

**5. Cleveland Abbe and the Birth of the National Weather Service,  
1870-1891**

Edmund P. Willis

*Kinsale Research  
Alexandria, Virginia, USA*

and

William H. Hooke

*American Meteorological Society  
Washington, DC, USA*

Cleveland Abbe (1838-1916) made substantial scientific and administrative contributions to nascent national weather services during their first twenty years under the aegis of the U.S. Army Signal Corps. Prior studies of the Signal Service, however, give short shrift to Abbe's work. In particular most accounts barely mention Abbe's scientific endeavors during the initial decade, 1871-1880.<sup>1</sup> This paper examines three aspects of Abbe's career: (a) his background; (b) the science he initiated; and (c) his administrative accomplishments. Two conclusions emerge: first, Abbe initiated significant, broad-based scientific research, beginning in the 1870s; and second, Abbe's scientific contributions deserve recognition for their part in the evolution of 19<sup>th</sup> century meteorology.

Abbe shared the background and many of the characteristics of American scientists in the 19<sup>th</sup> century. His father, George W. Abbe, was a New York merchant of New England ancestry. His parents raised him in the Baptist tradition of service and respect for others. He took his undergraduate degree in 1857 from the Free Academy, forerunner of the City College of New York, where he demonstrated an interest in meteorology. He went on to study astronomy in 1859 at the University of Michigan, and began work with the U. S. Coast Survey in 1860 at its office in Cambridge, Massachusetts. There he acquired a desire for graduate study abroad. Having read Piazzi Smyth's book, *Three Cities in Russia* (1862), he bypassed German universities (the more usual destination for American scholars) in favor of Russia. There he served as

supernumerary astronomer at the Nicholas Central Observatory in Pulkovo, near St. Petersburg, from 1865-67.<sup>2</sup> Otto Struve, the observatory's director, set him to work re-analyzing James Bradley's 18<sup>th</sup> century stellar observations.<sup>3</sup> After two years at Pulkovo, Abbe returned home and took a job with the Naval Observatory in Washington, DC. On the voyage across the Atlantic, speaking with another passenger, he voiced his ambition to head an observatory. A report of this chance conversation found its way to the Cincinnati Astronomical Society then seeking a director for its observatory. The association sought out Abbe and hired him to begin work in 1868.<sup>4</sup>

Abbe found the Cincinnati observatory neglected and in disrepair. He initially proposed an ambitious program of astronomy, meteorology, and study of geomagnetism. The Society, however, lacked the financial resources, and so Abbe focused on weather forecasting. The Cincinnati Chamber of Commerce agreed to support the effort for three months, beginning September 1, 1869.<sup>5</sup> Abbe organized a system of volunteer weather observers, and persuaded the Western Union Company to provide free telegraph services. He commenced predictions on schedule, and forecasting actually continued until June, 1870.<sup>6</sup> Ultimately the Astronomical Society could not fund the operation at a level satisfactory to Abbe, and so he returned to New York City in 1870.<sup>7</sup>

At about that time a movement commenced to create a national weather service. Increase Lapham of Milwaukee, as early as 1848, had observed growing storm damage to vessels and loss of seamen on the Great Lakes.<sup>8</sup> In 1869 he petitioned the federal government to provide a storm warning system for the Lakes. His Congressman, Halbert G. Paine, expanded the proposal to include the entire nation. Paine's bill reached Congress in December, 1869 and passed in February, 1870.<sup>9</sup> Coincidentally, with declining military budgets, Colonel Albert Myer, the Army's Chief Signal Officer (CSO) sought a peacetime mission. He pleaded with Paine to head the new service, offering experienced leadership and a disciplined workforce. In 1870 Congress made the War Department responsible for the storm warning system and Myer got his wish.<sup>10</sup>

Colonel Myer brought unique qualifications to the task. While studying medicine in the 1840s he worked as a telegrapher. As an Army medical officer, serving in Texas before the Civil War, his duties included reporting local weather conditions to the Surgeon General. While there he developed a semaphore signaling system for the Army. With the onset of the Civil War Myer won appointment as Chief Signal Officer in the Union Army. Based on his wartime exploits contemporaries knew Myer as an aggressive problem solver with political connections.<sup>11</sup> As he set out in 1870 to organize the new weather service, Myer consulted leading scientists, but hesitated to hire civilian expertise. He finally took on Increase Lapham late in 1870 to issue storm warnings for the Great Lakes. Lapham, however, resigned after a few weeks. Myer then contacted Abbe in New York and hired him in January, 1871 as Professor and Chief Meteorologist.<sup>12</sup>

Myer and Abbe set up headquarters in Washington, DC. Abbe organized the forecasting process, and published the first "indications" or "probabilities" on February 19, 1871. He trained Army lieutenants to continue the predictions, and provided a verification procedure. He selected equipment, and began reducing barometric readings to sea level equivalents.<sup>13</sup> As the system developed numerous questions arose, within the headquarters staff, from the field observers, and from the general public. Abbe grappled with these questions both practical and theoretical in his office, known as the Study Room.<sup>14</sup> From these issues sprang a program of basic and applied science.

The annual reports of the Chief Signal Officer provide a window into Signal Service science accomplished under Abbe's direction. These reports cite some 77 separate investigations conducted in the period 1871-1880. No report cites fewer than four such studies, with ten or more studies in three of the years.<sup>15</sup> The varied scientific investigations and initiatives ranged broadly over the meteorological spectrum, and fall into *nine major categories*. Some of the earlier work established or utilized *baselines* and *climatologies*, e.g., elevations of observation stations,<sup>16</sup> meteorological variations at different elevations on Mount Washington,<sup>17</sup> the height and range of tides at important ports,<sup>18</sup> and charts of average barometric pressure, rain areas, and prevailing winds.<sup>19</sup> Abbe and his team from the very beginning sought the most advanced *instrumentation*, e.g., balloon-borne sensors,<sup>20</sup> self-recording instruments,<sup>21</sup> and instruments that recorded remotely.<sup>22</sup> They undertook *case studies of severe weather*, along lines established by James Espy and others earlier in the century,<sup>23</sup> e.g., Abbe's study in 1873 of two severe coastal storms, using ships' logs,<sup>24</sup> and Sgt. Theodore Smith's report on the storm of April 14-18, 1873.<sup>25</sup>

The several acts of Congress establishing and expanding weather services specifically mentioned support of agriculture and commerce in addition to public safety.<sup>26</sup> Accordingly, the Signal Service conducted *economic studies*, such as Lapham's reports on shipping disasters,<sup>27</sup> the 1875 study of temperatures that would freeze canals and halt commerce,<sup>28</sup> and the 1877 study of high and low river levels and their relation to navigability.<sup>29</sup> Similarly they did *ecological studies*, such as the 1877 cooperative study with the Interior Department on locust swarms,<sup>30</sup> and studies of water temperatures for use in fisheries management.<sup>31</sup> Other papers addressed *geomagnetic activity*, e.g., Abbe's 1873 compilation of auroral observations,<sup>32</sup> and his case study of the auroral display of April 7, 1874.<sup>33</sup> In 1873 he instituted direct support of the public and the scientific community by *publishing* the *Monthly Weather Review*. He brought out the *Bulletin of International Simultaneous Observations* two years later.<sup>34</sup> Finally, Abbe addressed *other fields*, such as his paper in 1875 on seismic observations,<sup>35</sup> and his report on the 1878 solar eclipse.<sup>36</sup> Indeed the CSO's reports during the 1870s attribute some 20 scientific endeavors to Abbe by name.<sup>37</sup> Beginning in 1881, Myer's successor, Brig. Gen. William B. Hazen, formally instituted the Study Room, enabling Abbe to recruit distinguished scientists such as William Ferrel and Thomas Mendenhall. Thereafter the CSO reported a swelling number of scientific studies. The annual reports, however, clearly indicate that scientific projects began in earnest under General Myer in the 1870s.

As a science administrator Abbe trained field observers (Army enlisted men) and the forecasting staff (Army junior officers). He selected the textbooks and lectured. Abbe initially supervised the Indications Department, where he and the Army officers took turns on a monthly rotation, issuing weather forecasts. He saw to the selection, procurement, calibration, and development of instrumentation for use by the observers. He established a records system that accumulated mountains of meteorological and climatological data, from the United States, Canada, the Caribbean, and Europe, and sought to make these available to other scientists. From the start Abbe built a professional library to support the scientific work. By 1872 the shelves contained 1,340 volumes, and by 1887 the collection had grown to 9,845.<sup>38</sup> Abbe also compiled an extensive bibliography on meteorology, aiming to include every title since the beginning of printing. By 1887 he had almost 55,000 entries. The CSO considered the

bibliography so important that, lacking a specific appropriation for it, he had it distributed in typescript.<sup>39</sup> In addition to the two weather journals, the Signal Service published thousands of weather maps and bulletins,<sup>40</sup> including the first global weather map that Abbe put together in 1872.<sup>41</sup> In addition, he wrote some 40 articles in the 1870s, and another 64 papers in the 1880s.<sup>42</sup> He urged universities to offer courses in meteorology for which he designed curricula. He translated numerous foreign meteorological articles and disseminated them to American scientists. He carried on a voluminous correspondence with foreign meteorologists. Also during this period, Abbe demonstrated his appetite for science administration in another arena: the development and adoption of standard time. Although Abbe ran into political difficulties in attaining the goal, he designed the basic time system and laid out the path ultimately used to reach the necessary national and international agreements.<sup>43</sup>

In summary, Cleveland Abbe made his mark as a practicing scientist and meteorologist, not as a theoretician. As a visionary entrepreneur he began weather forecasting from Cincinnati and attempted there to put meteorology on a commercial basis. The daily forecasts that he initiated from Washington have continued uninterrupted to the present. He operated from a global perspective, translating and disseminating foreign weather science, and the two journals he edited and his correspondence reached a worldwide audience. He conceived a wide-ranging program of basic and applied meteorological science. He served as a manager of science, training observers and forecasters, collecting and disseminating data. Abbe understood that advancing meteorological sciences and services made unique demands on infrastructure—the network of trained observers and instruments, a centralized facility for analysis, a schedule of predictions, and organized sustained research to improve the whole. Working with a succession of Chief Signal Officers, he helped to develop this system, and set national weather policy through establishing organizational and operational precedents. Brig. Gen. William Hazen in 1885 said, “[to Abbe] we are indebted for the very existence of the Weather Bureau”.<sup>44</sup> Though no scientific phenomenon or theory bears his name, Abbe provided the scientific instincts, leadership, and administrative energy that helped shape the era in American meteorology that Fleming has termed the period of “government service (1870-1920)”.<sup>45</sup> Moreover, as the American weather service expanded its reach across the continent, grew in personnel, created a variety of weather products, and amassed its professional collections, Abbe and the Signal Service moved the United States to the center of world meteorology.<sup>46</sup>

## Endnotes

<sup>1</sup> See for example Donald R. Whitnah, *A History of the United States Weather Bureau*, Urbana, University of Illinois Press, 1961, pp. 38-40; Paul J. Scheips, "Albert James Myer, Founder of the Army Signal Corps: A Biographical Study", American University, Ph.D. dissertation, 1965; Rebecca R. Raines, *Getting the Message Through: A Branch History of the U.S. Army Signal Corps*, Washington, DC, Center of Military History, 1996, p. 54.

<sup>2</sup> Alan H. Batten, *Resolute and Undertaking Characters: The Lives of Wilhelm and Otto Struve*, Dordrecht, Neth.: D. Reidel, 1988, p. 105; William J. Humphreys, "Biographical Memoir of Cleveland Abbe", National Academy of Sciences, *Biographical Memoirs*, VIII (1919), 469-508, pp. 469-470, 472; Cleveland Abbe, "What I Remember About My Friends and Myself", U.S. Library of Congress, Cleveland Abbe Papers, Container 32, typescript, pp. 48-49. Hereafter: Abbe Papers.

<sup>3</sup> Truman Abbe, *Professor Abbe...and the Isobars: The Story of Cleveland Abbe America's First Weatherman*, New York, Vantage Press, 1955, p. 38.

<sup>4</sup> *Ibid.*, pp. 85-91, 97-98; C. Abbe, "What I Remember", Abbe Papers, pp. 64-65.

<sup>5</sup> T. Abbe, *Professor Abbe*, op. cit., pp. 97-105; James R. Fleming, *Meteorology in America, 1800-1870*, Baltimore, Johns Hopkins University Press, 1990, pp. 150-151; George McLaughlin, Secretary of the Cincinnati Chamber of Commerce to Prof. Cleveland Abbe, July 17, 1869, Collections of the Cincinnati Historical Society Library, Cincinnati, Ohio, MSSVF 3065.

<sup>6</sup> T. Abbe, *Professor Abbe*, op. cit., pp. 106, 109-116; Fleming, *Meteorology in America*, op. cit., p. 152.

<sup>7</sup> Julius Dexter, Secretary of the Cincinnati Observatory Board, to Abbe, Dec. 3 & 15, 1870; William Hooper, Cincinnati Astronomical Society, to Abbe, Dec. 21, 1870, Abbe Papers, MSS, Container No. 6.

<sup>8</sup> Eric R. Miller, "The Evolution of Meteorological Institutions in the United States", *Monthly Weather Review*, 59 (Jan., 1931), 1:1-6, p. 4; Miller, "New Light on the Beginnings of the Weather Bureau from the Papers of Increase A. Lapham", *Monthly Weather Review*, 59 (Feb., 1931), 2: 65-70, pp. 65-66.

<sup>9</sup> Patrick Hughes, *A Century of Weather Service...1870-1970*, New York, Gordon and Breach, 1970, p. 7; C. Abbe, "The Meteorological Work of the U. S. Signal Service, 1870 to 1891", *Report of the Chicago Meteorological Congress*, Part II, Extract (1893), 1-53, p. 4; A. Hunter Dupree, *Science in the Federal Government*, Cambridge, MA, Harvard University Press, 1957, p. 187; Eric R. Miller, "Tradition Versus History in American Meteorology", *Monthly Weather Review*, 58 (Feb., 1930), 65-66, p. 65; Miller, "New Light" op. cit., pp. 66-67; Chief Signal Officer, *Annual Report of the Chief Signal Officer to the Secretary of War*, Washington, Government Printing Office, 1891, Appendix 8, p. 338.

<sup>10</sup> Dupree, *Science*, op. cit., p. 188; Fleming, *Meteorology in America*, op. cit., pp. 155-156; Miller, "Tradition Versus History", *Monthly Weather Review*, op. cit., p. 65; Miller, "New Light", *Monthly Weather Review*, op. cit., p. 68.

<sup>11</sup> *American National Biography* (hereafter ANB); Miller, "New Light", *Monthly Weather Review*, op. cit., pp. 68-69; Scheips, "Albert James Myer", op. cit.

<sup>12</sup> C. Abbe, "Meteorological Work of the U. S. Signal Service", op. cit., p. 8; T. Abbe, *Professor Abbe*, op. cit., pp. 123-124; Raines, *Signal Corps*, op. cit., p. 72, note 38; Albert J. Myer to Cleveland Abbe, Dec. 10 & 27, 1870, Abbe Papers, Container No. 6; Cleveland Abbe to William A. Eddy, Aug. 21, 1888, Abbe Papers, Container No. 8.

<sup>13</sup> C. Abbe, "Meteorological Work of the U. S. Signal Service", op. cit., pp. 5-7, 47-49; *Annual Report of the Chief Signal Officer* 1871, pp. 3-16, 47-48; Mark Monmonier, *Air*

*Apparent: How Meteorologists Learned to Map, Predict, and Dramatize Weather*, Chicago, University of Chicago Press, 1999, pp. 7-8.

<sup>14</sup> C. Abbe, "Meteorological Work of the U. S. Signal Service", op. cit., pp. 9-11; *Annual Report of the Chief Signal Officer* (1871), pp. 12,14; (1872), pp. 86-87; (1879), p. 195; U. S. Congress, Senate, *Testimony before the Joint Commission to Consider the Present Organizations of the Signal Service, Geological Survey, Coast and Geodetic Survey, and the Hydrographic Office of the Navy Department, with a View to Secure Greater Efficiency and Economy of Administration...* 49<sup>th</sup> Cong., 1<sup>st</sup> Sess., Senate, Misc. Doc. No. 82, Washington, Government Printing Office, 1886, pp. 91-92, 248, 302-305.

<sup>15</sup> Abbe's scientific vision in the 1870s prompted a research program by a handful of researchers, that anticipated the whole research agenda of the National Oceanic and Atmospheric Administration in the late 20<sup>th</sup> century, occupying some 1,000 scientists.

<sup>16</sup> *Annual Report of the Chief Signal Officer* (1872), p. 85.

<sup>17</sup> Ibid. (1872), p. 86.

<sup>18</sup> Loc. cit.

<sup>19</sup> Ibid. (1874), p. 89.

<sup>20</sup> Ibid. (1872), p. 86.

<sup>21</sup> Ibid. (1872), p. 87.

<sup>22</sup> Ibid. (1877), p. 136; U. S. Congress, Senate, *Testimony before the Joint Commission*, op. cit., p. 249.

<sup>23</sup> For a summary of this work see Fleming, *Meteorology in America*, op. cit., pp. 23-43.

<sup>24</sup> *Annual Report of the Chief Signal Officer* (1873), p. 309.

<sup>25</sup> Loc. cit.

<sup>26</sup> C. Abbe, "Meteorological Work of the U. S. Signal Service", op. cit., p. 5; Chief Signal Officer, *History of the Signal Service*, Washington, Government Printing Office, 1884, pp. 4-5; *Annual Report of the Chief Signal Officer* (1891), Appendix 8, p. 338; Fleming, *Meteorology in America*, op. cit., pp. 155-156.

<sup>27</sup> *Annual Report of the Chief Signal Officer* (1873), p. 309; (1875), p. 108. These reports continued annually after Lapham's death in 1875, see for example *Annual Report of the Chief Signal Officer* (1878), p. 169.

<sup>28</sup> Ibid. (1875), p. 100.

<sup>29</sup> Ibid. (1877), p. 130.

<sup>30</sup> Ibid., pp. 132-133.

<sup>31</sup> Ibid. (1875), p. 100; (1878), p. 166.

<sup>32</sup> Ibid. (1873), p. 308.

<sup>33</sup> Ibid. (1875), p. 108.

<sup>34</sup> The *Monthly Weather Review* commenced uninterrupted publication in January, 1873 and remains a preeminent scientific journal. C. Abbe, "Meteorological Work of the U. S. Signal Service", op. cit., pp. 23, 26.

<sup>35</sup> *Annual Report of the Chief Signal Officer* (1875), pp. 108, 374.

<sup>36</sup> U.S. Army, Signal Corps, [Daily Journal], Study Room, MSS (1881-1884), I, pp. 1-2, Rarebook Collection, NOAA Library, Silver Spring, MD, USA.

<sup>37</sup> *Annual Report of the Chief Signal Officer* (1872), pp. 84-85; (1873), pp. 308-309; (1874), p. 88; (1875), pp. 108, 374; (1876), pp. 301-335, 485ff; (1877), pp. 142, 433; (1878), pp. 168-169; (1879), pp. 188, 195.

<sup>38</sup> Ibid. (1872), p. 87; (1887), p. 41.

<sup>39</sup> Ibid., pp. 39-40; the bibliography was republished in James R. Fleming & Roy E. Goodman, eds., *International Bibliography of Meteorology, from the Beginning of Printing to 1889*, Upland, PA, Diane Publishing Co., 1994.

<sup>40</sup> *Annual Report of the Chief Signal Officer* (1891), pp. 11-17.

<sup>41</sup> C. Abbe, "Meteorological Work of the U. S. Signal Service", op. cit., p. 25.

<sup>42</sup> Abbe published some 290 papers during his lifetime, and the titles are listed in Humphreys, "Biographical Memoir of Cleveland Abbe", op. cit., pp. 489-508.

<sup>43</sup> Ian R. Bartky, *Selling the True Time: Nineteenth Century Timekeeping in America*, Palo Alto, Stanford University Press, 2000, pp. 101-103, 130-136.

<sup>44</sup> U. S. Congress, Senate, *Testimony before the Joint Commission*, op. cit., p. 1057.

<sup>45</sup> Fleming, *Meteorology in America*, op. cit., p. xix.

<sup>46</sup> U. S. Congress, Senate, *Testimony before the Joint Commission*, op. cit., pp. 247-252; Whitnah, *Weather Bureau*, op. cit., p. 35.