same year he established the American Philosophical Society, Franklin witnessed a series of arresting electrical demonstrations in Boston, performed by a touring Scot named Archibald Spencer. Exploiting his links to Collinson and other London patrons, as well as skilled local craftsmen, Franklin obtained glass tubes and electrostatic generators for experiment, in his home and at the Library Company of Philadelphia. The extraordinary sequel redefined the 'electric fire' throughout Europe and America as an economy of positive and negative charges that suggested, by analogy, how metal conductors might be employed as lightning rods to secure buildings from the devastating electrical discharges of thunderclouds. Partly in response to the early replication of the 'Philadelphia experiments' in France, the Royal Society awarded Franklin its Copley medal in 1753, an unprecedented honor for a colonial and one that cut against the truism that authoritative interpretation of natural phenomena was a metropolitan prerogative.<sup>26</sup>

In British America, demonstrators of varying social backgrounds began touring from New England to the Caribbean, selling thrilling electrical spectacles for pretty sums. These performances displayed electricity both as a rational wonder tamed by Franklinist philosophy and the lightning rod, and as a disorienting force that ambushed the senses, defying complete control. Shocks and sparks that made audiences gasp and convulse were not merely diverting. Electricity was compelling as a form of non-rational, sometimes mystical experience. Lightning rods often mysteriously failed; commentators linked atmospheric electricity to nervous disorders and spontaneous combustion; demonstrators emphasized the persistence of divine agency in natural powers; and one electrotherapist even declared that the medical powers of electricity signaled that the Millennium was at hand. This dynamic American electrical culture – utilitarian *and* zealously visionary – was governed less by institutions than the markets for leisure and therapy, as well as the lack of an established church.<sup>27</sup>

In the American Revolution, patriots and sympathizers made the lightning rod into a symbol of the professed natural relationship between republicanism and experiment, in which liberty and freedom of inquiry were cast into a revolutionary force of world-historical agency. Franklin became a Promethean god who had outstripped even Newton in stealing the fires of electricity and liberty for mankind, and whose plain observational style in his experimental writings embodied his republican humility. This was, however, a swift improvisation. Franklin's studies of natural phenomena

had in fact both aimed at harmonizing the interests of empire and colonies, and been highly speculative in character. In his arithmetical predictions of British America's demographic increase, Franklin became a Creole Petty, turning New World reproduction into an argument promoting American manufactures without, he insisted, reducing British exports (at that time protected by legal restrictions on American productivity). Later editions of his book on electricity were filled with miscellaneous conjectures on natural history, including the Atlantic Ocean itself. Most notably, Franklin drew on his connections to American mariners to produce the first accurate charts of the Gulf Stream – not for the United States, but the imperial postal service. The broader culture of electrical demonstration that flourished before the Revolution had fostered both a sense of active participation in European cultural life, and superiority over Amerindians and slaves. Demonstrators juxtaposed lightning rods with the electrocution of uncomprehending 'model negroes', while newspapers reported native Americans marveling at Christian experimenters' godlike powers. Electricity and enlightenment were imperial long before they were revolutionary.<sup>28</sup>

Electricity's Atlantic history is much more than its Philadelphia story. Compare Franklin's work on lightning rods with the more obscure, but no less revealing story of Edward Bancroft. Bancroft was a journeyman physician from Massachusetts who worked in the Dutch sugar plantations of Guiana in the 1760s, where he happened upon the extraordinary powers of the electric eel. Opportunistically emulating trials conducted by the Dutch settlers, and relying on the assistance of native guides and African slaves, Bancroft published the first account in English of experiments demonstrating that such fish possessed specifically electrical powers. Arriving in London on the eve of revolution, he was befriended by Franklin himself but, unlike his new patron, became a loyalist, acting as a spy for the British in the American delegation's wartime negotiations with France. Bancroft's career decenters both the nationalist story of Franklin's American triumph over lightning, and the history of science narrative that sees the invention of the first current-generating battery exclusively as the result of laboratory work in Europe. Thanks to Franklin, Bancroft's experiments were repeated in Europe using torpedo fish, whose organs were adopted as models for constructing artificial batteries, so that when Alessandro Volta published a description of his electric 'pile' around 1800, he explicitly invoked the natural model of electric fish. Bancroft's role in this sequence shows how colonial natural history

and metropolitan physical science intersected in decisive ways, with the path to the battery in Italy first being laid by commercial fortune-seekers, aided by natives and slaves, in American marchlands like Guiana.<sup>29</sup>

The final decades of the eighteenth century witnessed dramatic revolutions in politics and scientific practice, reversing perspectives on American nature. Travelers like Josselyn and Catesby, and settlers like the Puritans, had long looked on the Americas as a violent and lawless wilderness in need of strict subjection. For commentators like the Comte de Buffon and Cornelius de Pauw, American degeneracy was a natural fact of the western hemisphere, whose allegedly miasmatic character left its flora, fauna and peoples bereft of vitality.<sup>30</sup> The most pointed riposte from anglophone America came from the self-avowed empiricist and Creole nationalist, Thomas Jefferson, whose writings both laid bare the richness of Virginia's natural resources to reassure revolutionary allies, and mystified them as the work of inscrutably powerful divine forces. Jefferson's most obvious target was Buffon's degeneracy thesis, in reply to which he marshaled tables of measurements that made a highly favorable comparison of the sizes of American and European quadrupeds, placing what he termed American 'facts' in damning opposition to distant metropolitan 'theory'. 'He is less remote from the truth who believes nothing, than he who believes what is wrong', he averred in an apt geographical metaphor of error.<sup>31</sup> As a citizen of the independent United States, Jefferson could assert facts, where colonial forerunners like Byrd had sought solace in satire, crafting in the process the persona of a cautious republican knower who identified the remote theorization of nature with centralized authority hostile to local experience. His descriptions of the sublime passions inspired by Virginia's environmental monuments, like the 'natural bridge' and the confluence of the Potomac and Shenandoah rivers in the Blue Ridge Mountains, were functions of his republican equation of theory with empire. This was an equation republican knowledge should invert, literally from the ground up. Thus it was no accident that Jefferson experienced 'rapture' only when he was on the ground looking up at the natural bridge, and 'violent head ach' when he mounted it and gazed down.<sup>32</sup>

Patriotic predictions of scientific glory notwithstanding, the American Revolution fostered a dilemma over the political constitution of scientific authority. With early republican culture divided between Hamiltonian centralizers and Jeffersonian localists, the absence of federal institution-building meant that sciences



of description and utility (such as natural history, agriculture and chemistry) flourished more than philosophically driven experimental or academic research, which required costly apparatus and less constraining utilitarian demands. Nationalist impulses nevertheless expressed themselves through a range of projects: Consider the reorientation of natural history collections. Colonials like Cotton Mather had sent fossils and curiosities to London collectors, which might be included in repositories with global pretensions like the British Museum. The remarkable Sir William Johnson, meanwhile, the Irish-born Superintendent of Indian Affairs in mid-century New York, assembled a sizable collection of Amerindian objects, reflecting his commercial, diplomatic and personal relations with Iroquois peoples (he fathered several children by Mohawk women).<sup>33</sup> After the revolution, however, Americans sought to construct their own national displays. While Joseph Banks was refashioning a post-revolutionary botanical empire for Britain that could move natural resources across Pacific, Atlantic and European theaters – for example, shipping breadfruit trees from Tahiti to feed Britain's Caribbean slaves – American collectors now looked to their western interior to construct museum spaces for the new United States.<sup>34</sup> As settlers' displacement of natives from western lands nourished fantasies of vanishing aboriginals, Jefferson developed an avid interest in Amerindian linguistic genealogies, and formed his own collection of precious Indian objects at Monticello. When Lewis and Clark sent back a package of artefacts from the Mandan people of the Great Plains during their survey of the Louisiana Territory, their destinations were not European cabinets, but rather Monticello, and Charles Willson Peale's Museum in Philadelphia, best known for its proud display of giant, recently exhumed American mastodon bones.<sup>35</sup>

Medical science also took an avowed nationalist turn. Where Jefferson was cautious, the physician Benjamin Rush was bold, devising an aggressive array of schemes to inculcate republican virtue through micro-physical strategies based on a materialist understanding of morality. The specter of materialism had long vexed Christian interpreters of nature, especially in relation to Newton's discussions of active principles such as gravity and electricity, as potential grounds for atheistic belief in the self-directing power of matter. Mechanical planetaria called 'Orreries', like those constructed by the virtuosic astronomer-mechanic David Rittenhouse, seemed to confirm this view by casting the universe literally in the form of a Newtonian machine (Newton himself

devoutly believed the creation was necessarily sustained by an immanent God).<sup>36</sup> Rush, however, saw no contradiction between materialism and zealous Christian belief; for him, materialism grounded enlightened medical techniques for building a virtuous Christian republic. The leading member of an entire generation of Philadelphia physicians trained in the dynamic Edinburgh school of nervous physiology, Rush confidently viewed the task of American medicine as the engineering of 'republican machines'. His philosophy of the 'influence of physical causes upon the moral faculty' was not metaphorical but literal. Physical environments governed moral behavior, which was the direct result of such factors as climate, diet, disease, pain, sociability, noise, smell, and light and darkness. Physiological engineering, not moralizing, would correct vice, in combination with new institutions for compelling virtuous and productive behavior, like the penitentiary and the manufactory. 'The bridewells and workhouses of all civilized countries prove that labor is ... the most benevolent of all punishments', Rush believed.<sup>37</sup> His was a sweepingly holistic program of republican discipline, ideally suited to its moment, as industrial manufacturing began to challenge the primacy of agriculture in American political economy.

Ultimately, making knowledge in the Atlantic world necessitated not simply the accounting of resources and conditions, but also peoples.<sup>38</sup> The labor of Africans and their American descendants became the foundation of the Atlantic economy, replacing white indentured servitude on the mainland and in the West Indies by the late-seventeenth century. Like the economy to which they were so closely tied, natural history and botany required regimes of labor organization and long-range discipline to function. It was thus entirely logical to make slaves active in the production of knowledge and exploit the expertise brought about by their forced immersion in the world of the plantation. The antiquarian-collector John Woodward enthused on collecting as a function of group servitude: 'Gathering and preserving ... may be done by the Hands of Servants; and that too at their spare and leisure times: or in Journies, in the Plantations, in Fishing, Fowling, &c'.<sup>39</sup> James Petiver, the London apothecary, explicitly advised American correspondents to instruct slaves in the art of specimen gathering, while Sloane declared that his Jamaican natural history relied in part on the information of knowledgable Africans. In Guiana, Bancroft paid slaves in glasses of rum for every snake they brought him (he claimed to possess some 300).<sup>40</sup> Perhaps most strikingly, African

men and women expert in rice cultivation were transported en masse to Carolina to establish what would become one of that colony's staple crops.<sup>41</sup>

Exceptionally, Africans might gain recognition, as in the remarkable case of Graman Quacy of Surinam, for whom Linnaeus named a tree and who was received by the Dutch royal family.<sup>42</sup> Yet, inevitably, slave knowledge involved intensely fraught issues of trust, resistance, and danger. Colonial natural histories did not spare their readers uncompromising images of the violence and instability of plantation regimes. Already in 1657, Richard Ligon's *True and Exact History of the Island of Barbadoes* described Africans' attacks on the 'ingenios' or sugar mills they worked, often to their deaths.<sup>43</sup> Sloane's account of the torture and execution of rebellious slaves in Jamaica was so meticulously vivid that, perversely, it later became key evidence for abolitionists in America and Britain. In an era where African slaves were regarded as cultureless chattels, Sloane also appears to have been the first person in Europe to have collected and preserved the things of slaves, such as musical instruments, whips and nooses for punishing them, and even specimens of their resistance to their masters, in the form of clothing and weapons used by Jamaican Maroons. The curious gaze of natural history was not efficiently filtered by imperial ideology, but made public disturbing and morally ambiguous images of slavery's role in the Atlantic economy.<sup>44</sup> Masters profited from African botanical expertise but also lived in fear of their poisons, disdainfully acknowledging their skill as 'cunning', fearing an expertise they did not fully comprehend. Such ignorance was most obvious when it came to shamanistic African and Afro-Creole religious practices like 'obeah'. The uprising in Jamaica in the 1760s, known as Tacky's Rebellion, witnessed an extraordinary contest between British and rebel African knowledge in Jamaica. The British placed the heads of decapitated slaves on poles to convince the rebels that death would not return them to Africa as they believed, and even resorted to the use of electric shocks to demonstrate the superior power of experimental machinery over obeah. There is no evidence, however, that either of these strategies had the desired deterrent effect.<sup>45</sup>

Naturalists had expressed growing curiosity about innate racial difference as a demonstrable physical phenomenon since the seventeenth century. By the mid-eighteenth century, Linnaeus and others had accentuated interest in this question by constructing taxonomies of human variation as spatial maps of the world's peoples, combining cultural traits and anatomical features to sketch

out approximate regional groupings within the field of natural history. With Buffon, the internal physiological effects of factors like climate and diet became important in new efforts to explain, rather than simply classify varieties. Both approaches cast human variation as environmental and fluid, not inherent or fixed.<sup>46</sup> Towards the century's end, by contrast, as abolitionists intensified their campaign to end slavery both in the United States and the British Empire, apologists for human bondage, like Jefferson in Virginia and Edward Long in Jamaica, advanced insistent arguments that nature had fixed irrevocable and unbridgeable physical differences between white and black. The sciences themselves increasingly assumed explicit racial significance in era of intensifying 'scientific racism'. Contrast the genius of Newton, the commonplace now ran, with the savagery of the Hottentot: could these really be members of the same race?

Africans themselves raised their voices against the putative facts of the new racism, appropriating the authority of natural science to do so. In his landmark autobiography (1789), Olaudah Equiano argued against the link between dark skin color and chattel slavery, citing evidence that color was not the mark of a permanent curse but the effect of contingent factors such as climate. His source was an essay recently published by Thomas Clarkson, the former Cambridge University student turned abolitionist campaigner. Clarkson's original source? The anatomical experiments performed by the naturalist John Mitchell on the bodies of slaves at his home in Urbanna, Virginia, and published by the Royal Society back in the mid-1740s. Mitchell's Atlantic world was overwhelmingly structured by the tobacco trade between Virginia and Scotland, where his father's wealth had allowed him to train as a physician. Mitchell's original essay had in fact sought to naturalize the African body as uniquely suited for hard labor and resistant to climatic and physical violence, by contrast with the more delicate constitutions of Amerindians and Creoles. Clarkson and Equiano simply ignored this, however. What they found useful in the context of abolitionism was Mitchell's use of Newton's optical theories to argue for the contingency rather than innateness of 'black' color, in an intricate account of the way hot climates thickened skin structure, thus preventing the transmission of light and making skin look black.<sup>47</sup>

The link between Equiano and Mitchell suggests how Atlantic histories of science should combine the social history of colonization with the conceptual history of human difference, by placing circulations of practical knowledge at their center. Here, after all, was an

extraordinary moment of convergence and transformation: a black African in London turning the meaning of experimental dissections performed by a pro-slavery American Creole into an argument against the seemingly natural equation of blackness and bondage. Where a metropolitan grandee like Sloane had embodied an image of global enlightenment by gathering together the wonders of the world into a single collection, and Newton incarnated the European genius that could explain the entire physical universe, Equiano – and other former slaves across the Atlantic, like the mathematician Benjamin Banneker – now stepped forward to reclaim their humanity specifically by demonstrating their own rational curiosity about nature, and their determination to publicize facts against slavery, racism and the empire that had built its wealth on slave labor. This is ultimately what examining science in the Atlantic world stands to uncover: how reckonings of nature and peoples fit together as the interlocking parts of a single history of knowledge and colonization.

## Part III Identities

31. Rhys Isaac, 'Evangelical Revolt: The Nature of the Baptists' Challenge to the Traditional Order in Virginia, 1765 to 1775', *WMQ*, 3rd ser., 31 (1974) 345–68.
32. Anthony F. C. Wallace, *The Death and Rebirth of the Seneca* (New York, 1969); Gregory Evans Dowd, *A Spirited Resistance: The North American Indian Struggle for Unity, 1745–1815* (Baltimore, 1992); Douglas R. Egerton, *Gabriel's Rebellion: The Virginia Slave Conspiracies of 1800 and 1802* (Chapel Hill, NC, 1993); James Sidbury, *Ploughshares into Swords: Race, Rebellion, and Identity in Gabriel's Virginia, 1730–1810* (Cambridge, 1997).
33. J. C. D. Clark, *The Language of Liberty, 1660–1832: Political Discourse and Social Dynamics in the Anglo-American World* (Cambridge, 1994).
34. Nancy L. Rhoden, *Revolutionary Anglicanism: The Colonial Church of England Clergy during the American Revolution* (New York, 1999); Stephen J. Stein, *The Shaker Experience in America: A History of the United Society of Believers* (New Haven, CT, 1992).
35. Ruth H. Bloch, *Visionary Republic: Millennial Themes in American Thought, 1756–1800* (Cambridge, 1985).
36. David Hempton and Myrtle Hill, *Evangelical Protestantism in Ulster Society, 1740–1890* (London, 1992), pp. 27–9.
37. James H. Merrell, *The Indians' New World: Catawbas and their Neighbors from European Contact through the Era of Removal* (Chapel Hill, NC, 1989).

## Chapter 5: Science

1. For a nuanced discussion of this theme, see Anthony Grafton, *New Worlds, Ancient Texts: The Power of Tradition and the Shock of Discovery* (Cambridge, MA, 1992).
2. Bruno Latour, *Science in Action: How to Follow Scientists and Engineers through Society* (Cambridge, MA, 1987), and Latour, *Reassembling the Social: An Introduction to Actor-Network Theory* (Oxford, 2005).
3. Walter Raleigh, *The Discoverie of the Large, Rich and Bewtiful Empyre of Guiana* (1596), ed. Neil Whitehead (Manchester, 1997), p. 178.
4. Richard H. Drayton, *Nature's Government: Science, Imperial Britain, and the 'Improvement' of the World* (New Haven, 2000), pp. 3–25.
5. Ralph Bauer, 'A New World of Secrets: Occult Philosophy and Local Knowledge in the Sixteenth-Century Atlantic', in James Delbourgo and Nicholas Dew, eds, *Science and Empire in the Atlantic World* (London, 2008), pp. 99–126.
6. Francis Bacon, *The Great Instauration* (1620), ed. Jerry Weinberger (Wheeling, Ill., 1989), p. 32.
7. Bacon, *Great Instauration*, ed. Weinberger, p. 26.
8. Francis Bacon, *New Atlantis* (1627), ed. Jerry Weinberger (Wheeling, Ill., 1989), pp. 81–2.

9. Joyce E. Chaplin, *Subject Matter: Technology, Science, and the Body on the Anglo-American Frontier, 1500–1676* (Cambridge, MA, 2001), chaps. 2–4.
10. Thomas Hariot, *A Briefe and True Report of the New Found Land of Virginia* (London, 1588).
11. Chaplin, *Subject Matter*, chaps. 5–7; on Boyle, see Steven Shapin and Simon Schaffer, *Leviathan and the Air-Pump: Hobbes, Boyle, and the Experimental Life* (Princeton, NJ, 1985), and Chaplin, *Subject Matter*, pp. 292–5.
12. Cotton Mather, *The Christian Philosopher: A Collection of the Best Discoveries in Nature, with Religious Improvements* (1721), ed. Winton U. Solberg (Gainesville, Fla., 1968), p. 137.
13. Isaac Greenwood, *An Experimental Course of Mechanical Philosophy* (Boston, 1726); on Brattle, see Raymond P. Stearns, *Science in the British Colonies of America* (Urbana, IL, 1970), p. 158.
14. John Josselyn, *An Account of Two Voyages to New-England* (1675), in *The English Literatures of America, 1500–1800*, eds. Myra Jehlen and Michael Warner (London, 1997), pp. 498–503; David D. Hall, *Worlds of Wonder, Days of Judgment: Popular Religious Belief in Early New England* (New York, 1989).
15. Shapin and Schaffer, *Leviathan and the Air-Pump*; Increase Mather, *Essay for the Recording of Illustrious Providences* (1684), in *The English Literatures of America*, eds. Jehlen and Warner, pp. 504–17; Cotton Mather, *Christian Philosopher*; Michael P. Winship, *Seers of God: Puritan Providentialism in the Restoration and Early Enlightenment* (Baltimore, 1996), pp. 93–110.
16. Thomas Sprat, *The History of the Royal-Society of London for the Improving of Natural Knowledge* (London, 1667), p. 407.
17. Drayton, *Nature's Government*, pp. 3–25; for a typical handbook of the period, see John Woodward, *Brief Instructions for Making Observations in all Parts of the World* (London, 1696).
18. William Petty, 'American Plantations', in *The Petty Papers: Some Unpublished Writings of Sir William Petty*, ed. Marquis of Lansdowne, 2 vols. (London, 1927), vol. 2, pp. 95–121; Mary Poovey, *A History of the Modern Fact: Problems of Knowledge in the Sciences of Wealth and Society* (Chicago, 1998), pp. 120–38.
19. Simon Schaffer, 'Golden Means: Assay Instruments and the Geography of Precision in the Guinea Trade', in Marie-Noëlle Bourguet, Christian Licoppe and H. Otto Sibum, eds, *Instruments, Travel and Science: Itineraries of Precision from the Seventeenth to the Twentieth Century* (London, 2002), pp. 20–50.
20. Patricia Cline Cohen, *A Calculating People: The Spread of Numeracy in Early America* (Chicago, 1982), esp. pp. 47–80; Marcus Rediker, *Villains of All Nations: Atlantic Pirates in the Golden Age* (Boston, 2004), pp. 1–82; David Hancock, *Citizens of the World: London Merchants and the Integration of the British Atlantic Community, 1735–1785* (Cambridge, 1995).

21. James Delbourgo, 'Slavery in the Cabinet of Curiosities: Hans Sloane's Atlantic World', British Museum website (2007): <[http://www.thebritishmuseum.ac.uk/the\\_museum/news\\_and\\_debate/news/hans\\_sloanes\\_atlantic\\_world.aspx](http://www.thebritishmuseum.ac.uk/the_museum/news_and_debate/news/hans_sloanes_atlantic_world.aspx)>; *The General Contents of the British Museum: with Remarks, Serving as a Directory in viewing that Noble Cabinet* (London, 1761), pp. vii, 18.
22. For the range of Sloane's networks, see Arthur MacGregor, ed., *Sir Hans Sloane: Collector, Scientist, Antiquary, Founding Father of the British Museum* (London, 1994).
23. Ralph Bauer, *The Cultural Geography of Colonial American Literatures: Empire, Travel, Modernity* (Cambridge, 2003), pp. 179–99.
24. Susan Scott Parrish, *American Curiosity: Cultures of Natural History in the Colonial British Atlantic World* (Chapel Hill, 2006).
25. Edmund and Dorothy Smith Berkeley, *Dr John Mitchell: The Man Who Made the Map of North America* (Chapel Hill, 1974); Thomas P. Slaughter, *The Natures of John and William Bartram* (New York, 1996).
26. James Delbourgo, *A Most Amazing Scene of Wonders: Electricity and Enlightenment in Early America* (Cambridge, MA, 2006), chaps. 1–2.
27. Delbourgo, *Most Amazing Scene of Wonders*, chaps. 3, 6, 7.
28. Delbourgo, *Most Amazing Scene of Wonders*, chap. 4; Joyce E. Chaplin, *The First Scientific American: Benjamin Franklin and the Pursuit of Genius* (New York, 2006).
29. Alessandro "Volta, 'On the Electricity Excited by the Mere Contact of Conducting Substances of Different Kinds', *Philosophical Transactions* [of the Royal Society] 90" (1800), pp. 403–31; Delbourgo, *Most Amazing Scene of Wonders*, chap. 5, and 'Fugitive Colors: Shamans' Knowledge, Chemical Empire, and Atlantic Revolutions' (forthcoming).
30. Antonello Gerbi, *The Dispute of the New World: The History of a Polemic, 1750–1900*, trans. Jeremy Moyle (Pittsburgh, 1973).
31. Thomas Jefferson, *Notes on the State of Virginia* (1785), ed. Frank Shuffelton (Harmondsworth, 1999), pp. 34–5.
32. Jefferson, *Notes on the State of Virginia*, p. 26.
33. Wanda Burch, 'Sir William Johnson's Cabinet of Curiosities', *New York History*, 71 (1990), pp. 261–82.
34. 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).
35. Anthony F. C. Wallace, *Jefferson and the Indians: The Tragic Fate of the First Americans* (Cambridge, MA, 1999), esp. pp. 75–107, 130–60; Paul Semonin, *American Monster: How the Nation's First Prehistoric Creature Became a Symbol of National Identity* (New York, 2000).
36. Brooke Hindle, *David Rittenhouse* (Princeton, NJ, 1964).
37. Benjamin Rush, 'The Influence of Physical Causes upon the Moral Faculty' (1786), in *The Selected Writings of Benjamin Rush*, ed. Dagobert Runes (New York, 1947), p. 195.
38. On this topic, see also the chapters in this volume by Joyce Chaplin and Christopher Brown.

39. Woodward, *Brief Instructions for Making Observations*, pp. 15–16.
40. On Petiver, see Parrish, *American Curiosity*, p. 271; Hans Sloane, *A Voyage to the Islands of Madera, Barbados, Nieves, S. Christophers and Jamaica, with the Natural History of the ... Last of those Islands*, 2 vols. (London, 1707–25), vol. 1, preface (unpaginated); Edward Bancroft, *An Essay on the Natural History of Guiana, in South America* (London, 1769), p. 220.
41. Judith Carney, *Black Rice: The African Origins of Rice Cultivation in the Americas* (Cambridge, MA, 2001).
42. For Quacy, see Parrish, *American Curiosity*, pp. 1–7.
43. Richard Ligon, *A True and Exact History of the Island of Barbadoes* (London, 1657).
44. Sloane, *Voyage*, vol. 1, p. lvii; Delbourgo, 'Slavery in the Cabinet of Curiosities'.
45. Vincent Brown, 'Spiritual Terror and Sacred Authority in Jamaican Slave Society', *Slavery and Abolition*, 24 (2003) 24–53; Delbourgo, *Most Amazing Scene of Wonders*, pp. 126–7.
46. Phillip "Sloan, 'The Gaze of Natural History', in Christopher" Fox, Roy Porter and Robert Wokler, eds, *Inventing Human Science: Eighteenth-Century Domains* (Berkeley, 1995), 112–151.
47. Olaudah Equiano, *The Interesting Narrative of the Life of Olaudah Equiano, or Gustavus Vassa, the African, Written by Himself*, 2 vols. (London, 1789), vol. 1, p. 41; Thomas Clarkson, *An Essay on the Slavery and Commerce of the Human Species, Particularly the African* (London, 1786), p. 205; John Mitchell, 'An Essay upon the Causes of the different Colours of People in different Climates', *Philosophical Transactions*, 43 (1744–45) 102–50; James Delbourgo, 'The Newtonian Slave Body: Racial Enlightenment in the Atlantic World' (forthcoming).

## Chapter 6: Civility and Authority

Earlier versions of this chapter were delivered at the workshop in Harvard in September 2001 and at a conference on 'Shaping the Stuart World, 1603–1714', at the Huntington Library, California, in January 2001; and to seminars at the universities of Harvard, Pennsylvania State, and Keele. The author would like to thank the audiences on those occasions for their helpful comments. He is also particularly grateful to David Armitage, Joyce Chaplin, and Karen Harvey for their comments on earlier drafts of this chapter.

1. Michael J. Braddick, *State Formation in Early Modern England* (Cambridge, 2000), esp. ch. 2.
2. *Ibid.*, pp. 71–85; Michael J. Braddick and John Walter, 'Grids of Power: Order, Hierarchy and Subordination in Early Modern Society', in Braddick and Walter, eds, *Negotiating Power in Early*

## Chapter 5: Science

The cultural history of the natural sciences in the British Atlantic world is a growing field, with enormous potential for original work on under-exploited sources and under-studied figures. Four works make the best current introduction to the field: Joyce E. Chaplin, *Subject Matter: Technology, Science and the Body on the Anglo-American Frontier, 1500–1676* (Cambridge, MA, 2001), and *The First Scientific American: Benjamin Franklin and the Pursuit of Genius* (Boston, 2006); Susan Scott Parrish, *American Curiosity: Cultures of Natural History in the Colonial British Atlantic World* (Chapel Hill, NC, 2006); and James Delbourgo, *A Most Amazing Scene of Wonders: Electricity and Enlightenment in Early America* (Cambridge, MA, 2006). Several older studies provide useful surveys: Raymond Stearns, *Science in the British Colonies of America* (Urbana, IL, 1970); Brooke Hindle, *The Pursuit of Science in Revolutionary America, 1735–1789* (Philadelphia, 1956); Herbert Leventhal, *In the Shadow of the Enlightenment: Occultism and Renaissance Science in Eighteenth-Century America* (New York, 1976); and also Richard H. Shryock, *Medicine and Society in America, 1660–1860* (New York, 1960).

Scholars of British Atlantic science can learn much from new studies of Iberian, French and Dutch colonialism in the early modern world. See Jorge Cañizares-Esguerra, *Nature, Empire, and Nation: Explorations of the History of Science in the Iberian World* (Stanford, 2006); Harold J. Cook, *Matters of Exchange: Commerce, Medicine, and Science in the Dutch Golden Age* (New Haven, 2007); and James Delbourgo and Nicholas Dew, eds, *Science and Empire in the Atlantic World* (New York and London, 2008), whose introduction discusses the problematics of Atlantic knowledge from a non-national perspective. On rethinking center–periphery relations from Creole and non-western perspectives, see Jorge Cañizares-Esguerra, *How to Write the History of the New World: Histories, Epistemologies and Identities in the Eighteenth Century Atlantic World* (Stanford, 2001); Ralph Bauer, *The Cultural Geography of Colonial American Literatures: Empire, Travel, Modernity* (Cambridge, 2003); and, on India, Kapil Raj, *Relocating Modern Science: Circulation and the Construction of Knowledge in South Asia and Europe, 1650–1900* (New York, 2007). For imperial perspectives see Richard H. Drayton, *Nature's Government: Science, Imperial Britain, and the 'Improvement' of the World* (New Haven, 2000), and Larry Stewart, 'Global Pillage: Science, Commerce, and Empire', in Roy Porter, ed., *The Cambridge History of Science*, vol. 4: *Eighteenth-Century Science*, ed. Roy Porter (Cambridge, 2003), pp. 825–44. On the commercial dimensions of knowledge see Pamela H. Smith and Paula Findlen, eds, *Merchants and Marvels: Commerce, Science and Art in Early Modern Europe* (New York, 2002); Londa Schiebinger and Claudia Swan, eds, *Colonial Botany: Science, Commerce and Politics in the Early Modern World* (Philadelphia, 2005); and Cook, *Matters of Exchange*. On conceptualizing the study of science and colonialism see Roy McLeod, ed., *Nature and Empire: Science and the Colonial Enterprise*, Osiris, 2nd ser., 15 (2000).

In addition to works cited in my chapter, the following should be consulted on particular issues: on Elizabethan sciences of empire see Lesley B. Cormack, *Charting an Empire: Geography at the English Universities, 1580–1620* (Chicago, 1997), and Eric H. Ash, *Power, Knowledge, and Expertise in Elizabethan England* (Baltimore, 2004); on gender and environment, Carolyn Merchant, *Ecological Revolutions: Nature, Gender, and Science in New England* (Chapel Hill, NC, 1988); on pharmacopoeia, Renate Wilson, *Pious Traders in Medicine: A German Pharmaceutical Network in Eighteenth-Century North America* (Philadelphia, 2000); and on knowledge and public culture, Sara S. Gronim, *Everyday Nature: Knowledge of the Natural World in Colonial New York* (New Brunswick, 2007). On botany and travel, see Joyce Chaplin, 'Mark Catesby, A Skeptical Newtonian in America', in Amy Meyers and Margaret Beck Pritchard, eds, *Empire's Nature: Mark Catesby's New World Vision* (Chapel Hill, NC, 1998), pp. 34–90; and Londa Schiebinger, *Plants and Empire: Colonial Bioprospecting in the Atlantic World* (Cambridge, MA, 2004). On Jefferson, compare Charles A. Miller's intellectual history, *Jefferson and Nature: An Interpretation* (Baltimore, 1988), with Silvio A. Bedini's social and practical account of Jefferson's scientific interests in *Thomas Jefferson: Statesman of Science* (New York, 1990), while, for broader context, see John C. Greene's useful *American Science in the Age of Jefferson* (Ames, Iowa, 1984). On Rush and medical science see Jacquelyn C. Miller, 'The Body Politic and the Body Somatic: Benjamin Rush's Fear of Social Disorder and his Treatment of Yellow Fever', in Janet Moore Lindman and Michelle Lise Tarter, eds, *A Centre of Wonders: The Body in Early America* (Ithaca, 2001), pp. 61–74. On museums in America see David R. Brigham, *Public Culture in the Early Republic: Peale's Museum and its Audience* (Washington, DC, 1995). On slavery and race, see Winthrop Jordan, *White Over Black: American Attitudes towards the Negro, 1550–1812* (Chapel Hill, NC, 1968), esp. pp. 216–65; on race and gender, Londa Schiebinger, 'The Gendered Ape: Early Representations of Primates in Europe', in Marina Benjamin, ed., *A Question of Identity: Women, Science, and Literature* (New Brunswick, 1998), pp. 119–51.

## Chapter 6: Civility and Authority

This chapter develops some themes first explored in Michael J. Braddick, *State Formation in Early Modern England, c. 1550–1700* (Cambridge, 2000), which contains full references to secondary literature, and in the editor's introduction and Braddick's essay in Michael J. Braddick and John Walter, eds, *Negotiating Power in Early Modern Society: Order, Hierarchy and Subordination in Britain and Ireland* (Cambridge, 2001). The latter collection contains a number of essays relevant to the themes of this chapter. The relationship between this approach and the analysis of political change is also explored in Braddick, 'State Formation and Political Culture in Elizabethan and Stuart England: Micro-histories and Macro-historical Change', in Ronald Asch and Dagmar Freist, ed., *Staatsbildung*