Rulers of the Winds

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Chapter 1

Building Networks for Science: Conflict and Cooperation in Nineteenth-Century Global Marine Studies[1]

On the 23rd of August 1853, twelve delegates from ten different countries convened in Brussels with the aim of reaching agreement on a uniform system of meteorological and hydrographic observations aboard ships. The celebrated Belgian polymath Adolphe Quetelet presided over the meeting. This gathering was noteworthy in three respects. To begin with, it was one of the earliest international scientific congresses ever held. Second, the participants were, with the exception of the president, almost all naval officers. And finally, an unparalleled large-scale project lay behind this attempt at standardization that was to result in fast and safe sailing routes across the oceans.[2]

The maritime conference marks a transitional phase in the history of science when the boundaries of scientific practice were not clearly defined. During this time, academically trained members of the scientific elites, or "gentlemen of science" as the scientific clerisy came to call itself, were gradually setting themselves up as the exclusive gatekeepers of the newly emerging scientific disciplines.[3] While mapping physical quantities across the earth had become the dominant form of scientific inquiry since Alexander von Humboldt's famous

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[1] A shortened version of this chapter was published in *Isis*. Azadeh Achbari, "Building Networks for Science: Conflict and Cooperation in Nineteenth-Century Global Marine Studies," *Isis*, 2015, *106*: 257–82.

[2] On the meeting as one of the first international conferences see Pierre-Yves Saunier, *Transnational History* (Hampshire: Palgrave Macmillan, 2013), pp. 85–86. *Maritime Conference held at Brussels for devising an uniform system of meteorological observations at sea. August and September 1853* (Brussels, 1853).

[3] Jack Morrell and Arnold Thackray, *Gentlemen of Science: Early Years of the British Association for the Advancement of Science* (Oxford: Oxford University Press, Clarendon Press, 1982), pp. 21–29; and Susan Faye Cannon, *Science in Culture: The Early Victorian Period* (New York: Science History Publication, 1978), p. 34.

travels, investigations of the atmosphere and the ocean surface had not been appropriated by these elites.

This phase was part of a more extensive period that has often been described as a period of transformation from natural philosophy to modern science with differentiated disciplines and specialisms, and with the separation of scientific work from unqualified research. As David Cahan, editor of the volume *From Natural Philosophy to the Sciences*, notes, "the scientific enterprise underwent enormous and unprecedented intellectual and social changes." In this period "the modern disciplines of chemistry, physics, mathematics, biology, and the earth sciences … assumed their more or less contemporary form and simultaneously reshaped the institutional landscape of science."[4]

The transformation of natural philosophy into modern science has been so successful that it has blurred our view of preceding ways of knowledge production that do not fit the resulting categories and their continuity with practical affairs. So it seems pertinent to take a closer look at the very distinctions that were made at the time between science and other forms of intellectual activity, and the creation of hierarchies, differentiating between "abstract"' or "theoretical," and "practical" science.[5]

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[4] David Cahan, "Looking at Nineteenth-Century Science: An Introduction," in *From Natural Philosophy to the Sciences*, ed. Cahan (Chicago: University Chicago Press, 2003), pp. 3–4.

[5] In the scholarly literature, the nineteenth-century distinction between "abstract" or "theoretical," and "practical" science is often treated as self-evident. See, for example, the discussion of the "strong practical orientation of the [mathematical] practitioners" versus the "abstract mathematical gyrations [of the members of the Cambridge network]" in David Philip Miller, "The Revival of the Physical Sciences in Britain, 1815–1840," *Osiris*, 1986, N.S. *2*:107–134, on pp. 109–110. A more recent study by Robert Bud is not quite informative either. He traces the phrase "practical science" in early nineteenth-century Britain. Then the term was "simply used to describe the practice that complemented theoretical knowledge." Robert Bud, " 'Applied Science': A Phrase in Search of a Meaning," *Isis*, 2012, *103*:537–545, on pp. 541–542. Two exceptions are the studies by Daniel Kevles and Paul Lucier on American science following the Civil War. Kevles offers a definition of the two categories, with " 'abstract' science as the study of nature for the sake of understanding its substance, its working, its laws; and 'practical' science as the exploitation of nature and nature's laws for the sake of material development." Daniel J. Kevles, *The Physicists: The History of a Scientific Community in Modern America* (New York: Random, 1977), pp. 7–8. In

Helen Rozwadowski, Michael Reidy, Katherine Anderson, Fabien Locher, and James Cawood have written excellent histories of mid-nineteenth-century studies of the ocean's depths, the tides, the atmosphere, and the properties of the earth's magnetic field.[6] This chapter builds on their work by analyzing the transformation of the investigations of physical phenomena at sea, which although not distinct as a separate branch of science, gradually grew to acquire increasing social relevance in the mid-nineteenth century and were appropriated to the scientist's professional domain.

As Rozwadowski points out, "early ocean science," like other Humboldtian field sciences "blended the promise of tangible economic benefit with the political potency that derived from mapping and discovering." As such, these sciences were particularly relevant in relation to contemporary global trade and colonial expansion.[7] This chapter shows how nineteenth-century Dutch university professors promoted their field sciences of astronomy, meteorology, and hydrography by conjuring up visions of potential commercial,

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Paul Lucier, "The Professional and the Scientist in Nineteenth-Century America," *Isis*, 2009, *100*:699–732, the author discerns two types of people involved in nineteenth-century American science: the "professional" seeking commercial relations with private enterprises, and the "scientist," who rejected such commercial work. See also Paul Lucier, "The Origins of Pure and Applied Science in Gilded Age America," *Isis*, 2012, *103*:527–536.

[6] Helen M. Rozwadowski, *Fathoming the Ocean: The Discovery and Exploration of the Deap Sea* (Cambridge, Mass.: Belknap, 2005); Michael S. Reidy, *Tides of History: Ocean Science and Her Majesty's Navy* (Chicago: University Chicago Press, 2008); Katharine Anderson, *Predicting the Weather: Victorians and the Science of Meteorology* (Chicago: University of Chicago Press, 2005); Fabien Locher, *Le savant et la tempête: Étudier l'atmosphère et prévoir le temps au XIXe siècle* (Rennes: Presses University Rennes, 2008); John Cawood, "The Magnetic Crusade: Science and Politics in Early Victorian Britain," *Isis*, 1979, *70*:492-518; and John Cawood, "Terrestrial Magnetism and the Development of International Collaboration in the Early Nineteenth Century," *Annals of Science*, 1977, *34*:551-587.

[7] Rozwadowski, *Fathoming the Ocean* (cit. n. 6), p. 5 (quotation). Since Cannon's canonical work on the subject, the type of field study that Alexander von Humboldt carried out for most of his life has come to bear his name. Cannon, *Science in Culture* (cit. n. 3), pp. 76–78, 105. On the economic and political relevance of early ocean science see Reidy, *Tides of History* (cit. n. 6), p. 282; Anderson, *Predicting the Weather* (cit. n. 6), pp. 235–237; Miller, "Revival" (cit. n. 5), pp. 113–115; and Hugh Richard Slotten, *Patronage, Practice and the Culture of American Science: Alexander Dallas Bache and the U.S. Coast Survey* (Cambridge: Cambridge University Press, 1994), p. 45.

economic, imperial, and military benefits, such as the means for safe navigation or improvements in mapping. They entered into a mutually beneficial relationship with naval officers in a far from straightforward process, in order to attract the attention of the emerging nation-states and win support for their field investigations, which they promoted as being practically applicable, commercially rewarding, and consequently of national importance. By collaborating with navy departments, the professors sought to give their research the public legitimacy needed for the establishment of official research institutes. At the same time they had to take constant care to maintain their autonomy.

Naval officers hoped to gain from cooperating with professors, on the assumption that their connection with science and its growing visibility in society would give them the opportunity to obtain scientific credentials and advance socially. They followed the example of an older generation of naval and military officers like Francis Beaufort, Louis Duperrey, and Edward Sabine who encouraged their subordinates to undertake scientific research while abroad, and who achieved major scientific results themselves.[8]

This chapter argues that the shared interests of naval officers and professors in maritime investigations did indeed create opportunities for mutual cooperation, which eventually helped to establish the study of marine currents and winds as a significant branch of science. However, the perceived need of cooperation also gave rise to serious tensions in the relationships between academic men and naval officers. These tensions could derive from personal and professional disagreements or national rivalries and interests. Who was to assume a leading role and who would have to submit to a subordinate role? Who was allowed to speak in the name of science? How were scientific ambitions and practical concerns to be balanced?

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[8] Cannon, *Science in Culture* (cit. n. 3), pp. 44, 45; and Miller, "Revival" (cit. n. 5), p. 123. Cannon's description of Sabine and Beaufort as the "scientific men of the armed forces" or "scientist[s] of the government department" is telling; there is no proper labelling for these men who had accomplished major scientific results, but were not scientists in the modern use of the term.

According to Thomas Gieryn, both "interests" and "strains" are meaningful markers, and help to understand the types of strategies that scientists used as a means to demarcate their science from other forms of intellectual inquiry in order to create professional authority, a process which he names "boundary-work." In a short but influential paper, Gieryn explained how scientists have been using boundary-work as a strategy to expand, monopolize, or protect their professional authority and resources "by distinguishing their work and its products from non-scientific intellectual activities."[9]

Boundary-work is an important theme in Reidy's history of nineteenth-century investigations of the tides. He demonstrates how William Whewell created space for the "scientist" by ensuring the cooperation of instrument makers, observers, calculators, and other "subordinate labourers," whose participation in the large-scale geophysical sciences was indispensable. At the same time, he shows how Whewell's compelling rhetorical style aimed to subsume the role of subordinate labourers in the process of scientific knowledge creation, thereby establishing and securing the authority of the scientists.[10]

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[9] Thomas F. Gieryn, "Boundary-Work and the Demarcation of Science from Non-Science: Strains and Interests in Professional Ideologies of Scientists," *American Sociological Review*, 1983, *48*:781–795, on p. 781. For studies on scientists' attempts to define their role and position the boundaries of science see also Peter J. Bowler and Iwan Rhys Morus, *Making Modern Science: A Historical Survey* (Chicago: University Chicago Press, 2005), pp. 333–334; Iwan Rhys Morus, *When Physics Became King* (Chicago: University Chicago Press, 2005), p. 53; Thomas F. Gieryn, *Cultural Boundaries of Science: Credibility on the Line* (Chicago: University Chicago Press, 1999), pp. 4–5; Bernard Lightman, "Introduction," in *Victorian Science in Context*, ed. Lightman (Chicago: University Chicago Press, 1997), p. 10; Richard Yeo, *Defining Science: William Whewell, Natural Knowledge, and Public Debate in Early Victorian Britain* (Cambridge: Cambridge University Press, 1993), pp. 28–29; and Miller, "Revival" (cit. n. 5), p. 133. See also Frank M. Turner, "The Victorian Conflict between Science and Religion: A Professional Dimension," *Isis*, 1978, *69*:356–376, on pp. 360–362; Roy Porter, "Gentlemen and Geology: The Emergence of a Scientific Career, 1660–1920," *Historical Journal*, 1978, *21*:809–836, on pp. 809–811; and Nathan Reingold, "Definitions and Speculations: The Professionalization of Science in America in the Nineteenth Century," in *The Pursuit of Knowledge in the Early American Republic*, ed. Alexandra Oleson and Sanborn C. Brown (Baltimore: Johns Hopkins University Press, 1976), pp. 33–69.

[10] Reidy, *Tides of History* (cit. n. 6), pp. 238–246.

Reidy discusses the role of the British Admiralty primarily as an ally for science. He argues that a cooperative relationship developed between the Admiralty and the scientific elite dating from the beginning of the nineteenth century, a bond that was cemented during the century.[11] The current chapter, by contrast, discusses how men such as Whewell and Herschel, followed by Bache and Henry, and their Dutch peers, Buys Ballot and Kaiser, marginalized the role of naval officers in scientific research to their own advantage.

This chapter examines the complexities of the boundary-work involved in the efforts of naval officers and men of science to create (or obstruct the creation of) networks of maritime meteorological and hydrographic investigations across the seas by looking at both Gieryn's interests and strains as motivating forces. Yet instead of taking the scientists' perspective, this chapter sheds light on these complexities from the viewpoint of naval officers, whose constitutive role in the process of network building, the recruitment of observers, the management of data collection, the reduction and analysis of data, and the establishment of official research institutes has been obscured by the successful campaign of elite scientists to claim scientific authority in marine and atmospheric research.

Furthermore, while previous studies have focused on British and American contributions to maritime science, this study takes the establishment of Dutch-American networks as its point of departure, a choice that is motivated by the size and the significance of the Dutch commercial fleet, which was the third largest in the world at the time.[12] It looks into the efforts of two of the leading characters at the Brussels conference prior to the meeting: the American naval officer Maury and the Dutch naval lieutenant Jansen. It shows how these men came to know one another and teamed up, how they responded to encountered difficulties, and how they reached agreements with their fellow officers, men of science and government authorities.

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[11] *Ibid.*, pp. 254–255.

[12] Roger H. Charlier, "Fratres in Maribus 150 Years Ago: The First International Ocean-Science Conference," *Journal of Coastal Research*, 2004, *20*:347–350, on p. 350.

Matthew Fontaine Maury and The Depot of Charts and Instruments

Matthew Fontaine Maury was born into a large farming family in Virginia in 1806. Contrary to the wishes of his father, who wanted his son to take up farming, Maury pursued a career in the Navy. He entered the Navy in 1825 and passed the Lieutenant exam in 1831. In his early studies he developed a fascination for mathematics and its application to navigation. He was dedicated to tackling the challenges arising in the art of navigation and he shared his knowledge by coaching other midshipmen.[13]

When serving on the sloop-of-war *Falmouth* on an official journey along the coast of South America, Maury took great interest in recording precise observations of winds, currents, the state of the weather, the variation of the compass, and astronomical phenomena. The importance of accurate sailing directions and information on winds and currents became clear to him when he was ordered to navigate a ship around Cape Horn.[14] He decided to write a scientific paper about his observations and the best sea passages that he had found in the area. The paper was published in *American Journal of Science and Arts* in June 1834. On board the same sloop *Falmouth*, Maury conceived the idea of writing a textbook on navigation, which he thought was needed for the training of future naval officers. The book was completed in 1835 and published a year later under the title, *A New Theoretical and Practical Treatise on Navigation*.[15]

In 1839 while travelling on a stagecoach through Ohio, Maury was involved in an accident that crippled one of his legs and forced him to retire from active duty. After his accident he remained involved with marine affairs by writing papers for the *Southern Literary Messenger*. His views concerning immediate reform of the navy and national

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[13] Frances Leigh Williams, *Matthew Fontaine Maury. Scientist of the Sea* (New Brunswick, N.J.: Rutgers University Press, 1963), pp. 31–33, 87–88.
[14] Williams, *Maury* (cit. n. 13), p. 91–92; Susan Schlee, *The Edge of an Unfamiliar World. A History of Oceanography* (New York: E.P. Dutton and Co., 1973), p. 38.
[15] Matthew Fontaine Maury, "On the Navigation of Cape Horn," *American Journal of Science and Arts*, 1834, *26*:54-63; Matthew Fontaine Maury, *A New Theoretical and Practical Treatise on Navigation* (Philadelphia: E. C. and J. Biddle, 1845).

marine policy did not go unnoticed. In 1842 he was appointed superintendent of the Depot of Charts and Instruments in Washington, D.C. by the Secretary of the Navy. This was an opportunity for Maury to carry out his maritime ambitions on shore now that his active duties in the navy had ended.[16]

At the Depot, one of Maury's prime tasks was the determination of time by means of highly accurate chronometers. In addition to the lunar-distance method chronometers were being used at the time to establish a ship's longitude so as to find its precise position at sea. Essential for a navigator's calculations was the rate of error of timekeepers that were kept on all ships. Before a vessel went to sea these sensitive instruments were calibrated by astronomical observation.[17]

Many navies of seafaring nations had a special committee that was responsible for the verification of navigation instruments, the examination of naval officers, and the improvement of sea charts. These committees were often part of surveying bureaus, observatories or hydrographic offices established as early as the eighteenth century, which investigated multiple subjects related to seafaring. Ocean currents for instance, which had been known to influence the duration of sea voyages, had come under scrutiny in the 1770s on both sides of the Atlantic by Benjamin Franklin and James Rennell.[18] These studies aimed at assisting the numerous navigators who went on commercial journeys in search of raw materials and new markets for their goods.[19]

In Britain early attempts by the state to support navigators were made through the Board of Longitude, which had been created as a

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[16] Schlee, *Edge* (cit. n. 14), pp. 37–38.

[17] Steven J. Dick, *Sky and ocean joined. The US Naval Observatory 1830-2000* (Cambridge: Cambridge University Press, 2003), pp. 73, 84; Derek Howse, *Greenwich time and the discovery of longitude* (Oxford: Oxford University Press, 1980), pp. 92–94, 116–117.

[18] Benjamin Franklin was one of the first, in the 1770s, to publish about the Gulf Stream and map it. Philip L. Richardson, "Benjamin Franklin and Timothy Folger's First Printed Chart of the Gulf Stream," *Science*, 1980, *207*: 643–645, on p. 643. Rennell charted ocean currents in British naval service and later in the East India Company. Margaret Deacon, *Scientists and the Sea 1650-1900. A Study of Marine Science* (London and New York: Academic Press, 1971), pp. 220–222.

[19] Schlee, *Edge* (cit. n. 14), p. 13.

result of the Longitude Act of 1714. This agency offered public rewards for solutions to the problem of longitude. In the course of the century other initiatives followed. In 1795, the British Admiralty established the Hydrographic Office, the board of which was made responsible for surveys, charts, sailing directions, and other nautical aids.[20] In France, Le Dépôt des Cartes, Plans, Journaux et Mémoires Relatifs à la Navigation was established in 1720 with the purpose of preserving the Navy's maps, charts and instruments, followed in 1795 by Le Bureau des Longitudes which was commissioned with providing and publishing astronomical and navigational data.[21]

These bureaus had their counterparts in other European countries as well. The Dutch 'Commission for the determination of longitude at sea and the improvement of sea charts', for instance, was founded in 1787.[22] In the United States there were two agencies involved in hydrographic investigations and surveys. The Coast Survey was the first to be established, in 1807. This civilian agency, the establishment of which had been lobbied for by a group of East Coast merchants, was given the task of surveying the nation's harbours, ports, and coastal waters. The other, the Depot of Charts and Instruments, instituted in 1830, operated under the flag of the United States Navy.[23]

At his post as the superintendent of the Depot, Maury became responsible for the determination of time, the examination and purchase of instruments, the preservation of charts, and routine

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[20] The Board was in function until 1828 when the British Parliament deemed the issue solved and abolished it. Morrell and Thackray, *Gentlemen of Science* (cit. n. 3), p. 42. Andrew Cook, "Alexander Dalrymple and the Hydrographic Office," in *Pacific Empires. Essays in Honour of Glyndwr Williams*, ed. Alan Frost and Jane Samson (Victoria: Melbourne University Press, 1999), pp. 53–68, on p. 54.

[21] Jean Bourgoin, "La carte marine française, de ses débuts à 1800," *Bulletin du Comité Français de Cartographie*, 1987, *113*:30–32, on p. 31. Olivier Chapuis, *À la mer comme au ciel. Beautemps-Beaupré & la naissance de l'hydrographie moderne (1700–1850). L'émergence de la précision en navigation et dans la cartographie marine* ([Paris]: Presses de l'Úniversité de Paris-Sorbonne, 1999), pp. 159–160; Maurice Crosland, *Science under Control. The French Academy of Sciences, 1795-1914* (Cambridge: Cambridge University press, 1992), pp. 41–42, 143–144.

[22] C.A. Davids, *Zeewezen en wetenschap. De wetenschap en de ontwikkeling van de navigatietechniek in Nederland tussen 1585 en 1815* (Amsterdam and Dieren: De Bataafsche Leeuw, 1985), pp. 188–189.

[23] Schlee, *Edge* (cit. n. 14), p. 24-27.

meteorological studies such as readings of wind direction and wind force.[24] Soon, however, he would experience far-reaching changes in his daily activities. The American Congress was discussing two naval bills that were of great relevance for Maury's professional career. One bill proposed the reform and the reorganization of the Navy into a Bureau system. The other bill concerned the housing of the Depot in a new building, where 'a respectable observatory' could be housed as well. As a result of these two naval bills that were passed in August 1842, the depot was brought under the Department of Ordnance and Hydrography, which strengthened Maury's conviction that its primary function was the preparation of ocean charts.[25] Until then, American ships had relied on foreign charts, French or English, for the open seas but also, surprisingly, for their own waters. Here lay a great opportunity, according to Maury, for the Navy to conduct surveys of the nation's coastline and waterways.[26]

By analyzing and combining the information on weather and currents that Maury found in the large number of logbooks kept at the depot, he and his staff of midshipmen were able to draw up charts and sailing charts for frequently navigated routes, such as the route from New York to Rio de Janeiro. Maury is believed to have followed the example of William Redfield, a transportation engineer and self-taught man, who in the 1820s extracted data from ships' logs to chart the course of hurricanes.[27]

Measurements of the currents were made in at least two ways. Empty bottles, each containing a piece of paper with the exact location

[24] Williams, *Maury* (cit. n. 13), p. 145-146.
[25] Robert V. Bruce, *The Launching of Modern American Science 1846–1876* (New York: Alfred A. Knopf, 1987), p. 177.
[26] Williams, *Maury* (cit. n. 13), p. 148. Although the government-funded U.S. Coast Survey was responsible for the survey and mapping of the coastline, its slow progress gave congressmen reasons to complain. Frequent attempts were made to take over the Coast Survey's tasks. These challenges came from both the army and the navy and continued until well into the 1860s. Apparently, Maury also cherished this ambition. See Slotten, *Patronage* (cit. n. 7), pp. 49–53, 98; and Bruce, *Launching* (cit. n. 25), pp. 170–174.
[27] Schlee, *Edge* (cit. n. 14), p. 38; and W.C. Redfield, *On Whirlwind Storms: With Replies to the Objections and Strictures of Dr. Hare* (New York: J. S. Redfield, 1842), p. 1.

of a ship, were thrown overboard. The destinations of the collected bottles indicated the course of the currents. Another method involved comparing a ship's calculated position at sea with its estimated position, which was obtained by dead reckoning. As currents could cause vessels to drift, the ship itself could serve as an instrument to determine the direction and force of the currents that influenced the course first set out by the captain. A ship's location at sea could be estimated from a known past position by determining its direction and speed. This estimate was then compared with the ship's exact location, which was calculated by the lunar-distance method or by means of timekeepers. The difference between these two values indicated the effect of currents. Wind force was estimated by observing the state of the sea or by the effect of the wind on sails, and was recorded in registers using Beaufort's wind force scale. A wind vane was used to determine wind direction, which was registered by the use of a compass.[28] Logbooks were the perfect means for the charting of winds and currents, since they contained data on exact locations, estimated locations, conditions of the winds, and other variables, which were, in addition, registered on a daily basis. At the depot, masses of logbooks were analyzed in order to find out the average weather conditions of specific sea routes for different times of the year.[29]

Maury's charting method consisted of dividing the seas into squares of five degrees of latitude and longitude, and filling in all the wind and current information found in the logs. This grouping of marine data, known as the Marsden square, had a precedence in the charting practices of the British chief naval assistant in the Hydrographic Office, Alexander Bridport Becher (1796–1865). In 1831, Becher had begun compiling books of meteorological data representing the winds, the

[28] On the method of tracking bottles see Duncan Carr Agnew, "Robert Fitzroy and the Myth of the 'Marsden Square': Transatlantic Rivalries in Early Marine Meteorology," *Notes and Records of the Royal Society London*, 2004, *58*:21–46, on p. 28. On comparing a ship's estimated position with its calculated position see A. D. Morrison-Low, *Making Scientific Instruments in the Industrial Revolution* (Aldershot: Ashgate, 2007), pp. 265–267. On determining wind force and direction see Dennis Wheeler, "An Examination of the Accuracy and Consistency of Ships' Logbook Weather Observations and Records," *Climatic Change*, 2005, *73*:97–116.
[29] Williams, *Maury* (cit. n. 13), p. 149.

weather, and the currents of the Indian Ocean for each month of the year. He used a similar graphical method of representation, dividing the oceans into squares of two degrees latitude and longitude. Maury, however, was probably not aware of Becher's meteorological books when he compiled his track charts. And Becher was soon forced to halt his activities, which he performed out of office hours because of their extremely time-consuming nature.[30]

Maury next envisioned developing charts depicting possible winds and currents at any given location or season. For this purpose, he needed access to more logbooks. His proposal won the approval of his superior, William Montgomery Crane, who ordered all naval captains to submit meteorological, hydrographical, and navigational information. From then on, the depot became engaged in processing the incoming data. In the following years, Maury was able to develop charts with the best routes to the West Indies, South America, and the coasts of California.[31]

The Dutch Naval Officer Marin Henri Jansen

As yet unfamiliar with Maury's charting pursuits, the Dutch naval officer, Marin Henri Jansen, was measuring the same Southeast Asian waterways in the 1840s. His career in the Dutch Navy started in 1831 when he applied at the age of fourteen to the newly established Royal Institute for the Navy. He was a clever and ambitious student who passed the examination for the rank of officer in 1835. Soon he was promoted to the position of lieutenant during a charting mission on the Dutch colonial island of Java.[32]

During the Napoleonic Wars (1804–1815), Java, as part of the Dutch East Indies, had been seized by the British to keep the trade routes to China through Southeast Asia safe from French incursions. Following the defeat of France in 1815, Britain returned the wartime

[30] Agnew, "Robert Fitzroy" (cit. n. 28), pp. 27–28.
[31] Schlee, *Edge* (cit. n. 14), p. 38.
[32] M. H. Jansen and S. P. L' Honoré Naber, *Het leven van een vloothouder: Gedenkschriften* (Utrecht: Kemink, 1925), pp. 51, 137–140.

confiscations to Dutch control. The British pursued a policy aimed at both maintaining a strong Dutch state as a buffer state against France, and avoiding excessive military expenditure for the defence of Southeast Asia.[33] Back in control, the government of the Dutch East Indies resumed the charting practice where it had been left off before the English interlude.

Originally, the *Vereenigde Oost-Indische Compagnie* or Dutch East India Company had organized the charting of the trade area under its command since 1619. At Batavia, the administrative centre of Java, a cartographic bureau had been established which controlled the surveying and charting of the region.[34] After the British interregnum, the Governor General, Van der Capellen, initiated the establishment of a new Committee for the improvement of East-Indian sea charts in 1821. Two years later, a Depot of Charts, Books and Instruments was established to be administered by the Committee.[35]

Few to begin with, the land and waterway surveys grew in number after the reorganisation of the Royal Dutch Navy in 1838, which encouraged the charting of major strategically important sites.[36] In that year, Jansen was given his first assignment to survey the bay of Riouw (Bintan), together with the crew of the *Krokodil*, the ship he served on. In the next two years, the *Krokodil* was commissioned to survey several bays and waterways along the coast of Java, where Jansen gained experience in taking measurements in rough seas.[37]

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[33] Anthony Webster, *Gentlemen capitalists: British imperialism in South East Asia, 1770-1890* (London and New York: I.B. Tauris, 1998), pp. 53, 83-85.

[34] C. J. Zandvliet, *Mapping for Money. Maps, Plans and Topographic Paintings and Their Role in Dutch Overseas Expansion during the 16th and 17th Centuries* (Amsterdam: De Bataafsche Leeuw, 1998) pp. 131-164.

[35] E. G. van der Plaat, "Overzigt van de Hydrografische verrigtingen in den Indischen archipel, gedurende de laatste jaren. (uittreksel uit het verslag van de werkzaamheden der Kommissie tot verbetering der Indische zeekaarten gedurende het jaar 1853)," *Natuurkundig tijdschrift voor Nederlandsch Indië*, 1854, *7*:1-15, on p. 1-2.

[36] Van der Plaat, "Overzigt," (cit. n. 35), p. 4. The British probably prompted the growth of Dutch cartographic activities. Around 1836, the British government warned the Dutch that they would come to the East Indies themselves, to maintain order and to survey and chart the islands, if the Dutch refused taking responsibility. M.H. Jansen, *De zeemagt, beschouwd in verband met de Oost-Indische bezittingen van het rijk* ('s Gravenhage: Erven Doorman, 1847), p. 48.

[37] Jansen and L' Honoré Naber, *Het leven*, (cit. n. 32), pp. 127, 137-143.

In 1846 he became a member of the research committee at Surabaya, one of the largest cities on Java. His tasks consisted of charting the island's reefs, and included tidal observations, examination of changes in water depths, and readings of the force and direction of winds and currents. His daily tasks provided him with a thorough perception of the problems that vessels encountered when they tried to enter Surabaya's harbour. As commerce on the island was expanding every year, the waterway to Surabaya needed to be improved to accommodate the incoming and outgoing vessels. On his own initiative, Jansen made proposals to upgrade the existing waterway, drafted sailing directions to assist navigators, and guided ships into and from the harbour. From the president of the Merchant Company's trading post in Java, Jansen received a golden timekeeper for his efforts. He left the island after rounding off the survey project, saying he was "deeply touched" by the "token of gratitude."[38]

Back in the Netherlands, Jansen was given temporary leave of absence to recover from his long tour of duty. At home, he found other activities to pursue and he decided to put his strong convictions about the state of the Dutch Navy on paper. Jansen published a pamphlet in which he argued that the institution needed to pay more attention to the nation's colonial possessions. He believed that the East Indian archipelago required a strong and active maritime force to control the inhabitants, stimulate commerce, and protect merchants against native and foreign powers. He believed that an increased Dutch presence on the islands also meant that better charts of the colonial coastlines and waterways were necessary.[39]

It is not a coincidence that both Jansen and Maury urged their countries to chart their nations' waterways. Such ideas perfectly fit the age of empire when consolidation of power and territory was a priority. Moreover, the colonial powers were not unwilling to fund projects that would improve worldwide commerce through safer and faster routes. The voyage of HMS *Beagle* around the world in the years

[38] *Ibid.*, p. 224-235. Here and throughout this book, translations into English are my own unless otherwise indicated.
[39] Jansen, *De zeemagt* (cit. n. 36), pp. 3–7, 47–67, 93–94.

1831–1836, for instance, which has become legendary in particular because of Charles Darwin's presence on board, was actually a surveying expedition to South America under Commander Robert Fitzroy. In the United States, cartographic surveys followed in the wake of the westward expansion.[40] Furthermore, the US Congress funded the Exploring Expedition in 1838, to survey the lands and seas of the Pacific Ocean. The promise of new trading areas and better routes in the Antarctic helped convince congressmen to support the expedition. Also, some felt it necessary that America should sponsor its own explorations, just like the British and the French.[41]

Jansen and Maury were not only defending the national interests of their countries but were also trying to establish a formal institutional framework for their cartographic efforts. While Maury brought cartography within the depot's official domain, Jansen pursued a suitably paid position for his surveying and charting activities, which he had been carrying out as part of his naval duties.[42]

Some time after the publication of Jansen's pamphlet, the journal *De Gids* published a reaction by an anonymous writer, who endorsed the need for reforms in marine policy regarding the Dutch colonies. However, the author noticed Jansen's lack of understanding of charting techniques. According to this author, the naval officer had no eye for developments in science that could advance the navigational techniques and tools used by mariners. To strengthen his argument, he referred to the Dutch astronomer Frederik Kaiser, who had often argued for combining astronomy and navigation, "not for the sake of science" but "in the best interests of [a seafaring] nation."[43]

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[40] G. S. Ritchie, *The Admiralty Chart: British Naval Hydrography in the Nineteenth Century* (Edinburgh: Pentland, 1995), pp. 219–240. William H. Goetzmann, *Exploration and Empire: The Explorer and the Scientist in the Winning of the American West* (New York: Knopf, 1966), pp. 231–233.
[41] Schlee, *Edge* (cit.n. 13), pp. 27–28; and Goetzmann, *Exploration* (cit. n. 40), pp. 233–236.
[42] Jansen and L' Honoré Naber, *Het leven* (cit. n. 32), pp. 255–256.
[43] The anonymous review was titled: "Onze zeemagt. Een woord over en naar aanleiding van de brochure: De Zeemagt, door M.H. Jansen," *De Gids*, 1849, *13*:413–426, on pp. 420–421.

It seems likely that it was Kaiser himself who wrote the anonymous reaction.[44] Kaiser was a professor at Leiden University who was beginning to make his name as the nation's expert in astronomy. He had been struggling for years to raise the status of astronomy in the Netherlands. In popular articles that he wrote, he frequently complained about the lack of a proper national institution in the country where astronomical research could be carried out. The Dutch kingdom had, in fact, established a national observatory in the 1820s, but had lost the institution, together with its southern provinces, after the secession of Belgium in 1830.[45] Consequently, the Netherlands had no official national observatory. The notable Dutch astronomer was confined to a "draughty and gaunt" space in the attic of the Leiden Academy to do his astronomical research.[46]

To win public legitimacy for the establishment of a national observatory, Kaiser often emphasized in his publications the benefits to be derived from practical astronomy for navigation.[47] By writing about seafaring, a public concern at the very heart of a maritime power, he hoped to raise awareness among influential people who could support him in advancing his astronomical plans. More important still, he suggested repeatedly that the Dutch Navy accept the scientific services

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[44] Note, for example, the similarities in diction and style in *ibid.*, pp. 415–416, 420; and F. Kaiser, *De sterrekundige plaatsbepaling in den Indischen Archipel, en de maatregelen op gezag van Z.E. den Minister van Koloniën, tot hare voorbereiding genomen* (Amsterdam: Sulpke, 1851), pp. 1–4.

[45] Elly Dekker, "Frederik Kaiser en zijn pogingen tot hervorming van 'Het sterrekundig deel van onze zeevaart,' " *Tijdschrift voor de Geschiedenis der Geneeskunde, Natuurwetenschappen, Wiskunde en Techniek (TGGNWT)*, 1990, *13*:23–41, p. 26. For Kaiser's comments in his popular publications see, for example, F. Kaiser, *Het Observatorium te Leiden* (Leiden: H. W. Hazenberg, 1838), pp. 16–17; F. Kaiser, "Gotha en de Seeberg," *De Gids*, 1848, *12*:319–368, on p. 366; and Kaiser, *De sterrekundige plaatsbepaling* (cit. n. 44), pp. 2–3, 10, 32–33. The official correspondence concerning the establishment of a national observatory is kept at the Royal Academy in Belgium: Académie Royale de Belgique, Brussels, CAQ, no 38.

[46] P. de Geer, "De Leidsche sterrenwacht en haar stichter," *Vaderlandsche Letteroefeningen*, 1873, *113*:541–574, on p. 545.

[47] F. Kaiser, *De Sterrenhemel. Tweede deel* (Amsterdam: Sulpke, 1845), pp. 31–32; Kaiser, *Beschouwingen van den sterrenhemel* (Leeuwarden: Suringar, 1849), p. 189; and Kaiser, *De sterrekundige plaatsbepaling* (cit. n. 44), pp. 2–3.

that he as a "qualified" and "experienced practical astronomer" could offer to seafaring.[48]

It is interesting to note that Kaiser characterized himself as a "practical" astronomer. In the early nineteenth century astronomy was divided in two separate branches of investigation. Practical astronomy was concerned with making observations, and classifying and recording all heavenly phenomena by instruments and calculations. Its complement, "physical" astronomy, was concerned with explaining the motions of heavenly bodies by applying the law of universal gravitation. In the late 1840s, a third branch was also recognized. "Spherical" astronomy dealt with determining the location of objects on the celestial sphere.[49] Yet, no sharp distinctions were drawn between the branches and the boundaries shifted regularly. Physical and spherical astronomy, for instance, were often referred to as theoretical astronomy.[50] At times, practical astronomy as a category was reduced to only those activities that related to the use of instruments, while calculations were classified as theoretical.[51]

The epithet "practical," however, also highlighted the act of practicing astronomy as if it were a trade or a skill. A practical astronomer was a skilled astronomer, who knew how to use the instruments and eliminate errors in observations and computations. Kaiser, for instance, constantly characterized himself as an experienced man of science, who had studied the latest "mathematical theories,"

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[48] Kaiser, *De Sterrenhemel* (cit. n. 47), p. vii; and Kaiser, *De sterrekundige plaatsbepaling* (cit. n. 44), pp. 15–16, 42–43.

[49] Charles Bossut, *Essai sur l'Histoire Générale des Mathématiques. Tome Second* (Paris: Louis, 1802), p. 190; Gustav Adolph Jahn, *Practische Astronomie, oder, Beschreibung und Gebrauch der vorzüglichsten astronomischen Instrumente und Tafeln* (Berlin: Reimer, 1834), p. xiii; Kaiser, *Het Observatorium* (cit. n. 45), p. 37; Denison Olmsted, *An Introduction to Astronomy: Designed as a Textbook for the Use of Students of Yale College* (New York: Collins, Keese, 1839), p. 1; Johann Heinrich von Mädler, *Populäre Astronomie* (Berlin, Heymann: 1849), pp. 1–2; Robert Grant, *History of Physical Astronomy, from the earliest ages to the middle of the XIXth Century* (London: Bohn, 1852). pp. iii, 501; and James Challis, *Lectures on Practical Astronomy and Astronomical Instruments* (Cambridge: Deighton, Bell, 1879), pp. 1–2.

[50] Johann Georg Heck, *Bilder-Atlas zum Conversations-Lexikon* (Leipzig: Brockhaus, 1849), p. 20.

[51] Kaiser, *Het Observatorium* (cit. n. 45), p. 37; Challis, *Lectures* (cit. n. 49), pp. 1–2; and Mädler, *Populäre Astronomie* (cit. n. 49), pp. 1–2.

and possessed the know-how to "use the instruments properly." Distinct from other branches of astronomy, practical astronomy came to mean that it could deliver material solutions to problems encountered in practice. "Practical" thus emphasized the utility of astronomical observations for challenges in areas such as navigation, surveying, and mapping.[52]

In a detailed study, Kaiser explained the utility of practical astronomy for the Dutch surveying projects in the East Indies. Referring to Jansen's surveying mission, he claimed that the charts and maps of different parts of the island of Java were "useless" unless they were linked by means of "astronomical positioning" so as to create a coherent representation of the entire area. As it was, not a single location on Java had so far had its coordinates determined astronomically. In Kaiser's words, it was the "[government's] duty to start with the astronomical observations, to which important material concerns of the mother country [were] tied."[53]

The anonymous reaction urged Jansen to contact Van den Bosch, the minister of the navy, and encourage him to involve Kaiser in the preparation of charts. The minister gave Jansen permission to ask for Kaiser's assistance. Once involved, Kaiser explained the absence of astronomical determination of coordinates in Dutch cartographic practices by the "lack of knowledge in practical astronomy" among naval officers.[54] For the astronomical survey specific knowledge and tools were required, he argued, and who knew better what tools to use and which skills were required than the expert himself?

Kaiser made no attempts to hide his opinions about the existing Dutch policy concerning the surveys of the East Indies. In his view, the government's plans to finance a complete, new astronomical station on

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[52] Kaiser, *De sterrekundige plaatsbepaling* (cit. n. 44), pp. 40–54. Note how "practical astronomy" in this sense approaches Daniel Kevles's definition of "practical science." Kevles, *The Physicists* (cit. n. 5), pp. 7–8. Kaiser discussed in what ways practical astronomy could be used to solve problems in navigation and mapping in *De Sterrenhemel* (cit. n. 47), p. 32.

[53] Kaiser, *De sterrekundige plaatsbepaling* (cit. n. 44), pp. 1–4, 11.

[54] On Jansen being given permission to ask for Kaiser's help see *ibid.*, pp. 4–5; and Jansen and L' Honoré Naber, *Het leven*, (cit. n. 32), pp. 255–256. For Kaiser's comment see Kaiser, *De sterrekundige plaatsbepaling* (cit. n. 44), pp. 6–7.

Java made absolutely no sense "while ... the mother country possess[ed] nothing that resemble[d] a real observatory." He seemed to have thought that the chances of establishing a national observatory in the home country would only diminish if there was already a station on Java. Instead, he hinted at the establishment of a national observatory in the Netherlands first, where personnel could be trained.[55]

An effective agreement resulted from the meeting between Jansen and Kaiser. Jansen's intervention enabled Kaiser to find an entré into Dutch naval circles. The minister agreed with Jansen that Kaiser's involvement as astronomer would advance the surveying project of the East Indies. Accordingly, it was arranged that Kaiser would train one naval officer per year for a period of two years at the Leiden Academy to carry out the project. Naval officers would learn from Kaiser how to use instruments for the readings and they would pass on their knowledge to their fellow officers when they were on a mission.[56]

The first officer under Kaiser's guidance was S. H. de Lange. In 1850, De Lange was officially promoted to geographical engineer and was sent to the East.[57] Although Kaiser was glad that he had managed to play a role in the charting project as the scientific expert, he had to wait until 1857 to finally have his actual wish fulfilled and to see a proper astronomical observatory established in Leiden.[58]

Jansen, on the other hand, was pleased that his astronomical positioning project in the Dutch East Indies was finally realized. A small part of his proposal, however, was not implemented. He had also proposed the establishment of a national hydrographical bureau that would take charge of the geographical survey of the East Indian archipelago and would be responsible for the storage of charts. The departure of Van den Bosch as minister of the navy interfered with Jansen achieving all his goals. Nevertheless, he was satisfied with the results he did obtain.[59]

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[55] Kaiser, De sterrekundige plaatsbepaling (cit. n. 44), pp. 8, 10–11, 12.
[56] Jansen and L' Honoré Naber, *Het leven* (cit. n. 32), pp. 255, 267.
[57] Kaiser, *De sterrekundige plaatsbepaling* (cit. n. 44), pp. 13–23.
[58] De Geer, "De Leidsche sterrenwacht" (cit. n. 46). p. 555.
[59] Jansen and L' Honoré Naber, *Het leven* (cit. n. 32), pp. 255–256.

Jansen's acquaintance with Kaiser not only resulted in initiating the astronomical positioning in the East, but proved crucial to Jansen's career in other respects too. When Jansen received orders to sail to the West Indies and Central America in 1851, Kaiser gave him a copy of Maury's charts and *Explanations and Sailing Directions to Accompany the Wind and Current Charts* (widely known as *Sailing Directions*) to take along with him. Jansen must have become very excited about carrying out investigations himself when he read Maury's directions. Aboard the vessel *The Prince of Orange* he used the directions to determine the course to St. Eustatius and, in his account, it proved to be shorter than the course set out by the ship's commander. With a strong sense of anticipation, Jansen set off to Washington, DC, to meet Maury in person.[60]

Collaborating with Academics

Before we discuss Jansen's journey to Washington in 1851, it will be useful to take a closer look at the nature of his relationship with Kaiser. This may shed light on why these men with their different backgrounds considered cooperating with each other. The agreement that resulted from the meeting between Jansen and Kaiser shows how each was dependent on the other to advance his own cause. Jansen, the naval lieutenant, could use Kaiser's name and title to lend scientific status to the surveying project, which would be carried out in accordance with the latest astronomical methods.

Kaiser, on the other hand, argued that it was "highly recommended that … use is made of our existing astronomy in the interest of the nation and its overseas possessions." He also advised that Dutch "military and naval officers [should be] trained at an observatory by a qualified astronomer."[61] He clearly viewed Jansen's project as a matter of national concern that, he suggested, required the expertise that he

[60] *Ibid.*, pp. 278–279, 283–285. Matthew Fontaine Maury, *Explanations and Sailing Directions to Accompany the Wind and Current Charts* (Washington, D.C.: C. Alexander, 1851).

[61] Kaiser, *De sterrekundige plaatsbepaling* (cit. n. 44) pp. 3, 7.

could offer as a professor in astronomy. By repeatedly emphasizing the practical utility of his research and offering his scientific services to society, Kaiser hoped to gain public support and induce the government to establish a proper astronomical observatory in Leiden. At the observatory he would again be serving the state by training the officers.[62]

A similar bond of convenience was forged between Jansen and another man of science in Dutch academic circles, Christopher Buys Ballot. Because of the striking similarities in these cases of cooperation, it is worthwhile having a look at the nature of Jansen's relationship with Buys Ballot as well. By considering the circumstances that brought these men with diverging interests together, the importance of the role that Jansen played in connecting them to the same work is brought into sharper focus.

Buys Ballot, a professor in mathematics at Utrecht, had begun taking an interest in weather conditions in 1844. When still a student at the University of Utrecht, he had published a paper on the periodical variation of air temperature due to the rotation of the sun. For this purpose, he had studied a series of weather observations made in the Netherlands since 1729. During a visit to the Brussels observatory in 1847, in the same year that he was appointed professor, he met the Belgian astronomer Quetelet. Impressed by the astronomical and meteorological observations that were being made in Brussels, Buys Ballot adopted the idea of establishing a meteorological observatory in Utrecht. For someone who aspired to a career in science, he had by now come to view the study of the weather as a suitable and promising niche.[63]

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[62] Phrases that related to the national importance of astronomy can be found in abundance in Kaiser's publications; for example, "astronomy [could] advance the material well-being of the country," "practical astronomy [is] an essential necessity in society." and "the advancement [of astronomy] is essential for … the material prosperity of the people." Kaiser, "Gotha en de Seeberg" (cit. n. 45), p. 368; Ludwig Bleibtreu, Gerard Moll, and Friedrich Kaiser, *Beschrijving van den sterrenhemel* (Amsterdam: Sulpke, 1830), p. xvi; and Kaiser, *Beschouwingen* (cit. n. 47), p. iii.
[63] E. van Everdingen, *C.H.D. Buys Ballot 1817–1890* (The Hague: Daamen, 1953), pp. 57–58. C. H. D. Buys Ballot, *Toespraak over de noodzakelijkheid eener veelzijdige beoefening van wetenschap* (Utrecht, 1846), p. 37.

Within a year, he had found a suitable location in an old Utrecht military fort, known as Sonnenborgh, and he had asked his companions from his university days to assist him with making weather observations. His former tutor at the university, Richard van Rees, provided the necessary instruments. Frederik Krecke, a friend and fellow student, agreed to carry out the observations, and designed and built several additional instruments for this purpose. In the following years, Buys Ballot published more papers on weather-related subjects, such as the influence of weather conditions on plant growth.[64]

Buys Ballot was convinced that existing meteorological studies, which at the time concentrated chiefly on mapping the average values of air temperature, air pressure, and the force and direction of the wind, would gain significantly from synoptic observations carried out at widespread stations. The development of the electric telegraph, which facilitated a rapid exchange of data, promised significant assistance. From research into the deviations of the acquired values, Buys Ballot hoped to discern underlying laws, which might eventually result in the possibility of making weather predictions. As his study of synoptic observations required large numbers of measurements, he was from the start keen to create a network of observers. Soon he began recruiting observers at seven other stations in the Netherlands. In 1851, he was ready to publish the results of the observations from the preceding two years.[65]

A logical next step in Buys Ballot's undertaking was to widen the scope of his meteorological studies by including observations that were made abroad. To this end, he travelled around Europe to establish connections with leading men of science at thirteen different

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[64] In July 1849, Van Rees wrote to his friend Quetelet about Buys Ballot's plan to establish a meteorological observatory in Utrecht; see Richard van Rees to Adolphe Quetelet, 18 July 1849, CAQ, no 2095. C. H. D. Buys Ballot, *Verslag omtrent waarnemingen aangaande het verband van weersgesteldheid en plantengroei* (Utrecht, 1849).

[65] C. H. D. Buys Ballot, "On the great importance of *Deviations* from the mean state of the Atmosphere for the Science of Meteorology," *Philosophical Magazine*, 1850, *37*:42–49, on p. 43. C. H. D. Buys Ballot, *Uitkomsten der meteorologische waarnemingen gedaan in 1849 en 1850 te Utrecht en op eenige andere plaatsen in Nederland* (Utrecht: Kemink en Zoon, 1851), pp. 1–2, 20–24, 27.

observatories (Brussels, Paris, Greenwich, Richmond, Cambridge, Hamburg, Berlin, Prague, Dresden, Munich, Heidelberg, Frankfurt, and Bonn). Through these connections, he hoped to establish a transborder network of meteorological stations around a central observatory.[66] He envisioned the Sonnenborgh observatory in Utrecht as the centre of a European meteorological network, where all observations could be gathered and processed into weather reports and then distributed across the continent with use of the telegraph.[67]

Yet, in order to position the Sonnenborgh observatory at the center of a European meteorological network or, in other words, to claim the authority to establish connections at the international level, he needed the Utrecht station to obtain the status of an official state institute.[68] For this purpose, he needed to convince the Dutch Minister of the Interior Johan R. Thorbecke that the research conducted at Sonnenborgh was of public concern. Thorbecke was known as a conservative statesman who would only be willing to support private initiatives that yielded clear practical results. To satisfy this requirement, Buys Ballot used his connection with Jansen, with whom he had come into contact in 1849.[69]

Just a year before, the naval officer had been offered a position as an official at the Ministry of the Colonies. In this position, he was often in contact with the minister of the navy. Buys Ballot asked Jansen to intervene on his behalf and to appeal to the minister to have logbooks of warships sent to him for study; the navy Minister agreed.[70] Having

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[66] Van Everdingen, *Buys Ballot* (cit. n. 63), p. 59. Buys Ballot, *Uitkomsten* (cit. n. 65), p. 2.

[67] C. H. D. Buys Ballot, *Meteorologische waarnemingen in Nederland en zijne bezittingen en afwijkingen van temperatuur en barometerstand op vele plaatsen in Europa 1854* (Utrecht, 1854), p. iii; and Buys Ballot, "On the great importance of *Deviations*" (cit. n. 65), p. 43.

[68] Frans van Lunteren, "De oprichting van het Koninklijk Nederlands Meteorologisch Instituut: Humboldtiaanse wetenschap, internationale samenwerking en praktisch nut," *TGGNWT*, 1998, *21*:216–243, on p. p. 232.

[69] Jansen and L' Honoré Naber, *Het leven* (cit. n. 32), p. 292.

[70] *Ibid.*, p. 250; Engelbertus Lucas to C. H. D. Buys Ballot, 22 May 1850, National Archives of the Netherlands (hereafter NA), The Hague, entry 2.12.01 Ministry of Navy, inventory 2259.

established a connection with the Dutch Navy, Buys Ballot could now promote his work at the observatory as being in the general interest.

Just like Kaiser, who repeatedly stressed the utility of practical astronomy for navigation and surveying in order to obtain ministerial approval for the astronomical positioning project, Buys Ballot used utilitarian arguments to win the support of Thorbecke. In a letter to the minister, Buys Ballot emphasized the following: "The application [of meteorology is] important to shipping and trade; the advancement of the science will also be of great importance to agriculture and industry. However, [meteorology] cannot advance and be practically useful, without the establishment of a centre where observations … are collected." Buys Ballot's analysis of the maritime observations promised to increase knowledge of the weather at sea. The state would benefit greatly from his research, which promised to deliver practical results by way of finding shorter routes to the East Indies or preventing ships from being shipwrecked.[71]

These practical benefits buttressed Buys Ballot's request to the government to transform the Sonnenborgh observatory into a state institute. And Jansen, an experienced navigator himself, supported him by promoting the extension of the research that was carried out at the observatory and affiliated stations to seafaring circles. He campaigned actively to secure their cooperation with Buys Ballot's meteorological program. In this way, Jansen enabled Buys Ballot to extend his network of observers.[72] He continued to support the Utrecht professor by mediating with the Dutch shipmasters and the minister of the navy, which was crucial for Buys Ballot to obtain access to logbooks. The similarities to the astronomical positioning project, which involved Jansen's other academic ally, Kaiser, are evident. Once again, he acted as an intermediary between a man of science and the state, facilitating governmental support for scientific research. Next, he would be

[71] C. H. D. Buys Ballot to Johan R. Thorbecke, 19 July 1852, Utrecht Archive (hereafter UA), Utrecht, entry 90 KNMI, inventory 1192.
[72] Van Everdingen, *Buys Ballot* (cit. n. 63), pp. 61–62.

building ties across the ocean by mediating between Buys Ballot and the American lieutenant Matthew Maury.[73]

Trust and Rivalry

When Jansen met Maury in 1851, Maury was already a national celebrity and widely acclaimed for his marine investigations.[74] Around 1840, however, he was struggling to win governmental support for a vast system of meteorological data compilation. In 1843, he was appointed one of the directors of the National Institute for the Advancement of Science. To realize his meteorological project Maury needed to win over the majority of the Institute's members. During one of his first meetings at the institute, he lobbied for his plan to have blank charts, which he had designed himself, filled in with hydrographical and meteorological observations by all government vessels. In this way, he would achieve a regular system of observation and be assured of receiving the relevant data that he needed. After discussing the plan with other members of the institute, Secretary of the Navy Abel P. Upshur agreed to it.[75] Still, despite the official request, naval captains often refused to cooperate with Maury's meteorological research. They were apparently not easily persuaded to make the required observations.[76]

In other meetings at the Institute Maury further popularized his goals and interests. He had a deep fascination for the kind of research that Alexander von Humboldt had initiated. In 1849, he decided to write to Humboldt himself and to inform him of the results of his

[73] Jansen introduced Buys Ballot to Maury and familiarized him with his work. C. H. D. Buys Ballot to M. F. Maury, 24 July 1852, National Archives and Records Administration (hereafter NARA), Washington, DC, Record Group 78.2 Records of the Naval Observatory, entry 7 letters received.

[74] Bruce, *Launching* (cit. n. 25), pp. 177, 181.

[75] Williams, *Maury* (cit. n. 13), p. 153. Charles Lee Lewis, *Matthew Fontaine Maury* (1927; repr., New York: Arno, 1980), pp. 51–52.

[76] A reviewer of Maury's *Sailing Directions* (cit. n. 60) wrote: "It is not to be supposed that Mr. Maury did not meet with both opposition and difficulty in the prosecution of his enterprise. There is no class of people more opinionated, or who more dislike innovation, than old sailors." The quote is cited in "Maury's Sailing Directions," *Hunt's Merchants' Magazine and Commercial Review*, 1854, *30*:531–547, on p. 532.

studies. Five years previously the proposed Naval Observatory had been constructed, and Maury was promoted to act as its superintendent.[77] Through his work at the observatory he had probably come into contact with the Hamburg astronomer Carl Rümker while compiling a catalogue of stars. It was Rümker who brought Maury in touch with the world's most famous naturalist and explorer, and he mediated in sending Humboldt a set of Maury's charts. Humboldt did not respond immediately. Yet, in 1851 when Maury contacted him again through the Prussian ambassador Friedrich von Gerolt in Washington, DC,, Humboldt sent him a letter of praise for his undertakings in maritime research, and wrote of his support for initiatives.[78]

The network of acquaintances that Maury built up during this period, including savants like Humboldt, may have helped him to secure wider academic support for his efforts. On behalf of Humboldt, for example, the president of the geographical society in Berlin, Carl Ritter, praised Maury's work during a meeting and thanked him publicly for his accomplishments in the field. Also, through these contacts Maury could spread his ideas and promote his cause. However, he had to deal with opposition from individuals he would normally have considered as colleagues. His contacts with the "Lazzaroni," a group of American men of science who endeavored to bring American scientific contributions to European quality, were especially troublesome; their leader Alexander Dallas Bache was especially difficult. Bache and Maury often frustrated each other's plans.[79] It is pertinent to discuss the uneasy relationships they had with

[77] Williams, *Maury* (cit. n. 13), p. 188. Lewis, *Maury* (cit. n. 75), pp. 44-45.

[78] Reinhard A. Krause, "Georg von Neumayer (1826–1909)–A Pioneer of Antarctic Research," *Berichte zur polar- und meeresforschung*, 2007, *560*:112–121, on p. 112. See Rümker's letter to Humboldt in Friedrich Wilhelm Heinrich Alexander von Humboldt and Ingo Schwarz, *Alexander von Humboldt und die Vereinigten Staaten von Amerika. Briefwechsel* (Berlin: Akademie-Verlag, 2004), p. 257. Williams, *Maury*, p. 208; and see Humboldt's letter to Maury in Humboldt and Schwarz, *Alexander*, p. 284.

[79] Carl Ritter to M. F. Maury via J. G. Fluegel, 13 June 1852, NARA, RG 78.2, entry 7 letters Received. Slotten, *Patronage* (cit. n. 7), pp. 89–90, 98. There are different accounts of Maury's relations with Bache. Whereas Williams depicts Maury as a victim of malice, James Fleming portrays him as the instigator of disputes. Williams, *Maury* (cit. n. 13), pp. 203–204, 210; and James Rodger Fleming, *Meteorology in America,*

each other, for it demonstrates some remarkable aspects of nineteenth-century scientific culture. The tension that existed between Bache and Maury reveals contemporary views on the lines separating what was thought of as valuable scientific activity from other less-esteemed intellectual pursuits. It also shows what personality characteristics and what type of education or social background were generally considered requisite for a career in science.

Several reasons can be put forward for the animosity between Bache and Maury. They became acquainted with each other when the latter joined the National Institute in 1841. At that time they got along well. But soon, differences in opinion and practice accumulated and led to frictions. First of all, Maury and Bache were competitors in the same field. As superintendent of the US Coast Survey (1843–1867) Bache's professional interests overlapped with Maury's. The Coast Survey was one of the oldest scientific institutions in the United States and was responsible for producing accurate charts and maps of the nation's entire coastline.[80]

Bache and Maury also shared an interest in the intellectual challenges that Humboldtian science had instigated. Seeking to enlarge the scope of the Survey's research, Bache used his position to advance Humboldtian sciences like meteorology, tidology, geodesy, and terrestrial magnetism. Before his appointment, he had conducted geomagnetic research from a privately funded observatory at Girard College. He had also carried out regular and systematic tidal observations and was, just like Maury, fascinated by the Gulf Stream.[81]

As Hugh Richard Slotten has argued, disputes between Maury and Bache sprang from the boundary-work practiced by the Lazzaroni to enhance the status of American science in order to meet European standards. They did so by sharply dividing their practice of a higher, "abstruse" science from the work of assistants and naval officers

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1800–1870 (Baltimore: Johns Hopkins University Press, 1990), pp. 95, 106–110. Cf. Schlee, *Edge* (cit. n. 14), pp. 39–40, 58; Bruce, *Launching* (cit. n. 25), pp. 183–186; and Slotten, *Patronage* (cit n. 6), p. 87.

[80] Schlee, *Edge* (cit. n. 14), pp. 36, 39–40; and Slotten, *Patronage* (cit n. 6), p. 98.

[81] Fleming, *Meteorology* (cit. n. 79), pp. 48–49; and Slotten, *Patronage* (cit. n. 7), pp. 116–118, 121–128.

involved in the same type of research. Bache distinguished his method of surveying as systematic, experimental, and grounded in physical theories, while the "scientific work of naval officers" was based on common sense and experience. He felt that only men with a proper scientific education were competent to supervise the science at institutes such as the Coast Survey and the Naval Observatory.[82]

Bache saw his position at the Coast Survey as an opportunity to dictate the standards of American science and to lift and improve its institutional structure.[83] Consequently, he felt that Maury, the practical naval officer, did not meet the scientific standards that he considered necessary for American science to equal science in Europe. In his view, Maury and other naval officers such as James Ferguson and C. M. Eakin, whom Bache discharged from the Coast Survey, looked like "charlatans," whose character did not match the conduct of "genuine men of science."[84] One of the charges against Maury was that he exhibited a "remarkable excitability which blinds him to right and wrong and produces a fidgetty desire to meddle with things which do not concern him." Maury's broad interests and his desire to be involved in multiple research projects were seen as a lack of proper moral values and qualities of character such as "moderation, sobriety, patience and self-control," which Bache considered "necessary to produce genuine science." As Slotten put it, Maury became "Bache's main nemesis."[85]

Bache's fiercest criticism was aimed at Maury's insufficient education. He had "only" been taught at a local academy and most of his relevant schooling came from self-education and experience aboard ships. Bache, on the other hand, had graduated at the Military Academy at West Point. He had renounced a career as an army engineer, although he could have had a higher income.[86] Bache may

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[82] Hugh Richard Slotten, "The Dilemmas of Science in the United States: Alexander Dallas Bache and the U.S. Coast Survey," *Isis*, 1993, *84*:26–49, on pp. 28, 44, 47–49.
[83] *Ibid.*, pp. 29–30; Slotten, *Patronage*, (cit. n. 7) pp. 5–6, 25; and Reidy, *Tides of History* (cit. n. 6), p. 261.
[84] Williams, *Maury* (cit. n. 13), pp. 203–204. Slotten, *Patronage* (cit. n. 7), pp. 60, 31, 98.
[85] Slotten, *Patronage* (cit. n. 7), p. 98 (first quotation); 32, 87.
[86] On Maury and Baches's educations see *ibid.*, p. 1; and Bruce, *Launching* (cit. n. 25), p. 177. For a discussion of American men of science and their income see Paul Lucier, "The Professional" (cit. n. 5), pp. 712–713.

have felt that his lineage required him to pursue a more honourable social position as a man of science. He was the grandson of the well-known Benjamin Franklin, who had studied and mapped the Gulf Stream around 1769.[87] The study of sea currents was thus a cherished heritage to Bache. As a result he felt that there was an abysmal difference between what he considered his scientific calling and Maury's mundane interests.[88]

Bonds of Profit and Friendship

Despite mounting criticism from American academic circles, Maury's *Wind and Current Charts* became increasingly popular with the wider public. This process took some time but inspired spectacular events, such as a series of sailing races with and without the use of charts. Much of the attention came from commercial groups. In fact, Maury possibly campaigned actively behind the scenes to involve these commercial contacts in his project as a means of assuring a larger meteorological database.[89] His charts appealed especially to marine merchants because they were reputed to shorten the duration of sea voyages considerably. To give an example, it was claimed that with Maury's charts, the passage from New York to San Francisco took only eighty-nine days with a saving of up to thirty days. He also attracted the interest of other parties such as insurance companies and shareholders who, he felt, would benefit from the reduction of travel time. This resulted in risk reduction, a decrease of accidents, less damage to cargo, and a smaller loss of life.[90]

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[87] Slotten, *Patronage* (cit. n. 7), p. 137; and Philip L. Richardson, "Benjamin Franklin and Timothy Folger's First Printed Chart of the Gulf Stream," *Science*, 1980, *207*:643–645, on p. 643.

[88] Slotten, *Patronage* (cit. n. 7), pp. 24, 96, 98.

[89] D. Graham Burnett, "Matthew Fontaine Maury's 'Sea of Fire': Hydrography, Biogeography, and Providence in the Tropics," in *Tropical Visions in an Age of Empire*, ed. Felix Driver and Luciana Martins (Chicago: University Chicago Press, 2005), on p. 125. An account of one of the races between captains of four clippers is published in "Maury's Sailing Directions," on p. 533 (cit. n. 76). On Maury involving commercial interests see Williams, *Maury* (cit. n. 13), pp. 184–192.

[90] Schlee, *Edge* (cit. n. 14), p. 39. The passage of eighty-nine days from New York to San Francisco was a record established by the clipper *Flying Cloud* in 1851. *Daily Alta*

In addition, other events in this period help to explain the enthusiastic purchase of Maury's charts. They appeared, for instance, at the same time as the clipper, a vessel at the cutting edge of mid-nineteenth century shipbuilding. To meet the nautical and economic demands of the day, shipbuilders from Baltimore and New York had developed the clipper as a merchant vessel with enough cargo space to be cost effective, but light enough to make great speed. With Maury's charts it was claimed these clippers could achieve even shorter voyage times. Another circumstance that increased the popularity of the charts was the massive migration to California, where gold was discovered in the late 1840s. The gold rush intensified the booming clipper industry and increased the sea-borne traffic around Cape Horn.[91] Some fortune seekers took the challenge of sailing to the Isthmus of Panama, where they cut through the forests and were picked up at the other side by vessels that sailed the Pacific Ocean to their golden destination. Because of the high mortality in such ventures, but also in pursuit of other benefits, many, including Maury, urged the building of a railroad connecting the Atlantic and Pacific Oceans. By 1850 the construction of the railroad had already started.[92]

At this point, the Dutch officer, Jansen, makes his reentry. One of the prime reasons for Jansen's visit to the West Indies and Central America in 1851 related precisely to the railroads of Panama. As an official he was ordered to inspect the construction of the railways. The Dutch government anticipated profiting from the new network infrastructure for its colonies. Jansen had direct orders to meet the vice-president of the Panama Railroad Company, Stevens, in Aspinwall City

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California, 1 Sept. 1851. Under usual conditions the passage would have taken about one hundred and twenty days. As testimonies by captains show, Maury's charts generally enabled captains to shorten the passage by ten to twenty days. Samuel Edwards to M. F. Maury, 30 July 1852; and Josia Richardson to M. F. Maury, 14 Aug. 1852, NARA, RG 78.2, entry 7 letters received. On the interest of insurance companies and shareholders see Williams, *Maury* (cit. n. 13), pp. 180–184.

[91] Bruce, *Launching* (cit. n. 25), p. 181; and Lewis, *Maury* (cit. n. 75), p. 90.

[92] Williams, *Maury* (cit. n. 13), p. 189; and Michael LaRosa and Germán R. Mejía, eds., *The United States discovers Panama: The writings of soldiers, scholars, scientists, and scoundrels, 1850–1905* (Lanham: Rowman & Littlefield, 2004), pp. 1–4.

(Colón) to inquire about the technicalities involved in the construction.[93]

Besides examining the Panama railways, Jansen had other tasks to fulfil. His official trip actually began in Venezuela, a young state that had struggled with many changes of power after it had declared its independence in 1811. Because of its colonial possessions in Suriname and the Antilles, the Dutch fleet frequently visited the area. The new political atmosphere offered the Dutch colonies opportunities for commercial relations. The Netherlands hoped to make the nearby island of Curaçao a centre of trade. Jansen's task in the Venezuela capital, Caracas, was specifically to obtain information on commerce.[94]

After visiting Caracas and Curaçao, Jansen sailed to Nicaragua and Cuba to eventually arrive in the United States. In Annapolis, he visited the Naval School, recently founded in 1845. From there, he continued his journey to Norfolk where, according to his own account, he made inquiries about a direct steamship connection between America and Europe. In New York, he spent some time seeking information about building clippers. Jansen obtained a clipper model that he eventually took to the Netherlands and after which the future Dutch clipper *Kosmopoliet* was to be fashioned. In 1857 this clipper broke the record for the voyage from the Netherlands to Java with a seventy-four-day trip.[95]

The most important event of Jansen's entire journey took place in Washington, DC, where he met his future collaborator, Maury. As soon as they met, they became friends. There was not just a personal rapport between the two men, they were also of mutual assistance to each other. Jansen could help Maury in establishing connections with Dutch sea captains. The Dutch commercial fleet, the third largest in the world, just after the British and the French, was especially relevant to

[93] Jansen and L' Honoré Naber, *Het leven* (cit. n. 32), pp. 281–282.
[94] Major George Flinter, "The Commencement of the Revolution in Venezuela," in *The Wars of Independence in Spanish America*, ed. Christon I. Archer (Wilmington: Scholarly Resources, 2000), on pp. 163–166. On Jansen's work on commerce in South America see Jansen and L' Honoré Naber, *Het leven* (cit. n. 32), p. 279.
[95] Jansen and L' Honoré Naber, *Het leven* (cit. n. 32), pp. 284–287.

Maury's project.[96] With the participation of Dutch captains, Maury could expand his observations to areas where these ships sailed. Also, he could obtain access to a much larger database. To secure assistance from Dutch shipmasters, Jansen suggested they receive a copy of *Sailing Directions* in return for their observations, to which Maury agreed.[97]

By cooperating with Maury, Jansen, in turn, hoped to win state support for Buys Ballot's plan to transform the Utrecht observatory into a state meteorological institute, where he could play a role in coordinating the observations made by the Dutch shipmasters. The Dutch government was only willing to support projects with obvious practical benefits. The implementation of Maury's project in the Netherlands would, in Jansen's view, help meet this demand. With the use of the *Sailing Directions*, Dutch voyages to the East Indies could become much shorter and safer.[98]

Jansen could not have chosen a better time to visit Maury, because the latter had just adopted the idea of designing a uniform abstract log for worldwide meteorological observations. Maury invited Jansen to cooperate with him in drawing up the log.[99]

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[96] On Maury and Jansen meeting see Matthew Fontaine Maury, *Explanations and Sailing Directions to accompany the Wind and Current Charts* (Washington, DC: C. Alexander, 1853), p. 245. On the Dutch fleet and Maury's project see Charlier, "Fratres" (cit. n. 12), p. 350.

[97] Van Everdingen, *Buys Ballot* (cit. n. 63), p. 61. The terms upon which Maury's *Sailing Directions* were furnished to the Dutch merchant ships were once again confirmed in Jansen's later correspondence with Maury after he returned home: M. H. Jansen to M. F. Maury, 28 July 1852, NARA, RG 78.2, entry 7 letters received, and M. F. Maury to M. H. Jansen, 7 May 1853, NARA, RG 78.2, entry 1 letters sent.

[98] C. H. D. Buys Ballot to M. F. Maury, July 24; M. H. Jansen to M F. Maury, 28 July 1852, NARA, RG 78.2, entry 7 letters received. In April 1854, Jansen informed Maury about a new record in voyage time from the English Channel to Java via The Cape of Good Hope, which would usually take at least three months. With the use of the *Sailing Directions* the voyage took seventy-eight days: M. H. Jansen to M. F. Maury, 1 April 1854, NARA, RG 78.2, entry 7 letters received.

[99] Jansen and L' Honoré Naber, *Het leven* (cit. n. 32), p. 285; and Williams, *Maury* (cit. n. 13), p. 217.

Call for Concerted Action

In 1851 Maury received a proposal from Lieutenant-General John Burgoyne of the British Royal Engineers for cooperation in meteorological observations on land at its foreign stations. Although he saw benefits from such cooperation, Maury declined the proposal. Officially, he claimed that cooperation with the British would delay the progress of meteorological research in the United States. This was likely to happen if the British system of observations was adopted without adjustments, since he thought that it was not compatible with the system already established in America.[100] It seems more likely that he wished to both take the lead in worldwide observations and safeguard his maritime measurements project.

Instead, Maury suggested an international conference involving all maritime nations in order to adopt a uniform system of meteorological and hydrographic observations. Furthermore, he proposed including meteorological measurements at sea, since the atmosphere does not stop at the seashore. He further pointed out that other nations were interested in these investigations as well. Some foreign meteorologists, such as the Russian Theodor Kupffer, had already shown their readiness to participate in the conference.[101] Ultimately, Maury proposed inviting all seafaring nations, and notably England, France, and Russia, to cooperate by their vessels keeping an abstract log according to a universal and uniform system of meteorological and hydrographical observations.

Previous experience had shown that chances to have governments agree to an international meeting were slim. Kupffer and Buys Ballot had earlier proposed an international conference for the advancement of meteorology, but these attempts had failed. Kupffer's attempt failed because of the political upheavals in France and the British unwillingness to cooperate with Russia, fearing its loss of supremacy at

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[100] Jim Burton, "Robert Fitzroy and the early history of the Meteorological Office," *British Journal for the History of Science*, 1986, *19*:147–176, on p. 149; and Pauline Halford, *Storm Warning: The Origins of the Weather Forecast* (Gloucestershire: Sutton, 2005), pp. 54–55.

[101] Charlier, "Fratres" (cit. n. 12) , p. 348.

sea. Buys Ballot was then still a young professor just beginning to build up his international reputation, and he lacked any scientific authority.[102]

The U.S. administration, however, decided to support Maury's plan, probably because it promised to yield economic benefits by finding safer and shorter trade routes at sea. A counterproposal was made to the British government to organize a conference on land and sea meteorology. The aim of an international gathering was to discuss and agree upon a uniform mode of measurements through the use of common standards and instruments. Maury was authorized to take charge of the matter and to obtain advice from foreign officials. He started by informing the American ambassadors to England and France, and then contacted the ambassadors and chargés d'affaires of more than twenty countries. He further contacted the Vatican to ask for cooperation through its worldwide network of missionaries.

Thereafter, he set out promoting the international meeting by contacting foreign scholars and societies. The first dignitary on his list was obviously Humboldt, who explicitly supported the initiative. He further contacted the French astronomer Francois Arago, and other savants, such as Kupffer, Heinrich Dove, Johann von Lamont, and Buys Ballot, who were all supportive of the undertaking. To ensure that Arago, who suffered from bad health, could attend the conference, Maury pressed for it to be held in Paris. Unfortunately, before the gathering could take place Arago's health failed rapidly and he passed away.[103]

[102] On the earlier failed attempt to organize the meeting see *ibid.*, p. 348. In 1850 Buys Ballot asked whether Quetelet could use his position as director of the Belgian Academy of Sciences to organize and preside an international meteorological conference in order to bring unity to the measurements that were carried out in the surrounding countries: C. H. D. Buys Ballot to A. Quetelet, 29 March, 1850, CAQ, no. 561.

[103] On Maury contacting England, France, and the Vatican see Williams, *Maury* (cit. n. 13), pp. 208–209. On contacting savants see Halford, *Storm Warning* (cit.n. 83), pp. 61–62. On the conference's location and Arago see G. Houvenaghel, "La conférence maritime de Bruxelles en 1853: première conférence océanographique internationale," *TGGNWT*, 1990, *13*:42–49, on p. 45.

The organization of the conference faced other problems as well. As a maritime superpower, the British presence at the conference was of the utmost importance for Maury. He therefore contacted Lieutenant-Colonel Edward Sabine, astronomer, Fellow of the Royal Society, and advisor to the Admiralty, who had the authority to decide whether to send a representative to the international event. Sabine advised the British government to lend its support to cooperative efforts of meteorology at sea only. He believed that agreement on a standard mode of land observations would be extremely hard to achieve, because most countries already had their own system that they would probably not be willing to give up. However, the benefits of collective meteorological research at sea seemed to outweigh Sabine's other considerations. Consequently, in order to safeguard the conference, Maury had to drop land measurements from his scheme. But, even with this major adjustment to the plan, the British government put off its response regarding attendance of the meeting until the last minute.[104]

Sabine's terms and conditions for British participation in the international meeting are rather understandable. Land meteorology had been and continued to be a contested field among researchers. In Britain alone, there were at least four institutions engaged in meteorological science.[105] Foreign meddling with measurement and observation procedures was considered especially unwelcome. However, while scientists were competing with each other as they carved out lands into areas for geophysical research, the sea remained a vast and scientifically unclaimed geographic space, and at the time only was accessible to experienced captains and naval officers.

Therefore, as a research topic and location for the production of knowledge, the sea worked as an advantage to Maury's international program. Even more so, as it gave the conference a sense of urgency and economic relevance. The determination of shorter and safer trade routes at sea was bait that helped lure maritime nations in to participate in the international meeting. In addition to the relative ease of developing the system of information exchange, the small means

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[104] Agnew, "Robert Fitzroy" (cit. n. 28), p. 25. Williams, *Maury* (cit. n. 13), p. 216.
[105] Anderson, *Predicting the Weather* (cit. n. 6) , pp. 90–97.

required for its creation induced authorities to give their approval to the collective endeavour. Both Rozwadowski and Reidy have argued that national economic and political interests played a significant role in prompting international collaboration in twentieth-century ocean science, and nineteenth-century tidal studies, respectively.[106] Here too, governments were willing to endorse collective research for the sake of economic and political benefits, realizing that ocean winds and currents could be studied effectively only by means of collaborative initiatives.

Maury proceeded with finding a suitable location for the conference. His choice fell on Brussels because of its central position, its excellent accessibility by train, and its neutral position with regard to the existing relations of the maritime powers. At Buys Ballot's suggestion, Maury asked Quetelet to preside over the meeting. The Belgian astronomer and statistician held two prominent positions in Brussels. He was the permanent secretary of the Royal Belgian Academy of Sciences, Letters and Fine Arts, and the director of the Royal Observatory of Belgium.[107] The latter institution had originally been founded by the Dutch king, William I, when Belgium was still part of the larger Kingdom of the Netherlands. Quetelet made an excellent president because of his academic standing, and his versatile affinities for astronomy, meteorology, and statistics. Luckily, he agreed to host the conference.

Meanwhile, Jansen had returned to the Netherlands in June 1852. At home, he was required to give an account of his journey to the Dutch minister of the navy, James Enslie, who became intrigued when he learned of Jansen's meeting with Maury. Jansen sought to interest the minister in adopting a similar system of information exchange as existed between Maury and the American shipmasters. He probably envisioned himself acting as the head of a Dutch meteorological department. Much to his pleasure, Enslie went along with implementing Maury's project in the Netherlands. He agreed to

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[106] Helen M. Rozwadowski, "Internationalism, Environmental Necessity, and National Interest: Marine Science and Other Science," *Minerva*, 2004, *42*:127–149, on p. 128; Reidy, *Tides of History* (cit. n. 6), p. 160.

[107] C. H. D. Buys Ballot to M. F. Maury, 24 July 1852, NARA, RG 78.2, entry 7 letters received. On Quetelet see Charlier, "Fratres" (cit. n. 12), pp. 348–349.

Jansen's call for logbooks of certain voyages by the Navy to be sent to him for study. Furthermore, he assigned Jansen to devise a logbook for Dutch warships to gather observations. And finally he asked Jansen to attend Maury's international conference as the Dutch delegate. Jansen happily agreed. Not only would he enjoy the prestige of participating in an international meeting, he could also see his friend Maury. Knowing that he would make an impression at the conference, Jansen took with him the extract of the first meteorological logbook that had just been submitted by the Dutch man-of-war, the *Prince of Orange*.[108]

The Brussels Conference

The conference opened in Brussels in August 1853. Of the twenty-five maritime nations that had been invited, twelve delegates from ten countries attended the meeting.[109] Of all the delegates, only Quetelet and Henry James, from the British Royal Engineers, were not attached to their national navies. The rest of the delegates all held high naval positions in their home countries.

On August 23, the delegates were received by the Belgian Minister of the Interior at the Bellevue Hotel. During the first session Quetelet was unanimously chosen to chair the conference. Maury opened the meeting by sharing his views concerning a uniform mode of meteorological observations and its significance for international seafaring. He explained the advances made in the shortening of voyages by the use of his *Sailing Directions*, which also helped to make the

[108] J. Enslie to M. H. Jansen, 24 June 1853, NA, entry 2.12.01, inventory 2274. In a letter to Enslie, Maury had recommended Jansen as a delegate for the Netherlands: M. F. Maury to M. H. Jansen, 7 May 1853, NARA, RG 78.2, entry 1 letters sent. On taking the *Prince of Orange*'s logbook see Jansen and L' Honoré Naber, *Het leven* (cit. n. 32), pp. 288–289.

[109] Quetelet was joined by Victor Lahure from Belgium, P. Rothe from Denmark, A. Delamarche from France, F.W. Beechey and Henry James from Great Britain, Nils Ihlen from Norway, J. de Mattos Corrêa from Portugal, Alexis Gorkovenko from Russia, Carl Anton Pettersson from Sweden, Jansen, and Maury. See *Maritime Conference* (cit. n. 2), p. 2.

journeys much safer. After these opening words, the assembly went on to discuss their collective aims.[110]

One of the difficulties to overcome were the differences in the scales of the various instruments that were used. Due to these differences, the measurements could not be compared to each other. Unfortunately, it seemed that a solution to this problem was not easy to attain. The meeting decided to set this issue aside, except for the thermometer. It was agreed that two scales be used from then on. Alongside the one that was used in the different countries, a new scale in centigrade was added.[111]

More successful were the attempts to reach agreement on the need for regular verification of instruments. This could take place by comparing the barometer and thermometer with standard instruments. The delegates also urged that cheaper and more accurate instruments be developed. At that time, most barometers only displayed the rise and fall in air pressure, but not the actual value. The participants also decided to encourage each other, and those in their own countries, to keep standard instruments and hand out instructions in order to establish uniformity and comparability of the observations.[112]

The participants then agreed on a common registration form to secure uniformity of the records. After some discussion the logbook that had been prepared by Maury and Jansen was adopted. It became known as the abstract log.[113] The exchange system of free charts in return for observations, devised by Maury for American merchant vessels, was also implemented generally. Commercial vessels qualified for free charts, and were requested to keep records of at least the following variables: "the position of the vessel and the set of the current, the height of the barometer, the temperature of the air and water … once per day, the force and direction of the wind three times a

[110] Jansen and L' Honoré Naber, *Het leven* (cit. n. 32), pp. 289–290. *Maritime Conference* (cit. n. 2), pp. 12, 34–40.
[111] Maritime Conference (cit. n. 2), pp. 14, 20–22.
[112] *Ibid.*, p. 24.
[113] At the conference, the Russian delegate Gorkovenko joined Maury and Jansen in preparing the journal's definitive form. See *Maritime Conference* (cit. n. 2), pp. 48, 114.

day, and the observed variation of the [magnetic] needle occasionally."[114]

Another issue under discussion was the processing of incoming journals. The participants expressed their concern that logbooks be gathered at certain points to be carefully processed. Three delegates announced that measures had been taken in their countries to set up departments for this purpose. The meteorological station in Utrecht was one of them. The other two countries that planned to set up meteorological departments were Portugal and Belgium. After the conference, the British government clearly felt compelled to follow suit and set up a bureau as well. The British Meteorological Department, as it came to be called, was founded in 1854, and operated under the Marine Department of the Board of Trade. Captain Robert Fitzroy, the former commander of HMS *Beagle*, was appointed as head of the new department.[115] He had to report to Captain Frederick W. Beechey, who was one of the two British delegates at the conference.

At the end of the meeting, all participants agreed that decisions made at the conference would not entail any obligations for the participating countries. Yet, they hoped that a free exchange of data would be realized. In addition, they hoped that cooperating ships would enjoy the same privilege of a free and safe passage that vessels of discovery had in time of war. The assembly then expressed its desire that "a system of investigation shall be spread as a net over [the ocean's] surface, and become rich in its benefit to commerce, navigation and science, and productive of good to mankind."[116] After seventeen days in session and with a promising outcome, the conference came to a close.

Afterward, Jansen went home and informed Buys Ballot of the conference. Maury went to Berlin to meet Humboldt in person. He also traveled to the Netherlands for a short period and, at Jansen's request, he gave two public lectures. In Amsterdam and Rotterdam, Maury

[114] Matthew Fontaine Maury, *Explanations and Sailing Directions to Accompany the Wind and Current Charts*, 6th ed. (Washington, D.C.: C. Alexander, 1854), p. 58.
[115] *Maritime Conference* (cit. n. 2), pp. 28–30. On Britain's later decision see Halford, *Storm Warning* (cit. n. 100), p. 67. Burton, "Robert Fitzroy" (cit. n. 100), pp. 150–152.
[116] *Maritime Conference*, (cit. n. 2), p. 32.

communicated his ideas and plans to local shipowners and commanders. Jansen had organized these lectures to popularize the meteorological project. He also gave several lectures himself.[117] These efforts helped to raise public awareness and eventually prompted the Dutch Ministries of the Navy and Interior to transform the Utrecht station into a state institution. Within a year after the conference, the Royal Dutch Meteorological Institute (KNMI) was founded. Buys Ballot and Jansen's lobbying efforts had finally come to fruition. Jansen's wish was fulfilled and he could start his new function as director of the marine department at the KNMI, to which he had been promoted by the minister of the navy, Enslie.[118]

At the institute Jansen became responsible for the extraction of the abstract logs that Dutch navy and merchant vessels sent in. Rather soon however, Jansen became involved in serious disagreements with the institute's chief director, Buys Ballot, about his job description. In the institution's yearbook Buys Ballot complained about the high expenses of the maritime department amounting to more than half of the institute's budget. Tension mounted when Buys Ballot suggested a number of adjustments to the abstract log. Jansen took this as a blunt intrusion into his work domain and complained to the secretary of the navy, the person whom he still considered his superior.[119] Apparently, Jansen was not aware of or perhaps was unwilling to accept his subordinate position at the institute and saw himself as an equal of Buys Ballot's. After lengthy discussions with Buys Ballot and the

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[117] Jansen and L' Honoré Naber, *Het leven* (cit. n. 32), pp. 291–292. Jansen wrote to Maury how once after he gave a lecture, the audience shouted "Hurrah for our Maury!" See M. H. Jansen to M. F. Maury, 1 June 1854, NARA, RG 78.2, entry 7 letters received.

[118] Jansen and L' Honoré Naber, *Het leven* (cit. n. 32), p. 291. Jansen wrote to Maury about his recent promotion: M. H. Jansen to M. F. Maury, 9 Feb. 1854, NARA, RG 78.2, entry 7 letters received.

[119] Jansen's job description written by Buys Ballot, and their correspondence with each other and the minister of the navy throughout 1854 have been compiled in a separate dossier at the Utrecht Archive: UA, entry 90, inventory 1199. On Buys Ballot's complaint see Buys Ballot, *Meteorologische waarnemingen* (cit. n. 67), p. iii. Jansen also explained to Buys Ballot that he wished he could make decisions independently; as when, for example, he needed to hire an assistant. M. H. Jansen to C. H. D. Buys Ballot, 3 March and 28 July 1854, UA, entry 90, inventory 1199.

minister, Jansen felt he had no option but to leave the institute. A couple of months later he wrote to Maury: “I have tried to convince [the] government of the necessity to let the wind and current bureau have its own independent action. But in vain. When I saw that [the] government was determined to keep Professor Buys Ballot at the head of the Institute and to give him direction over the labours of the wind and current bureau, I resigned my position as his first clerk.”[120]

It is striking that Jansen’s British colleague Robert Fitzroy who presided over the Meteorological Department in London, experienced similar tensions in his position. Fitzroy had been appointed by Sir James Graham, first lord of the admiralty. Accordingly, he received his salary from the admiralty. Fitzroy’s department, however, operated under the Marine Department of the Board of Trade, and he had to cooperate with Captain Beechey, who often disagreed with Fitzroy on how to carry out the tasks that he was assigned to. When Fitzroy, for instance, made an effort to redesign the format of the abstract log, Beechey protested strongly. He insisted that the log, to which he had given his approval in Brussels, should stay as it was. Only when Beechey became ill and was absent for a long period, did Fitzroy change the log.[121]

The strained relationships between Jansen and Buys Ballot, and between Fitzroy and Beechey, illustrate the teething problems of early governmental scientific institutes. The interest that these men shared in meteorology had prompted them to cooperate in advocating the establishment of official meteorological institutions in their respective countries. However, their views as to what role they would play at their institutes turned out to differ considerably. From the start, the competing ambitions of Fitzroy and Beechey led to serious clashes at the Meteorological Department. In her study of Victorian meteorology, Katherine Anderson argues that Fitzroy had much higher ambitions

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[120] J. Enslie to C. H. D. Buys Ballot, 16 Aug. 1854, UA, entry 90, inventory 1199. On Jansen’s decision to leave the institute see Jansen and L’ Honoré Naber, *Het leven* (cit. n. 32), pp. 293–297. M. H. Jansen to M. F. Maury, 11 Jan. 1855, NARA, RG 78.2, entry 7 letters received (quotation).
[121] Halford, *Storm Warning* (cit. n. 100), pp. 91, 95. Fitzroy to Maury, 19 Sept. 1855, NARA, RG 78.2, entry 7 letters received.

than his job description would allow. Rather than being a mere statistician, Fitzroy hoped to develop a theory of atmospheric circulation. His attempts were often frustrated by his superiors. Just like Fitzroy, Jansen had hoped to enjoy an independent position under the Navy Department. He deplored being stationed in the inland town of Utrecht instead of a seaport town. Jansen had accepted the directorship of the marine department at the KNMI originally, in the belief that he had to report to the minister of the navy, Enslie, and not to the civilian superintendent, Buys Ballot. Disagreements at the institute prompted minister Enslie to urge Buys Ballot to send Jansen a detailed description of his job.[122] Jansen, however, declined to accept a subordinate position at the institute and resigned.

In the job description for Jansen's position, Buys Ballot defined the division of labour at the institute as follows:

> I would not dare to claim that I should understand a logbook as well as a naval officer, and I acknowledge with pleasure that this is one of the reasons why naval officers and experienced clerks are placed at the Institute; another reason is to determine sea routes from collected data, a practice which no one but a seaman should dare to undertake; but the method of collecting, classifying and efficiently connecting [the facts] is the work of science, and therefore the naval officer, a purely *practical* man, must consult with the purely *theoretical* man. The merit of Maury's labour would have been valued more highly, if the advances of science had been completely known to him. … I have repeatedly asserted that science should lead practice. That

[122] On Fitzroy's frustrations see Anderson, *Predicting the Weather* (cit. n 5)., pp. 108-109, 119. On Jansen's frustrations see Van Everdingen, *Buys Ballot* (cit. n. 63), p. 64. When Buys Ballot asked Jansen to take over the control of the institute's maritime instruments, Jansen refused, claiming that he received his orders from the minister of the navy. M. H. Jansen to C. H. D. Buys Ballot, 4 Aug. 1854, UA, entry 90, inventory 1199. J. Enslie to C. H. D. Buys Ballot, 16 Aug. 1854, UA, entry 90, inventory 1199.

> is her calling! … To find itself, *praxis* needs the assistance and the direction of science.[123]

The boundary-work of Buys Ballot is evident here. Again, a distinction is made between the "scientific" and the "practical" in order to define the role of the scientist as distinct from those who were viewed as subordinate labourers. It is interesting to note the similarities in the differentiating tactics of Buys Ballot to those of Alexander Bache and William Whewell, as demonstrated by Slotten and Reidy.[124]

Just like Fitzroy and Jansen, Maury had a hard time in his position at the Naval Observatory. When he returned home after the conference, he risked being removed from the active service list of the U.S. Navy. As the superintendent of the observatory, it was claimed, there was no reason for him to remain a lieutenant. At the same time, his position was criticized in scientific circles. His general theories on the circulation of atmosphere and ocean, which he formulated in his 1855 *Physical Geography of the Sea*, met strong criticism from the British astronomer John Herschel. Maury was discredited for his hasty conclusions and speculative theories. Joseph Henry, the secretary of the Smithsonian Institution, argued that the book contained "more absurd propositions than are to be found in any book ever published by a person in such a high position."[125]

Apart from these tense conditions at the various institutes, the system of exchange of meteorological observations that resulted from the Brussels conferences worked well from the start. At least in the Netherlands, there was a steady flow of information about weather and currents that was sent to the Meteorological Institute, and from there to Maury.[126] He was more than pleased with the Dutch

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[123] C. H. D. Buys Ballot to J. Enslie, 24 Aug. 1854, UA, entry 90, inventory 1199 (italics added).

[124] Slotten, *Patronage* (cit. n. 7), pp. 96–98; and Reidy, *Tides of History* (cit. n. 6), pp. 240–246.

[125] Halford, *Storm Warning* (cit. n. 100), pp. 101–103. Slotten, *Patronage* (cit. n. 7), p. 98 (quotation).

[126] C. A. Davids, "Van Vrijheid naar Dwang. Over de relatie tussen wetenschap en zeewezen in Nederland," *TGGNWT*, 1990, *13*:5–22, on pp. 9–12; and Van Everdingen, *Buys Ballot* (cit. n. 63), pp. 69–70.

cooperation. And quite rightly, the participation of the Dutch fleet in Maury's program was remarkable. Except for the American data, the collection of data gathered by Dutch merchant vessels outstripped other countries' efforts until well into the 1870s.[127]

Conclusion

The nineteenth-century history of maritime meteorology and hydrography is an important episode in the history of science because it serves as a focal point that allows us to take a closer look at the formulation of some of the dividing categories in science, which often tend to be overlooked. As we have seen, distinctions began to be made in this period between "theoretical" and "practical" science, between "genuinely scientific work" and the pursuit of utility, and between "authentic men of science" and "purely practical men." Unlike their contemporary conventional use suggests, these distinctions were not dichotomous.[128] As this study has shown, classifications such as theoretical, practical, and scientific were used concurrently and served different purposes in different settings.

In search of a new niche in science allowing them to make their name and to obtain public acclaim for new discoveries, several nineteenth-century academic professors turned to the fashionable Humboldtian sciences. Their ambitious programs required material and financial means that could only be provided at a national or imperial level. At the same time, nineteenth-century imperial politics and growing international trade made these field studies, especially the science of ocean winds and currents, relevant and urgent, and this may partly explain their popularity at the time. In order to give their large-scale research programs public legitimacy and to obtain state support, the professors promoted their science as *practical* science that could deliver material benefits to the state. The Dutch astronomer Kaiser was

[127] Scott D. Woodruff et al., "Early Ship Observational Data and Icoads," *Climatic Change*, 2005, *73*:169–194, on p. 170.
[128] Lucier noted that the terms pure science and applied science were often conjoined as pure *and* applied in Gilded Age America. Lucier, "The Origins" (cit. n. 5), p. 536.

one of the first in the Netherlands to proclaim the utility of practical astronomy for mapping and navigation. The label "practical" was not coincidentally applied to other fields, such as geology, chemistry, and meteorology, reflecting the utility of such research for the public in general.[129]

When cooperating with naval officers, men of science emphasized the navigational, commercial, and military advantages that could result from atmospheric and maritime investigations. Furthermore, cooperation with naval departments enabled the professors to gain access to observations carried out at sea by relying on the experience of naval captains in making accurate measurements in all weather conditions. They could build on existing infrastructure and workforce. Also, the alliance helped to win state support for the establishment of research institutes where maritime investigations could be carried out according to standard procedures. As Jansen and Buys Ballot hoped, the international maritime conference of 1853 indeed served as a catalyst for government-sponsored meteorological research by committing the Dutch government to establishing an official institute.

At the conference Maury and Jansen produced the extract of a standardized logbook, the abstract log, which served as an example of

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[129] The Englishman and fellow of the Geological Society of London Joshua Trimmer explained the utility of practical geology as follows: "But what is the use of geology? … On this point we are prepared to … vindicate the utility of our science. We shall begin with its economical importance. As regards utility, … geologists must be contented to yield the first place to astronomy. We pretend not to guide the sailor across the deep, and to enable him, by measuring the distance of the moon from some of the fixed stars, to ascertain, within five miles, his situation on the pathless ocean … but upon our own element, the land, we can confer upon mankind, benefits of no mean order. We can assist the farmer to fertilize the surface of the earth, so that two blades of grass shall grow where one grew before; and we can impart system to the labours of the miner, so that … he may … extract from the earth the treasures there stored up for our use." Joshua Trimmer, *Practical Geology and Mineralogy: With Instructions for the Qualitative Analysis of Minerals* (London: Parker, 1841), pp. 17–18. The same author wrote a book on practical chemistry; See Joshua Trimmer, *Practical Chemistry for Farmers and Landowners* (London: Parker, 1842). For practical meteorology, see John Drew, *Practical Meteorology* (London: Van Voorst, 1860); and Anderson, *Predicting the Weather* (cit. n. 6), pp. 118, 122. On the inextricable links among knowledge of the ocean, geopolitics, and the growth of modern science see Michael S. Reidy and Helen M. Rozwadowski, "The Spaces In Between: Science, Ocean, Empire," *Isis*, 2014, *105*:338–351.

what could be expected from collective efforts in making uniform observations. Data gathered from as many ships and locations across the ocean as possible enabled Maury to make improvements to his charts and to *Sailing Directions*; the book was used by mariners to determine shorter and safer routes. The *Sailing Directions* provided Buys Ballot and Jansen with precisely the practical results they needed to win government support for the establishment of the meteorological institute.

However, the events after the international meeting show the temporary nature of the bonds of convenience between naval officers and the professors. Once the meteorological institutes had been established, collective initiatives were often frustrated by conflicting concerns. Fitzroy and Beechey often disagreed on how the British Meteorological Department should operate. Bache, Henry, and Herschel frequently challenged the competence and authority of Maury as he tried to develop theories that sought to explain the causes for winds and currents. In a similar manner, Fitzroy's attempts to explain the causes of storms were intensely criticized. He continued to be seen as the practical navigator whose extramural scientific activities were at best condoned, but certainly not appreciated by the scientific elites.[130]

The strained relations between, on the one hand, Maury, Jansen, and Fitzroy as practical naval officers, and men of science like Bache, Henry, Herschel, and Buys Ballot, on the other, which sometimes escalated into public conflicts, clearly reveal the fault lines that were consciously highlighted by academically trained meteorologists to differentiate their own knowledge-creating practices from the research activities that were emerging in naval contexts.[131] The label "practical," which was increasingly being applied to the work of naval officers, began to serve as one of the dividing criteria. As Anderson notes, "practical benefits … linked science with commercial values in ways

[130] Halford, *Storm Warning* (cit. n. 100), pp. 99–100, 105. Anderson, *Predicting the Weather* (cit. n. 6), pp. 115–123.

[131] C. H. D. Buys Ballot to J. Enslie, 24 Aug. 1854, UA, entry 90, inventory 1199. Slotten, *Patronage* (cit. n. 7), p. 95. Whewell aimed to demarcate the role of the scientist from that of observers, calculators, instrument makers, and other "subordinate labourers." Quoted in Reidy, *Tides of History* (cit. n. 6), pp. 240–246.

that many men of science found humiliating and destructive."[132] However, when the public value of their research needed to be emphasized, men of science availed themselves freely of phrases related to practical utility.

Classifications like "practical" and "scientific" served as rhetorical tools of boundary-work used by men of science to differentiate their research from other types of investigations. This boundary-work involved dealing with persistent tensions. Meteorologists with an academic degree had to emphasize the practical value of their research in order to win public legitimacy, while at the same time avoiding the risk of losing their autonomy by distinguishing their "science" from the research activities of naval officers. Accordingly, the boundaries of science were drawn and redrawn.

The establishment of governmental meteorological institutions further accelerated this process of differentiation. Government authorities who supported the establishment of these institutes tended to give the professors precedence over naval officers, thereby reinforcing the authority of the academically trained meteorologists. The reason why they did so deserves further attention and careful study. Slotten observed this pattern in his study of Bache's boundary-work at the US Coast Survey. As he noted, when Bache decided to dismiss an assistant from the Survey, he sought and obtained the approval of congressmen who endorsed his views of science.[133] In the Netherlands, Buys Ballot enjoyed the backing of the minister of the navy in his disputes with Jansen, which ended with the latter's resignation.[134]

The success of the scientists' campaign in appropriating meteorological research to their professional domain is evident from a glance at the list of attending delegates at the next two international meteorological conferences, which convened in Leipzig in 1872 and Vienna in 1873. Whereas the Brussels meeting was notable for its

[132] Anderson, *Predicting the Weather* (cit. n. 6), p. 85 (quotation).
[133] Slotten, *Patronage* (cit. n. 7), pp. 87–93.
[134] C. H. D. Buys Ballot to J. Enslie, 24 Aug. 1854; and J. Enslie to C. H. D. Buys Ballot, 28 Aug. 1854, UA, entry 90, inventory 1199.

almost exclusive naval composition, the Vienna Congress only admitted official delegates, which meant that only meteorologists who were formally attached to one of the national meteorological services could participate; the vast majority of these delegates were academically trained. The only military representative at the Vienna Congress was the American general and director of the US Weather Service, Albert J. Myer.[135] By that time, meteorology had been reshaped into a science that required academic training, leaving no room for naval officers.

[135] Anderson, *Predicting the Weather* (cit. n. 6), p. 245. Although naval officers remained active in the marine division at the Dutch Meteorological Institute, the chief directors were all scientifically trained. The same applied to the British Meteorological Department from 1867. Of all sixteen superintendents at the US Weather Service, only one was not scientifically trained.