

# At the Sign of Newton's Head: Astronomy and Cosmology in British Colonial New York

Sara S. Gronim  
*Rutgers University*

In 1745 Anthony Lamb, an instrument maker and vendor in New York City, advertised that he could provide Davis quadrants, forestaffs, nocturnals, rectifiers, and compasses at "the Sign of the Quadrant and Surveying Compass." As the name of his shop indicated, navigators and surveyors were Lamb's primary customers. In the mid-eighteenth century, New Yorkers sailed trade routes to and from the West Indies and Europe and steadily acquired land for farming to the north and west of the Hudson Valley, and Lamb, no doubt, did a good business. But in the 1750s, Lamb changed the name of his instrument shop. Now customers were directed to "the Sign of Sir Isaac Newton's Head." By using Newton as his icon, Lamb was signifying that he could satisfy demands for astronomical instruments beyond those that were simply practical. This expansion of demand reflected both in the public interpretation of celestial events in British colonial New York and in the cultural allegiances of those claiming the authority to make such interpretations. The promulgation of a new cosmology among New Yorkers, however, proved to be difficult and only partially successful.<sup>1</sup>

\* \* \* \* \*

Understandings about the structure and meaning of the universe changed dramatically among European astronomers in the Early Modern period. In the hundred years following the publication of Nicolaus Copernicus' *De revolutionibus orbium caelestrum* in 1543, Ptolemy's earth-centered cosmology was replaced by the Copernican sun-centered universe. By the time of the English conquest of New Netherland in 1664, Copernicanism was the consensus among serious astronomers in Europe and throughout Europe's colonial empires. In 1687 Isaac Newton, an Englishman, published his *Principia mathematica philosophiae naturalis* (usually referred to as the *Principia*), a work which demonstrated mathematically that celestial objects were kept in their orbit by a universal force called "gravitation." In the years following England's Glorious Revolution in 1688, Newton's work was embraced by a wide band of the British elite who saw in his achievement conclusive evidence of an orderly, mathematical universe (and, not coincidentally, British intellectual superiority.) Indeed, "Copernicanism" and "Newtonianism" often serve as short-hand for the Scientific Revolution, the turn towards the objective, mathematical

analysis of the natural world. As such they serve as synecdoches for the transition between the not-modern and the modern, "them" and "us." Taught as we are from an early age that the Earth moves around the Sun and is kept in its orbit by gravitational forces, these facts represent to us that we know the world not superstitiously but as it really is.<sup>2</sup>

Most people who colonized the area in and around the port town on Manhattan Island and up the Hudson River Valley in the seventeenth and early eighteenth centuries knew little of such "high" cosmology. Like most Europeans, whether in Europe itself or in its colonies, few were astronomers or had experience themselves of the mathematical calculation of celestial orbits which demonstrated the accuracy of Copernicanism and Newtonianism. And yet, they had considerable familiarity with the sky. The sun marked the passage of days, as the pattern of night stars did the changes of seasons. Some had reason to pay even closer attention, as did navigators who located their position on the open ocean by measuring the altitude of the sun and well-known stars. Spectacular events like comets and lightning were part of everyone's experience. When weighing assertions about the structure of the cosmos, New Yorkers could measure them against the evidence of their own senses.<sup>3</sup>

Up through the 1750s almanacs were the most important expression of beliefs in British colonial New York about the nature of the universe. The cosmology presented to readers of English (and, in translated editions by at least 1738, to Dutch readers) was a compound of astronomy and astrology that slowly separated from each other as almanacs shifted from a Ptolemaic to a Copernican universe during the middle third of the eighteenth century. The slowness and, indeed, the incompleteness of this shift reflected both political and religious fractures in the colony, as well as the continued allegiance of many New Yorkers to the evidence of their own senses. Nevertheless, after roughly 1750 the site of authoritative cosmology in New York was displaced from almanacs to newspapers and public lectures. Newspaper contributors and itinerant lecturers espoused Copernicanism and Newtonianism as part of a larger British Atlantic natural philosophy. The interest in natural philosophy shown by local men, and particularly in the demonstration of its truths through both electricity and astronomy, became a mode through which a particular stratum of New Yorkers attempted to assert public control of celestial events and to construct themselves as gentlemen. However, their efforts to shift beliefs about the universe provoked acrimonious debate. For the new men, no less than for the almanac makers, the sky was primarily a text of God. Consequently, claims about cosmology were claims about the nature of God himself.<sup>4</sup>

The public contentiousness with which Copernicanism and Newtonianism were debated in British colonial New York was a reflection of the peculiar social structure of the colony. Until the middle of the eighteenth century, a

thin layer of the British imperial elite ruled over a heterogeneous populace with origins throughout northern Europe and Africa. New York was a strikingly factionalized colony, in which local elites competed vigorously with each other and local "middling sorts" were strongly disinclined to defer to anyone. Although English had become the language of business and government by 1710, the adoption of wider English fashions (including intellectual ones) grew slowly in the 1720s and 1730s. Only in the 1750s, as evidenced by the advertisements of booksellers, the establishment of a college, and the circulation of theater companies and portrait painters, did "Anglicization" become strongly marked, most evidently in New York City. The defeat of French Canada in the Seven Years War brought a flood of British immigrants to New York in the 1760s. Only then did New York have a large number of settlers with experience of and allegiance to British "genteel" culture. However prominent Anglicization may have been in realms of consumption and entertainment, however, it did little to further cohesion and harmony among local elites or to promote a general deference to one's "betters" among the lower orders. Political culture was openly rancorous throughout the British colonial period.<sup>5</sup>

In Britain Newtonianism was not only embraced for its material account of the cosmos but also because important members of the Anglican establishment believed that it displayed particularly clearly the reasonableness and order of God's creation, a reasonableness and order which they extended to the British political and religious establishment. New York was as notable for the heterogeneity of its settlers' religious allegiances as for their national origins, with Reformed Protestants, Lutherans, Presbyterians, Quakers, and other Protestant Dissenters far outnumbering local Anglicans. Cosmological questions were, in their British Atlantic context, equally theological ones. Differences in the interpretation of celestial events reflected religious differences, and religious differences which in turn rivaled the rancorous political disputes in the colony.

The slowness and shallowness with which Copernicanism and Newtonianism came to be accepted by the literate but not learned middling sorts in British colonial New York may not have been particularly different from other colonies of the British Atlantic. All colonies had varying numbers of non-English and/or non-Anglican settlers and all had some political conflict. New York is perhaps distinctive for the intensity and openness of its political and religious contentions, an openness which allows us to see particularly clearly how the adoption of new ideas about the natural world was not simply a matter of their reasonableness or usefulness, but was inevitably bound up with other cultural issues.<sup>6</sup>

Even a cursory reading of colonial almanacs shows that they were intended to be useful. The major purpose of any almanac was to serve as a time-keeper: the monthly calendar not only marked the passage of days, but the times of sun rise and set, of high tides, of phases of the moon, and of "southings" (passage across the meridian) of various bright, familiar stars. But almanacs purveyed much more information about celestial bodies than simply timing. They consequently revealed extensive beliefs about cosmology. Colonial New York almanac makers were initially committed to an active universe of a powerful and sometimes wrathful God, a God who wrote in the sky commands to repent and reform.

Almanac makers who wrote under their own names or can be otherwise identified generally came from the same artisanal strata as the surveyors and ship captains who were Anthony Lamb's customers, although some bordered on genteel status. Daniel Leeds, New York's earliest almanac maker, described himself as self-taught, since his father, a "mechanick," could not afford to educate him formally. The Leeds family emigrated to West Jersey in the 1680s as Quakers, but Daniel Leeds had a theological falling out with his fellow Quakers and rejoined the Church of England, though his theology continued to be distinctly millenarian. He served for a time on the Governor's Council of West Jersey, testimony to some degree of social standing, but was replaced because of his otherwise undescribed "arbitrary proceedings." Daniel Leeds taught his son Titan the mathematical skills and astronomical knowledge needed by an almanac maker. Titan was the preeminent New York almanac maker from 1714 until his death in 1738. Titan educated a successor in John Nathan Hutchins who advertised as a mathematics and astronomy teacher in New York City between 1751 and 1767 and who published almanacs from 1749 to 1774. John Clapp and Roger Sherman were of similar origins. Literate but not learned, they saw themselves as reliable, knowledgeable observers of the natural world dispensing sensible information to their fellow colonists.<sup>7</sup>

In the early decades of New York almanacs, Ptolemaic cosmology predominated. The Earth was suspended at the center of the universe and each of the seven heavenly bodies observed to have significant motion (the Sun, the Moon, and the five planets of Mars, Venus, Mercury, Jupiter, and Saturn) was fixed in its own crystalline sphere which rotated at a distinctive rate around the Earth. The "fixed" stars (fixed, that is, in relationship to each other) were on the outermost crystalline sphere "like some golden nails driven into a ceiling." This sphere, too, revolved, going through one revolution in a year, giving Earth a continuously changing pattern in the night sky. The Ptolemaic model matches ordinary observations of the heavens very nicely. When Daniel Leeds described an eclipse in 1699 as occurring "when the Moon is under the Earth," he was assuming a universe consonant with the everyday experience in which he was "rightside up," a universe in which planets and the Sun and

Moon plainly arched overhead and then circled around under the Earth before arching overhead again.<sup>8</sup>

As we can assume New Yorkers were unaware that they were on a trajectory to the modern, we can ask why they might have preferred one model of the universe over another, or, indeed, why any model mattered at all. Although John Clapp briefly described the Copernican system in his almanac of 1697, he did not calculate the year's eclipses correctly (which everyone could see for themselves) and so his almanac could hardly have persuaded many of the truth of Copernicanism. A full exposition of the Copernican system was put before New York almanac readers for the first time in 1723. Before setting out the details, however, the author, "B.A.", told his readers that he expected that what he wrote would probably be censored because it was so unfamiliar. Nevertheless, he published it for "the unlearned, that they may know the general received Opinion of the Learned World." As this almanac is the only one known to have been written by this author, the unlearned of New York may not have bought it, in both senses of the word.<sup>9</sup>

Titan Leeds, who wrote most of the almanacs printed in New York between 1714 and 1744, presented his readers with a hybrid universe. Titan Leeds, though clearly aware of the Copernican revolution in cosmology, mixed Copernican assertions that the Earth moves with continued Ptolemaic assertions that it is the Sun that moves. Like other literate colonials, Titan Leeds had become aware that Ptolemaic cosmology was now considered archaic by the learned in Europe, but he, himself, was uncertain of how far to trust distant learned opinion and how much to trust the evidence of his own eyes.<sup>10</sup>

In contrast to almanac readers, the imperial elite of New York—royal governors, high provincial officials, and members of the Governor's Council—accepted distant learned opinion as the erudition appropriate to gentlemen. Even in such remote reaches of the British empire in the first half of the eighteenth century as New York, some members of the imperial elite kept up with intellectual developments in London. Cadwallader Colden, New York's Surveyor General from 1720 to 1754 and on the Council until his death in 1776, had been educated at the University of Edinburgh. While trying unsuccessfully to make a living as a physician in London, he had been on the edges of that part of London society whose members were interested in the natural world. After he emigrated to the colonies, he continued his interest in issues debated in London. One such issue in the mid-eighteenth century was the conundrum of gravitation. While in his *Principia* Sir Isaac Newton had demonstrated *that* gravitation worked at a distance, he had not explained *how* gravitation worked at a distance. Colden ruminated on the problem of the mechanism of gravitation's effect on celestial bodies during winters on his farm in the Hudson Valley and published his thoughts in 1746 in a short book entitled *An Explication of the First Causes of Action in Matter, and, of the Cause of Gravitation*.<sup>11</sup>

Colden's work interested the erudite on both sides of the Atlantic. Colden's elaboration of Newton caught the attention of those with similar interests because Colden asserted that his own theory explained not only the nature of things in a philosophical sense but also led to superior mathematical calculations of celestial motions. Through his principles, Colden said, "more easy and certain Methods may be found for determining the Orbits of Planets, and even of the Moon, and of forming Aequations for that Purpose." James Alexander, a fellow member of the Governor's Council who also had astronomical interests, wrote Colden that if his mathematics could remove some of the sources of uncertainty and dispute in astronomy, "they will be lasting obligations on the Learned world and transmitt your name to posterity with more honour than the Conquest of Kingdoms." Colden sent copies of the book to a correspondent in London who circulated it among those with similar interests and wrote back encouragingly of their interest. Consequently Colden expanded his explanation and published it in London in 1751 as *The Principles of Action in Matter, the Gravitation of Bodies, and the Motion of the Planets, explained from those Principles*. Although it was ultimately unsuccessful in explaining gravitation, Colden's treatise was sufficiently respected to be reviewed in the London "polite" press.<sup>12</sup>

Colden's efforts to correct Newton's deficiencies did not impress many of his fellow New Yorkers, however. Colden had written his first treatise while in semi-retirement from local politics, but soon after its publication he was drawn back into controversy. A new governor, George Clinton, was struggling with the powerful judge and great merchant Stephen DeLancey over the conduct of King George's War. In Colden's first three decades in New York, he had consistently ended up on the losing side in political battles, having, apparently, little personal ability in cultivating allies or picking winning fights. This conflict was no different. Clinton had dissolved the Assembly, hoping new elections would bring a more tractable group into office. Colden wrote an exhortatory election pamphlet in which he styled himself a simple man and appealed to his fellow "middling sorts" to stand against the wealthy and arrogant elite. It was more than a little disingenuous and, although it was published anonymously, everyone knew perfectly well who wrote it. One writer to a local paper suggested that rather than continually "bedawbing" the public prints with "the Excrements of his Brain," Colden should leave off politics and return to his "Starr Gazing." You should, the writer advised Colden, "indulge thine Excess of Folly and vanity . . . in thy conceit of thy self sufficiency for making further improvements upon Sir Isaac Newton's Philosophy. Then wilt thou be out of the way of doing further Mischief, or Harm, to anyone but thyself." Far from impressing local people with his erudition, Colden had merely confirmed his pretentiousness, a claim to superiority of understanding that the imperial elite repeatedly displayed when trying to carry their way in politi-

cal conflicts in the province, a superiority of understanding few of the “middling sort” were willing to grant. Indeed, New Yorkers may have been reluctant to admire Newton at least in part because his name was associated with such a disliked colonial official.<sup>13</sup>

Nevertheless, by the late 1740s almanac makers in New York had abandoned any references to the Ptolemaic system and began to present the Copernican solar system to their readers. Clearly, their readers, however, resisted. In 1756 the display of a mechanical model of the universe, the “Microcosm,” in New York elicited this poem submitted to a local newspaper:

To Minds unskill'd can Sciences impart,  
And teach 'em more within a Night or Two  
Than all the Astron'mers of th' Age can do;  
And make to them Copernicks wholly known,  
Which they before cou'd not be brought to own.

In 1767 “Frank Freeman” still felt impelled to lecture readers of his almanac on their recalcitrance and offered, like “B.A.” in 1723, a complete presentation of Copernicanism in order “to root out Error and Superstition.” In the minds of newspaper poets and almanac writers, at least, New Yorkers incompletely and reluctantly assimilated the sun-centered Copernican model during the British colonial period. The question is, why did it matter that they do so?<sup>14</sup>

The “Error and Superstition” Freeman decried was not so much Ptolemaic cosmology in itself but the accompanying practice of astrology. In the visualization of the Ptolemaic universe, each crystalline sphere nestled inside another and so the heavenly bodies embedded in each sphere were relatively “close,” and close to Earth as well. The basis for astrology was the belief that the planets, as they moved into and away from positions of proximity to each other, systematically influenced the natural world. Astrology, like any cultural practice of long duration, was not static. By the end of the seventeenth century astrology as practiced in Britain had been divested of much of its elaborate and arcane calculations and had moved towards the adoption of a more Baconian transparency. As Peter Eisenstadt had shown in a recent issue of *Pennsylvania History*, this “disenchantment,” the movement from astrology as an occult practice towards astrology as a collection of practical “recipe knowledge,” characterized almanacs of the eighteenth century throughout the British colonies. In New York, as well, astrology limited itself more closely to what an attentive observer could see in the actual night sky and practitioners consistently claimed that the correlation between the movements of the planets and the effects on earth were accessible to everyday experience.<sup>15</sup>

Despite their formal adoption of Copernicanism, almanacs in New York continued to assert that the positions of the planets influenced the material natural world throughout the entire British colonial period. Virtually ubiquitous in New York Almanacs was the "Man of Signs", a woodcut of a seated figure with the twelve signs of the zodiac arrayed around him, each sign connected to a body part. All almanacs listed the moon's daily zodiacal sign and almost all of them gave explicit directions on how to coordinate healing practices like bleeding and purging with the Moon's sign and the relevant "governed" body part. The Moon's sign and phase also were offered as a guide to agricultural practices like gelding livestock and planting crops. I have found no evidence in personal letters or diaries that anyone in colonial New York followed the Moon's sign in healing practices, but there is scattered evidence that farmers synchronized some agricultural practices with the Moon. In the margins of a 1705 almanac a user wrote "The first full Moon that's in July/ Sow turnip seed [Ye't moist?] or dry," and Lambert Borghard, a Kinderhook farmer, kept a record in the 1760s of how he planted his flax, corn and pumpkin seeds with similar attention to the phase of the Moon. And, of apparently great importance to readers, virtually all published almanacs used predicted shifts in planets' positions to forecast the weather. In 1699 Daniel Leeds published a chart to show readers the method he used. A conjunction of Saturn and Jupiter brought unsettled weather: rain and thunder if in summer, turbulent air if in winter, blustery rain if in fall or spring. By publishing his chart, Leeds presented weather prediction not as the occult knowledge characteristic of a conjurer, but as the rational, systematic assessment of the natural world.<sup>16</sup>

When "Frank Freeman" published his first almanac in 1767 and declared, "The influence of the Planets are altogether imaginary," readers objected. Freeman told his readers that in the name of rationality he would not put in his almanac "the poor tortured Man" the Anatomy, or even the weather. "A Method to form a right Judgment of the Weather with infallible Certainty, I will now acquaint you with it," he wrote. "It is, to wait until it comes." The next year Freeman had to own ruefully that, although he sold 3,000 copies, "many did refuse to buy because of the omissions." Because he would not pretend to prediction himself, he said, he had intended to put in the weather using the throw of a die. But as it happened someone "who pretends to be an Adept" had offered to calculate that part for him and thereafter Freeman's almanacs predicted the weather.<sup>17</sup>

Almanac makers were sensitive to readers' complaints, for they knew readers could evaluate an almanac's accuracy through the evidence of their own senses. Daniel Leeds complained in 1696 that he'd gotten so much abuse from readers that he was tempted not to go on. Certainly many readers could assess the sky sufficiently to judge the worth of an almanac. When Daniel Leeds mocked a Philadelphia rival for calculating that each month the Full Moon would



cross the meridian at the same time two nights running, Leeds scoffed, "Everyone that can but read" knew the Moon crossed the meridian fifteen minutes later each night, full or not. Upon hearing that the Iroquois did not know how to forecast eclipses, the Albany trader Robert Saunders responded, "Ask my smallest girl when such a thing will happen ten, even twenty years from now. She will be able to tell you in less than an hour." Indeed, almanac writers attributed their sales to readers' ability to match their forecasts against the readers' own experience. Such attributions were a staple of almanac competition, as in 1761 when John Nathan Hutchins bragged that his almanacs sold so well presumably because his calculations were so esteemed, and Thomas More claimed that he had such great sales because readers "easily found the Difference between my calculations and my Brother John Nathan Hutchins" (to which Hutchins retorted, "The biggest Whore calls Whore first.")<sup>18</sup>

Such forecasts were always approximations, however. In this the content that we now deem "astronomical," like the time of sun rise and set, was little different from the "astrological" forecasts like the weather. "Artis Amor" wrote the *New-York Mercury* that he had wanted to compare his old favorite Hutchins with a new contender, Frank Freeman. He and a friend sat outside with his pendulum clock on one particular evening and found that Hutchins' forecast of the time of moonset was off by only a few minutes, while Freeman erred by more than an hour. Even such precision as this was probably irrelevant to most readers, for clock time did not penetrate many households in the Hudson Valley until the nineteenth century. Nonetheless, readers' complaints that almanacs were not altogether reliable led Thomas More to devote his 1754 opening page to an explanation. "We see by the Aspects that rain is to come at such and such a time," he wrote, "but the continent is large, it may be in one place, tho' not in another; ten or twelve miles often make a difference." Serious as almanac makers' efforts were, the natural world did not yield easily to precise prediction; approximation was the greatest they could claim.<sup>19</sup>

Historians usually identify astrology's vulnerable point not as inaccuracy regarding the natural world but as its practice of predicting events in the human one. Historians' explanation of the demise of astrology in Britain is the efflorescence of prophecy during the political turmoil of the seventeenth century with its subsequent suppression via censorship and marginalization using the label "superstition." In New York public prophesizing did not disappear until the 1750s. Part of the distinctiveness of the New York experience is attributable to the fact that none of the prophecies had clear political content (aside from the general and occasional "woe-will-come-to-great-men" prophecy) and no connections were drawn between the content of almanacs and social conflicts within the province. But, in addition, as with British seventeenth-century astrology, prediction as practiced in New York was integrated with Christian belief. When over the course of the 1750s prediction faded

away, its disappearance can be partially attributed to three causes: the increased strength of an "enthusiastic" Protestantism (in which the interpretation of the natural world was more strongly under ministerial control), a natural philosophy which interpreted the material world not as conveying messages from a chastising God but as continuously affirming his benevolence, and the scorn with which "the genteel" came to regard prophecy.<sup>20</sup>

Almanac makers until the 1750s predicted the effects of celestial events like eclipses and particular alignments of planets. An eclipse of 1710 would bode ill for women, especially widows, traders at sea, and seamen, predicted Daniel Leeds. William Birkett in 1738 predicted an eclipse would bring "Fevvers and Agues, Malice, Hatred and Envy." As with their predictions of weather, almanac makers made no claim to magical powers. "Astrology as well as Physick is nothing but a Bundle of Experience, which the industrious Observators have heaped up a Portion and Legacy to After-Ages," wrote Titan Leeds. "It is Experience that makes the Soldier politick, and it is Experience that makes Artists cunning, and it is Experience that must make every Science perfect." And while experience helped the almanac maker interpret celestial influences correctly, none doubted that those influences were under divine direction. God uses eclipses to presage direful effects and the need to tremble before him, John Clapp wrote in 1697. Daniel Leeds explained:

God rules this world by Stars and Angels, so  
As Angels Countermand what Stars can do.  
In general Judgements, Angels power's known;  
Our single fate he rules by Stars alone;  
For where's the man, who with success has Strove  
Against the power of Mars, Sol and Jove?<sup>21</sup>

Astrologers also interpret celestial events like eclipses and conjunctions as the bearers of specific Christian messages. Sometimes such events warranted merely a general exhortation to reform, as when George Christopher warned in 1754, "the stars seem to prognosticate this Year, as if some of our great Men would kick off the stage, therefore I think you ought to indeavor always to be ready." Upon occasion the messages of celestial events pointed to particular Christian revelation. In 1738 Titan Leeds saw that one eclipse would occur near the Dragon's Head and "therefore the Effects will not be bad to those that endeavor to avoid the Temptation of the great Red Dragon," a reference to a prophecy in Chapter 12 of the Book of Revelations. Leeds also looked ahead to two conjunctions of Saturn and Jupiter in 1742 and 1762, the latter occurring in Aries. "According to the Opinion of the Learned," he wrote, "those Conjunctions may cause wonderful Changes and Revolutions in the World . . . and perhaps then will be the beginning of the pouring forth of the Seven

Vials, or last Plagues upon Babylon or Tyrus, i.e. the Papacy." The thread of Protestant millenarianism so prominent in England during the mid-seventeenth century, while more subdued, was still publicly acceptable in eighteenth-century New York.<sup>22</sup>

Nevertheless, the attack on astrology that had been so successful among the learned of Europe eventually made itself felt in New York. The 1748 edition of George Fisher's *The American Instructor, or Young Man's Best Companion*, a popular self-help book, had a list of definitions useful for young men endeavoring to advance themselves. Astrology was defined as "that foolish Science which pretends to foretel future Events from the Motions of heavenly Bodies and in their Aspects one to another; or from some imaginary, hidden Qualities, which the weak Admirers of this Cheat will have to be in the Stars." Clearly, rational men were to spurn such credulity. The almanac maker John Nathan Hutchins at first resisted the rending of astronomy and astrology. "But why do I talk of Astrology?" he asked scornfully in 1753. "An Art so much condemned by many of our wise Zealots, whose thick Sculls can't penetrate to any Thing above the Earth, or out of the Reach of their Nose. . . . Yet are so wise as to call those Arts they know nothing of, sinful, diabolical, whimsical, and what not." But by the mid-1750s even he offered no interpretation of the eclipses or significant conjunctions which he forecast for the coming year. In 1764, surveying the defeat of Catholic France in North America, he wrote his readers, "It was in the Year 1737, my honored, but deceased Master, foretold many Things, that (to me) seemed strange, but I have lived to see great Part fulfilled." But this reference to predictive astrology in a New York almanac was now rare. Almanacs now were filled with agricultural and medical advice, entertaining stories, tables of currency exchanges, and the dates of fairs, but were generally silent on God's plans. They still calculated the aspects of the planets, but limited assessments of their influences to the weather. Eventually even Hutchins overtly spurned the older beliefs. "I assure you," he wrote for July 1774, "on the word of an ASS-trologer, we shall have no hard frosts, nor deep snows this month." Almanac makers had now retreated from public pronouncements on the universe.<sup>23</sup>

By the 1760s the task of interpreting celestial events publicly had been taken over by a new group of men. More modest in social position than members of the imperial elite like Colden, they were part of the emerging culture of "genteel" consumption in the mid-eighteenth-century Atlantic world. Some were born in New York, some emigrated in the swell that followed the success of the Seven Years War. They were men like Robert Harpur, born in Ireland, educated at the University of Glasgow, and appointed teacher of mathematics and natural philosophy at New York's King's College. David Colden, Cadwallader Colden's youngest son and an invalid, published electrical experiments. And Samuel Spencer Skinner, an English Quaker who made his

living as a rum distiller in New York City, was an avid astronomer. Their activities brought widespread public attention to natural philosophy and made its commitment to demonstrating the benevolence of God part of the public discourse in New York.<sup>24</sup>

Electricity was the subject that first drew general public attention in New York to the cosmology of a universe of natural laws which revealed God's benevolence. The demonstration that lightning, a seemingly capricious and occasional event, was in fact a manifestation of a more general phenomenon that pervaded the natural world, had made electricity a particularly compelling subject in the middle decades of the eighteenth century throughout the British Atlantic world. Electricity also attracted attention because evidence for it was presented by means of dramatic public spectacles. Furthermore, it showed that the investigations of natural philosophy were genuinely useful.<sup>25</sup>

An itinerant Dr. Spenser gave the first electrical demonstrations in New York in 1744. In 1748 Richard Brickell promised to demonstrate "the new Way of Electrifying several Persons at the same Time, so that the Fire shall dart from all Parts of their Bodies." Such dramatic public spectacles were made possible by the development of experimental apparatus like the Leyden jar, an electrical condenser which consisted of a glass jar coated part way up its sides inside and out with metal foil, with the inner foil connected to a rod which emerged into the air through the jar's cork stopper. Other items were rapidly added to the repertoire of the electrical lecturer, apparatus like a wooden model of a church which burst apart when its steeple was hit by "lightning." By the time William Johnson, an Irish Quaker and natural philosophy lecturer, toured the colonies in the 1760s, the repertoire of demonstrations available to public lecturers was considerable. Johnson advertised that he would make an artificial spider dance, fire a battery of seven guns from a spark issuing from a person's finger, and have a "bright Flash of real Lightning" strike from a painted cloud. There was, apparently, audience participation as well. For a demonstration of "the Salute repulsed," the cheeks and lips of a woman were electricized so that no man could kiss her, no matter how many were tried.<sup>26</sup>

Such demonstrations made graphic the contentions of those natural philosophers who investigated electrical phenomena. Those contentions were that electrical "effluvia" could be demonstrated to exist throughout the natural world, that lightning was simply one instance of this effluvia, and that electricity, when understood, could be channeled at will. A New York newspaper printed a letter from Rhode Island urging New Yorkers to attend Ebenezer Kinnersley's 1752 lectures. "The Wisdom of Providence," effused the Rhode Island writer, "having reserv'd the Discovery of that wonderful *Phenomenon*, which has been a Mystery, wrapp'd up in Clouds and thick Darkness ever since it's first Appearance, to the present Age, and entirely to the Improvements made of the Electric Fire, by ingenious *Americans*."<sup>27</sup>

Benjamin Franklin was the most famous of these “ingenious Americans,” widely admired in the British colonies, in Britain itself, and in France. Franklin’s fame can be attributable both to the coherence of his explanation and the development of the lightning rod as concrete testimony to his interpretive powers. Lightning rods, like smallpox inoculation, deflected the devastation wrought by naturally occurring phenomena. They reinforced a growing faith in “improvement” on the part of the genteel in the British Atlantic world. In the 1750s newspapers printed advice on the proper use of such rods and they were to some degree adopted throughout the British colonies. A 1773 account of a number of barns which burned to the ground in New Jersey reminded readers, “Barns filled with Grain and Hay, which abound with electrical Effluvia, are more than other Buildings, exposed to the Danger of Lightning, and therefore should always be guarded with pointed Iron Rods, for their Preservation.” The reference to “effluvia” pointed to how well Franklin’s ideas had been assimilated.<sup>28</sup>

As they had for Franklin, electrical demonstrations had the potential for vaulting successful practitioners into fame in a transatlantic public sphere, earning them esteem and stature. The practices of natural philosophy, construed broadly as it was in the eighteenth century to include all investigations into the natural world, had emerged in the British Atlantic as an arena in which middling men might demonstrate claims to gentility. However, when David Colden, the youngest son of Cadwallader Colden, took up experimenting on the family farm in the mid-Hudson Valley, he was unsuccessful in eliciting acknowledgment of his superior understanding. For while New Yorkers had begun to be interested in natural philosophy, they did not yet concede it a central place in the interpretation of the natural world.<sup>29</sup>

David Colden first attempted to make a name for himself when he came to Franklin’s aid. In 1754 a French experimenter, the Abbé Nollet, challenged Franklin’s electrical theory. David replicated some of the experiments that Nollet claimed refuted Franklin’s theory. The experiments did not support Noller’s claims and David sent his account to Franklin, a friend of his father’s, who published it as an appendix to the third edition of his *New Experiments and Observations in Electricity*. While David’s efforts earned him Franklin’s appreciation, they could hardly outshine Franklin’s own accomplishments. Next, David turned to writing a theoretical treatise that would demonstrate the truth of his father’s *Principles of Action in Matter*, a work which, while initially noticed respectfully, had failed to win acclaim in Europe on its own. This act of filio piety also failed to win the younger Colden respect. A leading British experimenter returned the manuscript and replying curtly, that since the father’s work was unintelligible, the son’s experiments made no sense, either.<sup>30</sup>

Unable to penetrate the British world of letters, David tried to find a local audience. He attempted to generate a sustained conversation on electricity by

submitting two novel experiments to one of the short-lived colonial "polite" magazines. His conclusions questioned the existence of a "negative" charge, but if he hoped to stimulate a public conversation on the fine points of electrical theory, he was disappointed. He received pointed criticism from Ebenezer Kinnersley, but otherwise the only response was silence. David eventually found a correspondent in William Johnson when the latter began his itinerant career as an electrical demonstrator, and the two shared mutual assurances of "that thirst for a discovery of Truth." But in order to serve the public good, a proper vocation for a true gentleman, the public had to show some interest in receiving their benevolence. Perhaps David's inability to make a public figure for himself can be partially attributed to the widespread dislike of his father. In any case, in New York the public seemed largely indifferent to issues that lacked the drama of "the salute repuls'd" or the utility of the lightning rod.<sup>31</sup>

Electrical demonstrators did not intend, however, merely to titillate their audience or to showcase the useful. As explicitly as the celestial events in almanacs, electrical demonstrations were interpreted to reveal the hand of God. William Johnson insisted that his electrical demonstration were religious experiences, for "the Knowledge of Nature tends to enlarge the human Mind, and gives us more noble and exalted Ideas of the GOD of NATURE." He reassured his audience that the demonstration of the lightning rod was not "inconsistent with any of the Principles of natural or revealed Religion" and quoted Psalm 111: "The Works of the Lord are great, and sought out by all of them that have Pleasure therein," positioning himself as primarily doing religious work. Similarly, Nina Reid-Maroney has described the impetus for Ebenezer Kinnersley's itinerancy in the early 1750s as his reaction against the Great Awakening. Kinnersley believed that nothing in the natural world could better counter what he perceived as the enthusiasts' bleak picture of the difficulties of salvation than this insight into the secrets of nature, which God clearly made known out of his desire for the well-being of his children. Electrical demonstrations were intended to reaffirm spectacularly the continued presence of a benevolent God.<sup>32</sup>

However, as Simon Schaffer has pointed out, the use of dramatic demonstrations to teach the moral lessons of natural philosophy was problematic. Some members of the audience may well not have made the intellectual leap from watching "the Salute repuls'd" to the contemplation of God's majesty. Moreover, for the already deeply religious, such demonstrations could be irrelevant. When Henry Melchior Muhlenberg, a German Lutheran who occasionally ministered to New York congregations, saw Kinnersley's demonstration, he did not find the spectacle essential to religious belief. "Great are the Lord's works of creation and preservation," he wrote in his journal, but added, "even greater is the work of redemption!" The connections between natural philosophy demonstrations and the knowledge of God were not necessarily clear.<sup>33</sup>

For all the drama of electrical demonstrations, few New Yorkers could attend them, for they were infrequent and offered only in port cities. By contrast, the night sky was available to everyone and on that account continued to warrant attention. Eclipses and the movements of the planets were reported occasionally in the newspapers, though as in almanacs, by the mid-1750's without comment. Newspapers also described unusually celestial phenomena, whether seen locally or reported from other places, as the sudden appearance of a "Globe of Fire" in the sky before two gentlemen riding near Newburgh. Such anomalies were only occasionally interpreted, however, and at most as a general call to repentance and reform. Generally the New York press adhered to the norms of the British "polite" press which had adopted a matter-of-fact style when reporting anomalies, that of simple reportage without commentary.<sup>34</sup>

The exception was comets. When a comet appeared in 1744, for example, the *New-York Weekly Post-Boy* printed a poem which said that the comet

"Warns every Creature thro' its trackless road,  
The fate of sinners, and the wrath of God."

Before the late 1750s, the interpretation of comets as prodigies which forcefully reminded people of their duty to God was unquestioned and unremarkable.<sup>35</sup>

Public representation of comets as a call to repentance shifted with the return of Halley's comet in 1758. Edmond Halley and Isaac Newton's analysis of the orbit of a comet they tracked in 1682 transformed cometology. The comet's return in 1758 as they had predicted confirmed decisively their assertions that comets were not adventitious objects that moved in straight lines but predictable ones akin to planets that moved in elliptical orbits around a fixed focus. New Yorkers were alerted to expect the comet's appearance by a newspaper notice in November 1757 and in Roger More's almanac for 1758 (which was offered for sale at the end of 1757). In June 1758 the *New-York Weekly Post-Boy* informed readers where they might begin to look for the comet in the night sky. Sightings of Halley's comet were reported to New-Yorkers until its disappearance in the spring of 1759. As Sara Schectner Genuth has argued, when Isaac Newton and Edmond Halley developed their comet theory, they did not abandon the widespread belief that comets were theologically significant. Rather, they redescribed those beliefs in the language of natural philosophy, retaining the conviction that the natural universe and the moral universe reflected each other. Therefore significant anomalies in the natural world would occur at those moments when the moral world was most awry. When Halley's comet returned, two New York almanac makers did not hesitate to interpret it theologically. Jesse Parsons fully understood that the orbits

of comets were "exactly agreeable to the Laws of Motion," and at the same time believed that this made them no less "the Instruments of Divine Vengeance," which he felt was well merited by the "guilty Inhabitants." But Roger More was more sanguine. While he acknowledged that the comet's tail might sweep the earth, More wrote, "But our comfort is, that the same great power that made the universe, governs it by his providence; and such a terrible catastrophe cannot happen till He sees it fit it should."<sup>36</sup>

The periodicity and predictability of comets such as Halley's was not as disruptive of local cosmology as the issue comets raised about the scale of the universe. Astrology's claim that the alignment of the planets affected events on Earth was based on the Ptolemaic assumption of an intimate universe. Copernicanism did more than displace Earth from the center of the universe; it also vastly expanded space.

One of the consequent projects of eighteenth-century astronomy was the measurement of the dimensions of the solar system. Infrequent events, the visible "transits" of Mercury and Venus across the face of the Sun, which occurred in 1753, 1761, and 1769, served as a basis for such calculations. Success required a number of skilled observers with precise instruments at widely spaced distances. James Alexander, Cadwallader Colden's supporter, had attempted to view the Transit of Mercury in 1753, training his son and another young man to assist him, but his effort received no local notice and, in any case, the day was cloudy. The Transit of Mercury in 1761 came at the end of the Seven Years War and similarly received no public notice in New York. By contrast, the 1769 Transit was widely noticed. A group of men on Manhattan, led by Robert Harpur, the natural philosophy teacher at King's College, was one of the many teams of observers scattered over the face of the globe.<sup>37</sup>

A New York newspaper published Harpur's account of the observation, an account expressed in the degrees, minutes, and seconds of arc necessary for a contribution to the grand project of measuring the solar system. Another participant, Samuel Spencer Skinner, submitted a drawing of the planet's path across the Sun so that the readership could visualize what the group had seen. But, surprisingly, the New York participation in this global project did not seem to have been communicated beyond its own borders. If such efforts were part of a transnational republic of letters, if, as Robert Harpur put it, the expectation was that "Gentlemen in every Part of the World . . . will duly exert themselves," the New York participants seem only to have performed for themselves.<sup>38</sup>

Nevertheless, local attention to this demonstration that space was vast and heavenly bodies far apart had marked effect on public discourse in New York because it had theological implications. A major argument defending astrology had been the assertion that, since God made everything for a purpose, the purpose of heavenly bodies was to effect events on Earth. With the



post-Copernican expansion of space such influences became less imaginable and the question of God's purpose in creating the stars and planets was reopened. When a comet appeared in the sky over New York in September of 1769, therefore, it elicited intense debate.<sup>39</sup>

Two unsigned letters first described the comet to New York newspaper readers in September. They were immediately followed by an extraordinary series of articles by Skinner, entitled "A Philosophical Description of Comets." Skinner's essays were a model of natural philosophy. He described the sequence of his observations, using terms appropriate for a wider audience than those adept with a telescope and angular measurements. He described the opinions of "our Modern Philosophers" like Sir Isaac Newton and William Whiston, reminding readers of Newton's calculations of comets' orbits. He explained that comets were "Opake, Compact, fixed and durable Substances," and, like other natural objects, they could be organized by species. The 1769 comet, wrote Skinner, was probably "a Comet Crinitus, or hairy Comet, throwing forth beams like hair, from every part of it." He addressed current debates in cometology, such as the existence of life on comets, and personally opined, "The Hypothesis of the plurality of Worlds, seems extremely rational . . . as God has made nothing in vain." But opinion in New York did not stay within the boundaries laid out by British natural philosophy.<sup>40</sup>

The shift in the image of comets from balls of fire hurtling in straight lines to populated spheres moving in predictable orbits did not settle their meaning for New Yorkers. The first letter alerting New Yorkers to the comet's presence, from Elizabeth Town, New Jersey, described the author's observations of the comet and his calculation of its likely path. The comet would draw near the Sun in less than thirty days, the author wrote, and, should it then pass on this side of the Sun, its tail would likely extend to Earth. "Therefore," the letter concluded, "it becomes all to be prepared for Consequences so alarming as those which must follow." A counter-interpretation was promptly published in the form of a poem which asserted that the aim of the comet was

To work the will of all-sustaining Love:  
From his huge vapory train perhaps to shake  
Reviving moisture on the numerous orbs,  
Through which his long ellipsis winds; perhaps  
To lend new fuel to declining suns,  
To lighten up worlds, and feed the eternal fire.

These, then, were the terms of the debate: was the comet a call for repentance and reformation in the face of "Consequences so alarming" or a call to rapturous contemplation of this evidence of "all-sustaining Love?"<sup>41</sup>

Throughout the autumn of 1769 the debate continued in the New York newspapers. The papers printed observations of the comet made both locally and in Boston, Rhode Island, and Philadelphia. More poems were offered as well, poems in support of the comet as a work of love, or taking the agnostic position of the futility of scanning the heavens to learn God's will. (One author of a poem "To Miss H— C—", used the comet to declare his love, indicating that not all were absorbed in the possibility of an immanent conflagration.) Most of the contributors wrote anonymously, in keeping with eighteenth-century conventions of writing for the public good (as distinct from Grub Street scribblers who wrote for profit), and so it is difficult to know their social positions or denominational allegiances. One observer asked readers to stay calm, "trusting to the care of heaven for its convoy," even though such care was not merited by "an ungodly, treacherous, degenerate and defenseless world." Skinner himself, for all his evident extensive reading in natural philosophy and comets, circled back several times to the uncertainty of current knowledge about comets and the historical association of large comets with disaster. He wavered in his presentation between celebrating this opportunity to extend mastery over an aspect of the natural world and worrying about the "very precarious and dangerous" situation that this undoubtedly large comet presented to Earth. But a letter to the *Boston Gazette* reprinted in New York had no such doubts, declaring bluntly, "I cannot conclude (my observations of the comet) without expressing my concern at the panic into which great numbers of people have been thrown by an absurd and ridiculous article from Elizabeth Town in the Jerseys, published in the papers. The writer, however good his intentions might be, appears quite unacquainted with Astronomy. Nothing can be more idle and contemptible than the calculations he pretends to have made of the comet."<sup>42</sup>

With his "idle and contemptible" designation, the Boston writer put the prognosticator of doom in his place as both inexperienced in astronomy and insensitive to the larger meaning of natural philosophy. Natural philosophy as it developed in its British form over the course of the eighteenth century was increasingly regarded not only as an investigation of God's works but as a call to a particular emotional response, that of awe, of the sublime. In reverse, the sensation of sublimity confirmed that one was, indeed, correctly apprehending God's works. Such a sensation confirmed that one was possessed of a particular sensibility, one unavailable to the "idle and contemptible."

It may not have escaped the reader's notice that all the participants in cosmology in British New York in this account, with the exception of Robert Saunder's smallest girl, have been male and white. One of the poems printed during the 1769 comet asserted:

The guilty nations tremble. But, above  
 Those superstitious horrors that enslave  
 The [illegible] herd, to mystic faith  
 And blind amazement prone, the enlightened few,  
 Whose godlike minds philosophy exalts,  
 The glorious stranger hail. They feel a joy  
 Divinely great; they in their powers exult;  
 That wondrous force of thought, [when?] mounting spurns  
 This dusky spot, and measures all the sky."

Indeed there are suggestions latent in all realms of developing practices of natural philosophy that only white and "gentle" people were naturally receptive to correct interpretations. A poem originating in South Carolina and printed in a New York newspaper lauded Benjamin Franklin and described the poem's author as "Sedate, Composed" in the face of lightning, now that he understands it, even as slaves fly from it like animals. Similarly, a news story from Philadelphia in 1772 reported a return visit of the Seneca Sachem Kayastita. On his last visit Kayastita had evidently attended some electrical experiments which "so much engaged his attention and admiration, that he now planned to attend Mr. Kinnersley's lectures to see more "thunder and lightning produced by human art." Here Kayastita is positioned not as moved to marvel at God but at Ebenezer Kinnersley.<sup>43</sup>

One of the striking silences in colonial New York records is the inattention to any Iroquois knowledge of the sky. If New Yorkers stood on the periphery of the British empire, they stood at the center of a crucial site of Indian-British relations, the border of Iroquoia. For all the volumes written about Iroquois war, trade, and society, New Yorkers noted only occasional instances of Iroquois knowledge of the natural world, and those were largely limited to the knowledge of territorial limits and of plants for food and healing. For New Yorkers, Iroquois knowledge of the sky was not "Christian." Their astronomy could not be the apprehension of a text of God, and so was worth no notice.<sup>44</sup>

The inclusion of white and gentle women within the bounds of those thought sufficiently sensitive to the lessons of natural philosophy was tentative. When Samuel Clossy advertised his evening series of natural philosophy lectures in 1771, for example, he said that each gentleman who enrolled might bring a lady. While Samuel Bard, a New Yorker sent to Scotland in the 1760s for a "gentleman's" medical education, conceded to his sister that in "the Sciences and Philosophy" some women might outshine men, he nevertheless reminded her that "the Customs of the World" were such that education for women was intended "to render them agreeable companions to Men of sense and learning." If gentle ladies were sometimes presented as marveling at the wonders of God through natural philosophy, a counter-narrative was as often

presented. John Nathan Hutchins, for example, writing on the qualifications of a good wife in one of his almanacs, insisted that she should have "a decent Share of Common Sense . . . but no Learning; no Learning, I say again and again (either ancient or modern) upon any Consideration whatever."<sup>45</sup>

Hutchins's rejection of learning for women may have struck a responsive note among the majority of New Yorkers who remained almanac readers. Despite the silencing of some aspects of the older cosmology, relatively few New Yorkers seemed to have aspired to the refined contemplation of the natural world advocated by natural philosophers, preferring their own experiences to remote "learned opinion." Booksellers advertised books on astronomy, electricity, and Newtonian mechanics with modest frequency. Almost as popular were the strongly theological interpretations of natural phenomena, such as those by Thomas Burnet, William Derham, and John Hutchinson, but even these were not advertised more than occasionally. Natural philosophy in any of its forms never matched the demand, for example, for works of pure theology or didactic works, such as books on navigation, husbandry, or medicine.<sup>46</sup>

When an occasional almanac maker appropriated to himself the emerging persona of "natural philosopher" instead of the sensible mathematical craftsman of earlier decades, he met with little success. "Father Abraham" claimed to be the second son of "a person of quality," the beneficiary of an excellent education and extensive world travel. He had now, he said, taken the last of his inheritance and purchased a modest farm on Long Island. There he lived with his library and mathematical instruments, the very picture of the detached philosopher, his neighbors awed by his erudition and soliciting his advice on every matter. "Copernicus Weatherwise" recounted a long story of the tête-à-tête in a garden between a "lady" and himself in which he offered a gentle rebuttal to her theological objections to Copernicanism. As "Father Abraham" apparently published only one almanac and "Copernicus Weatherwise" only two, it would appear that much of their audience was unimpressed. By the 1770s New York almanac-makers, like "Mark Time," stuck to a plainer style of providing information garnished with moral advice, or, like "Merry Andrew," leavened with witty observations.<sup>47</sup>

Despite the effect of the discourse and practices of natural philosophy on the public cosmology of British colonial New York, the evident indifference of almanac readers and bookshop customers indicates that the assimilation of the new cosmology was relatively shallow. Evelyn Fox-Keller has argued that the adoption of the Cartesian worldview, in which European men felt themselves to be separate from the natural world, was crucial to their experience of the natural world as available for mastery. But such a separation and such a mastery requires that the Cartesian worldview be naturalized in the social world in which men move. David Colden's efforts, as his friend William Johnson put it, of "searching into the secret recesses of Nature," were nearly invisible to

his social world. Human separation from the natural world is problematic when people experience themselves as subjects of a wrathful God who speaks to them through natural phenomena. After the Revolution, a Hudson Valley farmer and sometime-doctor, William Hooker Smith, wrote a diary of the "Remarkable acurances" that had happened to him over the course of his lifetime. In one instance when his horse behaved oddly and led him to ride back to his homestead just before the British attacked his militia unit. "Had not that beast bin providentially sent to me I undoubtedly had been kild," Smith concluded. For Smith, and presumably other New Yorkers, God was no distant architect of the universe, but an active being in the here and now.<sup>48</sup>

Despite the appeal of modes of gentility emanating from Britain, even so avid as astronomer as Samuel Spencer Skinner was uncomfortable reading into the natural world an unambiguous message of God's benevolence. The reluctance of New Yorkers to accept British "learned opinion" on cosmology can be partly attributed to the peculiarities of the local social structure, such as the marginality of the Anglican religion and the relative newness of the group claiming gentility. The strong suspicion towards the pretensions of the elite meant that the middling sorts, the literate but not learned, were disinclined to substitute distant learned opinion for the evidence of their own senses. After the mid-1760s in particular many of the middling sorts challenged the ruling groups' allegiance to the British imperial government which no doubt reinforced their suspiciousness. Their own observation of what appeared to be the movement of heavenly bodies and their satisfaction with simply approximations of the timing of those movements meant that, for many New Yorkers, the familiar cosmology would do. At the same time, Anthony Lamb recognizes that there was prestige (and sales) in an association with Newton's name. At least some of his customers, using telescopes and quadrants, saw evidence for themselves that confirmed the new cosmology. Nevertheless, whatever experiences New Yorkers had with the sky, none doubted that the sky was a text of God. Consequently their debates were as much about his nature as about the nature of the cosmos.

Nevertheless, the possibilities for the cultural interpretation of the natural world are not endless. A comet really did appear in the sky over New York in 1758, as Halley and Newton had said it would. New Yorkers had to adjust their beliefs to make them congruent with their experiences. As the debate over the meaning of the comet of 1769 shows, however, the natural world, even in the concreteness of its apprehension, did not define itself. We now take it for granted that what we see for ourselves in the sky is distinct from our account of the structure of the solar system, and accept that such astronomical activities as measuring the scale of the universe are distinct from discussions of the nature of God. But the transition was long. The vigor and volume with which New Yorkers recorded their engagement with the sky is testimony to the difficulty with which that was done.

## Notes

1. I thank Thomas P. Slaughter for his extensive advice and support for both this article and the larger project of which this is a part; for their most helpful comments on this article, I thank Robert Shaffer, Jenny Brier, and the members of the McNeil Center for Early American Studies; Lamb's 1745 advertisement: *New York Weekly Post-Boy*, 6 May 1745; advertisement for "the Sign of Sir Isaac Newton's Head": *New York Mercury*, 1 Dec. 1760; Anthony Lamb (1703-1784) was apprenticed to a mathematics instrument maker in London but was transported for burglary in 1724 to Virginia; after serving his term he made his way to New York: Silvio Bedini, "At the Sign of the Compass and Quadrant: The Life and Times of Anthony Lamb," *American Philosophical Society, Transactions* 74 (1984): 1-84.
2. There are many accounts of the adoption of Copernicanism; a good popular one is Timothy Ferris, *Coming of Age in the Milky Way* (New York: Doubleday, 1988), chaps 3-5; a more detailed but nevertheless accessible one is John North, *The Norton History of Astronomy and Cosmology* (New York: W. W. Norton, 1994), chaps. 11-12; the bibliography on Newton and his influence on science and on eighteenth-century British culture is enormous; the standard biography is Richard Westfall, *Never at Rest: A Biography of Isaac Newton* (Cambridge: Cambridge University Press, 1980); for his meaning for English elites: Margaret C. Jacob, *The Newtonians and the English Revolution, 1689-1720* (Ithaca: Cornell University Press, 1976); for a classic description of the English embrace of Newtonianism in other realms: Marjorie Hope Nicholson, *Newton Demands the Muse: Newton's "Opticks" and the Eighteenth Century Poets* (Princeton: Princeton University Press, 1946).
3. For navigation: Charles Cotter, *A History of Nautical Astronomy* (New York: American Elsevier Publishing Company, 1968); a lively account of the eighteenth-century difficulties in celestial navigation: Dava Sobel, *Longitude: The True Story of a Long Genius Who Solved the Greatest Scientific Problem of His Time* (New York: Walker and Company, 1995); for everyday knowledge of the sky held by other groups: Ray A. Williamson, *Living the Sky: the Cosmos of the American Indian* (Boston: Houghton Mifflin Company, 1984).
4. Almanacs in English were advertised as sold in New York beginning in 1686: Samuel

Atkins, *Kalendarium Pennsylvaniense, or America's Messenger. Being an Almanack for the Year of Grace, 1686*, (Philadelphia: Printed by William Bradford and sold by Philip Richards in New-York, n.d.); English language almanacs were printed regularly in New-York from 1694: Leeds, Daniel, *An Almanack for the Year of Christian Account, 1694* (New-York: Printed and Sold by William Bradford, n.d.); the first advertisement for a Dutch language almanac: *New-York Weekly Journal*, 7 Nov. 1737; the standard bibliography for American almanacs is Milton Drake, comp., *Almanacs of the United States*, 2 vol. (New York: The Scarecrow Press, 1962).

5. For an overview: Michael Kamman, *Colonial New York: A History* (Millwood, NY: KTO Press, 1975); for the Dutch: Alice P. Kenney, *Stubborn for Liberty: The Dutch of New York* (Syracuse, NY: Syracuse University Press, 1975); for the slowness of Anglicization among Dutch-speakers: Joyce D. Goodfriend, *Before the Melting Pot: Society and Culture in Colonial New York City, 1664-1730* (Princeton: Princeton University Press, 1992); John M. Murrin, "English Rights as Ethnic Aggression: The English Conquest, the Charter of Liberties of 1683, and Leisler's Rebellion in New York" in William Pencak and Conrad Edick Wright, eds., *Authority and Resistance in Early New York* (New York: New-York Historical Society, 1988); for Africans: Edgar J. McManus, *A History of Negro Slavery in New York* (Syracuse, NY: Syracuse University Press, 1966); for the contentiousness of New York politics: Patricia U. Bonomi, *A Factious People: Politics and Society in Colonial New York* (New York: Columbia University Press, 1971); for frequent truculence of non-elites towards authority: Douglas Greenberg, *Crime and Law Enforcement in the Colony of New York, 1681-1776* (Ithaca: Cornell University Press, 1974); for an excellent portrait of a New York governor in a transatlantic imperial context: Patricia U. Bonomi, *The Lord Cornbury Scandal: The Politics of Reputation in British America* (Chapel Hill: University of North Carolina Press, 1998); for the founding of King's College (and the disputes surrounding it): David C. Humphrey, *From King's College to Columbia, 1746-1800* (New York: Columbia University Press, 1976); for the argument that New York's elites moved in directions at odds with many of the middling and lower sorts in the two

decades before the Revolution: Edward Countryman, *A People in Revolution: The American Revolution and Political Society in New York, 1760-1790* (Baltimore: Johns Hopkins University Press, 1981) chap. 1, 2.

6. Margaret C. Jacob, *The Newtonians and the English Revolution, 1689-1720*; for the theology of the *Principia* itself: Andrew Cunningham, "How the *Principia* Got Its Name: Or, Taking Natural Philosophy Seriously," *History of Science* 29 (1991): 377-392; see also Richard Olsen, *Science Deified and Science Defied: The Historical Significance of Science in Western Culture* (Berkeley: University of California Press, 1990), vol. 1, chap. 3; for religion in New York: Richard W. Pointer, *Protestant Pluralism and the New York Experience: A Study of Eighteenth-Century Religious Diversity* (Bloomington: Indiana University Press, 1988); Randall H. Balmer, *A Perfect Babel of Confusion: Dutch Religion and English* (New York: Oxford University Press 1989), a good synopsis of the similarities and differences among colonies: John M. Murrin, "A Roof without Walls: The Dilemma of American National Identity," in Richard Beeman, Stephen Botein, and Edward C. Carter, II, *Beyond Confederation: Origins of the Constitution and American National Identity* (Chapel Hill: University of North Carolina Press, 1987), 334-339; Steven Shapin, "Social Uses of Science" in G. S. Rousseau and Roy Porter, eds., *The Ferment of Knowledge: Studies in the Historiography of Eighteenth-Century Science* (Cambridge: Cambridge University Press, 1980), 95-99.

7. With the exception of "B.A." in 1723, no almanac maker published anonymously in New York until "Copernicus Philomath" began publishing in 1745, followed by "Thomas More" in 1746; More was identified by John Nathan Hutchins as Theophilus Grew, a mathematics instructor in Philadelphia: letter, *New-York Mercury*, 23 Feb. 1761; subsequently other almanacs were published under pseudonyms: "Roger More" (beginning in 1756), "Abraham Weatherwise" (1759), "Vincent Wing" (1762), "Frank Freeman" (1767), "Copernicus Weatherguesser" (1768), "Mark Time" (1773) "Merry Andrew" (1774), "Richard Meanwell" (1774), and "Copernicus" (1774), none of whom I have as yet identified; for Daniel Leeds' father: D. Leeds, *The American Almanack for the Year of Christian Account 1712* (New-York: Printed by

William and Andrew Bradford, 1712); for the Leeds family: C. L. Humeston, *Leeds: A New Jersey Family* (Philadelphia: B. F. Leeds, n.d.); for service on Lord Cornbury's Council for West Jersey: "Daniel Leeds": James Grant Wilson and John Fiske, eds., *Appleton's Cyclopaedia of American Biography* (New York: D. Appleton and Co., 1855), vol. V, 42, 45; D. Leeds taught his son: Titan Leeds, *The American Almanack for the Year of Christian Account 1714* (New-York: Printed by William Bradford, 1714); William Bradford published a Leeds almanac up until 1744, as Titan Leeds had done the calculations in advance: Marion Barber Stowell, *Early American Almanacs: The Colonial Weekday Bible* (New York: Burt Franklin, 1977), 66-72; for Titan Leeds educating Hutchins: John Nathan Hutchins, *Hutchins Improved: Being an Almanack . . . For the Year of our Lord, 1764* (New-York: Printed by Hugh Gaine, n.d.); John Clapp first appeared in New York as "Captain Clapp" in 1690, was styled "gentleman" in a 1692/93 document, and when he wrote his almanac, kept a tavern in New York City: *New York Genealogical and Biographical Record*, 112 (1981): 135-138; Roger Sherman had no formal schooling other than possibly some rudimentary education in a country school, was apprenticed to a shoemaker, then opened a mercantile business with his brother in 1743; he studied both astronomy and law on his own and was admitted to the Connecticut bar in 1754; he is the Roger Sherman who signed the Declaration of Independence: "Roger Sherman," *Appleton's Cyclopaedia of American Biography*; examples of almanac maker's self-conception: D. Leeds, preface to the reader, *An Almanack for the Year of Christian Account, 1694* (New-York: Printed by William Bradford, n.d.); J. N. Hutchins, letter to the reader, *An Almanack for the Year of Christian Account 1753* (New-York: Printed by Hugh Gaine, n.d.).

8. The "nails in a ceiling" quote: B. A., *An Astronomical Diary, or an Almanack for the Year of Christ, 1723* (New-York and Philadelphia: Printed by William and Andrew Bradford, n.d.); for "Moon under the Earth": Daniel Leeds, *An Almanack for the Year of Christian Account, 1699* (New-York: Printed by William Bradford, 1699); in 1711 Daniel Leeds described an eclipse as being seen "by those People who go with their Feet to our Feet, as in Tartaria, Persia, the East Indies, etc.": D.

Leeds, *The American Almanack for the Year of Christian Account, 1711* (New-York: Printed by William and Andrew Bradford, 1711); for a survey of Ptolemaic cosmology in colonial almanacs generally, which the author found to be widespread until the 1720s: J. Rixey Ruffin, "Urania's Dusky Vails: Heliocentrism in Colonial Almanacs, 1700-1735," *New England Quarterly*, 70 (1997): 306-313; Ruffin presented some of his research at the Warren Susman Graduate Student Conference, Department of History, Rutgers, the State University of New Jersey, in April 1995.

9. John Clapp, *An Almanack for the Year 1697* (New-York: Printed by William Bradford, 1697); for his error in predicting eclipses: John T. Kelly, *Practical Astronomy during the Seventeenth Century: Almanac-Maker in America and England* (New York: Garland Publishing, 1991), 113-114; B. A., *An Astronomical Diary, or an Almanack for the Year of Christ, 1723* (New-York and Philadelphia: Printed by William and Andrew Bradford, n.d.)

10. A poem which was ambivalent about whether the planets shown by their own or reflected light: Titan Leeds, *The American Almanack for the Year of Christian Account 1725* (Philadelphia: Printed by Andrew Bradford, n.d.), the New York imprint is not extant; a similarly ambivalent poem about planets' motions which could support either the Ptolemaic or Copernican model: Titan Leeds, *The American Almanack for the Year of Creation, 1728* (Philadelphia: Printed by S. Keimer, and sold by W. Heurtin Goldsmith in New-York, David Humphreys at Flushing on Long Island (Beware the Counterfeit One), n.d.); in his 1734 almanac, he offered both a poem which described the sun as "Revolving thro' the Skys" and one which asserted "Copernicus . . . formed a wiser Scheme": Titan Leeds, *The American Almanack for the Year of Christian Account 1734* (New-York: Printed by William Bradford, 1734); William Birkett also published almanacs in the 1730s in both New York and Philadelphia. In 1739 he offered his readers "A Synopsis of the Seven Planets," which, by calling the Moon and the Sun "planets," implied that he believed them all to move around the Earth: William Birkett, *Poor William's Almanack for the Year, 1739*, (Philadelphia: Printed by Andrew Bradford, n.d.); Birkett's almanac offered for sale in New York: *New-York Gazette*, 30 Nov. 1738.

11. Two royal governors were Fellows of the

Royal Society: Robert Hunter (1710-1719) and William Burnet (1720-1728); for Hunter: Mary Lou Lustig, *Robert Hunter, 1666-1734: New York's Augustan Statesman* (Syracuse: Syracuse University Press, 1983); for Burnet: *Dictionary of National Biography* (London: Oxford University Press, 1921-1922). Burnet, in company with Cadwallader Colden and James Alexander, made observations of the satellites of Jupiter in 1723 in order to determine the longitude of Manhattan: William Burnet, "Observations on the Eclipse of the first satellite of Jupiter, communicated by his Excellency William Burnet, Esq., governor of New York, F.R.S.," *Philosophical Transactions* 33 (1724-25): 162-164; the value was corrected: James Bradley, "The Longitude of Lisbon, and the Fort of New York, from Wansted and London, determin'd by Eclipses of the First Satellite of Jupiter," *Philosophical Transactions* 34 (1726-27): 85-90; for Colden: Alice Mapelsden Keys, *Cadwallader Colden: a Representative Eighteenth Century Official* (New York: Columbia University Press, 1906); mid-eighteenth century concern with the mechanism of gravitation: J. L. Heilbron, *Elements of Early Modern Physics* (Berkeley: University of California Press, 1982), 38-60; Robert Scofield, *Mechanism and Materialism: British Natural Philosophy in an Age of Reason* (Princeton: Princeton University Press, 1970), chap. 5; Cadwallader Colden, *An Explication of the First Causes of Action in Matter and the Causes of Gravitation* (New-York: Printed by James Parker, 1745); the actual printing was early in 1746: James Alexander to Cadwallader Colden, 23 Feb. 1745/46, New-York Historical Society, *Collections* 52 (1919): 196.

12. For Alexander: Henry Noble MacCracken, *Prologue to Independence: The Trials of James Alexander, American, 1715-1756* (New York: J. H. Heineman, 1964); Colden's claim: Colden, *Explication of the First Causes of Action in Matter*, iv-v, 42; "conquest of kingdoms": James Alexander to Cadwallader Colden, 28 March 1748, New-York Historical Society, *Collections* 53 (1920): 30-31; London correspondent: Cadwallader Colden to Peter Collinson, "at the beginning of winter" (probably 1745), in Colden, *Scientific Manuscripts, microfilm*, New-York Historical Society; and C. Colden to Peter Collinson, 22 June 1745, New-York Historical Society, *Collections* 52 (1919): 117-119; encouragement: Peter Collinson to C. Colden, 27 March 1746/7,



New-York Historical Society, *Collections*, 52 (1919): 367-369; C. Colden, *The Principles of Action in Matter, the Gravitation of Bodies, and the Motion of the Planets, explained from those Principles* (London: Printed for R. Dodsley, 1751); reviews in London periodicals: *London Magazine* 21 (1752): 560-562; *Monthly Review* 7 (1752): 459-467; Brooke Hindle, "Cadwallader Colden's Extension of the Newtonian Principles," *William and Mary Quarterly*, 3d series, 13 (1956): 459-475.

13. For Colden's participation in a political struggle over the fur trade in the 1720s: Milton M. Klein, *The Politics of Diversity: Essays in the History of New York* (Port Washington, NY: Kennikat Press, 1966), 13-17; over quitrents and surveying: Carole Shammas, "Cadwallader Colden and the Role of the King's Prerogative," *New-York Historical Society Quarterly*, 53 (1969), 108; over opposition to Governor Clinton: Patricia U. Bonomi, *A Factious People: Politics and Society in Colonial New York* (New York: Columbia University Press, 1971), chap. 5; Kammen sums up Colden by writing "for all his vast learning, he remained one of the most naive and tactless figures in the British colonies": Kammen, *Colonial New York: A History*, 345-346; the pamphlet: (Cadwallader Colden), "Address to the Freeholders and Freeman of the Cities and Counties of the Province of New-York on the Occasion of the ensuing Elections of Representatives in General Assembly by a Freeholder in the Same Province," reprinted in *New-York Historical Society, Collections*, 52 (1919): 312-328; quoted letter from "A. Z.": *New-York Evening Post*, 8 Feb. 1747/48; similarly castigating letters; all in the *New-York Evening Post*: 25 Jan. 1747/48; signed "Philaethes": 1 Feb. 1747/48; 15 Feb. 1747/48; and 22 Feb. 1747/48.

14. Of almanac makers who published in New York in the 1740s, presumably "Copernicus Philomath," who wrote almanacs for 1745, 1746, and 1747, was a Copernican. Copies of his almanacs are in storage until the year 2000 while the Brooklyn Historical Society undergoes renovation. Almanac makers who assume Copernicanism explicitly in New York in the 1750s: Roger Sherman, *An Astronomical Diary, or an Almanack, For the Year of our Lord Christ, 1752* (New-York: Printed by Henry DeForeest, n.d.); one which includes a poem lauding Newton's Laws of Motion: Thomas More, *The American Country Almanack for the Year of Christian Account, 1755* (New-York:

Printed by J. Parker, n.d.); Jesse Parsons, *The American Ephemeris, or, an Almanack for the Year of Christian Account, 1757* (New-York: Printed by J. Parker and W. Weyman, for the Author, n.d.); Roger More is ambivalent: Roger More, *Poor Roger, The American Country Almanack for the Year of Christian Account, 1745* (New-York: Printed by J. Parker and W. Weyman, n.d.); Christopher George, John Nathan Hutchins, W. Jones and Abraham Weatherwise make no comments either way; for "Microcosm" poem: *New-York Gazette, or Weekly Post-Boy*, 15 March, 1756; Freeman's remarks: Frank Freeman, *Freeman's New-York Almanack, For the Year of our Lord 1767* (New-York: Printed by John Holt, n.d.).

15. The transformation in British astrology: Patrick Curry, *Prophecy and Power: Astrology in Early Modern England* (Princeton: Princeton University Press, 1989), 57-83; Peter Eisenstadt, "Almanacs and the Disenchantment of Early America," *Pennsylvania History: A Journal of Mid-Atlantic Studies*, 65 (1998): 143-169.

16. For the background of astrological beliefs and healing: Carole Rawcliffe, *Medicine and Society in Later Medieval England* (Phoenix Mill, England: Alan Sutton Publishers, 1995), chap. 4; earliest example of the Man of Signs in New York: Daniel Leeds, *An American Almanack for the Year of Christian Account, 1713* (New-York: Printed by William Bradford, 1713); almanacs printed before 1713 had no woodcut but the same information on a page entitled "Dominion of Moon in Man's Body,"; of the 130 almanacs printed in New York between 1694 and 1775 and examined for this article, only six authors printed neither the Man of Signs nor a substitute table; four of these authors (John Clapp, "B. A.", J. Gale, W. Jones) appears to have published only one almanac, the other two (Jesse Parsons and "Copernicus Weatherguesser") only two; in this consistent presentation of the Man of Signs, New York appears to be unusual, as Herbert Leventhal reviewed all colonial almanacs for 1760 and found that only 75% still had the Anatomy: Herbert Leventhal, *In the Shadow of the Enlightenment: Occultism and Renaissance Science in Eighteenth-Century America* (New York: New York University Press, 1976), 32; the almanac maker Titan Leeds expressed doubts about whether his readers indeed followed the "Man of Signs" but said he put it in because his readers ex-

pected it: Titan Leeds, *The American Almanack for the Year of Christian Account 1725* (Philadelphia: Printed by Andrew Bradford, n.d.), no New York imprint extant; for turnip seed marginalia: Daniel Leeds, *The American Almanack for the Year of Christian Account, 1705* (New-York: Printed by William Bradford, 1705), copy in Special Collections, New York Public Library; for Borghard: David Steven Cohen, *The Dutch-American Farm* (New York: New York University Press, 1992), 156; weather chart: Daniel Leeds, *An Almanack for the Year of Christian Account, 1699* (New-York: Printed by William Bradford, 1699); for practices in the British colonies more generally: Peter Eisenstadt, "Weather and Weather Forecasting in Colonial America," (Ph.D. diss.: New York University, 1990).

17. Frank Freeman, *Freeman's New-York Almanack, For the Year of our Lord, 1767*; Frank Freeman, *Freeman's New-York Almanack, For the Year of our Lord, 1768* (New-York: Printed by John Holt, n.d.).

18. D. Leeds, *An Almanack for the Year of Christian Account, 1696* (New-York: Printed by William Bradford, n.d.); full moon southing: Daniel Leeds, *The American Almanack for the Year of Christian Account, 1707* (New-York: Printed by William Bradford, 1707); Richard Saunders quote: Charles T. Gehring and Robert S. Grumet, "Observations of the Indian from Jasper Danckaerts's Journal," *William and Mary Quarterly*, 3rd series, 44 (1987), 110; Hutchins's claim: John Nathan Hutchins, *Hutchins's Improved: Being an Almanack and Ephemeris . . . For the Year of our Lord, 1761* (New York: Printed by H. Gaine, n.d.); More's claim: Thomas More, *Poor Thomas Improved: Being More's Country Almanack for the Year of Christian Account, 1761* (New-York: Printed by W. Weyman, n.d.); Hutchins's retort: John Nathan Hutchins, *Hutchins's Improved: Being an Almanack . . . For the Year of our Lord, 1762* (New-York: Printed by H. Gaine, n.d.).

19. Letter on comparing almanacs signed by "Artis Amor," *New-York Mercury*, 23 March 1767; for time and clocks: Martin Breugel, "Time that can be relied upon: The Evolution of Time Consciousness in the Mid-Hudson Valley, 1790-1860," *Journal of Social History* 28 (1995): 539-564; weather explanation: Thomas More, *The American Country Almanack for the Year of Christian Account, 1754* (New-York: Printed by J. Parker, n.d.);

for a description of the almanac maker's art: John T. Kelly, *Practical Astronomy during the Seventeenth Century: Almanac-Makers in America and England*; for a late eighteenth century almanac maker, when the British *Nautical Almanac* made calculations more accurate: Silvio Bedini, *The Life of Benjamin Banneker* (New York: Charles Scribners' Sons, 1972), 203-206.

20. The historiographical explanation for Britain: B. S. Capp, *Astrology and the Popular Press: English Almanacs, 1500-1800* (London: Faber and Faber, 1979), chap. 3; and Patrick Curry, *Prophecy and Power: Astrology in Early Modern England* (Princeton: Princeton University Press, 1989), 46-54; for a good discussion of the Anglican effort to render claims to interpreting special Providences superstitious: Michael P. Winship, *Seers of God: Puritan Providentialism in the Restoration and Early Enlightenment* (Baltimore: Johns Hopkins University Press, 1996), particularly chap. 2; for comments on evangelical Protestants' interpretations of the Book of Nature, I thank John Fea; Jon Butler suggests the link between evangelical ministry and declining belief in astrological prophecy: Jon Butler, "Magic, Astrology, and the Early American Religious Heritage, 1600-1760," *American Historical Review* 84 (1979): 339-345.

21. Daniel Leeds, *The American Almanack for the Year of Christian Account, 1710* (New-York: Printed by William Bradford, 1710); William Birkett, *Birkett, 1738. An Almanack For the Year of Christian Account 1738* (New York: Printed by William Bradford, 1738); experience quote: Titan Leeds, *The American Almanack for the Year of Christian Account 1729* (New-York: Printed by William Bradford, 1729); John Clapp, *An Almanack for the Year 1697*; poem: Daniel Leeds, *The American Almanack for the Year of Christian Account, 1708* (New-York: Printed by William Bradford, 1708); Judicial or natal astrology, the belief that the configurations of the planets at one's birth determines one's destiny, is nearly invisible in the New York sources. In order to forecast the weather, almanac makers had to calculate a complete ephemerides, or calendar of planets' positions, for the coming year. Almost all New-York almanac makers published the ephemerides as part of their almanacs, and, since such a chart could be used to locate the planets on a given date, it could presumably have been used to cast horoscopes.

Aside from one cryptic remark by Titan Leeds in his 1725 almanac ("The Ephemerides of the Planets Places in understood by the Sons of Art, to whom it is chiefly useful") almanac makers were uniformly silent on the use they expected their readers to make of the ephemerides. It may be that, having done the necessary arduous calculations, they published them simply as testimony to their own skill (I thank Robert Rosenberg for suggesting this possibility). Joseph Morgan, a Dissenting minister in New York and New Jersey who communicated various theories and schemes to the Royal Society, left evidence of his interest in judicial astrology: Alexander Hamilton, *Gentleman's Progress: The Itinerarium of Dr. Alexander Hamilton, 1744*, edited by Carl Bridenbaugh, (Westport, CN: Greenwood Press, 1948), 36; James Alexander once wrote curtly to Cadwallader Colden (perhaps in response to a question from Colden?) that he had no interest in "Judicial Astrology or knowledge of futurity": letter, 6 April 1739, New-York Historical Society, *Collections* 51 (1918): 193. But the absence of even vague castigations of the practice indicates that judicial astrology found a small audience, if any at all, in British New York.

22. George Christopher, *An Almanack for the Year of Christian Account, 1754* (New York: Printed by Hugh Gaine, n.d.); "dragon" Prophecy and 1742 and 1762 prophecy: Titan Leeds, *The American Almanack for the Year of Christian Account, 1738* (New-York: Printed by William Bradford, n.d.); the red dragon prophecy is in Revelations, chap. 12, verses 3-9; Governor William Burnet in his *An Essay on Scripture and Prophecy: Wherein It is Endeavored to Explain the Three Periods Contain'd in the XIIth Chapter of the Prophet Daniel* (New York: Printed by William Bradford, 1724) identified the red dragon as Rome, 80; the "dragon's head," like the "dragon's tail," is a point where the moon's orbit intersects the ecliptic: Herbert Leventhal, *In the Shadow of the Enlightenment*, 23.

23. George Fisher, *The American Instructor: Or Young Man's Best Companion . . . To which is added The Poor Planter's Physician*, 9th ed. (Philadelphia: Printed by B. Franklin, 1748), 297; John Nathan Hutchins, *An Almanack for the Year of Christian Account, 1753 According to the New Calendar, and Act of Parliament*. (New-York: Printed by H. Gaine, n.d.); John Nathan Hutchins, *Hutchin's Improved: Being*

*an Almanack . . . For the Year of our Lord, 1764* (New-York: Printed by H. Gaine, n.d.); John Nathan Hutchins, *Hutchin's Improved: Being an Almanack . . . For the Year of our Lord, 1774* (New-York: Printed by Hugh Gaine, n.d.)

24. For the timing of "genteel" consumption of material goods: Richard L. Bushman, *The Refinement of America: Persons, Houses, Cities* (New York: Alfred A. Knopf, 1992); for the importance of gentility for social signaling in a mobile Atlantic world: Cary Carson, "The Consumer Revolution in Colonial British America: Why Demand?" in Cary Carson, Ronald Hoffman, and Peter J. Albert, eds., *Of Consuming Interests: The Style of Life in the Eighteenth Century* (Charlottesville, Va.: University of Virginia Press, 1994); for the link between heightened consumption and ideals of progress: Colin Campbell, *The Romantic Ethic and the Spirit of Modern Consumerism* (Oxford: Blackwell, 1987); for Robert Harpur: David C. Humphrey, *From King's College to Columbia, 1746-1800* (New York: Columbia University Press, 1976); description of David Colden's poor health: Cadwallader Colden to John Bard, 5 July 1758, New York Historical Society, *Collections* 54 (1921): 234-247; for a brief biography: Gregory Palmer, *Biographical Sketches of Loyalists of the American Revolution* (Westport, CN: Meckler Publishing, 1984), 165; for Skinner: Gregory Palmer, *Biographical Sketches of Loyalists of the American Revolution*, 792.

25. For the significance of electricity to the development of science generally: J. L. Heilbron, *Electricity in the Seventeenth and Eighteenth Centuries: A Study in Early Modern Physics* (Berkeley: University of California Press, 1979); for electrical demonstrations in England: Simon Schaffer, "The Consuming Flame: Electrical Showmen and Tory Mystics in the World of Goods," in John Brewer and Roy Porter, eds., *Consumption and the World of Goods* (London: Routledge, 1993).

26. Dr. Spenser's advertisement: *New-York Weekly Post-Boy*, 16 Jan. 1744; for more on Dr. Spenser: I. Bernard Cohen, *Benjamin Franklin's Science* (Cambridge: Harvard University Press, 1990), chap. 4; Brickell's advertisement: *New-York Weekly Post-Boy* 2 May 1748; Johnson toured widely in the colonies between 1763 and his death in 1768: Raymond Phineas Stearns, *Science in the British Colonies of America* (Urbana, IL: University of Illinois Press, 1970), 511; for Johnson's demonstra-

tions: William Johnson, "A Course of Experiments and Entertaining Branch of Natural Philosophy, call'd Electricity; Accompanied with Lectures on the Nature and Properties of the Electric Fire" (New York: Printed by H. Gaine, 1765).

27. Letter, *New-York Weekly Post-Boy*, 1 June 1752.

28. For Franklin: I. Bernard Cohen, *Benjamin Franklin's Science*; and, most recently, I. Bernard Cohen, "Franklin's Scientist Enemies," *Pennsylvania History* 65 (1998): 7-20; for the argument that Franklin's theory was one among several well-received theories of electricity: Simon Schaffer, "Natural Philosophy and Public Spectacle in the Eighteenth Century," *History of Science* 21 (1983): 12-14; Franklin first published directions for constructing a lightning rod in his *Poor Richard's Almanack* of 1753: I. Bernard Cohen, "Prejudice Against the Introduction of Lightning Rods," *Journal of the Franklin Institute* 253 (1952), 401; New-York newspapers discussed lightning rods: *New-York Evening Post*, 3 Aug. 1752, *New-York Weekly Post-Boy*, 25 Aug. 1755, *New-York Weekly Post-Boy*, 31 July 1766, *New-York Weekly Journal*, 8 Aug. 1771 (the quote above), and *New-York Weekly Journal*, 19 Aug. 1773; unlike smallpox inoculation, I found no evidence that any New Yorkers resisted lightning rods for religious reasons; I. Bernard Cohen describes a 1760 discussion in Philadelphia about how best to persuade local people to use them (but not why they didn't) and a 1750 debate in Boston that was at least partially over whether lightning rods would blunt lightning's message of the need to repent: I. Bernard Cohen, "Prejudice Against the Introduction of Lightning Rods," 422-439; by 1764, Trinity Church in New York City had a lightning rod: David Colden to William Johnson, 7 May 1764, New-York Historical Society, *Transactions*, 55 (1922): 306-307; Franklin's honors were widely reported in New York: *New-York Evening Post*, 20 Nov. 1752; *New-York Mercury*, 6 Aug. 1753; *New-York Weekly Post-Boy*, 6 Aug. 1753; *New-York Mercury*, 18 March 1754; *New-York Weekly Post-Boy*, 8 July 1762; *New-York Mercury*, 12 July 1762; *New-York Journal*, 21 Jan. 1768; for "improvement": David Spadofora, *The Idea of Progress in Eighteenth-Century Britain* (New Haven: Yale University Press, 1990); John Gascoign, *Joseph Banks and the English Enlightenment: Useful Knowledge and Polite*

*Culture* (Cambridge: Cambridge University Press, 1994); Larry Stewart, *The Rise of Public Science: Rhetoric, Technology, and Natural Philosophy in Newtonian Britain, 1660-1770* (Cambridge: Cambridge University Press, 1992).

29. The classic conception of the public sphere: Jurgen Habermas, *The Structural Transformation of the Public Sphere: An Inquiry into a Category of Bourgeois Society*, translated by Thomas Burger with the assistance of Frederick Lawrence (Cambridge: MIT Press, 1989); for discussions of the multiple sites in which "public spheres" were possible, I thank Konstantin Dierks.

30. For David's efforts to support Franklin: Benjamin Franklin to Cadwallader Colden, 1 Jan. 1753, New-York Historical Society, *Transactions*, 53 (1920): 358-359; David's efforts published: Benjamin, *New Experiments and Observations on Electricity*, 3rd edition (London: Printed by D. Henry and R. Cave, 1760); J. L. Heilbron's assessment of David Colden's contribution is that he was an able young man who effectively countered some of the Abbe Nollet's objections but said nothing about other points, probably because he lacked the equipment to do the requisite experiments: J. L. Heilbron, *Electricity in the Seventeenth and Eighteenth Centuries*, 358-359; treatise supporting his father: Cadwallader Colden to R. Whytt, circa 1758, in Cadwallader Colden, "Scientific Manuscripts," microfilm, New York Historical Society; the elder Colden's mathematics were inadequate for the task he set himself in writing an extension of Newton: Sara S. Gronim, "Ambiguous Empire: the Knowledge of the Natural World in British Colonial New York," (Ph.D. diss.: Rutgers, The State University of New Jersey, 1999); John Canton's rebuff: Peter Collinson to David Colden, 7 May 1761, New York Historical Society, *Collections*, 55 (1922): 31.

31. Two novel experiments: "Further Experiments in Electricity," *The American Magazine, and Monthly Chronicle for the British Colonies*, Jan. 1758, 164-166; "E. K.'s" rejoinder: *The American Magazine, and Monthly Chronicle for the British Colonies*, Oct. 1758, 627-630; David's defense: *The New American Magazine*, April 1759, n.p.; "thirst for a discovery of Truth": David Colden to William Johnson, 30 Nov. 1763, New York Historical Society, *Collections*, 55 (1922): 249-251.

32. William Johnson, "A Course of Experi-

ments, In that Curious and Entertaining Branch of Natural Philosophy, call'd Electricity; Accompanied with lectures on the Nature and Properties of the Electric Fire"; the assertions on ennobling the mind and the Psalms quote are also in his advertisement: *New-York Mercury*, 4 Oct. 1763; Nina Ruth Reid-Maroney, "Theology and Science in Philadelphia's Enlightenment, 1740-1800," (Ph.D. diss.: University of Toronto, 1992), 52-65; the shift in the historiography of the Enlightenment towards an acknowledgment of the continued considerable strength of religious belief is summarized in Dorinda Outram, *The Enlightenment* (Cambridge: Cambridge University Press, 1995), chap. 3.

33. Simon Schaffer, "The Consuming Flame: Electrical Showmen and Tory Mystics in the World of Goods," Muhlenberg's comment: Henry Melchior Muhlenberg, *The Journals of Henry Melchior Muhlenberg*, translated by Theodore G. Tappert and John W. Doberstein (Philadelphia: The Muhlenberg Press, 1942), vol. 2, p. 159.

34. The Newburgh sighting: *New-York Weekly Post-Boy*, 13 June 1765; examples of reporting of other odd celestial events: *New-York Gazette*, 30 Jan. 1726/27; *New-York Evening Post*, 17 Sept. 1750; *New-York Journal*, 21 July 1768; *New-York Journal*, 7 Jan. 1773; for reporting without interpretation: Lorraine Daston, "Baconian Facts, Academic Civility, and the Prehistory of Objectivity," *Annals of Scholarship*, 8 (1991): 337-363; for the colonial press and British norms: Charles E. Clark, *The Public Prints: The Newspaper in Anglo-American Culture, 1665-1740* (New York: Oxford University Press, 1994), chap. 11.

35. Comet first reported: *New-York Weekly Post-Boy*, 9 Jan. 1743-44; poem: *New-York Weekly Post-Boy*, 19 Mar. 1743-44; report from Boston: *New-York Weekly Post-Boy*, 12 Mar. 1743/44.

36. First notice: *New-York Mercury*, 21 Nov. 1757; Roger More, *Poor Roger. The American Country Almanack for the Year of Christian Account, 1758*. (New-York: Printed by J. Parker and W. Weyman, n.d.); directions for watching for comet: *New-York Weekly Post-Boy*, 5 June 1758; accounts of: *New-York Weekly Post-Boy* 16 April 1759; *New-York Weekly Post-Boy*, 14 May 1759; Jesse Parsons, *The American Ephemeris, or, an Almanack for the Year of Christian Account, 1757*; explicit conclusion that it proved Newtonianism: *New-York Weekly Post-*

*Boy*, 28 Jan. 1760; Frank Freeman, *Freeman's New-York Almanack, for the Year of our Lord 1767*; Jesse Parsons, *The American Ephemeris, or, an Almanack for the Year of Christian Account, 1757* (New-York: Printed by J. Parker and W. Weyman, for the Author, n.d.); Sara Schechner Genuth, *Comets, Popular Culture, and the Birth of Modern Cosmology* (Princeton: Princeton University Press, 1997) chaps. 7-10; Simon Schaffer, "Newton's Comets and the Transformation of Astrology," in Patrick Curry, ed., *Astrology, Science and Society: Historical Essays* (Woodbridge, Suffolk, England: Boydell Press, 1987); Halley's comet was visible from 25 Dec. 1758 to 22 June 1759: Bruce G. Marsden and Gareth V. Williams, *Catalogue of Cometary Orbits*, 7th edition (Cambridge, MA: Smithsonian Astrophysics Center, 1992), 37.

37. James Alexander tried to elicit competent participation: (James Alexander), "Letters Relating to the Transit of Mercury over the Sun, which is to happen May 6, 1753" (Philadelphia: Printed by B. Franklin, 1753); his attempt to observe the Transit: James Alexander to Cadwallader Colden, 10 May 1753, New York Historical Society, *Collections*, 53 (1920): 388-389; for the Transits: Timothy Ferris, *Coming of Age in the Milky Way* (New York: Doubleday, 1988), 135; an account of the international effort: Harry Woolf, *The Transit of Venus: A Study of Eighteenth-Century Science* (Princeton: Princeton University Press, 1959).

38. Note of preparations by Harpur at King's College to observe: *New-York Journal*, 25 May 1769; Harpur's measurements and Skinner's drawing: *New-York Journal*, 29 June 1769; additions to the account: *New-York Journal*, 6 July 1769; a preliminary account: *New-York Journal*, 8 June 1769; accounts of observations in other places: *New-York Weekly Post-Boy*, 12 June 1769; *New-York Journal*, 29 June 1769; *New-York Journal*, 10 Aug. 1769; *New-York Journal*, 11 Nov. 1769; *New-York Weekly Post-Boy*, 23 Sept. 1771; the Transit of Venus was mentioned as coming in Roger More, *Poor Roger. The American Country Almanack, for the Year of Christian Account, 1769* (New-York: Printed by James Parker, n.d.); there is no note of New York's participation in the *Transactions* of the Royal Society nor in Harry Woolf's careful compendium of the international effort, *The Transits of Venus*; nor did the New York group apparently communicate with the American Philosophical Society in Philadel-

phia, which published North American observations extensively, including a cursory one made by James Alexander's son, the Earl of Sterling, in Basking Ridge, New Jersey: American Philosophical Society, *Transactions*, Vol. I (1769-1771).

39. For a description of this argument supporting astrology: Bernard Capp, *Astrology and the Popular Press*, 134-135.

40. Skinner's essays were printed in both *New-York Weekly Post-Boy* and the comparably dated issues of the *New-York Journal* in 1769; Essay #1: *New-York Weekly Post-Boy*, 11 Sept./*New-York Journal*, 21 Sept.; Essay #2: *New-York Weekly Post-Boy*, 18 Sept./*New-York Journal*, 28 Sept.; Essay #3: *New-York Journal* only, 5 Oct.; Essay #4: *New-York Weekly Post-Boy* only, 25 Sept.; Essay #5: *New-York Journal*, 12 Oct./*New-York Weekly Post-Boy*, 19 Oct.; #6: *New-York Weekly Post-Boy*, 30 Oct./*New-York Journal*, 2 Nov.; #7: *New-York Weekly Post-Boy*, 13 Nov./*New-York Journal*, 16 Nov.; #8: *New-York Journal*, 23 Nov./*New-York Weekly Post-Boy*, 27 Nov.; the discussion of the plurality of worlds is in Essay #4; for the British Atlantic context: Sara Schechner Genuth, "Devil's Hells and Astronomers' Heavens: Religion, Method, and Popular Culture about Life on Comets," in Mary Jo Nye, John Richards and Roger Steuwer, eds., *The Invention of Physical Science* (Dordrecht: Kluwer Academic, 1992); the plurality of worlds had occasionally been presented to New Yorkers before; the almanac maker B.A. in 1723, in the almanac in which he explained Copernicanism to the unlearned of New York, wrote that the planets of all the solar systems of the universe "are Worlds or Places of Habitation . . . and as these Heavenly Bodies or Globes are accommodated for Habitation, so are they consequently stocked with proper Inhabitants." B.A., *An Astronomical Diary, or an Almanack For the Year of Christ, 1723*. A poem in Titan Leeds' 1732 almanac described a debate in tavern over the nature of the Moon. A hitherto silent ploughman suddenly interjected that Bishop Wilkins had proved that the Moon was a world and pulled out the Bishop's book to prove it. All fell silent in admiration—and then began to imagine the trade opportunities the Moon would offer America: T. Leeds, *The American Almanac for the Year of Christian Account, 1732* (New-York: Printed by William Bradford, n.d.).

41. The first letter: *New-York Journal*, 7 Sept.

1769; the poem, signed "Thompson": *New-York Journal*, 28 Sept. 1769.

42. All citations in *New-York Journal*, 1769: Boston observations: 26 Oct.; Rhode Island observations: 11 Nov., 23 Nov.; Philadelphia observations: 2 Nov., 23 Nov.; observation with no place of origin noted: 30 Nov.; poem hailing comet: 5 Oct.; poem on futility (identified as being from Milton's *Paradise Lost*): 2 Nov.; Roger More's almanac published in the autumn of 1769 also concluded it was futile to try to interpret the comet, adding that he wondered why people thought it applied specifically to Britain, since everyone else saw it, too: Roger More, *Poor Roger. The American Country Almanack, for the Year of Christian Account, 1770* (New-York: Printed by James Parker, n.d.); love poem: 5 Oct.; "degenerate and defenseless" comment: 5 Oct.; "idle and contemptible" comment: 26 Oct.; the "precarious and dangerous" quote is from Skinner's Essay #5; for the distinction between writing for the public good and for profit: Douglass Adair, "A Note on Certain of Hamilton's Pseudonyms" in Trevor Colbourn, ed., *Fame and the Founding Fathers: Essays by Douglass Adair* (New York: W. W. Norton and Company, 1974), 272; I thank Richard Bernstein for this citation; for authorial identity and social position: Michael Warner, *The Letters of the Republic: Publication and the Public Sphere in Eighteenth-Century America* (Cambridge: Harvard University Press, 1990); see also David Shields, *Civil Tongues and Polite Letters in British America* (Chapel Hill: University of North Carolina Press, 1997), 262-263.

43. The poem is the same one by Thompson cited in note #41: *New-York Journal* 28 Sept. 1769; for Kayastita: *New-York Journal*, 19 Nov. 1772; poem "To B—n F—n, Esq., of Philadelphia, on his Experiments and Discoveries in electricity," by C. W., Cooper-River, S.C.": *New-York Weekly Post-Boy*, 15 Sept. 1754.

44. The anthropologist Lynn Ceci attempted to recover the knowledge of astronomy held by both the Iroquois and the coastal Algonkians; she found a few scattered references in traveler's journals in the sixteenth and early seventeenth century and then nothing further recorded until the mid-nineteenth: Lynn Ceci, "Watchers of the Pleiades: Ethnoastronomy among Native Cultivators in Northeastern North America," *Ethnohistory* 25 (1978): 301-317.

45. Samuel Clossy's advertisement: *New-York*

*Journal*, 12 Sept. 1771; other evening lectures in natural philosophy offered to "ladies and gentlemen": D. Eccleston, *New-York Weekly Post-Boy*, 15 Oct. 1770; Bryerly and Day, *Rivington's New-York Gazetteer*, 22 June 1774; Samuel Bard's letter: 2 June 1764, mss in Bard Collection, Malloch Rare Book Room, New York Academy of Medicine; Hutchins's remarks: "The Mental and Personal Qualifications of a Wife," *Hutchins's Improved: Being an Almanack . . . For the Year of our Lord, 1771* (New-York: Printed by Hugh Gainé, n.d.).

46. Advertising numbers have been culled from the following: William Bradford, publisher, *New-York Gazette*, 1725-1744; Zenger family, publishers, *New-York Weekly Journal*, 1733-1751; James Parker, and others, publishers, *New-York Weekly Post-Boy*, 1743-1773; Henry DeForeest, publisher, *New-York Evening Post*, 1744-1752; Hugh Gainé, publisher, *New-York Mercury*, 1752-1768; Samuel Farley, publisher, *American Chronicle* (New York, 1762); John Holt, publisher, *New-York Journal, or General Advertiser*, 1766-1773; James Rivington, publisher, *Rivington's New-York Gazetteer, or the Connecticut, New-Jersey, Hudson's River, and Quebec Weekly Advertiser*, 1773-1774; in the period between 1745 and 1775, Benjamin Franklin's *Letters on Electricity* was advertised 26 times; works by Newton or his popularizers (Desaguliers, Ferguson, Kiel, McLauren, Martin, and 'sGravesade) were advertised 80 times; Derham, Burnet, and Hutchinson's works 46 times; slightly more popular were encyclopedias like Chambers' *Dictionary of Arts and Sciences* (93 times), and popularizations like *Circle of the Sciences* (54 times); Thomas Burnet was the author of *The Theory of the Earth; Containing an Account of the Original of the Earth and all the Changes which it has undergone, or is to undergo Till the Consumation of all Time* (1688, 1689); William Derham, *Astro-Theology* (1711); John Hutchinson, *Moses's Principia* (1724); for Hutchinson see C. B. Wilde, "Hutchinsonianism, Natural Philosophy, and Religious Controversy in Eighteenth-Century Britain," *History of Science* 18 (1980): 1-24; see also Simon Schaffer, "Natural Philosophy" in G. S. Rousseau and Roy Porter, eds., *The*

*Ferment of Knowledge: Studies in the Historiography of Eighteenth-Century Science* (Cambridge: Cambridge University Press, 1980).

47. Copernicus Weatherguesser, *The New-Jersey Almanack for 1768* (New-York: printed by James Parker, n.d.); Abraham Weatherwise, Gent., *Father Abraham's Almanack (On an entire New Plan) For the Year of our Lord, 1759* (New-York: Printed by H. Gainé, "for 1759"); Copernicus Weatherguesser, *The New-Jersey Almanack for 1768* (New-York: Printed by James Parker, n.d.); Copernicus Weatherguesser, *The New-Jersey Almanack, Agreeable to the New-Style, and on An entire New plan. For the Year of Christian Account, 1769* (New-York: Printed by James Parker, n.d.); Mark Time, *The New-York Almanack, For the Year of our Lord, 1774* (New-York: Printed by John Holt, n.d.); Merry Andrew, *Star-Gazer, Merry Andrew's, New Almanack, For the Year of Our Lord, 1774* (New-York: Printed by John Anderson, n.d.); by the 1770s, only John Nathan Hutchins published almanacs in New York under his own name.

48. Evelyn Fox-Keller, *Reflections on Gender and Science* (New Haven: Yale University Press, 1985); "secret recesses": William Johnson to David Colden, 7 Dec. 1763, New York Historical Society, *Collections*, 55 (1922): 255-260; William Hooker Smith, "Remarkable acurances," manuscript in Special Collections Room, "Westchester Papers," New York Public Library; for the persistence of a natural world pervaded with spiritual forces in eighteenth-century southern New England: John L. Brooke, *The Refiner's Fire: The Making of Mormon Cosmology, 1664-1844* (Cambridge: Cambridge University Press, 1994); see also Ruth H. Bloch, *Visionary Republic: Millennial Themes in American Thought, 1756-1800* (Cambridge: Cambridge University Press, 1985); for an argument that the tremendous growth in Methodism after the Revolution can be partly attributed to a strong continued belief in a God active in the natural world: John H. Bigger, "Taking Heaven by Storm: Enthusiasm and Early American Methodism, 1770-1820," *Journal of the Early Republic*, 14 (1994): 167-194.