The Smithsonian Meteorological Project and Hokkaido, Japan

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Introduction

The history of meteorology in Japan, especially after the Meiji Restoration, has tended to be described in terms of knowledge diffusion from central Tokyo outwards to local areas, despite the fact that meteorological observations were carried out at places such as Nagasaki and Yokohama (Fig. 1).[1] The aim of this paper is to explore an alternative meteorological channel in Japan, operating in Hokkaido. The Japanese government considered Hokkaido a critical area for development and therefore set out to colonise and develop the region's agriculture by making use of American science and scientific advisors. Meteorology was crucial to this process. This paper contends that the development of meteorological capabilities in Hokkaido counters the centre-periphery model (Fig. 2) which has come to dominate the literature of history of science.[2]

[1] Kishocho, *Kisho hyakunenshi* [*100 Years' History of Meteorology*] (Tokyo: Kishocho, 1975); Sapporo Regional Headquarters, Kishocho, *Sapporo kisho hyakunenshi* [*100 Years' History of Meteorology in Sapporo*] (Sapporo: Sapporo Regional Headquarters, Kishocho, 1976). Exceptional works are as follows: Shigeru Kobayashi, "The Extension of Japanese Weather Survey in Relation to the China Coast Meteorological Service", *Abstracts from the General Meeting of the Association of Japanese Geographers 2017*, the Association of Japanese Geographers [in Japanese]; Togo Tsukahara, "Rangaku, Global Warming, Science and Empires: History and Climate, Based on Dutch Historical Archive," *Bulletin of Historiographical Institute of Tokyo University* 16 (2006): 79–108 [in Japanese].

[2] George Basalla, "The Spread of Western Science," *Science* 156, no. 3775 (1967): 611–22; Lewis Pyenson, *Civilizing Mission: Exact Sciences and French Overseas Expansion, 1830–1940* (Baltimore, MD: Johns Hopkins University Press, 1993).

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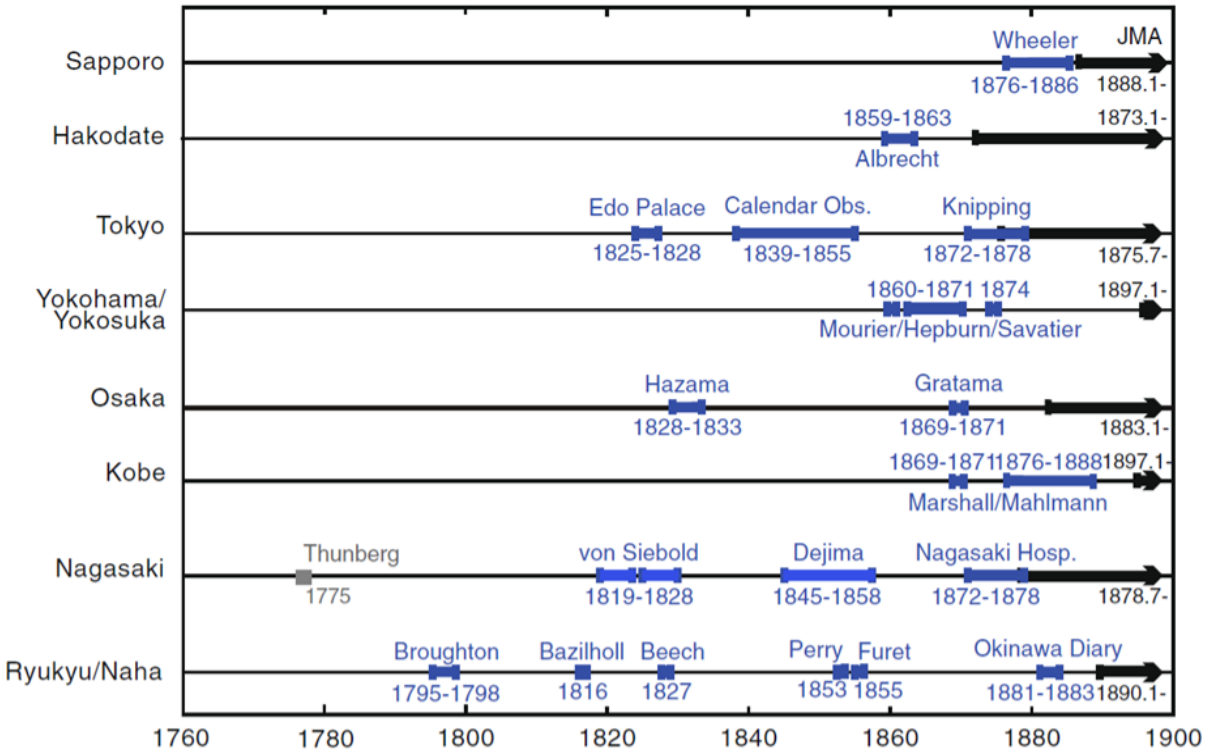

Fig. 1. Availability of instrumental meteorological data in Japan pre-1900 (Masumi Zaiki, Gunther P. Können, Keiji Kimura, Takehiko Mikami, and Togo Tsukahara, 2009).[3] The table shows how instrumental observations were carried out at a variety of places outside of Tokyo. NB: Blue and grey represents data that has been digitised; black represents official meteorological stations.

The focus of this paper will be on the introduction of the Smithsonian Meteorological Observation System to Hokkaido, a topic that appears to have been neglected in previous studies.[4] In so doing, it will offer a new perspective on early instrumental meteorological observation in Japan through the lens of transnational networks of knowledge exchange.[5] It takes the form of a detailed case study of the processes "through which knowledge and associated skills, practices, procedures, methods, and instruments are created in preference to 'big picture' accounts" and will contribute to recent studies of globally-linked enterprises:[6]

[3] Masumi Zaiki, Gunther P. Können, Keiji Kimura, Takehiko Mikami, and Togo Tsukahara, "Reconstruction of Historical Pressure Patterns Over Japan Using Two-Point Pressure-Temperature Datasets Since the Nineteenth Century," *Climatic Change* 95 (2009), 233.

[4] Kishocho, *Kisho hyakunenshi*; Sapporo Regional Headquarters, *Sapporo kisho hyakunenshi*.

[5] The records used for this article are from the Smithsonian Institution Archives and the National Archives and Records Administration (NARA). They comprise correspondence related to meteorology which was circulated by ship, railway, and telegraph, and they have never been examined from this perspective before. Thus they offer unique insight into these questions. It is important to note, however, that relying so heavily on the American-based records is problematic, but currently materials in Japan are very limited, or not yet available. Togo Tsukahara, Masumi Zaiki, and other scholars have excavated the local data. Masumi Zaiki, Gunther P. Können, Keiji Kimura, Takehiko Mikami, and Togo Tsukahara, "Reconstruction," 231–48, esp. 233–34; Masumi Zaiki and Togo Tsukahara, "Meteorology on the Southern Frontier of Japan's Empire," *East Asian Science, Technology and Society* 1, no. 2 (2007): 183-203.

[6] Kapil Raj, "Beyond Postcolonialism . . . and Postpositivism: Circulation and the Global History of Science," *Isis* 104, no. 2 (June 2013), 337–47, esp. 341.

exploring the circulation of knowledge in the global history of science.[7] To deepen understanding of the main topic, the article begins with an overview of the Smithsonian's International Exchange Service and the Smithsonian Meteorological Project.

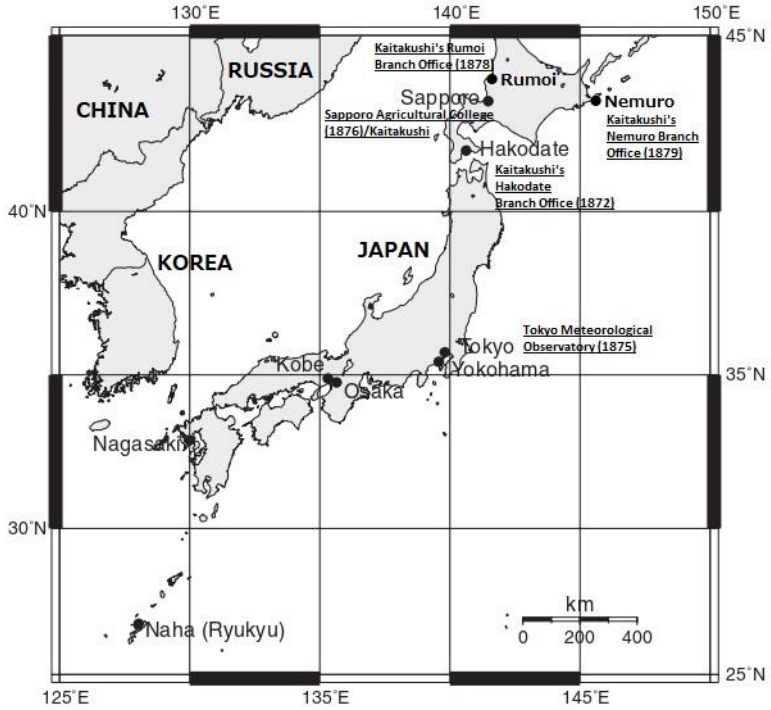

Fig. 2. Site locations of late nineteenth-century meteorological observations in Japan, including early observatories in Hokkaido (Kae Takarabe, 2020). This is based on the map in Masumi Zaiki, Gunther P. Können, Keiji Kimura, Takehiko Mikami, and Togo Tsukahara, 2009 and corresponds with Fig. 1.[8] The Kaitakushi's initiatives in Hokkaido are added; figures in parentheses represent the first year of observation.

The Smithsonian's Scientific Initiatives

The nineteenth-century drive to standardize and coordinate worldwide weather observations attempted to create a synoptic meteorology. The science expanded by exchanging instruments and enlisting observers, amassing data and comparing averages, charting airflows and sketching isolines, undertaking forecasts, and challenging hypotheses. Large-scale meteorology spread across boundaries: observations were carried by ship, railway, and telegraph.[9] In this same period, in 1846, the world-famous Smithsonian Institution was founded

[7] For example, Johan Östling, Erling Sandmo, David Larsson Heidenblad, Anna Nilsson Hammar, and Kari H. Nordberg, eds., *Circulation of Knowledge: Explorations in the History of Knowledge* (Lund: Nordic Academic Press, 2018); Raj, "Beyond Postcolonialism…and Postpositivism"; Kapil Raj, *Relocating Modern Science: Circulation and the Construction of Knowledge in South Asia and Europe, 1650–1900* (Houndmills and New York: Palgrave Macmillan, 2007); David N. Livingstone, *Putting Science in Its Place: Geographies of Scientific Knowledge* (Chicago: University of Chicago Press, 2003); Martin Mahony and Angelo Matteo Caglioti, "Relocating Meteorology," *History of Meteorology* 8 (2017): 1–14; Fiona Williamson, "Asian Extremes: Experience, Exchange and Meteorological Knowledge in Hong Kong and Singapore c.1840–1939," *History of Meteorology* 8 (2017): 159–78. Raj claims that science is not only taken to refer to the production of knowledge, but also to that of instruments, techniques, and services used in the production of knowledge.

[8] Masumi Zaiki, Gunther P. Können, Keiji Kimura, Takehiko Mikami, and Togo Tsukahara, "Reconstruction," 232.

[9] James Rodger Fleming, Vladimir Jankovic, and Deborah R. Coen, eds., *Intimate Universality: Local and Global Themes in the History of Weather and Climate* (Sagamore Beach: Science History Publications, 2006), x.

in Washington, DC, by the bequest of Englishman James Smithson, "for the increase and diffusion of knowledge among men".[10] The first Smithsonian Secretary was Joseph Henry and he and his contemporaries developed several international programs designed to disseminate their forms of knowledge and meteorological infrastructures including, for example, standardising directions and instrument types.[11] Henry in particular emphasised the pursuit of pure science and a desire to publish its achievements.[12]

Both of the first two Smithsonian secretaries, Henry and naturalist Spencer F. Baird, were keen to establish a network of foreign agents to receive and forward publications—and ultimately to provide other services, with the aim of integrating American science into the worldwide scientific system of knowledge exchange.[13] It was in the pursuit of this ideal that Henry initiated the Smithsonian's International Exchange Service in the late nineteenth century.[14] Indeed, Henry thought that "nothing is more desirable than the diminution of isolatedness of nations in science", and even wrote that "[t]he Institution may employ a translator".[15] Henry believed it important for each country to be informed of international discoveries, so that the isolated knowledge of individuals and nations might be compounded into one system for the good of the whole.[16] These ideas connected with the general trend and pursuit of science in the last half of the nineteenth century, which, in the words of Robert Bruce, had "become a collective enterprise", where the spread of scientific investigation hinged on the "systematizing of communication" among the growing number of practicing scientists and where individual scientists increasingly obtained scientific information through direct correspondence with fellow practitioners around the world.[17]

As the body of scientific literature grew substantially in the nineteenth century, the Smithsonian Institution became a world-leading agency for the international exchange of scientific publications by 1876.[18] Henry and Baird believed the institution's exchange service was itself an example of a new national role, a "fountainhead of science in America" necessary for communicating science at home and abroad. [19] The Smithsonian's exchange network became an important vehicle for ensuring that the products of American and of foreign science had an outlet.

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[10] 29th Congress, Session 1, 1846, "An Act to Establish the 'Smithsonian Institution,' for the Increase and Diffusion of Knowledge Among Men," 09 Stat 102 (1846) (Boston: Little, Brown and Co., 1862).

[11] James Rodger Fleming, *Meteorology in America, 1800–1870* (Baltimore: Johns Hopkins University Press, 1990), 75–93; Paul N. Edwards, "Meteorology as Infrastructural Globalism," *Osiris* 21 (2006): 229–50.

[12] Albert E. Moyer, *Joseph Henry: The Rise of an American Scientist* (Washington and London: Smithsonian Institution Press, 1997), 249–50.

[13] Nancy E. Gwinn, "The Origins and Development of International Publication Exchange in Nineteenth-Century America" (PhD diss., George Washington University, 1996), 207, 282, 284, 285.

[14] A. Hunter Dupree, *Science in the Federal Government* (Baltimore: Johns Hopkins University Press, 1986); Robert V. Bruce, *The Launching of Modern American Science, 1846–187*6 (New York: Knopf, 1987).

[15] Joseph Henry's Desk Diary, 20 May 1849, in *The Papers of Joseph Henry*, Vol. 7 (Washington: Smithsonian Institution Press, 1996), 538–39.

[16] *The Papers of Joseph Henry*, Vol. 8 (Washington: Smithsonian Institution Press, 1998), 417–18.

[17] Bruce, *Launching*, 4.

[18] At the Philadelphia Centennial Exhibition, the Smithsonian displayed bookcases containing all three classes of the institution's publications, and a series of tables showing the extent and importance of the international exchange system. Gwinn, "Origins and Development," 279.

[19] Ibid., 267, 281, 282, 311.

In addition to the formal international publication exchange program, the Smithsonian Institution's existence enabled and encouraged a large body of less formal mechanisms for exchanging scientific knowledge, including correspondence between key figures. Due to the prominence of the first secretaries, Joseph Henry and Spencer Baird, they developed large correspondence networks which became a mainstay of related scientific work. These letters and exchanges reveal the important role of the Smithsonian Institution in developing meteorological practices globally. This paper is mainly based on these correspondences.

Henry's particular focus was on meteorology. When he became Smithsonian secretary, he brought with him a longstanding interest in weather science, calling for a "system of meteorological observations for solving the problem of American storms" in the new "Programme of Organization of the Smithsonian Institution".[20] To emphasize the importance of establishing a meteorological program at the Smithsonian, Henry included Professor Elias Loomis' "Report on the Meteorology of the United States" in the Institution's first annual report. Loomis argued that meteorology could "contribute more directly and powerfully to the prosperity of our commerce; and, through commerce, add to the wealth and happiness of the whole country".[21] Henry's desk diary of 27 January 1852 clearly shows how he planned to use such arguments to persuade organizations such as the US Army, the US Naval Observatory, and the British government to cooperate in broadening the scientific network through meteorology.[22] His main tool in so doing was the Smithsonian Meteorological Project. Between 1848 and 1874, the project served as the national centre for meteorological research, providing standardised instruments, uniform procedures, and free publications to all involved.[23] The first *Directions for Meteorological Observations, Intended for the First Class of Observers* (1850) and the *Directions for Meteorological Observations and the Registry of Periodical Phenomena* (1855), for instance, were reprinted and distributed widely.[24]

The project was also characterized by an extensive system of volunteer observers who kept weather journals according to a common plan, submitting their reports monthly by mail. James F. Fleming pointed out that at its greatest extent, the system had over 600 correspondents located across the country and in Canada, Mexico, Latin America, and the Caribbean.[25] The

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[20] John D. Cox, *Storm Watchers: The Turbulent History of Weather Prediction from Franklin's Kite to El Niño* (Hoboken, New Jersey: John Wiley & Sons, 2002); Frank Millikan, "Joseph Henry's Grand Meteorological Crusade," *Weatherwise* 50 (October/November 1997): 14–18; Smithsonian Institution, *Programme of Organization of the Smithsonian Institution, Presented in the First Annual Report of the Secretary and Adopted by the Board of Regents, December 13, 1847* (Washington, 1847). PDF: https://www.loc.gov/item/rbpe.23204300/.

[21] *Annual Report of the Board of Regents of the Smithsonian Institution for the Year 1847* (Washington: Smithsonian Institution Press, 1848), 28–46.

[22] *The Papers of Joseph Henry*, Vol. 8 (Washington: Smithsonian Institution Press, 1998), 281–2; Fleming, *Meteorology in America*, 95.

[23] Fleming, *Meteorology in America*, 75.

[24] The latter was later re-classified as Smithsonian Institution Publication 148 (Smithsonian Miscellaneous Collection) in 1860 and reprinted in 1872. The contents are as follows: Placing and Management of the Instruments (thermometer, self-registering thermometers, psychrometer, barometer, ombrometer, snow-gage, wind-vane), Sky, Hydro-Meteorological Phenomena (dew, fog, clouds, rain, thunderstorms, tornadoes, and land spouts), Additional Observations During Storms, Accidental Meteoric Phenomena, Directions for Meteorological Observations and the Registry of Periodical Phenomena, Time of Observations, The Register, Special Directions to the Meteorological Observers of the Smithsonian Institution, Circular Relative to Earthquakes, Instructions for Observations of the Aurora, Green's Standard Barometer, Instructions for Observations of Thunderstorms, and Register of Periodical Phenomena.

[25] Fleming, *Meteorology in America*, 75; James Rodger Fleming, *Historical Perspectives on Climate Change* (Oxford: Oxford University Press, 1998), 41; Joseph Giacomelli, "Unsettling Gilded-Age Science: Vernacular Climatology and Meteorology in the 'Middle Border'," *History of Meteorology* 8 (2017): 15–16, 31; Philip Kopper, *Volunteer! O Volunteer!: A Salute to the Smithsonian's Unpaid Legions* (Washington, DC: Smithsonian Institution Press, 1983); Daniel Goldstein, "Yours for Science:

network even spread across the Pacific Ocean to incorporate some regions of Japan. Henry used the magnetic telegraph to notify these distant observers of approaching storms. This exemplifies Henry's three-pronged approach to the circulation of knowledge: first, circulating scientific publications, then collecting meteorological data by telegraph, and finally sending warnings via telegraph.

The international focus of the Smithsonian Meteorological Project also enabled Henry to introduce systematic meteorological observations to parts of Japan and to collate this data. An important cog in this wheel was the opening of the United States Naval Hospital in Yokohama in 1872, following the Meiji Restoration of 1868. The hospital engaged in meteorological observation and sent data to the Smithsonian from August 1872 through December 1873.[26] This all ended with the transfer of the Smithsonian system to the new American Signal Office in 1874. This was due to the re-building of the Smithsonian system after the Civil War of 1865, and the establishment of a new meteorological department under the US War Department's Signal Office.[27] The end of the Smithsonian network in Yokohama did not, however, mean the end of American meteorological involvement in Japan: another channel of the Smithsonian network had already emerged.[28]

While expanding US influence in meteorology was a critical aim of Henry and his contemporaries, the broader context in which the Smithsonian Meteorological Project influenced Japan is also important. Indeed, Henry had been very interested in Japanese modernisation and had showed off American science to the Man'en Gannen Mission at the Smithsonian Institution Building in 1860 and welcomed the Iwakura Embassy of 1872.[29] Considering Japan's physical and political isolation, Henry worried about the "isolatedness of nations in science".[30]

Crossing Global and Personal: Key Players in Growing US-Japanese Relations

Emerging from its post-settlement period, the early nineteenth-century US began to look toward global geopolitics. An important part of this trajectory was establishing regularised transpacific traffic to Japan and China. Thus in 1853, the US Navy arrived in Japan under command of Commodore Mathew Perry. With the Convention of Peace and Amity between the United States of America and the Empire of Japan, Perry could open the ports of Shimoda on the south shore of Honshu Island and Hakodate on the north shore to US vessels. The "Far

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The Smithsonian Institution's Correspondents and the Shape of Scientific Community in Nineteenth-Century America," *Isis* 85, no. 4 (Dec. 1994): 573–99.

[26] Kae Takarabe, "Meteorological Observation at the U.S. Naval Hospital in Yokohama from 1872 to 1873," *The History of Science of Tokai* 12 (2017): 126-30 [in Japanese]; "Classified Record of Monthly Meteorological Reports Preserved in the Smithsonian Institution," *Annual Report of the Smithsonian Institution for the Year 1873* (Washington: Smithsonian Institution, 1874), 84–131.

[27] Fleming, *Meteorology in America*, 146–150.

[28] Joseph Henry, "Report of the Secretary," *Annual Report of the Smithsonian Institution for the Year 1871* (Washington: Smithsonian Institution, 1872), 37.

[29] Kae Takarabe, "Samurai at the Smithsonian: First Japanese Visitors to Western Museum in the U.S.," *Cultures and Institutions of Natural History: Essays in the History and Philosophy of Science*, Michael T. Ghiselin and Alan E. Leviton, eds. (California Academy of Science, 2000), 161–82; Kae Takarabe, "Observation of the Smithsonian Institution by Members of the Iwakura Mission (1872)," *Journal of the Museological Society of Japan* 28, no. 1 (2002): 25–44 [in Japanese]; Kae Takarabe, "Arinori Mori and the Smithsonian Institution in the Early Meiji Era," *Journal of the Museological Society of Japan* 28, no. 2 (2003): 33–52 [in Japanese]; Kae Takarabe, "David Murray and the Smithsonian Institution," *Journal of the Museological Society of Japan* 30, no. 1 (2005): 21–46 [in Japanese].

[30] Joseph Henry's Desk Diary, 20 May 1849. *The Papers of Joseph Henry*, Vol. 7 (Washington: Smithsonian Institution Press, 1996), 538-39.

Eastern strategy" did not end with Perry's expedition. The American scientific lobby, which found Alexander Dallas Bache, Joseph Henry, and Matthew Fontaine Maury working together, demanded that a scientific expedition be sent to map and collect specimens from Japan and other little-known parts of the Far East.[31] Meteorology would be a critical component of this expedition.

As a result of the erosion of its national isolation policy, Japan experienced a phase of unprecedented westernisation and industrialisation. Until the mid-1880s, many Europeans and Americans in Japan worked as *oyatoi* (foreign employees), such as merchants, bankers, engineers, doctors, and educators, though most were soon replaced by the first generation of well-trained Japanese experts.[32] In the case of Japanese meteorology in the pre-1860 period, almost half the stations were operated by Japanese and half by Europeans; thereafter, *oyatoi* played a more active part.[33] The new Meiji government hired European employees to carry out meteorological observations in Tokyo using European methodology—purchasing instruments, carrying out observations, providing guidelines, and proposing a warning system by the signal office. In this way, the Tokyo Meteorological Observatory (TMO), the predecessor of the Japan Meteorological Agency (JMA), was established in 1875 (Fig. 3).[34]

Turning our eyes back to Hokkaido, with the visit of Commodore Perry as its momentum, Hakodate came under the direct control of the Tokugawa Shogunate. An officer took meteorological observations of wind, weather, temperature, earthquakes, and lightning twice a day, in the morning and evening, between 1854 and 1858. After Hakodate opened to foreign ships in 1859, a doctor at the Russian Consulate, Michael Albrecht, and later an English merchant, Thomas Blakiston, made meteorological observations until 1871. Subsequently, in 1872, the Hakodate Branch Office of Kaitakushi (see below) started meteorological observation, even before the establishment of the Central Observatory in Tokyo in 1875.[35] As we will see later, the American scientists of the Kaitakushi encouraged and supported the initiative of the Kaitakushi staff at Hakodate.

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[31] William H. Goetzmann, "Exploration and Early American Culture," *Proceedings of the American Antiquarian Society* 10 (1989): 235–36.

[32] Eikoh Shimao, "Some Aspects of Japanese Science, 1868–1945," *Annals of Science* 46, no. 1 (1989): 69–91; Noboru Umetani, *Oyatoi gaikokujin: Meiji nihon no wakiyakutachi* [Foreign employees in Meiji, Japan] (Tokyo: Kodansha, 2007).

[33] Zaiki, Können, Kimura, Mikami, and Tsukahara, "Reconstruction," 231–48, esp. 234.

[34] Kishocho, *Kisho hyakunenshi*, 47–51; *Report of the Meteorological Observations for the Ten Years 1876–1885* (Tokyo: Imperial Meteorological Observatory of Tokio, 1886). For the history of Japan Meteorological Agency (JMA), see http://www.jma.go.jp/jma/en/Background/history.html. Recently, several scholars have begun to reexamine the history of meteorology in Japan around the beginning of the Meiji restoration: Akira Yamamoto, "Establishment of a National Meteorological Service in Japan," *JAHIGEO Bulletin*, no. 48 (2017): 41–48 [in Japanese]; Hideo Izumida, "Reconsideration of Commencement of Engineering Education Under the Ministry of Public Works in the Meiji Japan: Contribution of Yozo Yamao and C. A. McVean to Conceptualization and Realization," *Journal of Architecture and Planning* 81, no. 720 (2016): 477–87 [in Japanese].

[35] Togo Tsukahara has pointed out that the colonisation of Hokkaido was the driving force behind this early institutionalisation: Tsukahara, "Rangaku, Global Warming, Science and Empires," 79–108, esp. 100–102.

Fig. 3. Tokyo Meteorological Observatory within the grounds of Chiri-ryo, Tokyo. Source: Japan Meteorological Agency website (http://www.jma.go.jp/jma/kishou/intro/gyomu/index2.html). There are Japanese vernacular-style buildings with wind vanes on the rooftop, as well as Stevenson screens.

Among numerous modernisation programs for industrial and economic expansion as well as for defense (especially against Russia, which was keenly interested in colonising Hokkaido), the Meiji government set up a department called the *Kaitakushi* (the Hokkaido Development Commission or the Hokkaido Colonization Office) in 1869. This department was in charge of development and settlement in Hokkaido under the Kaitakushi ten-year program. It was assumed that American knowledge and practical skills gained through developing the vast area of the American 'lower 48' and the territorial expansion into Alaska after 1867 would be adaptable to the cold Hokkaido wilderness. As such, the Kaitakushi employed lots of American scientists and engineers.[36]

Kiyotaka Kuroda (1840–1900) was charged with overseeing the colonisation effort in Hokkaido under the Kaitakushi. Kuroda went to the US to hire Americans and buy specialised equipment to aid in land development. Whilst there, he met with the *chargé d'affaires* of the new Japanese legation, Arinori Mori (1847–1889). Mori had been born in Kagoshima, the son of a Kagoshima clan samurai. He had learned Western science and technology, and in 1865 his clan sent him to University College London in Great Britain, where he studied Western techniques in mathematics, physics, and naval surveying. He returned to Japan just after the

[36] Fumiko Fujita, *American Pioneers and the Japanese Frontier: American Experts in Nineteenth-Century Japan* (Westport: Greenwood Press, 1994); Tomomi Nakagawa, "Frontier of Professionals: The Vision of American Advisors That Supported Hokkaido Development in the Early Meiji Period," *Historia Scientiarum* 27–3 (2018): 1–19; Michele M. Mason, *Dominant Narratives of Colonial Hokkaido and Imperial Japan: Envisioning the Periphery and the Modern Nation-State* (New York: Palgrave Macmillan, 2012).

start of the Meiji Restoration. He became the first Japanese resident diplomat in the US capital, serving from January 1871 to March 1873 in Washington, DC.

In the US, Mori and Kuroda visited General Horace Capron (1804–1885), who would later travel to Japan as an advisor to the Kaitakushi. When Capron began planning his visit, he recruited experts on geology and mining to accompany him. Joseph Henry, who had been in touch with Capron for many years, had an important role in this recruitment, as he was tasked to recommend suitable scientists and engineers for the Kaitakushi. Mori also acted as a mediator between Henry and the Kaitakushi and played an important role in introducing Smithsonian meteorological observation procedures to Hokkaido, though he himself was not a Kaitakushi member. It was during his stay in Washington that Mori came to know Joseph Henry. Henry and Mori met first at a US-Japan meeting aimed at building a scientific relationship, but the details of this event remain obscure.[37] The first note on Mori in Henry's desk diary suggests he had met with him on 14 July 1871 to discuss Japanese conditions, including population, food, and exports.[38] Thus, the key players, such as Henry, Capron, and Mori, who met in Washington, DC, would later cooperate in purchasing the meteorological instruments and recruiting American suitable scientists and engineers for colonisation in Hokkaido.

Creating Infrastructure: Instruments and Personnel

For a successful colonisation, the Kaitakushi needed instruments, including for meteorological observation and geological surveys. The Smithsonian's *Directions for Meteorological Observations* offered the information on details of standardised meteorological instruments. Among them was James Green's standard barometer, which became known as the Smithsonian barometer. Green began making Fortin-type barometers for the Smithsonian in the 1850s, though with a slightly different design for the cistern.[39]As we will see, it was Henry who actually placed the first order for Japan. Only a few days after Henry's visit with Mori, a letter passed between them on 18 July 1871 in which Henry described "Green of New York, the mathematical instrument maker" as having "in my opinion, no superior in this country in the line of instrument making".[40] The letter enclosed the bill of the instruments which Capron had ordered on the Kaitakushi's behalf. They were selected by one of Henry's recruits, Dr.Thomas Antisell (1817–1893). On the movement of instruments from the US to Japan, Henry had written that "[t]he Institution has taken much interest in the historical phenomenon of the movement in Japan in regard to the adoption of Western civilization" and made arrangements "for obtaining meteorological observations and specimens of archaeology and natural history".[41] A subsequent report by Henry to the Committee on the Library of

[37] Toshiaki Okubo, *Shinshu Mori Arinori Zenshu* [New Complete Works of Mori Arinori] (Tokyo: Bunsendoshoten, 1998); Ivan Parker Hall, *Mori Arinori* (Cambridge: Harvard University Press, 1973).

[38] "Called on the Japan Ambassador, found him as I had before a very intelligent man—quite anxious to improve the condition of his country" and "The land well cultivated—population redundant—food imported—articles of exportation—tea and silks—," Desk Diary, 14 July 1871, Joseph Henry Collection, RU7001, Smithsonian Institution Archives.

[39] Fleming, *Meteorology in America*, 119; https://americanhistory.si.edu/collections/search/object/nmah_1187988 [this needs to be at least name-described].

[40] Joseph Henry to Arinori Mori, 18 July 1871, RU33, Smithsonian Institution Archives.

[41] Joseph Henry, "Report of the Secretary," *Annual Report of the Smithsonian Institution for the Year 1871*, (Washington: Smithsonian Institution, 1872), 36–37.

Congress in early 1872 suggests how Mori had played a key role in obtaining instruments for "meteorological, magnetic, and other physical observations".[42]

Before Mori left the US that March, Henry wrote to him again, asking him to help by collecting records of weather observations and natural history specimens for the US when he was back in Japan. In the absence of instrumental observations, Henry argued that visual observation would suffice and that instrumental work could be introduced later.[43] He laid out clear instructions for Mori on the subject (Fig. 4):

> With regard to meteorology, any records which may have been made with regard to the weather are desirable, such as the time of opening and closing of rivers during a long period of unusually cold or unusually warm winters or summers. It is also important that meteorological observations for the future should be established such as accurate observations of the depth of rain, as measured by the rain gauge; the occurrence of thunder-storms, the direction from which the thunder cloud comes; the character of the lightning, such as the violence of the discharge, notice of any damage which may be done, trees or buildings struck; regular observations with barometer and thermometer; direction of the wind; appearance of the aurora-borealis, etc. For recording these observations, we send you a set of blank forms and also a rain-gauge such as is used by our observers.[44]

After Mori returned to Japan, he took on many government positions, including Minister of Education to the Meiji government. However, with a lack of any written evidence connecting Henry and Mori after the latter's return to Japan, their relationship becomes obscure after this point.

As mentioned previously, Horace Capron had an important role in recruiting American scientists and engineers for the Kaitakushi. Born in Attleboro, Massachusetts, Capron was active in agricultural societies during the antebellum period and had gained a reputation for applying scientific principles to farming. He was appointed as US Commissioner of Agriculture in 1867, where he stayed until 1871.[45] In the spring of 1871, the Kaitakushi's main office was opened in Sapporo and in August Capron went to Japan to take up the role of advisor to the Kaitakushi. Henry, who knew Capron well, worried: "I fear our friend, General Capron, will find himself in a difficult position" in Japan. [46] It was partly out of concern that Henry supported Capron's recruitment and instrument drive.

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[42] Charles Lanman, *The Japanese in America* (London: Longmans, Green, Reader, and Dyer, 1872), 51. Henry wrote "I have had frequent intercourse with Mr. A. Mori".

[43] Circular on Meteorology, November 1, 1848. *The Papers of Joseph Henry*, Vol. 7 (Washington: Smithsonian Institution Press, 1996), 419.

[44] Joseph Henry to Arinori Mori, 12 March 1873, RU33, Smithsonian Institution Archives. He also wrote that he was willing to "foster a friendly cooperation between this establishment [the Smithsonian] and the lovers of science" in Japan.

[45] Allen Johnson and Dumas Malone, eds. *Dictionary of American Biography*, Vol. 2 (New York: Charles Scribner's Sons, 1944).

[46] For instance, they had visited Savannah together on 21 November 1869. Joseph Henry to William Schley, 14 January 1870. *The Papers of Joseph Henry*, Vol. 11 (Washington: Smithsonian Institution, 2007), 277–279. On 13 March 1871, when the Washington Philosophical Society meeting was held at the Smithsonian, Henry was selected as president and Horace Capron was selected as one of the vice presidents. Desk Diary, March 6, 1871, *The Papers of Joseph Henry*, Vol. 11 (Washington: Smithsonian Institution, 2007), 345–46. Joseph Henry to Charles Lanman, Sept. 11, 1872, *The Papers of Joseph Henry*, Vol. 11 (Washington: Smithsonian Institution, 2007), 417–420. [I find the references here unclear]

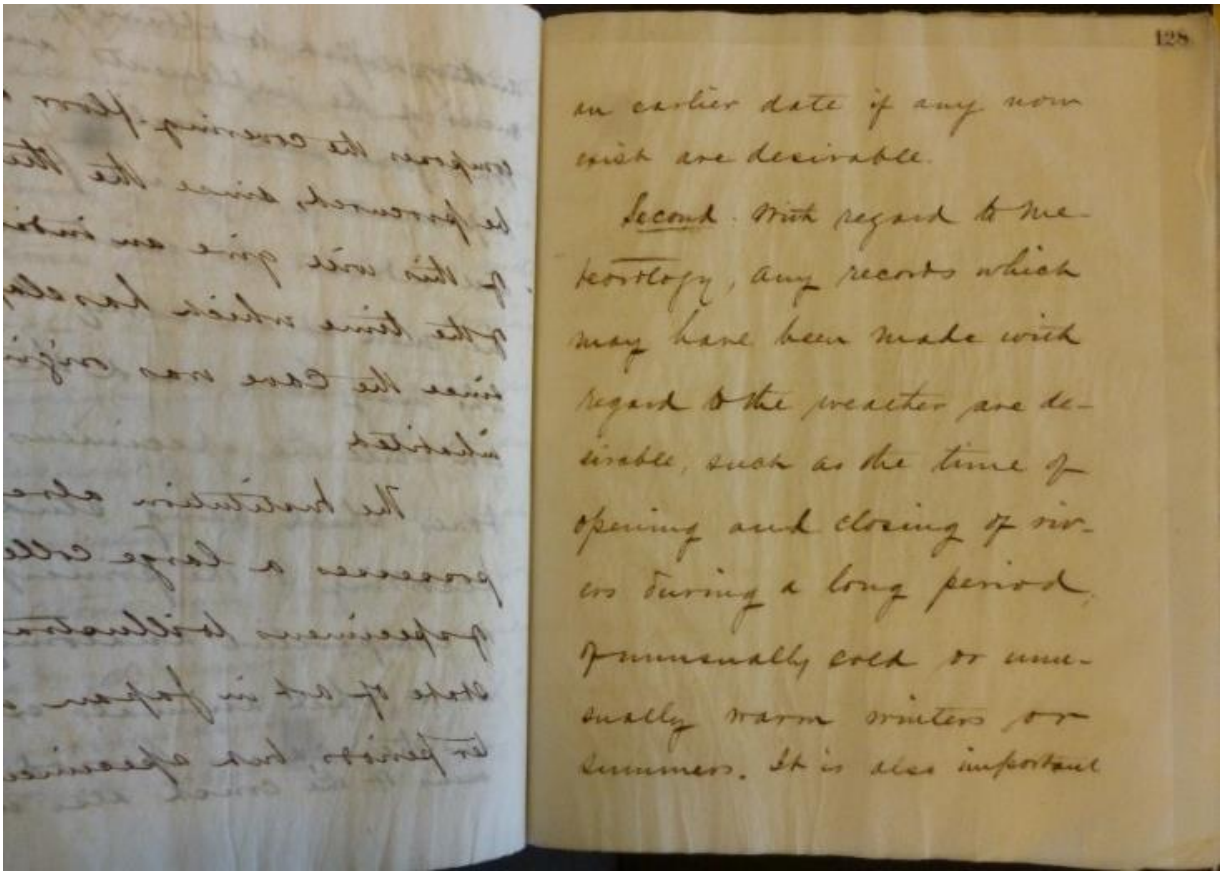

Fig. 4. Joseph Henry's letter to Mori Arinori, 12 March 1873, Smithsonian Institution Archives.

Like Kuroda, Capron remained in Tokyo. He sent geological engineer Thomas Antisell and another colleague to Hokkaido in the winter of 1871–1872 to survey and report on the island's climate and prospects.[47] In his letter to Henry on 5 August 1872, Antisell reported that he had kept meteorological observations and obtained "some Obs'n in Yezo kept for some years by others with an abstract of some kept here for eight years at Yokohama", and that he would put the important figures together and let Henry know something of the climate there.[48] Subsequently, on 10 September 1872, Antisell sent Henry "some tables of meteorology observations made here during the last 12 months—and have in past collated them with some made by Dr. Hepburn of Yokohama".[49] Antisell had used the Green's barometer and a small aneroid that was "very sensitive for small movements", but he did not know what corrections

[47] Thomas Antisell was born in Dublin, Ireland in 1817, where he was educated as a physician and a chemist. He emigrated to New York City in November 1848 and opened a medical office and a chemistry laboratory. In 1854, he entered government service as a geologist on the Pacific railroad survey in California and Arizona. After the survey, Antisell moved to Washington, DC, where he was a chief examiner in the US Patent Office and had sole charge of chemical inventions. After the Civil War, Antisell became a chief chemist of the Department of Agriculture from 1866 until 1871. He also taught chemistry at Georgetown University from 1858 to 1869 and at the Maryland Agricultural College from 1869 to 1870. *National Cyclopaedia of American Biography*, Current Volume A (New York: James T. White & Co., 1930); Horace Capron, *Memoirs of Horace Capron*, Vol. I: Autobiography, Special Collections, National Agricultural Library.

[48] Thomas Antisell to Joseph Henry, 5 August 1872, RU26, Smithsonian Institution Archives.

[49] Thomas Antisell to Joseph Henry, 10 September 1872, RU26, Smithsonian Institution Archives.

to apply. [50] He complained that "there surely must be some methods but I have no books here which say anything about it".[51] He also asked Henry about "the proper form to record" the earthquakes and "how to observe" them, and also about "any new seismometer of value".[52]

The tables of meteorological observations, which Antisell believed were "the first published efforts to arrive at a knowledge of this climate", were published as *On Meteorology in Japan* (1872), which Antisell submitted to the head of the Kaitakushi, Kiyotaka Kuroda. In creating this publication, Antisell made use of both his own records and Yokohama-based doctor James Curtis Hepburn's tabulated records from 1860–1863. The book also included maps showing the Japanese Kuroshio Current (also known as the Black Current or, in earlier literature, the Kuro Siwo), and a map of a typhoon on 25 August 1872. He concluded that "calling the attention of government to the necessity of establishing stations for meteorological observation along the line of Telegraph from Nagasaki northward" was needed so that "by proper signals" of the storms in port, great damages could be avoided.[53] Antisell sent this report to Henry, and thus, his Japanese observations were included in the Smithsonian's meteorological observation project.[54]

After this, Antisell decided to remain in Tokyo for the summer and autumn to organise the new college, Kaitakushi Karigakko (the Hokkaido Promotion Development Provisional School), saying "I have induced them to open industrial schools in the Polytechnic plans of Europe and we prepare to have at least three such opened in September—mechanical and civil engineering—mining—and agriculture".[55] When it opened in 1872, Antisell became vice president and taught chemistry and geology.

On the other hand, Capron submitted a preliminary report to Kuroda with reference to the opening and settlement of the island of Yesso, saying that "meteorological observations in Yesso have been so limited that all estimates of its agricultural capabilities have been mere conjectures, based upon private reports and comparison with climates of other countries".[56] To demonstrate that Hokkaido was suitable for colonization, Capron used both Antisell's reports and the Smithsonian Institution's meteorological reports, and he compared the climates of Hokkaido and the United States. He stated that "[t]he rainfall in the United States for twelve months is 38.05 inches, and in Hakodate is 36.92 inches. These statements are collected from the reports of the members of the commission and from the meteorological reports of the Smithsonian Institution."[57] He concluded that they "in no case show any marked difference in

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[50] Ibid.

[51] Ibid.

[52] Ibid.

[53] Ibid.; Thomas Antisell, *On Meteorology in Japan* (1872), Northern Studies Collection, Hokkaido University Library, https://www2.lib.hokudai.ac.jp/cgi-bin/hoppodb/record.cgi?id=0C001170000000000; Collection of Japanese and Chinese Classics, Waseda University Library, http://www.wul.waseda.ac.jp/kotenseki/html/i14/i14_a4564/index.html.

[54] "Japan. Meteorology of Japan. Dr. Thomas Antisell. 1872" appeared in "Classified List of Meteorological Publications, and Meteorological Articles in Periodicals, Received by the Smithsonian Institution in 1873, and Deposited in the Library of Congress," *Annual Report of the Smithsonian Institution for the Year 1873* (Washington: Smithsonian Institution, 1874), 135. However, his name did not appear in "Classified Record of Monthly Meteorological Reports Preserved in the Smithsonian Institution" in the same report. Twenty years later, he again discussed currents in the broader Pacific Ocean context, referring to his knowledge of the Kuroshio Current. Thomas Antisell, "The Currents of the Pacific Ocean," *Journal of the American Geographical Society of New York* 15 (1883): 101–32.

[55] Thomas Antisell to Joseph Henry, 5 August 1872, RU26, Smithsonian Institution Archives.

[56] Horace Capron, *Reports and Official Letters to the Kaitakushi* (Tokyo: Kaitakushi, 1875), 39.

[57] Ibid., 41.

either temperature or rainfall between Yesso and the richest and most populous States of the Union. The great fall of snow in Yesso (which is included in the rainfall), is a great advantage, serving, as it does, to protect grains and grasses from the frost and to prevent the freezing of the ground to any depth".[58]

In addition, Capron consulted with the Kaitakushi officers and supported their meteorological initiatives. In 1872, for example, Capron encouraged Naritoyo Fukushi, a survey officer from the Hakodate Branch of the Kaitakushi, by way of Thomas Blakiston, to propose the establishment of a new meteorological station. Capron lent Blakiston's meteorological instruments to Fukushi and set them up at the Hakodate Branch Office. The Kaitakushi ordered new meteorological instruments for this endeavor, this time from England, enabling the Hakodate Branch to set up a meteorological observatory and begin meteorological observations as the first government-run observatory on 26 August 1872. Fukushi and a few staff members were in charge of observation.[59]

From Humble Beginnings to Wider Applications

Benjamin Smith Lyman (1835–1920) joined the Kaitakushi as a replacement for Antisell when the latter quit the department due to a disagreement with Capron.[60] Lyman, a Harvard graduate of 1855, had been given his first job on a topographical and geological survey in Pennsylvania by his uncle, J. Peter Lesley, a noted geologist. Then, Lyman studied at the Imperial School of Mines in Paris from 1859 to 1860, and followed practical course at the Royal Academy of Mines in Freiberg, Saxony, from 1861 to 1862. Upon returning to the United States, Lyman established himself in Philadelphia, opening an office as a consulting mining engineer.[61] Henry had asked Lesley to name a geologist to be sent to Japan. Lesley immediately recommended his nephew, writing that "I know but one person who will meet your numerous requirements".[62]

Lyman arrived in Japan in January 1873 and was tasked with surveying Hokkaido's coal and oil fields, as well as those along the Sea of Japan's coastline. He also taught geology at the Kaitakushi Karigakko, and carried out geological surveys and measurements with students in Hokkaido until 1875. He continued to work under other ministries until the end of 1880. In 1873, Lyman wrote *The Climate of Japan*, submitting it to the Kaitakushi, as Capron and Antisell had done.[63] He compared Japan's climate with those of Europe and the US, and cited the famous old inscription of the Indian emperor, "If there be a Paradise on earth, it is here, it is here!".[64] Lyman emphasised that colonisation should be carried out in a way that suited the climate.

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[58] Ibid.

[59] Kishocho, *Kisho hyakunenshi*, 337–38.

[60] The discord between Capron and Antisell came to the fore in February 1872 when Antisell asked for a raise in salary. Later, Antisell wrote to Henry that "Mr C did not exert himself his favor, altho' I had it urged upon him to do so." Thomas Antisell to Joseph Henry, 5 August 1872, RU26, Smithsonian Institution Archives.

[61] *The Benjamin Smith Lyman Collection* [brochure] (University of Massachusetts Amherst Library).

[62] Joseph Henry to Peter Lesley, 8 May 1871, J. Peter Lesley Collection, American Philosophical Society Library; Peter Lesley to Joseph Henry, 9 May 1871, Horace Capron Papers, Library of Congress; Benjamin Lyman to Joseph Henry, 9 June 1871, Horace Capron Papers, Library of Congress.

[63] Benjamin Smith Lyman, *The Climate of Japan* (1873), Northern Studies Collection, Hokkaido University Library, http://www2.lib.hokudai.ac.jp/cgi-bin/hoppodb/record.cgi?id=0C026100000000000&lang=0.

[64] Ibid.

In a report to Capron in November 1874, compiled at Chiraiwatara (near Shibetsu), Lyman noted the importance of the "meteorology of science" for forewarning the frequent, severe storms that claimed hundreds of lives each year in that region.[65] He noted that "[i]n the first place a system of telegraphic weather reports throughout Japan, connected also with the one lately begun or soon to begin in China, would enable the weather on the coast of Yesso to be predicted commonly a day or two in advance, and storm signals could be set up at different points along the coast in the same manner as has been done for some years in Great Britain and in America".[66] Aligning the Kaitakushi plan to similar work in foreign countries would "doubtless help forward very much the science of meteorology, and perhaps lead to the possibility of predicting stormy weather still longer in advance".[67] His proposal for an Asian storm warning and weather reporting system along English and American lines advocated knowledge exchanges among the broader regional Asian network, beyond Japan. This contemporary Asian network commonly predicted the weather a day or two in advance.

Meanwhile, in March 1874, the head of the Kaitakushi asked Lyman, through Henry, to order seven sets of meteorological instruments for the six or seven new meteorological stations proposed for Hokkaido. These instruments included quicksilver barometers, aneroid barometers, rain gauges, anemometers, thermometers, heat thermometers (self-registering), cold thermometers (self-registering), wet bulb thermometers, and two small or pocket (compensated) aneroids, chiefly for measuring height.[68] Lyman made a significant contribution in enabling the Kaitakushi to acquire the instruments, including making the order and securing the payment, confirming the condition of the instruments on arrival, and arranging for subsequent repairs. Henry also continued to be a reliable advisor throughout this process, for instance, explaining to Lyman how to establish a workable registering system and providing instructions as to "how to construct a barometer" (Fig. 5).[69] Lyman readily took up Henry's suggestions, proposing to the Kaitakushi that "[t]he method he [Henry] gives of filling barometer tubes may sometime be useful to the[ir] meteorologists".[70]

[65] Capron, *Reports and Official Letters*, 439.

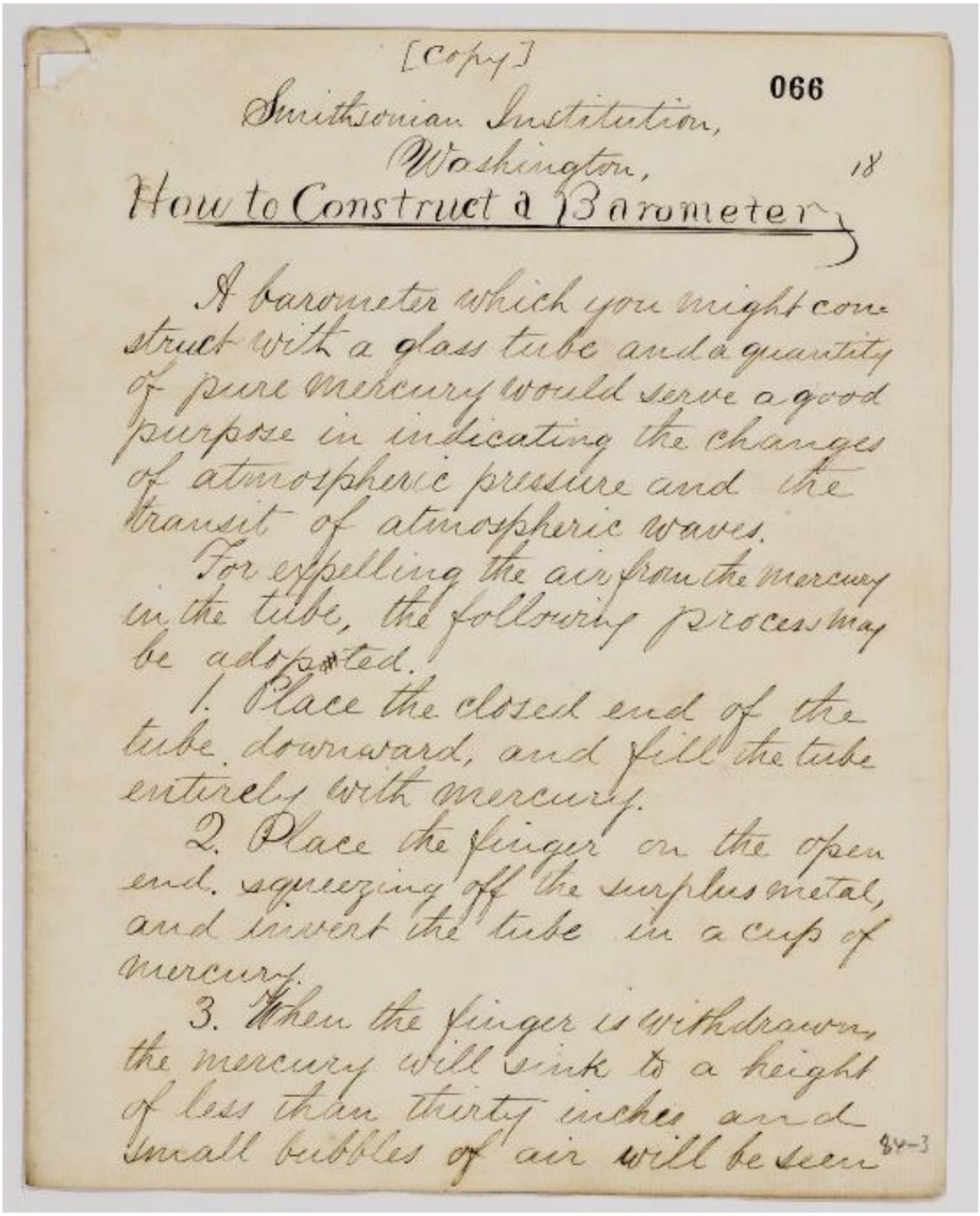
[66] Ibid.

[67] Ibid.

[68] Benjamin Lyman to Joseph Henry, 25 March 1874, Northern Studies Collection, Hokkaido University Library, http://www2.lib.hokudai.ac.jp/cgi-bin/hoppodb/record.cgi?id=0C026330000000000.

[69] Joseph Henry to Benjamin Lyman, 22 June 1875, Northern Studies Collection, Hokkaido University Library, http://www2.lib.hokudai.ac.jp/cgi-bin/hoppodb/record.cgi?id=0C027370000000000&lang=0, https://www2.lib.hokudai.ac.jp/cgi-bin/hoppodb/kyuki.cgi?id=0C027380000000000&page=1&lang=0.

[70] Benjamin Lyman to Kiyotaka Kuroda, 16 October 1875, Northern Studies Collection, Hokkaido University Library, http://www2.lib.hokudai.ac.jp/cgi-bin/hoppodb/record.cgi?id=0C027360000000000&lang=0.



[copy]

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Smithsonian Institution,
Washington, 18

How to Construct a Barometer.

A barometer which you might construct with a glass tube and a quantity of pure mercury would serve a good purpose in indicating the changes of atmospheric pressure and the transit of atmospheric waves.

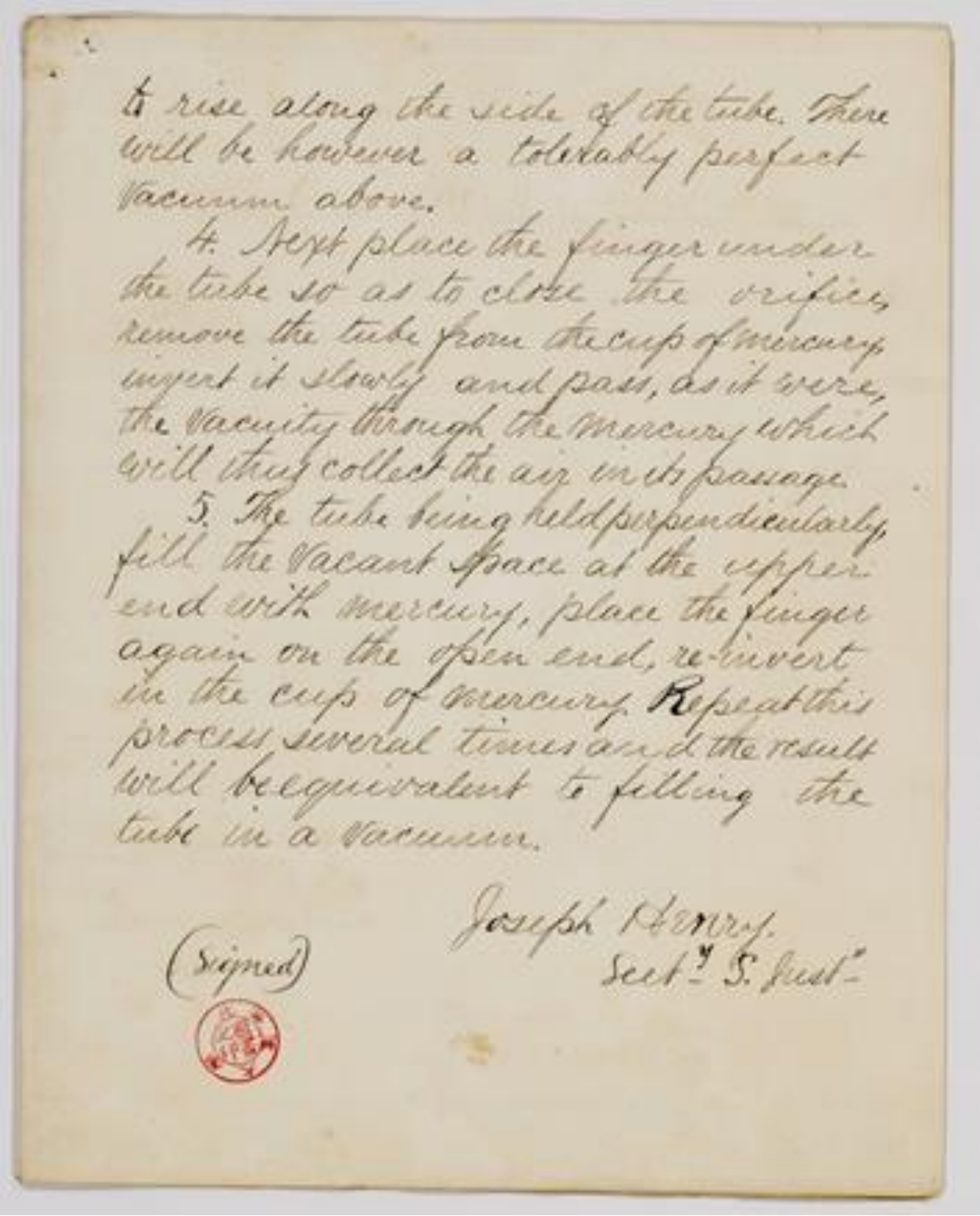
For expelling the air from the mercury in the tube, the following process may be adopted.

1. Place the closed end of the tube downward, and fill the tube entirely with mercury.

2. Place the finger on the open end, squeezing off the surplus metal, and invert the tube in a cup of mercury.

3. When the finger is withdrawn, the mercury will sink to a height of less than thirty inches and small bubbles of air will be seen

84-3



& rise along the side of the tube. There will be however a tolerably perfect vacuum above.

4. Next place the finger under the tube so as to close the orifice, remove the tube from the cup of mercury invert it slowly and pass, as it were, the vacuity through the mercury which will thus collect the air in its passage.

5. The tube being held perpendicularly fill the vacant space at the upper end with mercury, place the finger again on the open end, re-invert in the cup of mercury. Repeat this process several times and the result will be equivalent to filling the tube in a vacuum.

Joseph Henry.
Sect. S. Inst.

(signed)

Fig. 5. "How to Construct a Barometer" in Joseph Henry's letter to Benjamin Lyman, 22 June 1875. Source: Northern Studies Collection, Hokkaido University Library

In November 1875, the Kaitakushi also asked Lyman to secure seven copies of the Smithsonian Miscellaneous Collections Pamphlet 148 (the *Directions for Meteorological Observations*) from Henry.[71] On 14 February 1876, Garrick Mallery, the Chief Signal Officer, replied to Lyman, writing that G. J. Rockwell of Imperial College Tokio had already made a similar request.[72] His office answered that "A copy of 'Form E' of the 'Instructions to observer Sergeants' of the 'Bulletin of International Meteorological Observations' and of the Annual Report of this office for 1874" were now mailed to Lyman's address as printed matter, though the same ones had been mailed to Prof. Rockwell last October.[73] Mallery emphasised "the greater importance to cooperation on the part of official observers in the Empire of Japan in its labors, especially in that of the simultaneous observations now extended over the greater part of the civilized world".[74]

George Jewett Rockwell, mentioned above, had been hired by Kaitakushi Karigakko from January to July 1875, and had tried to obtain forms for meteorological observations through Henry on the last day of his employment. [75] By then, the Smithsonian Institution no longer carried out the Meteorological Observation Project, so Henry transferred the letter to the appropriate office, the War Department's Army Signal Service. On 27 October, Chief Signal Officer General Albert Meyer sent the forms to Rockwell, referring to the Bulletin of International Meteorological Observations.

Eventually, Lyman received seven copies of "Instructions to Observer Sergeants" and fifty blank forms.[76] Subsequently, Mallery encouraged Lyman to make meteorological observations in Japan based on this form and send them to his office.[77] When the Kaitakushi Karigakko moved to Sapporo in 1875, the pamphlets and instruments were transferred to Sapporo. In the following year, it was renamed Sapporo Agricultural College (Sapporo Nogakko). The college was opened on formally on 14 August 1876. Under the guidance of William S. Clark (1826–1886), the former president of the Massachusetts State Agricultural College, the Sapporo-based institute became a specialised centre for the theory and practice of large-scale agricultural management. Courses at the college called for three years of

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[71] Benjamin Lyman to Joseph Henry, 4 November 1875, Benjamin Smith Lyman Papers, American Philosophical Society Library. As mentioned previously, this publication was the *Directions for Meteorological Observations*, intended to be distributed to observers.

[72] Garrick Mallery to Benjamin Lyman, 14 February 1876, Northern Studies Collection, Hokkaido University Library, http://www2.lib.hokudai.ac.jp/cgi-bin/hoppodb/record.cgi?id=0C027710000000000&lang=0.

[73] Ibid.

[74] Ibid.

[75] George Jewett Rockwell was born in either 1850 or 1851. He graduated from New York University in 1872. He then studied analytical chemistry as a special student at Columbia University's School of Mines from 1872 to 1873. In 1874, Rockwell joined the US Transit of Venus Expedition and went to Siberia. Then he came to Japan to work under Horace Capron of the Kaitakushi, and taught as acting principal at the school attached to the Kaitakushi. He resigned after half a year, and in September 1875 became a teacher of chemistry and physics at Tokyo Kaisei Gakko. Again, he resigned after ten months and returned home.

[76] Garrick Mallery to Benjamin Lyman, 9 May 1876, Northern Studies Collection, Hokkaido University Library, http://www2.lib.hokudai.ac.jp/cgi-bin/hoppodb/record.cgi?id=0C027830000000000. They were the "fifty copies of Form E for use in making reports, and seven copies of 'Instructions to Observer Sergeants'" that Col. Mallery said he sent in July. Benjamin Lyman to Tokusaburo Yamauchi, 7 July 1876, Northern Studies Collection, Hokkaido University Library, http://www2.lib.hokudai.ac.jp/cgi-bin/hoppodb/record.cgi?id=0C027820000000000&lang=0.

[77] Garrick Mallery to Benjamin Lyman, 2 September 1876, Benjamin Smith Lyman Papers, American Philosophical Society Library, http://www2.lib.hokudai.ac.jp/cgi-bin/hoppodb/record.cgi?id=0C030210000000000.

preparatory work and four years of specialisation based on a broad foundation in the natural sciences, including training in chemistry, mathematics, and physics.[78]

Meteorology at Sapporo

William Wheeler (1851−1932), graduate of the Massachusetts State Agricultural College at Amherst and a civil engineer, had come to Japan with Clark to serve as a professor of mathematics and civil engineering, and succeeded Clark as the college's acting president and, later, as president. Wheeler took on a variety of projects as need, opportunity, and circumstance arose. One of them was meteorological observation.[79] Wheeler set up a small meteorological observatory as part of the college and started to carry out observations as early as 1 September 1876 (Fig. 6). "In order to facilitate the work of the observer, and to secure the highest degree of accuracy in the results", the station was erected in an isolated position, on the roof of the Kiu Honjin, Wheeler's off-campus residence and formerly the Kaitakushi's Inn. It was fitted out with a set of standard instruments made by Casella in London which Wheeler had come across almost accidently. They had been obtained originally by Lyman and kept for the college to use.[80] Wheeler also obtained fifty "pamphlet & form[s]" for making observations as the result of the cooperation of Lyman, Henry, and the Office of the Chief Signal Officer.[81]

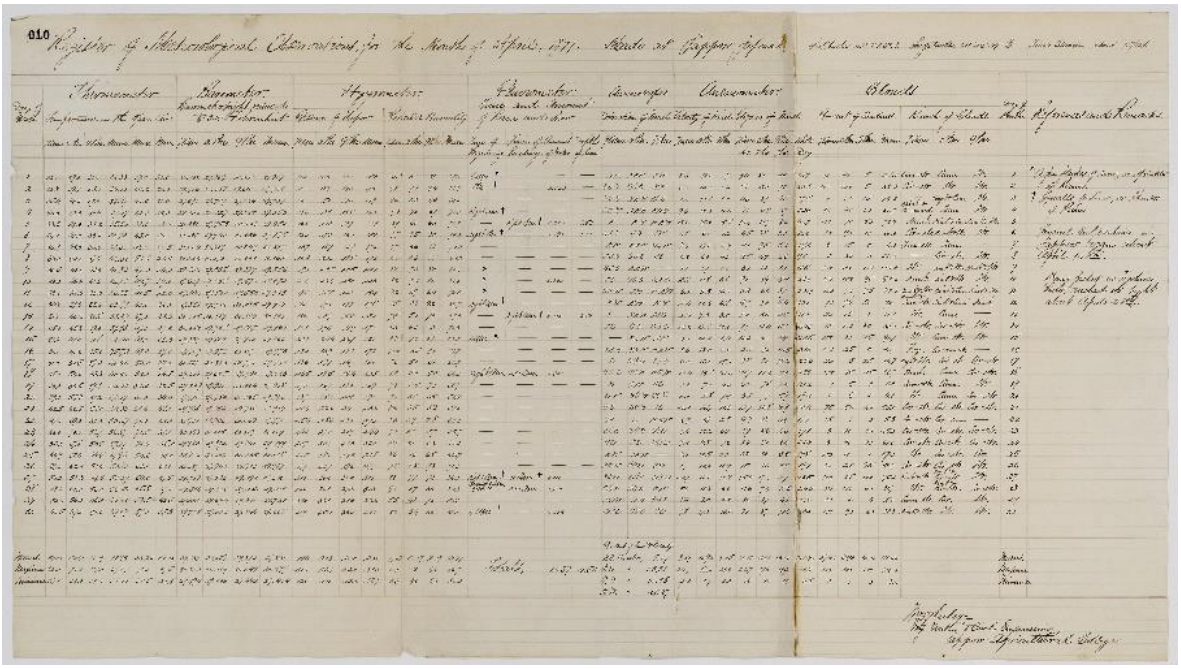

Fig. 6. William Wheeler's "Register of Meteorological Observations". Source: Northern Studies Collection, Hokkaido University Library.

[78] John M. Maki, *A Yankee in Hokkaido: The Life of William Smith Clark* (Lanham: Lexington Books, 2002).

[79] Tetsuro Takasaki, *William Wheeler: A Young American Professor in Meiji Japan* (Sapporo: Hokkaido University Press, 2009).

[80] William Wheeler, "Register of Meteorological Observations," in *First Annual Report of Sapporo Agricultural College* (Tokyo: Kaitakushi, 1877), 83–88, esp. 87; William Wheeler to Mary Wheeler, 10 September 1876, Northern Studies Collection, Hokkaido University Library. Wheeler appropriated instruments that had been previously obtained by Lyman and kept for college use.

[81]Tokusaburo Yamauchi to Benjamin Lyman, 20 September 1876, Benjamin Smith Lyman Papers, American Philosophical Society Library. "Meteorological instruments at Satsporo now in charge of Prof. W. S. Clark, president of the College, it is therefore certain proper observation and record to be made at Satsporo from this month, that pamphlet & form, I propose, to send to Prof. Clark for reference. College is now very prosperous."

Wheeler's "Register of Meteorological Observations" taken in Sapporo from September 1876 to March 1877 appeared in the *First Annual Report of Sapporo Agricultural College* in 1877. From this we can see that observations were being made three times daily "in accordance, mainly, with the standard system of the Smithsonian Institution, Washington, U.S.".[82] From these observations, Wheeler concluded that "there could be no better advertisement to invite enterprising settlers and capitalists to Yesso, than the assurance of a climate favorable to the highest excellence of her future agriculture, and promising pleasant, healthful homes to all her people".[83] He also referred to the educational value of accurate meteorological records, saying that "[t]he work that has here been entered upon will be an essential element in conducting agricultural experiments under the auspices of the College, and will afford a valuable source of instruction for the students".[84] He was a strong supporter of the American meteorological system, buying a copy of Lorin Blodget's 1857 book *Climatology of the United State*s and twenty copies of Elias Loomis' 1868 book *A Treatise on Meteorology* to use as one of the textbooks for his students' advanced classes. [85] Henry had trained Blodget and, to some extent, Loomis using the Smithsonian principles.

Wheeler also argued for a fuller implementation of the American system in Japan:

> By the adoption of a well-organized system of observations and comparisons of the meteorological phenomena in the United States, the approaching conditions of temperature, atmospheric pressure, rain, snow, wind, cloud, etc., are published daily with almost perfect accuracy, throughout the whole country, by the agency of the telegraph and the press; thus conferring countless benefits upon all classes, and especially upon agricultural and commercial enterprise. To prepare for the introduction of a similar system in Japan, additional stations must be established throughout the country, according to a comprehensive and carefully devised plan.[86]

Subsequently, in the final part of his report, he provided a concrete plan about additional stations. "Having been notified that a duplicate set of meteorological instruments belonging to the Kaitakushi is now in Sapporo," he recommended that they be utilised, and "that a station for observations be established at some point near the extreme eastern or north-eastern coast."[87]

In the *Second Annual Report*, Wheeler referred to the register of the Imperial Meteorological Observatory at Tokyo. He explained that "the prevailing winds at the same seasons, respectively, are approximately north-by-west and south-by-east,—the position of the mass of the island of Hondo [main island] on the north, and the warmer ocean currents being more nearly south, partially accounting for the difference noted".[88] In order to "determine conclusively the laws governing the entire movement of the storms along the eastern Asiatic Coast," "the extension of data for comparison" by "all future observers here and elsewhere in the Empire" would be crucial.[89] Thus, as his other contemporary Americans had pointed out,

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[82] Wheeler, "Register of Meteorological Observations," 84.

[83] Ibid., 87.

[84] Ibid.

[85] Keuffel and Esser's Invoice to William Wheeler, 25 October 1877, Northern Studies Collection, Hokkaido University Library, http://www2.lib.hokudai.ac.jp/cgi-bin/hoppodb/record.cgi?id=0C039990000000000&lang=0. William Wheeler to Hirotake Zusho, 25 December 1877, Northern Studies Collection, Hokkaido University Library, http://www2.lib.hokudai.ac.jp/cgi-bin/hoppodb/record.cgi?id=0C040040000000000.

[86] Wheeler, "Register of Meteorological Observations," 87–88.

[87] Ibid., 88.

[88] William Wheeler, "Meteorological Report and Register of Meteorological Observations," in *Second Annual Report of Sapporo Agricultural College* (Tokyo: Kaitakushi, 1878), 138.

[89] Ibid, 140.

Wheeler was proposing a storm warning system whereby "fifteen or twenty well equipped stations" would be established "at favorable points throughout the Empire, connected by telegraph with a central station" to enable "reliable predictions to be published at all important shipping ports … in advance of threatening weather.[90] Like Lyman, Wheeler used the argument that the expense of such a system would be trivial compared to "the saving of life and property, and the exercise of a nation's humanity".[91] He likewise suggested capitalising and building on the pre-existing Asian network, writing that "[a] few connected stations along the coast of China and Corea would greatly increase the extent and efficiency of the system".[92]

The Kaitakushi launched some of Wheeler's initiatives as official projects around the end of 1876, just three months after his start (Fig. 7). They adopted, for instance, the standards of the Smithsonian meteorological system, which had been shown to work successfully in Sapporo and all over Hokkaido in October 1877, implementing this new system in 1878.[93] Wheeler continued in an advisory role, cautioning the Kaitakushi to purchase only standardised instruments for the additional weather stations in October 1877.[94] Further, he explained to a surveyor in Sapporo why a difference in urban thermometric observation had occurred, saying "[i]t is customary in the United States Signal Service to establish the observatory—especially if in a city, —upon the most elevated places available, in order to secure correct observations of the wind".[95] In addition, Wheeler trained three officers to make meteorological observations at Hakodate as well as at the Kaitakushi's new branches in Nemuro and Rumoi from November 1877 to March 1878, even issuing them with a certificate.[96]

[90] Ibid.

[91] Ibid.

[92] Ibid.

[93] Sapporo Regional Headquarters, *Sapporo kisho hyakunenshi*, 22–23.

[94] William Wheeler to Motoi Hori, 25 October 1877, Northern Studies Collection, Hokkaido University Library, http://www2.lib.hokudai.ac.jp/cgi-bin/hoppodb/record.cgi?id=0C039980000000000.

[95] William Wheeler to Masakuni Yamada, 21 January 1878, Northern Studies Collection, Hokkaido University Library, http://www2.lib.hokudai.ac.jp/cgi-bin/hoppodb/record.cgi?id=0C040100000000000.

[96] William Wheeler to Heinai Orita, 18 March 1878, Northern Studies Collection, Hokkaido University Library, http://www2.lib.hokudai.ac.jp/cgi-bin/hoppodb/record.cgi?id=0C040220000000000&lang=0; William Wheeler to Motoi Hori, 27 March 1878, Northern Studies Collection, Hokkaido University Library, http://www2.lib.hokudai.ac.jp/cgi-bin/hoppodb/record.cgi?id=0C040330000000000&lang=0.

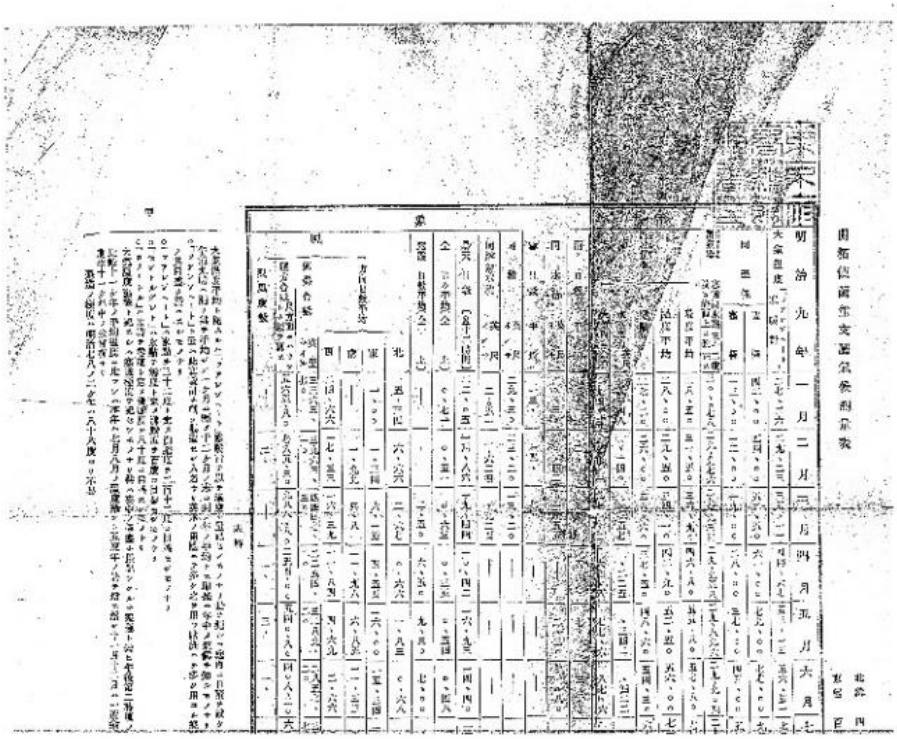

Fig. 7. The Kaitakushi's Register of Meteorological Observations at Hakodate. Source: National Diet Library Digital Collections, http://dl.ndl.go.jp/info:ndljp/pid/831559

The system established in Hokkaido continued for more than ten years and, for the most part, stayed true to the Smithsonian meteorological method (for example, routine observations were conducted three times daily). The US Signal Office had begun issuing a Bulletin of International Simultaneous Observations in 1875, which contained worldwide synoptic charts and weather observations in cooperation with other national weather services. Then, in 1881, the introduction of the International Simultaneous Meteorological Observations (Monthly Report) and Emergency Telegram enabled internationally-recognised business exchanges to be conducted among the weather stations (such as Sapporo or Hakodate), the Department of Geographical Survey of the Ministry of the Interior, and the Tokyo Meteorological Observatory. The Kaitakushi's operations ended with the completion of the Kaitakushi ten-year program but observations there continued and, in fact, expanded because of their importance to agriculture.

In August 1887, an order from the Ministry of Interior enacted and enforced nationwide meteorological observations to standardise the weather service, and the central government-run Tokyo Observatory standardised its own directions.[97] Hokkaido retained the Smithsonian

[97] Sapporo Regional Headquarters, *Sapporo kisho hyakunenshi*, 23, 27.

routine observation system for a while until the end of 1888. Eventually, in January 1889, the American system was completely replaced by the directions of Tokyo Observatory.[98]

Conclusion

This paper has demonstrated in detail the processes through which Smithsonian meteorological knowledge were applied in Hokkaido, Japan's new northern colony.[99] This national project, executed on the uncultivated northern island, was both geographically and scientifically far from Tokyo. Interestingly too, the Europeans then influencing Tokyo had little influence in the north. Most of the foreigners hired in Hokkaido were American, partly result of Capron's influence with the Kaitakushi. At that time in the US, it was perceived that the American style of meteorology held excellent potential for rapid development.[100] Therefore, this enabled both Henry and Mallery to easily persuade Japanese experts to adopt their framework for meteorological study, especially in light of the opening of Japan to Western civilisation.[101] Certainly, for the Americans engaged in agricultural and meteorological projects in Hokkaido, the centre of the meteorological observation system was Washington, DC—first, the Smithsonian, and later, the Signal Office, not in Tokyo.

In telling this story, this case study has hoped to provide ammunition to counter the centre-periphery model and also to show that American scientists and engineers did not forcibly impose American meteorological systems in Japan. The Kaitakushi's Japanese staff were not just passive reservoirs of the science. The agents involved in the transmission and appropriation of knowledge and skills were fully supportive of the efforts and Japanese scientists and staff were actively engaged in applying and elaborating the science in local contexts. So, while Mori, Henry, and Capron had started creating the networks between Hokkaido and Washington and coordinated the recruitment of American scientists and engineers for the Kaitakushi, and while Antisell, Wheeler, and Lyman had brought their style of knowledge to the ground in Hokkaido, it was the Kaitakushi who adopted and adapted the Smithsonian's directions and obtained instruments and advice from the Americans. Indeed, even as the Smithsonian meteorological project itself ended in the US, Hokkaido continued to employ Smithsonian style systematic observation, procedures, and instruments. As Kapil Raj suggested, this is a classic case of Western science disseminated "through complex processes of accommodation and negotiation, as contingent as those involved in their production".[102]

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[98] Ibid. This meant that American measurements, including feet and Fahrenheit, continued to be used in Japanese meteorological statistics even though the Japanese government had adopted the metric system. Takehiko Hashimoto, "The Introduction of the Metric System to Japan," in *The Introduction of Modern Science and Technology to Turkey and Japan* 11, Feza Günergun and Shigehisa Kuriyama, eds. (International Research Center for Japanese Studies, 1998), 187–203. The legacies of this system remained, as revealed in the persistance of the American measurement system in Hokkaido over the metric system, which Henry had rejected as "artificial", and which was not introduced for several more years. Henry thought "the adoption of the metre by the French Academy as a standard was a blunder of the first magnitude" and even expressed "in connection with England, as the two great fountains of supply of the Anglo Saxon race; a race which from its characteristics and its present aggressive indication is destined to control the political operations of the world." Indeed, Henry's nationalism could be credited as one of the reasons for the survival of American-style meteorology in Hokkaido. Joseph Henry to Hubert Anson Newton, 15 June 1865, *The Papers of Joseph Henry*, Vol. 10 (Washington: Smithsonian Institution, 2004), 523–24.

[99] This case study demonstrated one of the examples of "global" circulation of knowledge.

[100] By the 1870s, the US Army Signal Office's system of telegraphic storm warnings was the largest and best-funded in the world. Fleming, *Meteorology in America*, 163.

[101] Henry had written that "[t]he Institution has taken much interest in the historical phenomenon of the movement in Japan in regard to the adoption of Western civilization." Mallery also encouraged Japan to become a member of the civilised world, saying "simultaneous observations now extended over the greater part of the civilized world".

[102] Raj, *Relocating Modern Science*, 9; Raj, "Beyond Postcolonialism…and Postpositivism," 341.

As to how Smithsonian meteorological knowledge and associated practices were applied and "relocated" to Hokkaido, the Smithsonian's International Exchange Service, an international exchange of publications program, played an important role. This program transformed the Smithsonian into a national centre for American science, acclaimed by both American and international scientists. Through this program, important information such as the Smithsonian Meteorological Directions were distributed to Hokkaido for free. In addition to this formal international publication exchange program, there were also less formal mechanisms for exchanging scientific knowledge, which can be viewed in the surviving correspondence from which much of this paper is based, revealing the important role of informal channels of enthusiastic patrons in the dissemination of meteorological knowledge, thanks to the regular trans-pacific mail route and, of course, the development and expansion of the telegraph. These interchanges put scientists and amateurs in direct contact with one other, benefitting both metropole and settler societies.[103]

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[103] Historical geographer Alan Lester has termed it an "imagined geography of empire." Bertrum H. MacDonald, "The Smithsonian Institution and Nineteenth-Century Diffusion of Scientific Information Between the United States and Canada," *Science in Print*, Rima D. Apple, Gregory J. Downey, and Stephen L. Vaughn, eds. (Madison: University of Wisconsin Press, 2012), 87–106; Sally Kohlstedt, "International Exchange and National Style: A View of Natural History Museums in the United States, 1850–1900," *Scientific Colonialism: A Cross-Cultural Comparison*, Nathan Reingold and Marc Rothenberg, eds. (Washington, D.C.: Smithsonian Institution Press, 1987), 167–90.