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# The Popular and Scientific Reception of the Foucault Pendulum in the United States

By Michael F. Conlin\*

## ABSTRACT

In 1851 J. B. L. Foucault provided the first mechanical demonstration of the earth's diurnal rotation with a vibrating pendulum. He performed the experiment in the Panthéon in Paris, sparking a pendulum mania that raged across Europe and the United States. The interest in the Foucault pendulum provides an opportunity to examine the popularization of physical science in the antebellum United States. Laypersons attended public demonstrations, performed their own demonstrations, and disputed the principles of the Foucault pendulum. Their participation in physical science made them part of the American scientific community. These lay scientists performed most of the public demonstrations of the experiment. Some researchers performed public demonstrations, but others avoided this opportunity to popularize, deeming it unseemly to participate in pendulum mania. The geographical distribution of interest in the experiment challenges assertions made by historians about the relative level of scientific activity in the New England, mid-Atlantic, southern, and western regions of the United States.

FROM APRIL TO SEPTEMBER 1851 Americans joined Europeans in what *Putnam's Magazine* described as the "pendulum mania" sparked by Jean Bernard Léon Foucault's exhibition of the earth's diurnal rotation with a vibrating pendulum. (See Frontispiece.) A range of Americans—from distinguished scientists to unschooled enthusiasts—repeated the experiment in private and before crowds in at least twenty-five cities and towns. Private repetitions were conducted in houses, laboratories, and places of business; public demonstrations were conducted in government buildings, hotels, universities, and

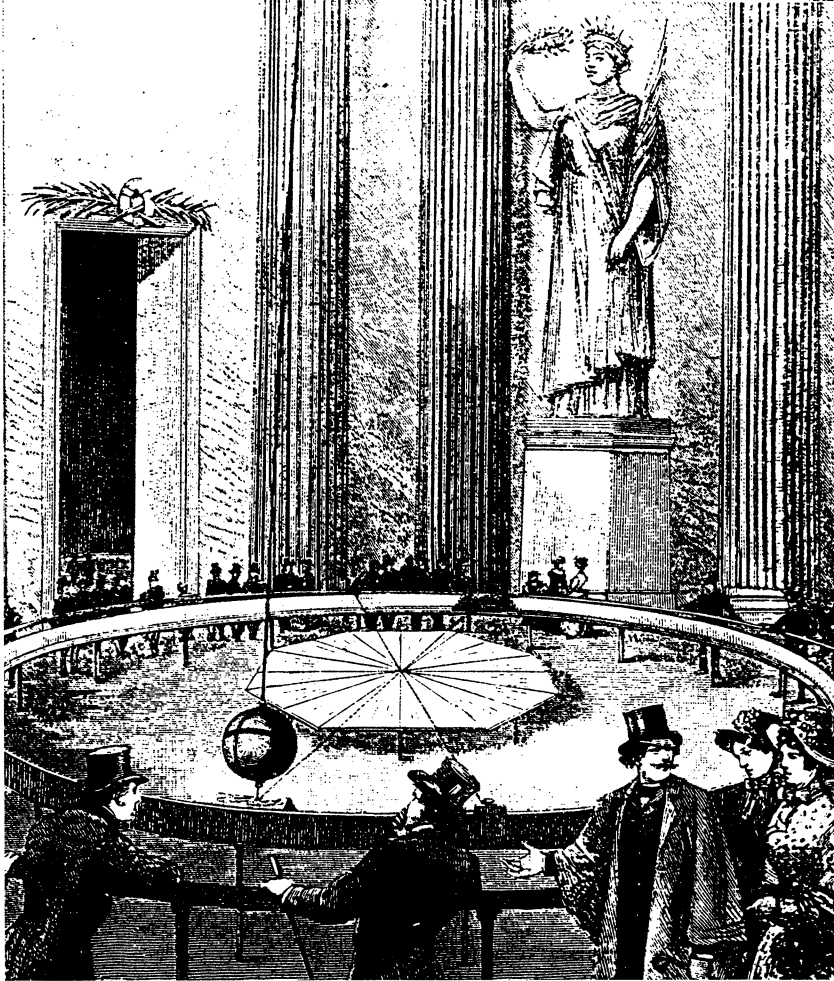
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*Illustration of Jean Bernard Léon Foucault's demonstration at the Panthéon in Paris from an unidentified French periodical, in Stéphane Deligeorges, Foucault et ses pendules (Paris: Éditions Carré, 1990), page 55.*

churches. Some who observed or performed these exhibitions described the experiment as “interesting,” “curious,” “beautiful,” and “sublime.” Many Americans wrote to newspapers demanding demonstrations, requesting explanations, and advancing theories of the Foucault pendulum. Commentators, ranging from scientists to newspaper editors, marveled at what James D. Dana, professor of geology at Yale College, called the “universal attention and interest” excited by the experiment. “Every body is delighted with the phenomenon,” a newspaper columnist noted, “and all are eager to understand it.”<sup>1</sup>

Because much of the popular reaction to physical science was modest and hence is invisible to historians, interest in the Foucault pendulum provides a valuable opportunity to examine the popularization of physical science in the antebellum United States. More than twenty years ago, Nathan Reingold sought to distinguish the American scientific community from the learned culture of professionals and merchants and from the vernacular culture of farmers and mechanics. He divided those interested in science into three groups: “researchers,” who published scientific work; “practitioners,” who made their living from science; and “cultivators,” who joined scientific societies. Although Daniel Goldstein expanded the base of the American scientific community to include the natural history collectors of the Smithsonian Institution, I argue that it must be expanded further to include members of the learned culture and members of the vernacular culture who performed demonstrations and disputed the principles of the Foucault pendulum. Members of the entire scientific community participated in the pendulum mania. Cultivators and practitioners conducted most of the public demonstrations. Some researchers performed public demonstrations and provided popular explanations, but many avoided the opportunity to popularize physical science offered by the Foucault pendulum. Reflecting regional and professional biases, New England researchers who participated in pendulum mania ignored contributions made by researchers from other regions of the United States as well as those made by practitioners, cultivators, and others. Two of the leading popularizers of physical science declined to participate in pendulum mania, perhaps because the field was so crowded with demonstrators. Moreover, the widespread distribution of interest in the experiment challenges assertions made by historians about the relative level of scientific activity in various regions of the antebellum United States.<sup>2</sup>

Pendulum mania reflected the interest Americans had demonstrated in astronomical phenomena since the early eighteenth century. Announcements of eclipses and comets regularly graced the pages of American newspapers. No other physical science so completely captured the public imagination as astronomy. Five years before the pendulum mania erupted, controversy over the discovery of Neptune had been a *cause célèbre* in the United States. In many ways the popular reception of the Foucault pendulum paralleled the popular reaction to the Neptune controversy. Like the Foucault pendulum, the Neptune

<sup>1</sup> “Foucault, the Academician,” *Putnam’s Monthly: A Magazine of Literature, Science, and Art*, 1856, 8:416–421, on p. 419; [James D. Dana], “Physical Demonstration of the Rotation of the Earth by Means of the Pendulum,” *American Journal of Science*, 2nd Ser., 1851, 12:112–113, on p. 112; and *National Intelligencer*, 7 June 1851, p. 2.

<sup>2</sup> Nathan Reingold, “Definitions and Speculations: The Professionalization of Science in America in the Nineteenth Century,” in *The Pursuit of Knowledge in the Early American Republic: American Scientific and Learned Societies from Colonial Times to the Civil War*, ed. Alexandra Oleson and Sanborn C. Brown (Baltimore: Johns Hopkins Univ. Press, 1976), pp. 38–51; Daniel Goldstein, “‘Yours for Science’: The Smithsonian Institution’s Correspondents and the Shape of Scientific Community in Nineteenth-Century America,” *Isis*, 1994, 85:573–599, on p. 573; Robert V. Bruce, “A Statistical Profile of American Scientists, 1846–1876,” in *Nineteenth-Century American Science: A Reappraisal*, ed. George H. Daniels (Evanston, Ill.: Northwestern Univ. Press, 1972), p. 68; and Sally Gregory Kohlstedt, *The Formation of the American Scientific Community: The American Association for the Advancement of Science, 1848–1860* (Urbana: Univ. Illinois Press, 1976), pp. 200, 209–210.



**Figure 1.** *Portrait of Jean Bernard Léon Foucault.*

controversy was widely covered in American newspapers, was touted as a confirmation of astronomical theory, and prompted Dana to note that it was of “much general as well as scientific interest.” The Neptune controversy and the reception of the Foucault pendulum, however, differed in the depth of public participation. Whereas the Neptune controversy attracted only researchers, the Foucault pendulum attracted researchers, practitioners, cultivators, and others. The Foucault pendulum’s popularity was a result of its highly visual effect, its illustration of a basic physical principle, its use of readily available apparatus, and its ability to fascinate observers. This last result can still be witnessed today at science museums around the world.<sup>3</sup>

#### FOUCAULT AND HIS PENDULUM

In France, Jean Bernard Léon Foucault was the leading experimental physicist of his day. (See Figure 1.) While working on a clock with a conical pendulum to keep a telescope continuously focused on a heavenly body during the long exposures required for mid-nineteenth-century photography, Foucault placed a steel rod in a lathe. After accidentally

<sup>3</sup> Brooke Hindle, *The Pursuit of Science in Revolutionary America, 1735–1789* (Chapel Hill: Univ. North Carolina Press, 1956), pp. 94–96, 156, 172; and Donald Zochert, “Science and the Common Man in Antebellum America,” *Isis*, 1974, 65:448–486, on pp. 448–449. John G. Hubbell and Robert W. Smith, “Neptune in America: Negotiating a Discovery,” *Journal for the History of Astronomy*, 1992, 23:261–291, on pp. 261–264, found “interest” in but no “particular popular reaction” to the Neptune controversy.

bumping the rod and causing it to vibrate, he noticed that the rod tended to maintain its plane of vibration even when rotated. He perceived that if an oscillating pendulum maintained its plane of vibration—as the rod did—it might provide a mechanical demonstration of the earth's rotation. On 8 January 1851 Foucault vibrated a pendulum two meters in length. To his delight, the pendulum maintained its position while the floor gradually moved along with the direction of the earth's rotation.<sup>4</sup> Discounting air resistance and friction at the point of suspension, the only forces acting on Foucault's pendulum were the pull of gravity and the tension of the wire, so that it oscillated independently of the earth's rotation.

On 3 February Foucault repeated the experiment before the Académie des Sciences in the National Observatory with a pendulum eleven meters in length. He determined that the period for the apparent precession of the plane of the pendulum's oscillation around the circle described by the pendulum's arc of oscillation varied by latitude: at the poles a complete precession took almost exactly twenty-four hours (one sidereal day), at the equator there was no precession, and in between the poles and the equator the period was inversely proportional to the sine of the latitude where the pendulum oscillated. By graduating the radius of the circle described by the pendulum's arc of oscillation, Foucault demonstrated that the earth had moved from the pendulum's plane of oscillation—compelling proof of the earth's rotation even to an unscientific observer. In March 1851 Foucault, at President Louis Napoleon's request, performed the experiment at the Panthéon in Paris with a gigantic pendulum sixty-seven meters in length. This dramatic demonstration attracted large crowds and sparked the pendulum mania in Europe and the United States.<sup>5</sup>

#### GREAT BRITAIN

Britons also exhibited great enthusiasm for the Foucault pendulum. In Great Britain, the pendulum vibrated before crowds in at least six cities. Londoners showed particular interest, watching demonstrations in at least five places. The *Athenæum* observed that the Foucault pendulum “has been the subject of so much popular notice . . . that it would be needless to go into a particular description of its nature or object.” In both Britain and the United States, the most widely circulated account of the experiment was that published by the *London Globe* on 5 April 1851. Heralding Foucault's discovery as “one of the most remarkable of the modern verifications of theory,” the *Globe* observed that the experiment aroused “feelings of profound interest and excitement.” The earth's rotation was “rendered actually visible to the crowds which daily flock to the Panthéon to witness this remarkable experiment.” The *Globe* incorrectly reported that at the Panthéon the pendulum's plane of oscillation precessed at the rate of fifteen degrees per hour, making a complete revolution every twenty-four hours.<sup>6</sup>

On 8 April the *London Times* reprinted the *Globe*'s account of Foucault's repetition at

<sup>4</sup> Harold L. Burstyn, “Jean Bernard Léon Foucault,” in *Dictionary of Scientific Biography*, ed. Charles Coulston Gillispie (New York: Scribner's, 1970), Vol. 5, pp. 84–87, on pp. 85–86.

<sup>5</sup> Léon Foucault, “Démonstration physique du mouvement de rotation de la terre au moyen du pendule,” *Compte Rendu des Séances de l'Académie des Sciences*, 1851, 32:135–138; *Journal des Débats Politiques et Littéraires*, 31 Mar. 1851, p. 3; Stéphane Deligeorges, *Foucault et ses pendules* (Paris: Carré, 1995), pp. 49, 54–59; Burstyn, “Foucault,” pp. 85–86; Henry Worms, *The Earth and Its Mechanism: Being an Account of the Various Proofs of the Rotation of the Earth* (London, 1862), pp. 103–107; and William Tobin and Brian Pippard, “Foucault, His Pendulum, and the Rotation of the Earth,” *Interdisciplinary Science Reviews*, 1994, 19:326–337, on pp. 327–328.

<sup>6</sup> *Athenæum*, 14 June 1851, pp. 637–638; and *London Globe*, rpt. in *London Times*, 8 Apr. 1851, p. 7.

the Panthéon, sparking a correction by Joseph J. Sylvester, a mathematician and fellow of the Royal Society. Unimpressed by the enthusiasm excited by the Foucault pendulum and unsympathetic to the popular difficulty in understanding the dependence on latitude of the period of the apparent precession of the pendulum, he pleaded that the “public should not be so unreasonable as to expect that every conclusion or calculation admits of being made clear to public apprehension.” Warning that repetitions must be “conducted with great care,” Sylvester lamented that careless experimenters had brought “some discredit” to the Foucault pendulum in Britain. “It is perfectly absurd,” he admonished, “for persons unacquainted with mechanical and geometrical science to presume to make the experiment.” This “too-hasty rush at the experimental verification of Foucault’s law may account for some persons in England, whose opinions when given with due deliberation are entitled to respect, having allowed themselves to express doubts (which I understand, however, to have been since retracted) as to the truth of the law itself.”<sup>7</sup>

Sylvester’s discretion prevented him from naming George B. Airy, the astronomer royal, and the Reverend Baden Powell, Savilian Professor of Geometry at Oxford University, as the mistaken scientists. In private correspondence, Airy had repeatedly dismissed the Foucault pendulum experiment as a “fraud.” He regarded the latitude-dependent formula for the period of the apparent precession of the pendulum as a “mathematical curiosity having no application whatever to the *soi-disant* experiment.” Attending no demonstrations, Airy based his conclusion on oral accounts of the experiment. Concurring with Airy, Powell accepted the theory but held that as a “practical question” the experiment was “doubtless open to every kind of doubt.” After learning of successful demonstrations by British scientists, Airy conducted his own experiments. Although it was possible to conduct the experiment properly, he concluded that the “difficulty of starting a free pendulum, so as to make it vibrate at first in a plane, is extremely great.”<sup>8</sup>

Although Airy and Powell kept their opinions private, popular journals learned of their rejection of the experiment. Linking Airy’s and Powell’s doubts to recent unsuccessful popular demonstrations of the experiment, these journals questioned the validity of the Foucault pendulum. The *London Literary Gazette* recommended caution to those who would attempt the experiment because “persons unqualified by previous habits of research and accurate investigation” had failed. The *Literary Gazette* knew of several exhibitions “in which, to the horror of the spectators, the earth has been shown to turn the wrong way.” The *Illustrated London News* expressed similar reservations, observing that the “experiment is now giving rise to much controversy, and it is hard to conceive that there is not some fallacy lurking at the bottom of it.” Parodying this controversy, *Punch* reported that a correspondent named Swiggins had observed the earth’s rotation in a manner that should satisfy those “sceptical and obstinate” persons who doubted that it was visible. After six cups of brandy, Swiggins did not need a pendulum to convince him that the earth was spinning; he had only to look at the ceiling.<sup>9</sup>

Powell and Airy attempted to disabuse the public of doubts concerning the Foucault pendulum. On 9 May, Powell, a leading British popularizer of science, gave an address

<sup>7</sup> *London Times*, 8 Apr. 1851, p. 7, 11 Apr. 1851, p. 8, 26 Apr. 1851, p. 8.

<sup>8</sup> George B. Airy to Baden Powell, 18 Apr. 1851, Airy to Powell, 23 Apr. 1851, Powell to Airy, 26 Apr. 1851, George Bidwell Airy Papers, Royal Greenwich Observatory Archives, Cambridge University Archives; and Airy, “On the Vibration of a Free Pendulum in an Oval Differing Little from a Straight Line,” *Memoirs of the Royal Astronomical Society*, 1851, 20:121–130, on p. 122.

<sup>9</sup> *London Literary Gazette*, rpt. in *Trenton State Gazette*, 14 June 1851, p. 2; *Illustrated London News*, 3 May 1851, p. 345; and *Punch*, 1851, 20:191.

on the Foucault pendulum at a public demonstration of the experiment at the Royal Institution. Listing the repetitions conducted by scientists in Britain and Europe, he noted that the “accordance of many of the results at different places within fair limits of error” confirmed the validity of the experiment. Powell cautioned, nevertheless, that the “sources of error are numerous and not easy to be effectually guarded against.” He reasoned that “these causes of error” affected “many of the public repetitions” whose results did not conform to theory. Powell also noted that Airy had confirmed the experiment. On 9 May, Airy had presented his results to the Royal Astronomical Society. Two months later, Airy observed in an address before the British Association for the Advancement of Science that the Foucault pendulum had “excited very great attention both in France and England” by “visibly proving, if proof were necessary,” the earth’s rotation. Although now “certain” that “Foucault’s theory is correct,” Airy warned that “careful adjustments” were necessary. “For want of these the experiment has sometimes failed.”<sup>10</sup>

### THE UNITED STATES

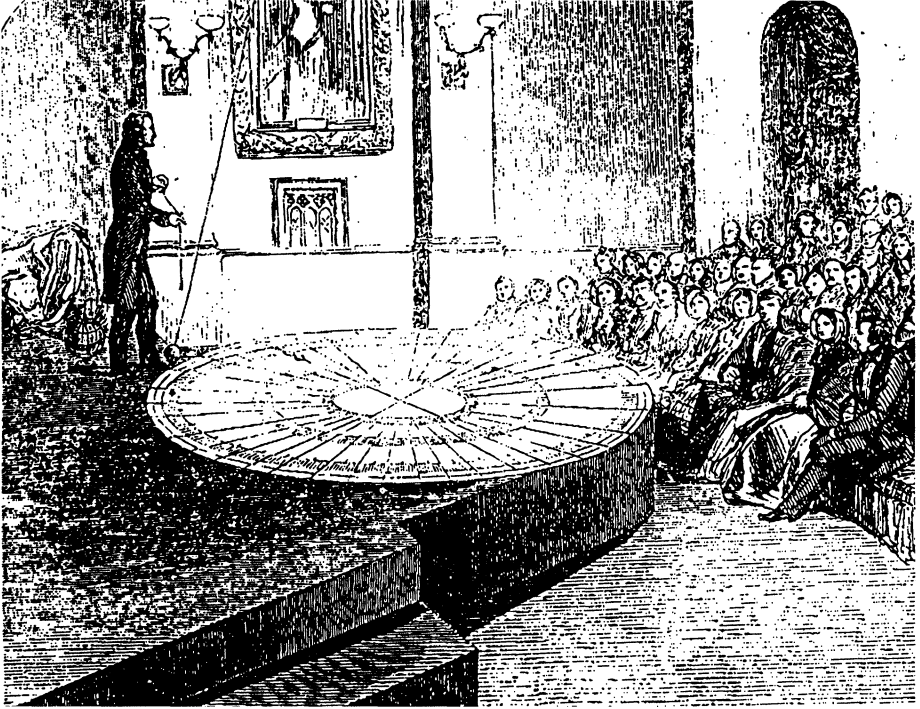
The hesitance of British scientists to endorse the Foucault pendulum slowed American reception of the experiment. Whereas pendulum mania peaked in Britain in April and May, it swept across the United States in May, June, and July. (See Figure 2.) In the mid-nineteenth century, Americans depended upon European science for education, motivation, and theory. While acknowledging this reliance and looking for approval from Europe, American scientists contended that they were the equals of any. Although James D. Dana informed American scientists of the Foucault pendulum in the *American Journal of Science* without mentioning the British controversy, the American public followed the dispute. The *Scientific American* observed that Foucault’s pendulum was the “subject of much controversy in England, some are stating that it is fallacious, others proving it to be the reverse.” A Pennsylvania newspaper noted that “quite a discussion has been started among some of the big guns of Europe in regard to it—some contending for it, others violently opposing it as a fallacy.” Airy’s endorsement of the experiment—which American newspapers and periodicals reprinted—invigorated American interest in the Foucault pendulum.<sup>11</sup>

Americans knew of the Foucault pendulum before they learned of Airy’s endorsement, but since the *London Globe* was their main source, the information was suspect. From late April to early May, Americans in almost every major city—Boston, Providence, Albany, New York, Newark, Trenton, Pittsburgh, Philadelphia, Savannah, Charleston, St. Louis, and San Francisco—first learned of the Foucault pendulum from the *Globe*’s erroneous account. In bilingual New Orleans, Anglophones were informed of the Foucault pendulum by the *Picayune*’s reprint of the *Globe*, while Francophones were apprised of Foucault’s “experience curieux” by the Paris correspondent of the *Courier de la Louisiane*. Secular journals, such as the *Scientific American* and the *International Magazine*, and religious

<sup>10</sup> *Athenæum*, 14 June 1851, pp. 637–638; Airy, “Vibration of a Free Pendulum” (cit. n. 8); and George B. Airy, “Address,” *Report of the Twenty-first Meeting of the British Association for the Advancement of Science*, 1852, 21:xxxix–liii, on p. xliii.

<sup>11</sup> Dana, “Physical Demonstration of the Rotation of the Earth” (cit. n. 1), pp. 112–113; “Demonstration of the Earth’s Rotation,” *Scientific American*, 1851, 6:289; *Miners’ Journal and Pottsville General Advertiser*, 7 June 1851, p. 2; “British Scientific Association, &c.,” *Sci. Amer.*, 1851, 6:362; and *Providence Journal*, 8 Aug. 1851, p. 2.





**Figure 2.** Illustration from "Demonstration of the Earth's Rotation," *Scientific American*, 1851, 6:289.

journals, such as the *Trumpet and Universalist Magazine* and the *Christian Watchman and Reflector*, also reprinted the *Globe's* account.<sup>12</sup>

Several Americans made efforts to remedy the *Globe's* errors. People in and around Boston first learned of the Foucault pendulum from the *Boston Evening Traveller's* reprint of the *Globe*, but Benjamin A. Gould, a Cambridge astronomer and editor of the *Astronomical Journal*, submitted a correction to the *Evening Traveller* as a public service because the *Globe's* account was "incorrect" and "unintelligible." Gould's article was not widely reprinted, unfortunately, and it had minimal impact on popular reception of the Foucault pendulum. Indeed, Gould's account did not disabuse all of the Boston newspapers of the *Globe's* errors. Two other Boston newspapers, the *Morning Commonwealth* and the *Evening Transcript*, repeated these mistakes. In Washington, readers learned of the Foucault pendulum on 22 April when the Paris correspondent of the *National Intelligencer* reported on the "beautiful experiment which all Paris is flocking to the Pantheon to see, and which is being repeated all over France and Europe." On 7 April the correspondent had visited the Panthéon to see the demonstration, but he waited until publication of

<sup>12</sup> *Boston Evening Transcript*, 26 Apr. 1851, p. 2; *Providence Journal*, 20 May 1851, p. 1; *Albany Journal*, 26 Apr. 1851, p. 2; *New York Herald*, 24 Apr. 1851, p. 2; *Newark Advertiser*, 29 Apr. 1851, p. 2; *Trenton State Gazette*, 28 Apr. 1851, p. 1; *Pittsburgh Gazette*, 29 Apr. 1851, p. 1; *Cummings' Evening Bulletin* (Philadelphia), 26 Apr. 1851, p. 3; *Savannah Republican*, 24 Apr. 1851, p. 2; *Charleston Courier*, 30 Apr. 1851, p. 2; *Missouri Republican* (St. Louis), 5 May 1851, p. 2; *San Francisco Herald*, 27 June 1851, p. 2; *Picayune* (New Orleans), 1 May 1851, p. 1; *Courier de la Louisiane* (New Orleans), 21 Apr. 1851, p. 2; *Sci. Amer.*, 1851, 6:267; *International Magazine of Literature, Art, and Science*, 1851, 3:296; *Trumpet and Universalist Magazine*, 1851, 23:208; and *Christian Watchman and Reflector*, 1851, 32:80.

Foucault's presentation of the experiment to the Académie before sending a report to avoid the "palpably gross errors" that appeared in the *Globe* and other newspapers. He also translated Foucault's notice into English. The *National Intelligencer's* account was not only the earliest American announcement of the experiment; it was also the most complete. Lacking a Paris correspondent, the *Washington Republic* carried the *Globe's* account almost a month after the *National Intelligencer* broke the story.<sup>13</sup>

### THE RISE OF PENDULUM MANIA

In addition to the *London Globe's* widely reprinted account, newspaper reports of local demonstrations of the experiment were an important impetus for pendulum mania. Learning of the Foucault pendulum from the *Newark Advertiser's* reprint of the *Globe*, H. D. V., a farmer from Plainfield, New Jersey, vibrated a thirty-foot-long pendulum from the rafters of his barn over a graduated circle traced on the dirt floor. On 1 May H. D. V. announced his repetition to the *Newark Advertiser* and encouraged others to repeat this "very simple" experiment. Newspapers, including the *National Intelligencer*, the *Chicago Democrat*, the *Richmond Enquirer*, the *St. Louis Intelligencer*, *Cummings' Evening Bulletin* (Philadelphia), and the *Augusta Constitutionalist*, and periodicals, including the *Spirit of the Times*, the *International Magazine*, and the *Scientific American*, reprinted H. D. V.'s letter. The *Scientific American* observed to its sixteen thousand readers, "Any of our farmers may try the experiment in their barns."<sup>14</sup>

Encouraged by H. D. V.'s example and intrigued by the press coverage, Americans of various degrees of scientific sophistication performed their own demonstrations of the Foucault pendulum. On 13 May a Washington gentleman vibrated a pendulum thirty feet in length at his home. Alexander C. Ross, a member of the American Association for the Advancement of Science (AAAS), exhibited the earth's motion for citizens of Zanesville, Ohio, attempting to vibrate a pendulum in the plane of its own shadow to determine whether "it will follow the shadow as long as it continues to vibrate." At the Paul Revere House, a fashionable Boston hotel, an unidentified person exhibited the earth's rotation. In Trenton, Samuel D. Ingham, a businessman and former treasury secretary, successfully performed the experiment in the rotunda of the New Jersey statehouse.<sup>15</sup>

Although most practitioners and researchers were slow to appreciate the popular appeal of the Foucault pendulum in May, several performed public demonstrations of the experiment. George R. Perkins, a professor at the Albany Normal School, performed the experiment at the Albany Institute. Both the *Albany Argus* and the *Albany Journal* agreed that the experiment was beautiful. Eben N. Horsford and William C. Bond independently demonstrated the experiment for the public in Cambridge and reported their results to the *Boston Evening Traveller*. Horsford, director of the Lawrence Scientific School of Harvard College, vibrated a thirty-six-foot pendulum in his laboratory, attracting "some hundreds"

<sup>13</sup> *Boston Evening Traveller*, 2 May 1851, p. 2; *Boston Morning Commonwealth*, 7 May 1851, p. 2; *Boston Evening Transcript*, 28 May 1851, p. 1; *National Intelligencer* (Washington, D.C.), 22 Apr. 1851, p. 2, 23 Apr. 1851, p. 2, 26 Apr. 1851, p. 2; and *Washington Republic*, 1 May 1851, p. 3.

<sup>14</sup> *Newark Advertiser*, 3 May 1851, p. 2; *National Intelligencer*, 6 May 1851, p. 3; *Chicago Democrat*, 2 June 1851, p. 3; *Richmond Enquirer*, 9 May 1851, p. 1; *St. Louis Intelligencer*, 14 May 1851, p. 2; *Cummings' Evening Bulletin*, 5 May 1851, p. 1; *Augusta Constitutionalist*, 29 May 1851, p. 2; *Spirit of the Times: A Chronicle of the Turf, Agriculture, Field Sports, Literature, and the Stage*, 1851, 21:149; *Int. Mag. Lit., Art., Sci.*, 1851, 3:296–297, on p. 296; and *Sci. Amer.*, 1851, 6:289.

<sup>15</sup> *Washington Republic*, 14 May 1851, p. 2; *National Intelligencer*, 2 June 1851, p. 3; *Boston Evening Transcript*, 31 May 1851, p. 2; and *Trenton State Gazette*, 29 May 1851, p. 2.

of spectators over ten days. After repeating the experiment at the Harvard College Observatory, Bond, director of the observatory, notified the *Evening Traveller* that he had set up a pendulum one hundred feet long at a ship house in the Charlestown Navy Yard.<sup>16</sup>

Intrigued by Foucault's performance at the Panthéon and by Bond and Horsford's local demonstrations, the Massachusetts Charitable Mechanics Association decided that the Bunker Hill Monument in Charlestown was the ideal place for the Cambridge scientists to repeat the experiment. The association provided funds for the apparatus, enlisted Bond and Horsford to exhibit the experiment, and applied to the directors of the Bunker Hill Monument Association to use the monument for that purpose. On 15 May the directors agreed to allow Horsford and Bond to conduct a repetition in the stairwell of the monument. Learning of preparations for a demonstration at Bunker Hill, the people of Providence clamored for their own demonstration. Bowing to popular demand, William A. Norton, professor of natural philosophy, and Alexis Caswell, professor of astronomy, both at Brown University, vibrated a pendulum ninety-seven feet in length at the Providence railroad depot. On 27 May Daniel Kirkwood, principal of the Pottsville (Pennsylvania) Academy, vibrated a pendulum eighty feet in length in the car house of the Reading Railroad at Schuylkill Haven, Pennsylvania. Intended for students, the exhibition attracted "a number of ladies and gentlemen," who were "very attentive, and manifested a deep interest in the subject." Pleased that Kirkwood had exhibited the experiment in Schuylkill Haven before Bond and Horsford had done so at Bunker Hill, the correspondent for the *Miners' Journal* incorrectly asserted that this was the first American demonstration of the Foucault pendulum. Adding to this error, he reported that Kirkwood's pendulum at Schuylkill Haven was twice the length of the one used by Foucault in the Panthéon. Yielding to popular demand, Kirkwood also performed the experiment with a shorter pendulum at the Pottsville courthouse. Reflecting the uneven ascent of pendulum mania, the Pittsburgh press ignored the experiment conducted by John Locke, a professor at the Ohio Medical College in Cincinnati, with a one-hundred-foot pendulum in the rotunda of the Pittsburgh courthouse.<sup>17</sup>

On 31 May Horsford and Bond vibrated a pendulum 211 feet in length—nine feet shorter than the one vibrated by Foucault at the Panthéon—before the directors of the Bunker Hill Monument Association, a committee of the Massachusetts Charitable Mechanics Association, and several scientists. By playing to the press, Horsford and Bond cultivated interest in the Foucault pendulum. They invited editors of the *Boston Advertiser*, the *Boston Courier*, the *Boston Evening Traveller*, and the *Boston Evening Transcript* to attend a private demonstration later that day. The *Transcript* observed that the "motion of the pendulum is beautiful in the extreme."<sup>18</sup>

In Boston, anticipation of public admission to the exhibition at the Bunker Hill Monu-

<sup>16</sup> *Albany Journal*, 9 May 1851, p. 2; *Albany Argus*, 12 May 1851, p. 2; *Boston Evening Traveller*, 5 May 1851, p. 2, 14 May 1851, p. 2; and *Boston Advertiser*, 19 May 1851, p. 2.

<sup>17</sup> *Boston Courier*, 10 June 1851, p. 1; *Boston Advertiser*, 19 May 1851, p. 2; Alexis Caswell and William A. Norton, "State of the Results of a Set of Observations in Repetition of the Foucault Experiment," *Proceedings of the American Association for the Advancement of Science*, 1851, 6:130–132, on p. 130; *Miners' J. Pottsville Gen. Advertiser*, 31 May 1851, p. 2, 14 June 1851, p. 2; and *Cincinnati Commercial*, 27 May 1851, p. 2.

<sup>18</sup> *Boston Advertiser*, 31 May 1851, p. 2; *Boston Courier*, 31 May 1851, p. 2; *Boston Evening Transcript*, 31 May 1851, p. 2; *Boston Evening Traveller*, 31 May 1851, p. 2; Eben N. Horsford to the Editors of the *Boston Evening Traveller*, 26 May 1851, Eben Norton Horsford Papers, Rensselaer Polytechnic Institute Archives and Special Collections, Troy, New York; *National Intelligencer*, 2 June 1851, p. 3, 5 June 1851, p. 2; and "The Motion of the Earth Rendered Visible," *Sci. Amer.* 1851, 6:280. An invitation to the inaugural vibration of the Foucault pendulum at the Bunker Hill Monument is located in the Eben Norton Horsford Papers.

ment intensified pendulum mania. Several days before the opening of the demonstration, two newspapers published front-page articles on the Foucault pendulum. The *Boston Advertiser* reprinted an English translation of Foucault's report of the experiment to the Académie. Reflecting the ambivalent relationship between American and European science—Americans respected European science but took every opportunity to demonstrate American competence—the *Advertiser* incorrectly reported that the demonstration at Bunker Hill “will give a pendulum quite as long as that in the Pantheon, if not longer.” Copying an illustration of the Panthéon demonstration from a French magazine, the *Transcript* cobbled together an article detailing the experiment and several American exhibitions from articles in five newspapers. During June and July, hundreds of Bostonians paid a small fee to view the pendulum at the Bunker Hill Monument through a glass door.<sup>19</sup>

### THE PEAK OF PENDULUM MANIA

Local newspaper accounts of the Bunker Hill demonstration sparked interest in the Foucault pendulum far beyond Boston. Newspapers in Providence, Albany, New York, Newark, Pottsville, Philadelphia, Washington, Richmond, Norfolk, Augusta, Savannah, Charleston, Mobile, Louisville, and San Francisco reprinted reports of the Bunker Hill demonstration. In early June Bird's Eye, who wrote the “Glimpses of Men, and Things, and Places” column for the *National Intelligencer*, observed that Bostonians “have just got up the experiment on a grand scale, turning Bunker Hill Monument into a stupendous pendulum, or rather pendulum case.” In late July Bird's Eye visited the Bunker Hill Monument and was treated to a personal demonstration. “The experiment, as has already been affirmed a thousand times, is a very interesting one,” Bird's Eye noted, “and it would be difficult to find a place better adapted for its exhibition than this.” Horsford and Bond's success at Bunker Hill encouraged others to conduct demonstrations. The length of the pendulum employed by Horsford and Bond and the interest it generated made Bunker Hill the benchmark for American exhibitions of the Foucault pendulum.<sup>20</sup>

From June to July, Americans vibrated pendulums at an astonishing rate. Led by Boston and Providence, New England expressed greater interest in the Foucault pendulum—as measured by the number of public demonstrations and newspaper articles relating to the experiment—than any other region of the country. Since the seventeenth century New England had led the nation in the pursuit of science. While Bostonians tramped up Bunker Hill, latter-day Puritans attended demonstrations of the Foucault pendulum throughout the region. In early June an unidentified person performed the experiment at the United States Armory in Springfield, Massachusetts. The *Boston Morning Commonwealth* reported that at a local hotel a pendulum consisting of a “bullet suspended by a hair” presented “a satisfactory illustration” of the experiment. On 23 June, at the request of the Connecticut Academy of Arts and Sciences, Chester S. Lyman, a Yale-trained astronomer then employed defining scientific words for *Webster's Dictionary*, vibrated a pendulum seventy-

<sup>19</sup> *Boston Advertiser*, 24 May 1851, p. 1; and *Boston Evening Transcript*, 28 May 1851, p. 1.

<sup>20</sup> *Providence Journal*, 20 May 1851, p. 2; *Albany Journal*, 21 May 1851, p. 2; *New York Journal of Commerce*, 31 May 1851, p. 4; *Newark Advertiser*, 17 June 1851, p. 2; *Miners' J. Pottsville Gen. Advertiser*, 7 June 1851, p. 2; *Cummings' Evening Bulletin*, 11 June 1851, p. 1; *National Intelligencer*, 22 May 1851, p. 3; *Richmond Enquirer*, 6 June 1851, p. 1; *American Beacon and Norfolk and Portsmouth Advertiser*, 5 June 1851, p. 2; *Augusta Constitutionalist*, 31 May 1851, p. 2; *Savannah News*, 6 June 1851, p. 2; *Mobile Register*, 12 June 1851, p. 2; *Charleston Courier*, 4 June 1851, p. 2; *Louisville Courier*, 6 June 1851, p. 2; *Alta California* (San Francisco), 7 July 1851, p. 2; and *National Intelligencer*, 7 June 1851, p. 2, 30 July 1851, p. 2.

one foot long from the dome of the statehouse in New Haven. Denison Olmsted, professor of natural philosophy and astronomy at Yale College, took his class to witness the demonstration. Olmsted and Lyman explained the principles of the experiment to the “large audience” that gathered “actually to see the motion of the Earth.”<sup>21</sup>

New England and the mid-Atlantic states led the nation in the pursuit of science, as measured by the birthplace of scientists, number of resident scientists, and number of AAAS members. But if Washington is included in the South, that region demonstrated greater interest in the Foucault pendulum than any except New England. Confirming the devotion to physical science in the antebellum South found by historians, southerners attended demonstrations of the Foucault pendulum in the city of Washington as well as in South Carolina, Alabama, and Georgia. Reflecting the uneven ascent of pendulum mania, New Orleans, the most populous and cosmopolitan city in the South, hosted no public demonstrations.<sup>22</sup>

Despite being the center of federal government, Washington remained a southern city. The city was second only to Boston in the number of public demonstrations of the Foucault pendulum and newspaper articles on the experiment. In June two public demonstrations were performed in Washington by local practitioners. From 6 to 11 June J. Homer Lane, an examiner in the Patent Office, vibrated a forty-five-foot pendulum before appreciative crowds at the National Gallery. On 9 June Captain Charles Wilkes, the renowned naval explorer, vibrated a pendulum 116 feet in length under the dome of the Capitol. Wilkes performed the demonstration on Sunday, the only day the Capitol could be sealed to prevent perturbing air currents. Many ladies and gentlemen observed Wilkes’s exercise. The Washington correspondent of the *Charleston Courier* observed that the Foucault pendulum “seems to have thrown all our savans into extacies [sic]. Every newspaper is filled with accounts of successful repetitions of the experiment or with suggestions in regard to it.”<sup>23</sup>

During June, three separate demonstrations of the Foucault pendulum were performed in South Carolina. J. A. Young, a member of the AAAS and a meteorological observer of the Smithsonian Institution, conducted “the French experiment” at his home in Camden with a ten-foot pendulum and under the steeple of the town hall with a pendulum forty-two feet in length before an appreciative crowd. Young reported to Joseph Henry, secretary of the Smithsonian Institution, that he obtained the “expected results.” Matthew J. Williams, professor of mathematics at South Carolina College, repeated the experiment with a twenty-foot pendulum in the college chapel before faculty, students, and residents of Columbia. Robert C. Gilchrist conducted the experiment at the Circular Church of Charleston with a pendulum fifty-two feet long, to the satisfaction of numerous spectators.<sup>24</sup>

<sup>21</sup> Robert V. Bruce, *The Launching of Modern American Science, 1846–1876* (New York: Knopf, 1987), pp. 32–39, 43–45; Bruce, “Statistical Profile of American Scientists” (cit. n. 2), p. 68; Kohlstedt, *Formation of the American Scientific Community* (cit. n. 2), pp. 200, 209–210; *Springfield Republican*, 10 June 1851, p. 2; *Boston Morning Commonwealth*, 17 June 1851, p. 1; *New Haven Palladium*, 24 June 1851, p. 2; and *Yale Literary Magazine*, 1851, 16:327.

<sup>22</sup> Ronald L. Numbers and Janet S. Numbers, “Science in the Old South,” *Journal of Southern History*, 1982, 48:163–184, on pp. 167–169, 175, 184. Bruce, “Statistical Profile of American Scientists,” pp. 74, 80, and Kohlstedt, *Formation of the American Scientific Community*, p. 200, place Washington, D.C., in the mid-Atlantic region.

<sup>23</sup> *Washington Republic*, 7 June 1851, p. 3, 11 June 1851, p. 3; *Trenton State Gazette*, 11 June 1851, p. 2; and *Charleston Courier*, 3 June 1851, p. 2.

<sup>24</sup> *Charleston Courier*, 30 May 1851, p. 1; J. A. Young to Joseph Henry, 10 June 1851, Weather Bureau, Meteorological Correspondence of the Smithsonian Institution 1847–67, Record Group 27, National Archives, Washington, D.C.; and *Charleston Courier*, 17 June 1851, p. 2, 28 June 1851, p. 2.

In Tuscaloosa, Alabama, Frederick A. P. Barnard, professor of chemistry and natural philosophy at the University of Alabama, and J. N. Jennings, principal of a local female seminary, vibrated a pendulum ninety feet in length under the dome of the statehouse. The *Mobile Register* took pride in the mistaken notion that Barnard and Jennings demonstrated the earth's rotation with a longer pendulum than that employed at Bunker Hill. The correspondent of the *Tuscaloosa Observer* reported that Jennings would repeat the experiment on request "for the gratification of the curious." In Penfield, Georgia, Joseph E. Willet, professor of natural philosophy at Mercer University, performed the experiment for students and faculty of the largest Baptist college in the United States and for residents of Penfield.<sup>25</sup>

Residents of the mid-Atlantic states expressed less interest in the Foucault pendulum than those of New England or the South. Although not producing as many scientists as New England, the mid-Atlantic states employed more scientists and had more AAAS members than any other region of the country. The surprising lack of pendulum mania in the mid-Atlantic states was due largely to apathy in Philadelphia and New York City. Like fads and epidemics, pendulum mania was localized, bypassing some places. No one in Philadelphia made a public demonstration of the Foucault pendulum or reported the results of a private repetition. The American Philosophical Society ignored the Foucault pendulum. Although once the leading scientific organization in the United States, the society had gradually lost interest in the physical sciences. By the 1840s it was largely devoted to the ethnology of the American Indian. Taking up the slack, the Franklin Institute published an English translation of Foucault's announcement of the experiment to the Académie as part of the "useful knowledge" it diffused to its members. At the Franklin Institute's request Charles J. Allen, a schoolteacher, prepared a trigonometric demonstration explaining the experiment. Apparently unaware of Allen's account, J. S. Brown, a Washington resident, offered a similar exposition. New York City witnessed only two private demonstrations of the Foucault pendulum. At the urging of William A. Norton and the editors of the *Literary World*, Elias Loomis, professor of astronomy at New York University, vibrated a pendulum about eight feet in length at the university. To satisfy their "curiosity to witness an illustration of the rotary motion of the Earth," compositors in the printing shop of Joseph T. Cromwell repeated the experiment in their office with a pendulum twelve feet long that had a section of stove pipe for a bob.<sup>26</sup>

New Jersey led the mid-Atlantic region in interest in the Foucault pendulum, with lively newspaper coverage and several demonstrations of the experiment. Editors of the state's leading newspapers, the *Newark Advertiser* and the *Trenton State Gazette*, debated the principles of the Foucault pendulum. Editors of the *Advertiser* explained that the period of the pendulum's apparent precession varied according to the latitude where the experi-

<sup>25</sup> *Mobile Register*, 18 June 1851, p. 2; and John L. Dagg, "Demonstration of the Theory of the Pendulum Experiment," *Amer. J. Sci.*, 2nd Ser., 1855, 19:280–281, on p. 280.

<sup>26</sup> Bruce, "Statistical Profile of American Scientists" (cit. n. 2), p. 68; Kohlstedt, *Formation of the American Scientific Community* (cit. n. 2), pp. 200, 209–210; Bruce, *Launching of Modern American Science* (cit. n. 21), pp. 45–47; Bruce Sinclair, *Philadelphia's Philosopher Mechanics: A History of the Franklin Institute, 1824–1865* (Baltimore: Johns Hopkins Univ. Press, 1974), pp. 136, 153; Léon Foucault, "Physical Demonstration of the Rotation of the Earth by Means of the Pendulum," *Journal of the Franklin Institute*, 1851, 51:350–353; Charles J. Allen, "Investigation of Foucault's Experiment," *ibid.*, 1851, 52:38–42; J. S. Brown, "Exposition of Foucault's Pendulum," *ibid.*, pp. 352–355; Elias Loomis, "Notice of the New Experiment for Demonstrating the Rotation of the Earth," *Literary World: A Journal of American and Foreign Literature, Science, and Art*, 1851, 8:509–510, on p. 509; William A. Norton to Elias Loomis, 24 June 1851, Elias Loomis Papers, Beinecke Rare Book and Manuscript Library, Yale University, New Haven, Connecticut; and *New-York Tribune*, 2 July 1851, p. 5.

ment was performed. Unfortunately, the *Advertiser* report did not satisfy the *State Gazette*. The latter wondered how the pendulum escaped the influence of the earth's rotation when "much lighter substances, the leaves on the trees, gossamer's web, smoke, steam, or the feathery cloud, or the rare higher strata of the atmosphere" did not. Although unaware of an unsuccessful demonstration, editors of the *State Gazette* did not understand how the experiment illustrated the earth's rotation. "The difficulty is felt," they observed, "by a good many persons besides ourselves." Despite additional attempts, the *Advertiser* could not explain the experiment to their rival's satisfaction. On 7 June Robert L. Cooke, a member of the AAAS, presented the results of his repetition at the Presbyterian church in Bloomfield to the Essex County Teachers' Association. On 21 June Theodore Strong, professor of mathematics at Rutgers College, devised a "more simple way" to exhibit the earth's rotation than vibrating a long pendulum with a massive bob. Strong reported to the *Advertiser* that he had vibrated a metal cylinder from a long thread and achieved the same result as the Foucault pendulum.<sup>27</sup>

In Newark C. Dowden, a correspondent of the AAAS, conducted an unsuccessful repetition in July. In an article for *Appletons' Mechanics' and Engineers' Journal*, Dowden explained that scientists had "jumped to a hasty and premature conclusion" in asserting that a vibrating pendulum could provide a visible proof of the earth's rotation because of two "unjustifiable" assumptions: that friction at the point of suspension was nothing and that the pendulum could vibrate independently of the earth's motion. Dr. William Kitchell, a member of the AAAS, and two other gentlemen repeated the experiment with a pendulum thirty feet in length at the New Jersey Art-Union Gallery in Newark. After numerous trials made over several days, they reported to the *Newark Advertiser* that the result was "invariably ELLIPTICAL MOTION!" While it might have been theoretically possible to take sufficient precautions to repeat the experiment successfully, they "reluctantly" concluded that air resistance and the impossibility of bringing the pendulum completely to rest before starting were "insuperable obstacles to its practical performance." After consultation with Dowden, Kitchell reasoned that Foucault's demonstration at the Panthéon and subsequent American exhibitions must have been "vitiated" by "unobserved errors." They boldly proposed another method to demonstrate the earth's motion with a pendulum by measuring the deviance between the calculated motion and the observed motion of the apsides of the ellipse. They hoped that Strong would determine the angular motion of the ellipse of a given pendulum so that they might perform the experiment. Assuring them that the Foucault pendulum demonstrated the earth's rotation, Strong offered to repeat the experiment for doubters. Dowden remained unconvinced, believing that he had a "positive duty" to reject the Foucault pendulum because its "advocates cannot agree among themselves," its proofs were "impossible," and its workings "absolutely absurd."<sup>28</sup>

Westerners expressed less interest in the Foucault pendulum than inhabitants of the other regions of the United States. With few cities, a short tradition of science, and a mobile population, the West lagged behind the South in the number of scientists produced and employed. Cincinnati led the West in science with three societies: the Western Academy of Natural Sciences, the Cincinnati Astronomical Society, and the Ohio Mechanics

<sup>27</sup> *Newark Advertiser*, 21 May 1851, p. 2; *Trenton State Gazette*, 27 May 1851, p. 2, 29 May 1851, p. 2; *Newark Advertiser*, 4 June 1851, p. 2; *Trenton State Gazette*, 6 June 1851, p. 2; and *Newark Advertiser*, 9 June 1851, p. 2, 24 June 1851, p. 2.

<sup>28</sup> C. Dowden, "Rotation of the Earth," *Appletons' Mechanics' and Engineers' Journal*, 1851, 1:407-408, on p. 407; *Newark Advertiser*, 8 July 1851, p. 2, 11 July 1851, p. 2; and C. Dowden to Editor, *Appleton's Mech. Eng. J.*, 1851, 1:447.

Institute. In late June John Locke yielded to popular demand in Cincinnati and vibrated an eighty-foot pendulum at the Ohio Mechanics Institute. On 13 June Dr. John L. Smith, a member of the AAAS, exhibited the experiment at the medical institute of the University of Louisville. Throughout July John Wise, an aeronaut and correspondent of the Smithsonian Institution, performed experiments relating to the Foucault pendulum from his balloon above Zanesville and Columbus, Ohio. Wise observed that oblong pieces of paper, an empty pint bottle, and two pieces of board dropped from the balloon at an altitude of one mile all “spun on their axes.” Wise reported to newspapers and the *Scientific American* that these objects partook of the same “rotary and gyratory motion” that gave the Foucault pendulum’s “variation with a given line.”<sup>29</sup>

The efflorescence of popular demonstrations by cultivators in the United States was stimulated by the public, newspaper editors, scientists, and the demonstrators’ own desire to witness the earth’s rotation or to participate in a scientific controversy. Not wanting to be left out of the excitement of pendulum mania, people in cities that had not enjoyed a public exhibition of the Foucault pendulum called for demonstrations. Even though the experiment had been confirmed many times before, a correspondent of the *Tuscaloosa Observer* noted that “every person finds it gratifying to be able to verify so remarkable a phenomenon with his own eyes.” In Boston, Providence, Pottsville, Columbia, and Cincinnati, demonstrators yielded to popular demand for public exhibitions of the Foucault pendulum, and other public demonstrations were probably due in part to such pressure. Newspaper editors were well placed to make such requests. The *St. Louis Intelligencer* pleaded for a “philosopher” to conduct the experiment in the rotunda of the courthouse to satisfy the curiosity of “thousands of our citizens” and to settle the dispute over the Foucault pendulum. The *New-York Tribune* recommended that the experiment be conducted on a “properly graduated clock dial” to “make old mother earth mark her own time” and to “tell the flight of time with an exactness hitherto unparalleled.” Apparently both calls went unanswered.<sup>30</sup>

Newspaper editors also encouraged cultivators to perform demonstrations of the Foucault pendulum by noting the simplicity and beauty of the experiment and recommending its repetition. The *Washington Republic* noted that the “experiment can be tried at a trifling outlay, and is certainly one of interest.” The *Albany Argus* observed that the Foucault pendulum had the “merit of being simple, and easily got up.” The *Boston Evening Transcript* noted that the “experiment may be easily tested in private houses as it is very simple.” The *Springfield Republican* exclaimed that the “experiment is so simple, the developments in its operation so wonderful, and the demonstration so beautiful, that the mind must be dull indeed that is not deeply interested in it.” A correspondent of the *New York Herald* observed that the “experiment can be performed by any person, down the opening of a circular staircase in a dwelling house or other building.” Not all editors encouraged cultivators to conduct their own demonstrations. Despite the apparent simplicity of the experiment, the *International Magazine* cautioned that “it should be attempted only by sci-

<sup>29</sup> Bruce, *Launching of Modern American Science* (cit. n. 21), pp. 54–56; Bruce, “Statistical Profile of American Scientists” (cit. n. 2), p. 68; Henry D. Shapiro, “The Western Academy of Natural Sciences of Cincinnati and the Structure of Science in the Ohio Valley, 1810–1850,” in *Pursuit of Knowledge*, ed. Oleson and Brown (cit. n. 2), p. 238; *Cincinnati Commercial*, 25 June 1851, p. 2; *Louisville Journal*, 17 June 1851, p. 2, 26 June 1851, p. 2; *Scioto Gazette*, 7 July 1851, p. 3, 19 Aug. 1851, p. 2; *Sci. Amer.*, 1851, 6:312; and John Wise, *Through the Air: A Narrative of Forty Years’ Experience as an Aeronaut* (Philadelphia, 1873), p. 420.

<sup>30</sup> *Mobile Register*, 18 June 1851, p. 2; *St. Louis Intelligencer*, 6 June 1851, p. 2; and *New-York Tribune*, 14 July 1851, p. 4.



entific men,” and it reprinted Joseph J. Sylvester’s admonition in the *London Times* against demonstrations by laypersons.<sup>31</sup>

Some researchers and practitioners encouraged cultivators to perform the Foucault pendulum experiment. Horsford informed the *Boston Evening Traveller*’s readers that “this beautiful experiment is so simple that it may be readily repeated in most of our dwellings,” as it required only a screw, a small weight, and a slender metal wire. Locke gave several tips to the readers of the *Cincinnati Commercial* who hoped to repeat the experiment, detailing the mode of suspension, the shape of the bob, and the type of wire. To allay concerns that a suitable pendulum must be made on a grand scale, Locke reported that he had “succeeded perfectly” in performing the experiment with short pendulums, including one only thirty-nine inches long. Lewis R. Gibbes, professor of astronomy at the College of Charleston, told interested persons not to be discouraged from performing the experiment for want of a proper pendulum. “Any heavy body suspended, free from friction, with a rod projecting from it horizontally, will indicate the motion as truly as a pendulum,” he explained, though it “would be more liable to disturbance from extraneous causes.”<sup>32</sup>

Not all demonstrators encouraged cultivators to perform the experiment. Quoting Sylvester’s warning in the *London Times*, John L. Smith asserted that supposing the Foucault pendulum to be a “popular” experiment was an “egregious error.” Smith observed that the Foucault pendulum demonstration was “not so easily understood or so readily performed” as many newspaper accounts suggested. Elias Loomis warned the readers of the *Literary World* that the “difficulties in the way of subjecting these results to the test of experiment are very serious.” Avoiding air currents and making sure the pendulum was at rest before beginning the experiment were crucial for success. To avoid these “evils,” Loomis observed that experimenters employed bobs as heavy and wires as long as possible and cited approvingly the dimensions of the pendulums vibrated at the Panthéon and the Bunker Hill Monument. Loomis cautioned that the slightest lateral impulse—even “a breath of air”—could cause elliptical oscillations and “vitiate” the experiment.<sup>33</sup>

#### THE CONFUSION OF PENDULUM MANIA

Tens of thousands of Americans read accounts of the Foucault pendulum and thousands attended demonstrations of the experiment, but many did not understand how it showed the earth’s rotation. The experiment provoked reactions ranging from admiration to incredulity to scorn. The *Boston Morning Commonwealth* identified the two questions raised by the Foucault pendulum that vexed the popular mind. Many Americans wondered how the pendulum oscillated independently of the earth’s rotation if its point of suspension was attached to the earth. Expecting the earth to return to the pendulum’s plane of oscillation in twenty-four hours, most Americans were confounded when they learned that at latitudes in the United States this process took over thirty-four hours. Even as they reprinted accounts of demonstrations of the Foucault pendulum, editors of several newspapers—the *Providence Journal*, the *Trenton State Gazette*, the *Scioto Gazette*, and the *Friends’ Weekly Intelligencer*—confessed that they did not understand the experiment. Their readers did

<sup>31</sup> *Washington Republic*, 14 May 1851, p. 2; *Albany Argus*, 12 May 1851, p. 2; *Boston Evening Transcript*, 31 May 1851, p. 2; *Springfield Republican*, 10 June 1851, p. 2; *New York Herald*, 13 June 1851, p. 3; and *Int. Mag. Lit., Art., Sci.* 1851, 3:296–297, on p. 296.

<sup>32</sup> *Boston Evening Traveller*, 5 May 1851, p. 2; *Cincinnati Commercial*, 27 May 1851, p. 2; and *Picayune*, 16 June 1851, p. 3.

<sup>33</sup> *Louisville Journal*, 17 June 1851, p. 2; and Loomis, “Notice of the New Experiment” (cit. n. 26), p. 510.

not understand it either. Many Americans wrote to newspapers seeking an intelligible explanation. Having read everything available on the Foucault pendulum, A. Z., a correspondent to the *National Intelligencer*, confessed, the “more I read the less I understand.” As the Foucault pendulum had given A. Z. many sleepless nights, he hoped that a scientist would explain the experiment in a “manner adapted to the understandings of those who . . . have more zeal for science than capacity for imbibing it.”<sup>34</sup>

Several researchers and practitioners responded to A. Z.’s call and similar requests made by others. Horsford wrote an explanation of the Foucault pendulum for the editors of the *Boston Evening Traveller*, the *National Intelligencer*, the *Scientific American*, the *American Railroad Journal*, and *Appletons’ Mechanics’ and Engineers’ Journal*. Caswell and Norton each wrote detailed explanations of the experiment for the *Providence Journal*. Lane wrote an explanation of the experiment for the *National Intelligencer*. Locke provided an explanation of the Foucault pendulum for “plain practical men” on the front page of the *Cincinnati Commercial*. At the urging of Norton and the editors of the *Literary World*, Loomis too wrote an explanation of the experiment.<sup>35</sup>

Cultivators and others also offered explanations of the Foucault pendulum. Perhaps the most interesting exchange took place in Providence. The explanation made by W. for the *Providence Journal*, which included awareness of the perturbing effects of air resistance and friction at the point of suspension, won praise from Caswell, who called the writer an “ingenious scientific friend.” Not all cultivators were so clever. Admitting no expertise in science, F. could not reconcile the twenty-four-hour rotation of the earth with the thirty-five-hour apparent precession of the pendulum’s plane of oscillation at Providence. Despite making no pretensions “to controvert the calculations and conclusions of learned professors,” F. offered a theory of his own: the pendulum partook of the earth’s rotation and completed a revolution every twenty-four hours. Proposing that scientists were “a little too fast in their calculations,” he called for experiments to be continued until a complete revolution of the pendulum’s plane of oscillation was achieved. Despite several explanations published in the *Providence Journal*, F. remained unpersuaded, contending that scientists had “been egregiously humbugged with a scientific nonentity.” After F. challenged “any learned man in the world” to show by theory or experiment that a pendulum could oscillate independently of the earth’s rotation, several accepted. One correspondent conceded that most of the explanations of the experiment printed in the *Providence Journal* contained too many “sines, cosines, tangents, and A.B.C.’s” to be interesting for the general reader but accepted the experiment as valid because of Airy’s endorsement. Another explained that the Foucault pendulum capped the Scientific Revolution, exhorting that everyone who gave the matter some thought must exclaim, like Galileo, “Yes, the earth turns!”<sup>36</sup>

Unconvinced by these explanations and aware of scientific hoaxes perpetrated by charlatans, several newspaper editors rejected the Foucault pendulum as a fraud. After “patient study,” the editors of the *Providence Post* rejected the experiment as “nonsense.” Citing

<sup>34</sup> *Boston Morning Commonwealth*, 5 June 1851, p. 1; *Providence Journal*, 21 May 1851, p. 2; *Trenton State Gazette*, 27 May 1851, p. 2; *Scioto Gazette*, 2 June 1851, p. 2; *Friends’ Weekly Intelligencer*, 1851, 8:75; and *National Intelligencer*, 30 May 1851, p. 2.

<sup>35</sup> *Boston Evening Transcript*, 6 June 1851, p. 2; *Sci. Amer.*, 1851, 6:312; *American Railroad Journal*, 1851, 24:355; *Appletons’ Mech. Mag. Eng. J.* 1851, 1:406–407; *Providence Journal*, 24 May 1851, p. 2, 28 May 1851, p. 2; *National Intelligencer*, 30 May 1851, p. 2; *Cincinnati Commercial*, 8 June 1851, p. 1; Norton to Loomis, 24 June 1851, Elias Loomis Papers; and Loomis, “Notice of the New Experiment” (cit. n. 26), p. 509.

<sup>36</sup> *Providence Journal*, 21 May 1851, p. 2, 28 May 1851, p. 2, 12 July 1851, p. 2, 28 Aug. 1851, p. 2, 29 Aug. 1851, p. 2, 6 Sept. 1851, pp. 1–2.

no sources, they asserted that the pendulum followed the magnetic meridian and “is undoubtedly just about as much a demonstration of the rotation of the earth, as may be found in the binnacle of any vessel in our harbor.” The *Charleston Mercury* took no notice of the Foucault pendulum except to reprint an unidentified Scottish experimenter’s assertion that the experiment did not work because the pendulum followed the earth’s magnetic meridian. The *New York Herald*, the *Savannah Daily News*, and the *Providence Journal* reprinted *Punch*’s method of affirming the earth’s rotation with liberal doses of brandy.<sup>37</sup>

The *Louisville Democrat* borrowed *Punch*’s joke to ridicule its rival, the *Louisville Journal*, which endorsed the Foucault pendulum. The two newspapers incorporated the experiment into partisan political dispute. In a series of fourteen editorials, the *Democrat* lampooned its Whiggish opponent for having been duped by the “pendulum hoax,” and the *Journal* defended itself by adducing names of scientists who had repeated the experiment. Observing that the earth was “no Locofoco editor to be ashamed of her movements,” the *Journal* noted that the earth proudly demonstrated its movement to the Foucault pendulum. The paper called upon John L. Smith, who had performed a recent demonstration, to settle the matter. Unconvinced by the explanation made by Smith or by doctors of medicine, theology, or chemistry, the *Democrat* would only accept the verdict of a true authority such as Pierre Simon Laplace. Adducing the support of Joseph J. Sylvester and William C. Bond, the *Journal* observed that “if we are not to take the opinion of doctors in medicine, of lawyers in law, and of philosophers in matters of philosophy,” then every man would be “his own doctor, lawyer, and philosopher”—with disastrous results.<sup>38</sup>

Just as Americans thronged to see Albert Einstein in 1921 even though they did not understand his theories of relativity, they were enthralled by the Foucault pendulum in 1851 even though they did not understand how it revealed the earth’s rotation. “Notwithstanding the many explanations of the French experiment which renders visible the rotation of the globe on its axis,” the *Albany Argus* observed, “there is a good deal of misapprehension” regarding the “*modus operandi* and the theory of it.” Newspaper coverage of the Foucault pendulum contributed to the confusion that surrounded the experiment. In their haste to encourage readers to perform their own demonstrations and to give a forum for explanations of the experiment, editors circulated erroneous and unintelligible accounts through the common practice of reprinting reports from other newspapers. Even when scientists provided newspapers with accurate accounts, errors appeared. Sending Loomis a newspaper article on the Bunker Hill demonstration, Horsford noted that “in general it is correct” and will need only a “few particulars” to satisfy a scientist.<sup>39</sup>

Not all scientists found the press so obliging. Yielding to popular demand that an account of his demonstration in Columbia, South Carolina, be published, Matthew S. Williams prepared a “neat distinctly written manuscript for each of the town papers.” Although the experiment was not performed under perfect conditions, Williams informed one newspaper that the “result was too striking to fail in convincing the most skeptical” of the earth’s rotation, except the “incurably ignorant or insanely skeptical.” Two newspapers published Williams’s account accurately; another “made only inconsiderable errors, the sense was

<sup>37</sup> *Providence Post*, 7 June 1851, p. 2; *Charleston Mercury*, 10 June 1851, p. 2; *New York Herald*, 13 June 1851, p. 3; *Providence Journal*, 30 May 1851, p. 1; and *Savannah News*, 9 June 1851, p. 2.

<sup>38</sup> *Louisville Democrat*, 14 June 1851, p. 2; *Louisville Journal*, 12 June 1851, p. 2, 16 June 1851, p. 2, 17 June 1851, p. 2; *Louisville Democrat*, 20 June 1851, p. 3; and *Louisville Journal*, 26 June 1851, p. 2.

<sup>39</sup> *Albany Argus*, 7 June 1851, p. 2; Allan R. Pred, *Urban Growth and the Circulation of Information: The United States System of Cities, 1790–1840* (Cambridge, Mass.: Harvard Univ. Press, 1973), pp. 57–58; and Horsford to Loomis, 9 June 1851, Elias Loomis Papers.

preserved”; but the *South-Carolinian*, “to whom I had given the plainest copy, made sheer nonsense” of it. After the editor of the *South-Carolinian* ignored Williams’s pleas to publish a correction, the poor scientist feared for his reputation.

Every paper I have seen in SC, many of the papers in Georgia, especially the Savannah papers and at least one paper of the North, how many more I know not, have republished this little communication of mine *and in every instance* the copy has been made from the *Carolinian*. Out of so many papers, falling into the hands of so many different persons it will not be thought too great a stretch of vanity to suppose some few men of sense and science may have read my article[.] And what DO they think? A grammatical mistake might be overlooked in a Mathematician, deficiency of taste would not perhaps be rigidly & severely criticized; but who so indulgent as to overlook sheer nonsense?<sup>40</sup>

Williams’s difficulties reflected the tension between accuracy and accessibility that researchers and practitioners faced when relying on newspapers to popularize physical science.

American religious spokesmen also participated in the pendulum mania. Rather than extolling the Foucault pendulum as proof of divine law, Methodist, Presbyterian, Baptist, and Universalist journals followed the secular press in marveling at the experiment. As antebellum Americans had reconciled science with theology, religious figures probably agreed with the editors of the *Boston Morning Commonwealth* who recommended the study of the Foucault pendulum as an insight into the Creator’s works because “there is nothing better adapted to enlarge the minds of the people.” Although several demonstrators had religious training—for example, James Curley, a Catholic priest; Chester Lyman, a Congregational minister; and Alexis Caswell, a Baptist minister—and at least three public exhibitions were made on church grounds, no record of such an exhortation has been found. Americans approvingly alluded to Galileo’s defiant whisper that the earth moved, but no one made religious objections to the demonstration of the earth’s rotation with a Foucault pendulum. Instead, churchmen participated in the scientific controversy. The Reverend John L. Dagg, a leading Baptist theologian and president of Mercer University, presented a geometric proof of the Foucault pendulum. Maintaining that the pendulum moved with the earth and oscillated in a series of intersecting planes, the Reverend S. B. Goodenow disputed the results of Robert L. Cooke’s demonstration at a Presbyterian church in Bloomfield, New Jersey, on scientific, not religious, grounds. Enoch Lewis, a Philadelphia Quaker who edited *Friends’ Review*, rejected the Foucault pendulum because it was “not explicable upon the principles of mechanical force.” Objecting to Gould and Horsford’s explanations of the experiment in the *Boston Evening Traveller* on “mechanical” grounds, Thomas Hill, a Congregational minister from Waltham, Massachusetts, and a member of the AAAS, asserted that “no free pendulum can be swung in common air and be confined to a mathematical plane.” After viewing the Bunker Hill demonstration, Hill noted that Horsford’s “great care and skill” mitigated this difficulty.<sup>41</sup>

<sup>40</sup> *Charleston Courier*, 17 June 1851, p. 2; and Matthew S. Williams to James Henry Thornwell, 14 July 1851, James Henry Thornwell Papers, South Caroliniana Library, University of South Carolina Archives, Columbia.

<sup>41</sup> *Zion’s Herald and Wesleyan Journal*, 1851, 22:115; *Christian Observer*, 1851, 30:100; *Christian Watchman Reflector*, 1851, 32:80; *Trumpet Universalist Mag.*, 1851, 23:208; Ronald L. Numbers, *Creation by Natural Law: Laplace’s Nebular Hypothesis in American Thought* (Seattle: Univ. Washington Press, 1977), pp. 25–27, 63–65; *Boston Morning Commonwealth*, 5 June 1851, p. 1; Dagg, “Demonstration of the Theory of the Pendulum Experiment” (cit. n. 25), p. 280; *Newark Advertiser*, 9 June 1851, p. 2; *Friends’ Review: A Religious, Literary, and Miscellaneous Journal*, 1851, 4:569–573, on pp. 570, 572–573; and *Boston Evening Traveller*, 7 May 1851, p. 2, 5 June 1851, p. 2.

## THE FALL OF PENDULUM MANIA

By late July pendulum mania had waned: only one public and a few private demonstrations of the Foucault pendulum were performed after this time. For the benefit of the Washington public, Dr. J. C. Hall exhibited the experiment at his residence. In his laboratory, Theodore Strong made another variant on the experiment by spinning a large wooden wheel with a steel needle in its hub over a glass socket. Strong asserted that when it was rotated in a room free from air currents the wheel precessed at the appropriate rate for its latitude. He found that the experiment could be successfully repeated with smaller wheels. Believing that Strong's wheel was the "latest perpetual motion [machine] we have heard of," the *New-York Tribune* contended that it "puts the French pendulum mode entirely in the shade." In a letter to Stephen Alexander, professor of astronomy at Princeton College, Joseph Henry disagreed, believing that friction would be too great for Strong's wheel to demonstrate the earth's motion. Henry's doubts seem well founded. Although the wheel was later exhibited at the Naval Observatory, Strong neither published nor presented an account of his experiment for a scientific audience.<sup>42</sup>

In late August, the annual meeting of the AAAS in Albany revived the pendulum mania. In addition to local newspapers, the *National Intelligencer* and the *New-York Tribune* sent reporters to the meeting. The Foucault pendulum had "half turned the heads of philosophers for some months past," Bird's Eye of the *National Intelligencer* observed, and it continued to do so. For two days discussion of the Foucault pendulum excited "general interest," with demonstrators presenting results and answering questions from the audience. Members of the AAAS—ranging from Eben Horsford, who had performed the famous Bunker Hill demonstration, to William Kitchell, who rejected the experiment after his repetitions consistently deteriorated into ellipticity—took a leading role in popularization of the Foucault pendulum, performing almost half of the identified public demonstrations. Despite this varied participation, the AAAS took notice only of the results of demonstrations conducted by a few practitioners and researchers—George R. Perkins, Lieutenant Edward B. Hunt of the United States Engineers, William Norton, and Horsford.<sup>43</sup>

Norton and Horsford alone had noteworthy results. After twenty-three trials of the pendulum they vibrated at the Providence railroad depot, Norton and Alexis Caswell had discovered that the apparent precession of the pendulum took longer than theory postulated, but they resisted speculation as to the cause of this discrepancy. They believed that the expected results could be obtained only by experiments in a closed room with a heavy weight and a long wire. Waiting several weeks until the number of spectators at the Bunker Hill Monument diminished before making detailed observations, Horsford discovered that the heat of the sun expanded the stones of the monument, which moved the pendulum's point of suspension. On sunny days the monument leaned northward about three-fourths of an inch. To compensate, Horsford changed the point of suspension once or twice a day according to the intensity of the sun. Joseph Henry found the discovery of the monument's movement a "very interesting result." The *New-York Observer* agreed, noting that "it is wonderful to think that the Bunker Hill Monument is bending like a bow backward and

<sup>42</sup> *National Intelligencer*, 24 July 1851, p. 3; David A. Wells, ed., *Annual of Scientific Discovery; or, Year-Book of Facts in Science and Art for 1852* (Boston, 1856), p. 158; *New-York Tribune*, 5 Aug. 1851, p. 7; and Henry to Stephen Alexander, 18 July 1851, Joseph Henry Papers, Smithsonian Institution Archives, Washington, D.C.

<sup>43</sup> *Albany Argus*, 26 Aug. 1851, p. 2; *National Intelligencer*, 2 Sept. 1851, p. 2; and *New-York Tribune*, 27 Aug. 1851, p. 6.

forward every day by the influence of the sun!" Although Horsford had informed newspapers of this finding a month earlier, it remained newsworthy.<sup>44</sup>

Not all of those who presented papers at the AAAS meeting had performed demonstrations, and not all of those who had performed demonstrations presented papers. James D. Dana offered a geometric explanation of the Foucault pendulum. Unconcerned with the forces involved, Dana does not appear to have performed the experiment. Although Robert L. Cooke, William Kitchell, and C. Dowden were members of the AAAS who had performed demonstrations of the experiment and who lived near Albany, not one of these cultivators was invited to present a paper. Nor was Theodore Strong, a practitioner who had achieved dubious results. This apparent snub may have been a consequence of the irregular transmission of reports of exhibitions, but a more likely cause was the association's division between researchers and practitioners who wanted to define the credentials necessary to be taken seriously by the profession and cultivators who wanted to open the organization to all with an interest in science. Although none of the presenters disputed others' findings, Bird's Eye reported that the "result" of the deliberations was that the "phenomena of the pendulum have not yet been fully mastered or clearly explained," suggesting that objections were raised by those demonstrators who were not invited to present their results or by others in the audience.<sup>45</sup>

Like the AAAS, Chester Lyman ignored demonstrations performed by many practitioners and cultivators. In two articles for the *American Journal of Science*, Lyman surveyed American demonstrations of the Foucault pendulum, identifying sources of error and comparing them to European demonstrations. He limited his review to his demonstration at New Haven, Bond and Horsford's at Bunker Hill, Loomis's at New York University, and Caswell and Norton's at Providence. Unaware of any demonstrations in which the oscillation of the pendulum did not gradually deteriorate from a rectilinear motion to an elliptical one, Lyman identified this tendency as the greatest obstacle to conducting the experiment successfully. Although an able experimenter could keep the ellipticity small, Lyman doubted that it would be possible to "conduct the experiment so skillfully as entirely to avoid these sources of error." Even with "theoretically *perfect*" conditions and apparatus, Lyman reasoned, the pendulum would travel in a slightly elliptical motion because of the earth's rotation. Only at the equator would it be possible to vibrate a pendulum without any elliptical motion. Lyman blamed "imperfections in the apparatus," lateral vibration of the pendulum "at the moment it is disengaged," and especially air currents for producing sufficient ellipticity to make an unsuccessful demonstration. Observing that even a "single breath" could disrupt a demonstration, he contended that the "wonder is, not that the experiments exhibit some discrepancy in results, but that they show so little."<sup>46</sup>

Reviewing demonstrations of the Foucault pendulum, Lyman praised Foucault's ingenuity but found American exhibitions of the experiment superior to those performed in Europe. (See Figure 3.) He noted that the pendulums at Bunker Hill, at Providence, and at New Haven were longer than those vibrated in Europe, except for Foucault's pendulum

<sup>44</sup> Caswell and Norton, "Observations in Repetition of the Foucault Experiment" (cit. n. 17), pp. 130–131; Horsford to Loomis, 9 June 1851, Elias Loomis Papers; Eben N. Horsford, "The Pendulum at Bunker-Hill Monument," *Proc. Amer. Assoc. Advance. Sci.*, 1851, 6:132–137, on p. 133; Henry to Alexander, 18 July 1851, Joseph Henry Papers; *Trenton State Gazette*, 21 July 1851, p. 2; and *New-York Observer*, 1851, 29:245.

<sup>45</sup> James D. Dana, "Foucault's Pendulum Experiment," *Amer. J. Sci.*, 2nd Ser., 1851, 12:200–204, on p. 200; Dana, "On the Pendulum Experiment," *Proc. Amer. Assoc. Advance. Sci.*, 1851, 6:132; Kohlstedt, *Formation of the American Scientific Community* (cit. n. 2), pp. 138–154; and *National Intelligencer*, 2 Sept. 1851, p. 2.

<sup>46</sup> Chester S. Lyman, "Observations on the Pendulum," *Amer. J. Sci.*, 2nd Ser., 1851, 12:251–255, on pp. 251–252; and Lyman, "Observations on the Pendulum Experiment," *ibid.*, pp. 398–416, on pp. 399, 401–403.

Place.	Length of pendulum.	Initial arc of vibration.	Observed motion per hour.	Calculated motion per hour.	Latitude, North.	Whole time observed.	
						hours	
Bristol, Eng., . . . (T. G. Bunt,) . . .	53 ft.	8 ft.	12·097 <sup>o</sup> 11·945	11·763 <sup>o</sup> “	51° 27' “	26½ ..	Mean of preceding with additional experiments. Corrected for ellipticity
	“	4 ft.	11·677	“	“	37	
	“	14 in.	11·651	“	“	4	
	“	short	11·750	“	“	326½	41 trials uncorrected for ellipticity. (Galbraith and Haughton.)
Dublin, . . .	35 ft.	4 ft.	11·900	12·073	53 23	..	4 trials.
York . . . (J. Phillips,) . . .	52 5¼	14 ft. 18 in.	13·12 11·94	12·163 “	53 58 “	..	4 “ weight 1½ lbs.
Geneva, Sw., . . . (Dufour & Wartmann)	66½ “	11 ft. “	11·848 10·522	10·856 “	46 12 “	9 9	4 “ E. and W. 4 “ N. and S.
New York City, . . .	9 ft.	—	9·733	9·815	40 44	—	(Prof. Loomis.)
Providence, R. I., . . .	97	5 ft.	9·955	10·030	41 49½	—	16 trials, (Profs. Carswell and Norton.)
New Haven, Ct., . . .	71	3 ft.	9·970	9·928	41 18½	18	16 trials.

Figure 3. Chart from Chester S. Lyman, "Observations on the Pendulum Experiment," *American Journal of Science*, 2nd Ser., 1851, 12:398–416, on page 403.

at the Panthéon. Long pendulums with heavy bobs provided more accurate results than shorter ones with light bobs, Lyman explained, because massive bobs vibrating at low velocity have low air resistance. Believing that European experimenters were more interested in exhibition than in experiment, Lyman observed that they gave the pendulum "a very wide swing" to make the precession of the plane of oscillation obvious to spectators. Although a long arc of oscillation was well suited for "popular audiences," Lyman asserted that "for the purpose of philosophical observation a smaller arc is much better" because both air resistance and elliptical motion were diminished. Lyman neglected over twenty American demonstrations, including those performed by John Locke, Frederick A. P. Barnard, Charles Wilkes, and Daniel Kirkwood with longer pendulums than his own at New Haven. Although Lyman may not have been aware of all of these exhibitions, he surely must have known about the well-publicized demonstrations, such as the one at H. D. V.'s barn. At the same time, Lyman praised an account of the experiment by James D. Dana, a scientist who did not perform a demonstration, as the best for "minds not specially trained for mathematical investigations." Appreciating the popular interest aroused by the experiment, Lyman reported that "many persons, even of education, find it difficult to understand" how a vibrating pendulum demonstrated the earth's rotation.<sup>47</sup>

Almost as important as those who performed public demonstrations of the Foucault pendulum were those who did not. Despite national and local interest in the Foucault pendulum, neither Ormsby M. Mitchel, director of the Cincinnati Observatory, nor Matthew F. Maury, director of the Naval Observatory in Washington, performed public dem-

<sup>47</sup> Lyman, "Observations on the Pendulum Experiment," pp. 399–408, 410.

onstrations or provided public explanations of the experiment. Their reticence is puzzling, as these two men were among the leading popularizers of physical science in the antebellum United States and they took advantage of almost every opportunity to attract attention to themselves and their observatories. Perhaps Mitchel and Maury found the field too crowded with demonstrators. Bond and Horsford had already conducted the most famous American exhibition at Bunker Hill, and many others had performed demonstrations as well. To follow the crowd would gain neither Mitchel nor Maury special distinction.<sup>48</sup>

Other prominent American scientists, including George P. Bond, Benjamin Peirce, Sears C. Walker, Alexander Dallas Bache, James Curley, and Joseph Henry, did not perform public demonstrations of the Foucault pendulum or make public comments on the experiment. Not wishing to be caught up in the excitement of pendulum mania, these researchers attended public demonstrations, repeated the experiment in private, discussed it among themselves, or took no notice of it. Inspired by his father's repetition at Bunker Hill, George Bond, en route to observe a solar eclipse in Norway, visited the Panthéon in June to see the experiment and meet Foucault. Although Peirce, Perkins Professor of Astronomy at Harvard College, and Walker, an astronomer in the United States Coast Survey, had precipitated the Neptune controversy, they shied away from pendulum mania. Peirce left no recorded reaction to the experiment. Walker wrote a letter to an unidentified correspondent in Cincinnati, probably his brother, explaining it. He dismissed the "many vague and trifling articles in the newspapers on the subject of Foucault's Pendulum experiment." Delighted by Wilkes's demonstration at the Capitol, Walker regarded Foucault as "another Galileo in this discovery" and marveled that "so simple a thing should have remained untried for so long." Walker's correspondent sent the letter to the *Cincinnati Commercial* to explain the experiment. Bache, superintendent of the United States Coast Survey, devised a simple method to determine whether a wire was sufficiently flexible in all directions to be used in a demonstration, which won praise from Lyman. The Reverend James Curley, director of the Georgetown College Observatory, performed the experiment at Georgetown College and requested that Henry do so as well. Henry repeated the experiment in private at the Smithsonian Institution. He tried to produce the "same effect" by floating a glass disk on water but found that friction was too great. Despite the Smithsonian policy of answering scientific questions and three public requests that he "explain the whole thing," Henry made no public comment on the Foucault pendulum.<sup>49</sup>

Perhaps Henry's silence on the subject can be attributed to a desire not to encourage pendulum mania, which he ruefully observed had "caused great excitement" in the Washington area. After reading accounts of the experiment and performing repetitions with an eleven-foot pendulum, Samuel Tyler, a lawyer from Frederick, Maryland, and a leading American philosopher, informed Henry that the Foucault pendulum was an "entire delusion" which "in no degree indicated" the earth's rotation because the pendulum's oscillation always deviated into an ellipse. An ardent Baconian, Tyler maintained that Foucault erred by considering the pendulum's oscillation as a "problem of rational mechanics," that

<sup>48</sup> Philip S. Shoemaker, "Stellar Impact: Ormsby MacKnight Mitchel and Astronomy in Antebellum America" (Ph.D. diss., Univ. Wisconsin–Madison, 1991), pp. 191, 220; and Bruce, *Launching of Modern American Science* (cit. n. 21), pp. 116–117, 176–178, 181–185.

<sup>49</sup> George P. Bond, "Journal," 25 June 1851, Harvard University Archives, Cambridge, Massachusetts; *Cincinnati Commercial*, 16 June 1851, p. 2; Lyman, "Observations on the Pendulum Experiment" (cit. n. 46), p. 399; *National Intelligencer*, 29 May 1851, p. 2; James Curley, "Journal of Things Relating to the Observatory," 11 June 1851, Georgetown University Special Collections, Washington, D.C.; Joseph Henry Locked Book, 28 June 1851, Joseph Henry Papers; and *National Intelligencer*, 28 May 1851, p. 2.



is, a mathematical problem, when it was really an experimental problem “made in the midst of all the forces of nature.” Until experimentation and deduction eliminated all other explanations, Tyler dismissed those based on “purely mechanical ideas.” Although claiming to have read accounts of the experiment, Tyler seemed unaware that Foucault’s inspiration came from experiments with clock pendulums rather than from mathematical deduction. After receiving Tyler’s letter, learning of Theodore Strong’s wheel, reading several unintelligible articles in the *National Intelligencer* on the Foucault pendulum, and seeing T. Egerton Browne at the Smithsonian library “almost every afternoon . . . looking at the pendulum,” Henry noted that “several persons have become deranged by studying it.” Ten days after Browne, a post office clerk, published a letter in the *National Intelligencer* asserting that Foucault had inadvertently discovered a “unit cube of mensuration,” he died of what Henry diagnosed as “brain fever on account of the excitement.” Given Henry’s dislike of charlatanism and popular science, he may have regarded pendulum mania as unseemly or at least not comporting with the dignity of scientists.<sup>50</sup>

### CONCLUSION

Benjamin A. Gould contended that the Foucault pendulum was unique among physics experiments: “probably none more beautiful was ever devised; certainly few have ever attracted equal attention from all classes of scientific men and from the public.” Many Americans agreed. Reflecting on advances since the Battle of Bunker Hill, editors of the *Newark Advertiser* praised the repetition at the monument as a sign of a historic improvement in world affairs. In 1851 France and the United States were allied again, not “for purposes of violence and destruction,” as in 1775, but “in the pursuit of science and the arts.” The Bunker Hill demonstration and the World’s Fair at Paris were sure indicators that the “good time has already come; our swords have been beaten into telescopes, and our spears into pendulums, and nations shall not learn war any more; but turn their attention entirely to Natural Philosophy and Astronomy.”<sup>51</sup> Pendulum mania showed that popularization of physical science in the antebellum United States was flourishing, but it divided the American scientific community along professional and geographical lines. Tens of thousands of Americans read popular accounts, hundreds (and perhaps thousands) attended public repetitions, and dozens performed their own demonstrations and disputed the physical principles of the experiment. Many cultivators, practitioners, and researchers took an active role in popularization, by performing public repetitions and by publishing popular explanations of the Foucault pendulum, but only a handful—Chester Lyman, Eben N. Horsford, William A. Norton, George R. Perkins, Edward B. Hunt, and James D. Dana—were invited to present papers on the Foucault pendulum at the AAAS meeting held in Albany. In a review for the *American Journal of Science*, Lyman ignored a dozen demonstrations conducted by his counterparts in the South and West. Many researchers missed the unique opportunity to be popularizers offered by pendulum mania. Some of them, such as Joseph Henry, Alexander Dallas Bache, Benjamin Peirce, Stephen Alexander, and Sears C. Walker, avoided repeating or even commenting on the experiment for the public. Others, such as Denison Olmsted, Elias Loomis, Lewis R. Gibbes, and Benjamin A. Gould, made

<sup>50</sup> Joseph Henry Locked Book, 28 June 1851; Samuel Tyler to Henry, 8 Aug. 1851, Joseph Henry Papers; *National Intelligencer*, 13 June 1851, p. 2, 7 Aug. 1851, p. 2; and Bruce, *Launching of Modern American Science* (cit. n. 21), p. 185.

<sup>51</sup> *Boston Evening Traveller*, 2 May 1851, p. 2; and *Newark Advertiser*, 17 June 1851, p. 2.

only limited public explanations. Two researchers, Ormsby M. Mitchel and Matthew F. Maury, finding the field of pendulum demonstrators too crowded, waited for a better opportunity to draw attention to themselves and their observatories.

The geographical distribution of interest in the Foucault pendulum, as indicated by the number of public demonstrations and newspaper articles relating to the experiment, challenges assertions made by historians about the diffusion of scientific knowledge and the level of scientific activity in the antebellum United States. No other American city had as many newspaper articles on the Foucault pendulum and as many public demonstrations of the experiment as Boston and Washington, though Providence, Albany, and Trenton were next in order. During the three months of pendulum mania, five Boston newspapers printed over fifty articles relating to the Foucault pendulum, and two Washington newspapers printed over forty articles on the experiment. These articles included accounts and notices of local demonstrations, reprinted reports of other American demonstrations, and letters questioning or explaining the experiment. The people living in the Boston area enjoyed five public demonstrations of the Foucault pendulum; the people of Washington, four. These figures suggest that while New England led the way in the pursuit of science and the West lagged behind, the South was not so far behind the mid-Atlantic states as historians have previously asserted.