Measuring and Mapping the Arctic: Cartography and the Legacies of Nineteenth-Century Arctic Science

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Cartographies of the Arctic are powerful instruments to support legal, political, commercial, and scientific claims and interests in the region. Polar projections on sea ice extension, the distribution of natural resources or the state of ocean currents in the Arctic, for example, are critical indicators for the future of the region. At the same time, natural scientific categories to describe the Arctic are products of historical processes in the production of geographical knowledge; they are not eternal givens. As disciplines such as oceanography, meteorology or hydrology emerged as fields of professional study during the nineteenth century, new theoretical and visual vocabularies equipped explorers and cartographers with the language of natural science to relate the regions and their representation in maps to the geopolitical, commercial, and scientific interests of nineteenth-century European and North American states. Grounded in historical data and archival research, this article discusses how such cartographies re-defined the Arctic region, how they generated a surge in Arctic expeditions, and how they continue to inform modern understandings of the region, one predominantly perceived as a region of nature. Specifically, this article discusses the theory of an Open Polar Sea—a body of navigable, ice-free water in the central Arctic Ocean—as a consequential re-envisioning of the central Arctic and a generator of scientific agendas of Arctic exploration across Europe and North America that, in turn, informed contemporary field science such as the recent MOSAiC expedition.

Introduction

When the research icebreaker *Polarstern* departed Bremerhaven in Germany in September 2019 to embark on a yearlong drift across the Arctic Ocean from the Laptev Sea to the East Greenlandic Sea, tons of scientific equipment and the first of three cohorts of researchers were not the only cargo the expedition transported to the Arctic. The urgency of understanding the multilayered processes of a changing climate in the central Arctic region that was at the heart of the MOSAiC expedition's scientific program may have had a distinct twenty-first century quality. Yet for all the urgency of the present moment, the expedition was inextricably embedded in the long history of European and American scientific activities throughout the circumpolar North. "The light of knowledge grows dim in the central Arctic during the winter months to this day," expedition leader Markus Rex wrote in his travel narrative, noting that the Arctic remains among the last corners of

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the planet yet to be unveiled by the instruments of modern science (Rex, 2020: 9). The 'disenchantment of the world', as Max Weber noted (Weber, 1919), a central project of European and American nineteenth-century exploration and science, retains a powerful grasp on the wider imagination of science in remote regions today. Its enduring salience, however, calls attention to a larger reality of science in the Arctic: scientific practices and theoretical categories are themselves informed by centuries of European and American expeditionary science in the Arctic. The history of science in the circumpolar world remains acutely present and continues to exert a firm grasp on the mental maps that shape the ways we make sense of the regions and its peoples today.

European and American efforts to measure and map the Arctic regions have importantly shaped the visual, rhetorical, and intellectual ways the circumpolar world has come to be understood and envisioned. As instruments of governance and scientific investigation, maps have a long history of acting as powerful instruments to support legal, political, commercial, and scientific claims and interests in the region. Long before the onset of a 'scientific' cartography in the early decades of the nineteenth century, astronomers and natural philosophers popularized polar projection maps, relating celestial movements to terrestrial events in the form of globes and portable instruments (Cosgrove, 2001; Bravo, 2019a). The emergence of the modern natural scientific canon in the formation of scientific disciplines as part of the modern research university during the nineteenth century importantly transformed the way knowledge of the circumpolar world was generated, validated, and distributed (Habermas & Przyrembel, 2013; Powell, 2015). As empires and states such as Czarist Russia, Austria-Hungary, Prussia, France, Great Britain, Norway, Sweden, and the United States increasingly directed their attention to the Arctic regions, they measured and mapped those lands and seas that were unknown to them. Travelers and organizers of Arctic science communicated their findings and future opportunities at scientific societies, museum exhibitions, and as part of a fast-expanding publishing landscape through the language of nineteenth-century meteorology, hydrology or oceanography. In these communications, innovations in the form of visualizing scientific data in the spatial plane of maps created powerful new 'habits of seeing' and understanding the Arctic regions (Kaalund & Woitkowitz, 2021). A seeming certainty vested in a positivist faith in the veracity of empirical data and measurement produced new categories and visual vocabularies to make claims in the description of the Arctic—including the promise of open shipping routes, unknown maritime and territorial formations, commercial opportunity, and national prestige.

European and American cartographies of the Arctic were not the first attempts to make sense of these regions. Practices of wayfinding and mapmaking have been integral aspects of Inuit culture for millennia. Migration and peopling of vast territorial and maritime expanses across the North American Arctic required reliable forms of orientation and navigation to ensure the safety and well-being of travellers, hunters, and communities. Movement and travel between distant communities, moreover, was a central aspect of Inuit life, linking different communities across geographical regions from Alaska to Greenland. For this, celestial constellations, land formations, and oral traditions inscribed the regions with markers and narratives and enabled travellers to move with and through the Arctic (MacDonald, 1998; Aporta, 2009; Bravo 2019a). Eighteenth and nineteenth-century encounters among Inuit and Western travellers, moreover, resulted in cartographies that drew on Indigenous knowledge and information (Gapp, 2021). As co-travellers of expeditions and co-producers of geographical knowledge, Inuit were consequential actors in the making of European and American cartographies of the Arctic regions.

This article provides a historical perspective on European and American nineteenth-century Arctic science and cartography. By way of a series of examples of scientific expeditions to the North American Arctic and the making of maps, it traces some of the theoretical and cartographical practices that helped establish specific 'habits of seeing' the Arctic. It illustrates how cartographies began to include scientific models of physical geography to make statements about the natural environment of the central Arctic Ocean, and how these re-cast the region as a space of opportunity. Specifically, this article examines the popular theory of an Open Polar Sea—a body of navigable, ice-free water purportedly endowed with riches of natural resources—as a cartographical re-envisioning of the Arctic. It shows how maps, in particular, acted as powerful instruments to advance the Open Polar Sea theory, and how they propelled scientific agendas of Arctic exploration across nineteenth-century networks in Europe and North America. Moreover, this article highlights the global connections of Arctic cartography and how historical actors moved across national boundaries to pursue commercial, political, and scientific agendas in the Arctic regions. Finally, this article draws attention to the enduring legacies of historical theories and their presentation in maps and how they continue to inform understandings and perceptions of the regions with important consequences for the Arctic and its inhabitants today.

Mapping the Open Polar Sea

Efforts to expand the geographical knowledge of the Arctic regions have been conducted by numerous actors, institutions, and states throughout the circumpolar north for centuries. Long before the term 'scientist' became attached to voyagers traveling to the polar regions to measure and to observe during the early nineteenth century, different groups of European and American travellers collected data and objects throughout the Arctic. Commercial actors such as whalers frequently sailed to fishing grounds in high latitudes across the European and North American Arctic. On their journeys, they gathered data on the extent and the state of sea ice, for example, which, in turn, provided data and lend credence to polar exploration agendas. Likewise, missionaries of the Moravian Church acted as lay scientists as part of their activities at mission stations throughout Alaska, Labrador, and Greenland. Beyond evangelization and social uplift, these missionaries received specific instructions since the eighteenth century to conduct observations about the natural environment, climate, and flora and to collect natural specimen and ethnographic objects (Lüdecke, 2005; Wilhjelm, 2013; Nippa, 2003; Woitkowitz, 2019).

Such field data, however, not only came to populate travel accounts, reports, and the storage facilities of early forms of natural history museums across Europe and North America. They also formed the evidentiary basis for the development of theoretical frameworks for the description of the physical geography of the Arctic regions during the nineteenth century. One such theory hypothesized the existence of an Open Polar Sea, a maritime body free of ice, readily navigable, and rich in Arctic fauna in the central Arctic Ocean. Debates over the existence of open water can be traced back to Greek philosophies, natural histories, and travel narratives on the polar regions, for example, by sixteenth-century Dutch explorer Willem Barents or nineteenth-century English whaler William Scoresby (Tammiksaar, Sukhova & Stone, 1999; Robinson, 2007; Craciun, 2010). During the nineteenth century, however, the theory took on a new sense of urgency as the Arctic regions moved increasingly into the focus of colonial and imperial ambition (David, 2000; Driver, 2001). Great power competition and expansionism made the search for passageways from the Atlantic to the Pacific world not only an objective of significant geopolitical concern. Travel and

science in the Arctic, moreover, were curated as indicators of technological progress and of a purported nation's quality of character (Berger, 1966; Grace, 2002; Robinson, 2006; Hill, 2008; Hulan, 2002). Nineteenth-century Arctic exploration acted as a badge of membership in the club of great powers. In this context, the promise of an Open Polar Sea appealed to commercial, naval, and political constituencies alike.

Imperial fantasies of an Arctic Eldorado, however, were not limited to the centres of colonial powers in London, Washington, Paris or Copenhagen. Science in the Arctic and the nineteenth-century economy of Arctic cartography was a fundamentally global and transnational phenomenon. If states such as the United States and Great Britain provided significant resources in the way of scientific infrastructure and naval capacity, travellers and scientists from various backgrounds participated in and initiated Arctic expeditions. As centres for imperial science, cities such as London presented geographers and mapmakers with what historians have come to describe as an 'empire of opportunity' (von Brescius, 2019; Kirchberger, 2014), that is the infrastructure and logistical capacities to apply their natural scientific expertise to the non-European world. Along with the regions of the global south, the circumpolar north was of interest to scientific actors across imperial boundaries.

Distributional cartography and Petermann's Open Polar Sea

The German cartographer August Petermann was one such trans-imperial actor. Educated in the emerging scientific landscape of the 1830s in Berlin and Potsdam in Germany under Heinrich Berghaus and Alexander von Humboldt, Petermann became a leading mapmaker and a relentless advocate of the Open Polar Sea hypothesis during the second half of the century. Following an apprenticeship in Potsdam and a brief interlude in Edinburgh in Scotland, he moved to London at a time when Arctic travel had galvanized the public's attention as a result of the missing expedition of John Franklin in the late 1840s (Felsch, 2010). In his maps, Petermann integrated travel narratives of past expeditions with recent innovations in the field of physical geography to recast contemporary understandings of the Arctic. Specifically, the presentation of scientific data in the spatial plane of maps opened up a new visual aesthetic and a new vocabulary to describe the physical geography of the Arctic regions.

The power of cartography in the making of the European and American understandings of the Arctic world can be illustrated by a brief discussion of Petermann's campaign for an Arctic expedition in search of an Open Polar Sea and the missing vessels of the Franklin expedition in the early 1850s. Travel to the Arctic regions for the purposes of exploration and science was dependent on the logistical, financial, and political support of patrons, scientific institutions, and the naval departments of national governments. In mid-nineteenth-century London, learned clubs and societies such as the Royal Geographical Society or the Athenaeum along with individual patrons such as Jane Franklin and the Admiralty of the British government were gatekeepers in the organization of expeditions. When Petermann launched his campaign, he activated a European network of supporters based at geographical societies, naval departments, and ministries, including the diplomatic envoy of Prussia to Britain to lobby public opinion in favour of his scheme. Most importantly, however, Petermann produced a small polar projection map of the Arctic to demonstrate the scientific basis for his plan and to train his audience's eyes on the central Arctic

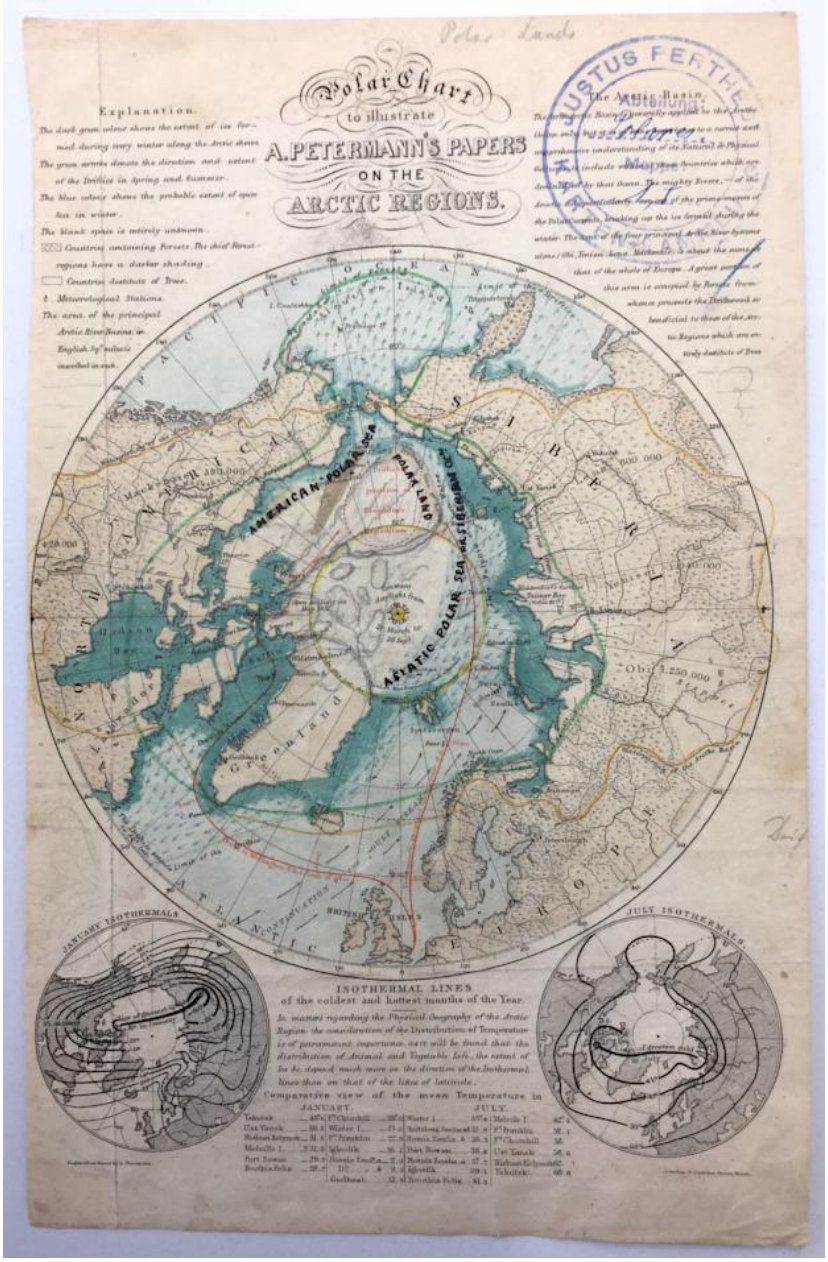

Figure 1. August Petermann, "Polar Chart," London, 1852, Sammlung Perthes, Gotha.

regions as valuable and accessible. An exceptional example of nineteenth-century science communication, "Polar Chart" (Figure 1) integrated data on the distribution of temperatures, ocean currents, sea ice, flora and river systems to make evident the existence of ice-free waters on the Asian and North American side of the Arctic. The power of the warm Gulf Stream pushing up far along the Eurasian side in combination with the freezing of the Siberian River systems during winter, so the German cartographer suggested, prevented the formation of sea ice in the East Siberian Sea and its movement westwards. Isothermal lines, shaded areas, and swarms of arrows represented the interplay of otherwise isolated natural phenomena. This distributional cartography, describing the Arctic as a system of interrelated forces, lend the German mapmaker the scientific language to suggest that open water existed and maritime navigation, including access to yet untraveled areas and potentially unexploited maritime riches, was possible.

Petermann's "Polar Chart" was a visual sensation and an important moment in the re-ordering of European and American 'habits of seeing' the Arctic regions. Physical geography and its cartographic representation in the form of distributional mapping helped recast the circumpolar world in the natural scientific categories of emerging scientific disciplines in the nineteenth century. The visual description of the Arctic, for example, in the language of isometrics and oceanography was consequential for seeing the Arctic as regions of nature and of commercial and geopolitical opportunity. Albeit ultimately unsuccessful in his campaign in London, Petermann's map was instrumental in raising attention to his expedition plan with the British Admiralty, the learned circles of the Royal Geographical Society, and the patrons of polar exploration across Europe and the United States. As U.S. interest in expansion throughout the American hemisphere took on the form of expeditions to the Arctic, "Polar Chart" received a much warmer welcome in the learned halls of New York, Philadelphia, and Washington D.C., helping to lay the foundation for another two decades of American Arctic exploration (Robinson, 2006; Felsch, 2010; Kaalund & Woitkowitz, 2021).

Knowledge and networks in a global Arctic

The Arctic was embedded in the global networks of exchange and transfer of the nineteenth century. As state and non-state actors travelled across the North Atlantic, they exchanged data and theories, news and gossip, and scientific objects among sites of collecting and knowledge-making in the Arctic and in the Euro-American world. In this context, cartographies acted as potent vehicles for the transfer of theories and knowledge about the most recent innovations and travels in the regions, further instigating the development of exploration agendas.

Transatlantic networks and American exploration

The theory of an Open Polar Sea was a catalyst in the emergence of American Arctic exploration in the 1850s. Early oceanographers and advocates of expansionism such as Matthew Fontaine Maury at the U.S. Navy Depot of Charts and Instruments and the U.S. Naval Observatory advanced the notion of open water, lending scientific credence to the theory with his charts of deep-sea soundings, winds, and currents (Rozwadowski, 2018; Hardy & Rozwadowski, 2020). Yet much like the close relations of German and British scientific networks of Arctic exploration, American travellers and institutions were not isolated from their European counterparts. The Euro-American republic of letters sustained a vibrant exchange among learned societies and scientific networks long before the installation of the transatlantic telegraph in the 1860s. Scientific theories and objects circulated among institutions such as the American Philosophical Society in Philadelphia, the American Geographical and Statistical Society in New York, and the Smithsonian Institution in Washington D.C. and their European counterparts in London, Paris, and Berlin.

Maps were powerful instruments in the campaigns by American explorers to secure the support of learned societies, patrons of exploration, and governmental agencies. In an effort to lobby Congress and the U.S. Navy to provide financial and logistical support for an expedition to the Smith Sound region along the north-western coast of Greenland, the newspaper owner and patron of Arctic exploration Henry Grinnell and the naval surgeon Elisha Kent Kane grounded their campaign in the theory of an Open Polar Sea. If European travellers sought to locate an entrance to this mythical body of water along the north-eastern passage ways and the East Greenlandic Sea, the route through Smith Sound, they argued, was the surest way to enter the fabled basin in the

central Arctic Ocean. Yet for all the novelty and distinction Grinnell and Kane claimed for their project, they enlisted the work and the charts of the British naval services and, most importantly, those of the German cartographer August Petermann in their campaign. Petermann's writings and his Polar Chart had been despatched to New York by various channels, including Jane Franklin's office. His map was frequently used at scientific meetings and public events to underwrite the scientific basis for the existence of an Open Polar Sea. Claims to exceptionalism and nationalism notwithstanding, from its earliest forms American Arctic exploration was embedded in transatlantic networks of science with European cartographies of the region playing a key role as instruments of knowledge and persuasion (Kaalund & Woitkowitz, 2021).

Missionary cartography, Inuit, and German Arctic exploration

European cartographies of the Arctic, however, not only circulated among European and American metropoles. Sites in the Arctic, likewise, played an important role in the making of geographical knowledge throughout the nineteenth century. Critical analyses of travel narratives frequently reveal the indispensable role of Inuit co-travellers across the North American Arctic in navigating the Northern and Arctic terrain, identifying geographical formations, and ensuring the survival and safe return of expeditions (Bravo, 2019b). While cartographies of such journeys readily record the 'discoveries' and 'acts of occupations' by non-Arctic voyagers, the presence of Inuit communities and their roles in the collection of such information often remain unacknowledged, erasing Indigenous agency and knowledge from the cartographic record and further solidifying colonial notions of a *terra nullius*.

The critical role of Inuit knowledge and intermediaries in the making of cartographies of the Arctic is evident in the first German scientific expeditions to East Greenland in the 1860s and 1870s. Interest in the polar regions as an object of scientific inquiry and a commercial and geopolitical region of concern was low at mid-century throughout the German states (Krause, 1992; Krause, 2010). Those Germans traveling to the Arctic regions such as whalers aboard Dutch fishing fleets, missionaries in collaboration with the Danish colonial authorities, or scientists as part of British naval expeditions took advantage of the global infrastructures of European empires in the Arctic. When preparations for the organization of a German voyage to the Arctic began in the early 1860s, historical and contemporary cartographies of Greenland were important instruments for advocates of an expedition around August Petermann and the Justus Perthes Geographical Establishment in Gotha in Germany. As part of the preparations, the charts and reports of Danish explorers and the Danish Navy along with English records were consulted. Yet Petermann's colleagues deemed as more accurate and reliable those maps that had been produced in Greenland itself, specifically the missionary cartography of the Moravian Church in Noorliit (Neu-Herrnhut) just south of Nuuk.

If missionaries acted as lay scientists in the field to collect natural specimen and ethnographic objects as late as the eighteenth century, they also joined the field of lay natural history and cartography in the nineteenth century. When the Danish colonial administration and the mission acquired printing presses at mid-century, missionaries soon began to write natural histories and geographies of Greenland. They also compiled linguistic works, prayer books, and music sheets as part of their missionary activities (Wilhjelm, 2013). Specifically the missionary Samuel Kleinschmidt emerged as a consequential figure in the collecting of data and the production of maps on the geography of Greenland. His map of Greenland, in fact, not only informed the preparations of the

Figure 2. Adolf Stieler, "Polar Map containing the Countries and Seas surrounding the North Pole," Gotha, 1874, Sammlung Perthes.

first German Arctic expeditions. It also appeared—without attribution—in one of the leading geographical publications in nineteenth-century Germany, the *Stieler Hand-Atlas*—rivalled only by Berghaus's *Physical Atlas* which was based on Humboldt's travels. Kleinschmidt, thereafter, prepared corrections and addendums to provide local spellings of toponyms and to specify the location of geographical features such as settlements, mountain ranges or coastal formations. In his writings, he emphatically stressed the importance of geographical information about regions untraveled by Europeans and Americans that he compiled on the basis of extensive reports and observations by Kalaallit as well as maps drawn by Aron and Abraham, two Kalaallit members of the Moravian mission. Indeed, missionaries and Inuit at mission stations of the Moravian Church were important nodes in the global web of meteorological measurements during the first International Polar Year in 1882 and 1883 (Lüdecke, 2005). As a result, European cartographies of the Arctic regions were not the products of seemingly disentangled centres of technology and science in the European or American metropole. Geographical knowledge of the Arctic was co-produced in a multilayered process of colonial governance, imperial science, and Indigenous knowledge. Acknowledgment of this co-productive aspect remained unusual and the encounters, some exploitative and violent, produced lasting consequences for Inuit across the circumpolar world (Bravo, 2019b; Cameron, 2016; LeMoine, Kaplan & Darwent, 2016).

If missionary cartography and Inuit knowledge of Greenland contributed to expanding and specifying understandings of the geography of mountain ranges and coastlines, they did little to disabuse cartographers of the speculative aspects in their work. The Open Polar Sea remained a popular theory in the advocacy and campaigns for Arctic travel throughout the second half of the nineteenth century. It was not until the 1893-96 *Fram* expedition under the Norwegian explorer Fridtjof Nansen that Petermann's hypothesis received a fatal blow. Nansen's ship drifted across the Laptev and East Greenlandic seas, proving the frozen state of the ocean and revealing a different phenomenon governing Arctic geography: the transpolar drift. Not unlike the Open Polar Sea, sixteenth-century theories of hyperborea, a mythical land and people around the North Pole, also remained potent myths among European cartographers as shown in a map published in *Stieler Hand-Atlas* of 1874 (Figure 2). These theories were grounded in alleged reports of Inuit migration in and out of mission stations in southwestern Greenland. Such ideas retained valuable appeal for political, commercial, and scientific funders of Arctic exploration far into the early twentieth century as the material of the Canadian Arctic Expedition (1913-1918) led by Vilhjalmur Stefansson document (Figure 3).

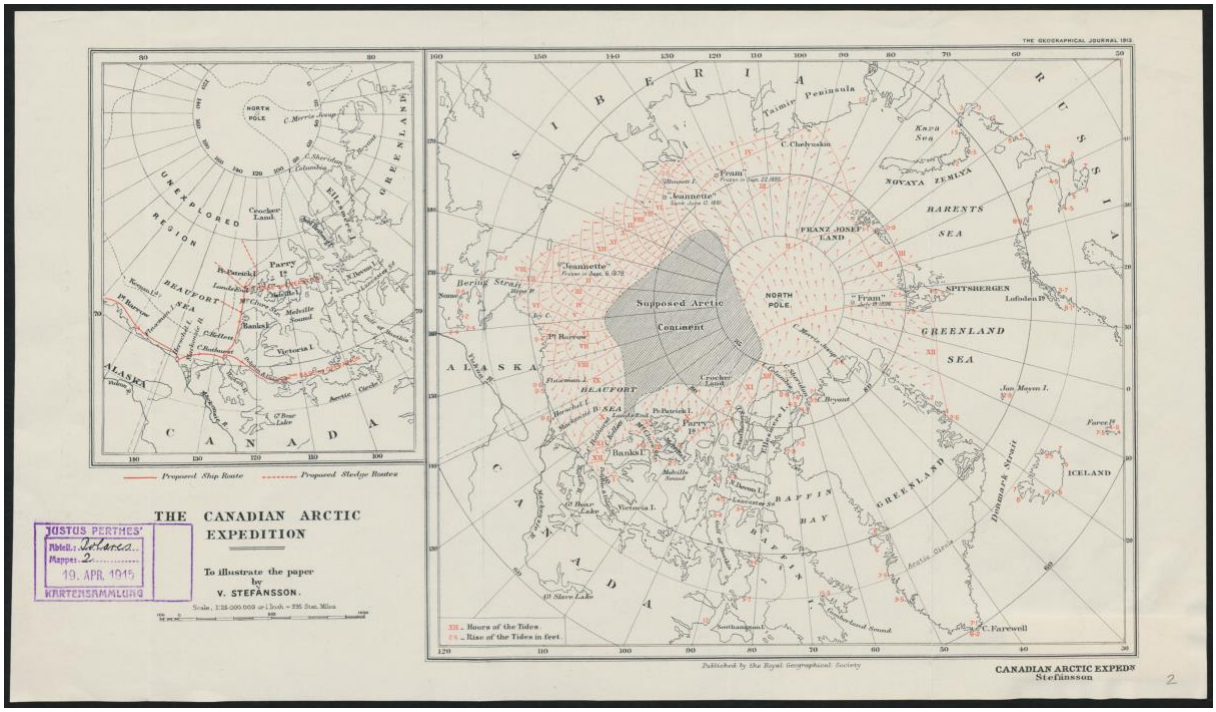

Figure 3. Vilhjalmur Stefansson, "The Canadian Arctic Expedition," Gotha, 1913, Sammlung Perthes.

Legacies of nineteenth-century Arctic cartography

Histories of science and cartographies of the Arctic endure in the mental maps and the wider perceptions of today. At the same time, such histories rarely present the easy narratives and pure heroes often enlisted in the circumpolar geopolitics of the twenty-first century (Powell & Dodds, 2014; Steinberg, Tasch & Gerhardt, 2015). Nineteenth-century activities to measure and map the Arctic importantly shaped those 'habits of seeing' that laid the foundation for present-day understandings, analytical categories, and wider public perceptions of the Arctic (Woitkowitz,

2021). As part of this process, European and American scientific activities in the Arctic regions have left complex and lasting legacies that place the present-day Arctic within the wider histories of colonial and imperial science in the non-European world of the nineteenth century. The field of science and the economy of mapmaking, as a result, have been entangled with the commercial, religious, and geopolitical interests of European and American governments, trading companies, missionary societies, and Inuit communities across the Arctic. Science and mapmaking have always existed alongside geopolitics, commerce, and Indigenous knowledge.

The emergence of scientific categories to describe the physical geography of the Arctic over the course of the nineteenth century has importantly shaped cartographical portrayals of the region. The presentation of measurements and observations not as isolated data but as interrelated phenomena produced a new visual and analytical vocabulary. The scientific debates over the existence of an Open Polar Sea are a powerful example that demonstrates the practice of relating early fields such as meteorology, oceanography, and marine biology to each other to make projections of the geographical nature of the Arctic Ocean. In cartographies such as Petermann's "Polar Chart," these arguments became translated into the visual language of physical geography and proved influential as effective forms of early science communication, securing logistical and financial support from patrons and governments. Echoes of the Arctic as a system of natural phenomena as a predominant lens to understand the regions remain potent in present-day images where the aesthetics of vast wastelands, melting glaciers, and vanishing sea ice retain a significant appeal among non-Arctic audiences.

These complex histories also highlight a little understood but fundamental quality of nineteenth-century Arctic science and cartography: for all the exceptionalist and nationalist rhetoric of expeditions to the circumpolar North, the collection of data and the production of maps about the Arctic regions was a global operation. Cartographers trained in Germany solicited logistical and financial support across Europe and the United States for field science in the central Arctic Ocean. Geographical information publicized in maps and atlases, moreover, were corrected and updated based on knowledge by Inuit and intermediaries. European and American cartographies of the Arctic often silenced such voices and left unacknowledged the role of Indigenous co-travellers and co-producers in the maps and atlases they sold, for example, in London, New York or Berlin. Perspectives that investigate such global flows of knowledge under conditions of unequal power, therefore, are imperative to fully understand the diversity of actors and institutions—state and non-state, Arctic and non-Arctic—involved in the long history of Arctic science and cartography.

The MOSAiC expedition of 2019/2020 enlisted the history of nineteenth-century expeditionary science in the Arctic as a touchstone in the design and communication of its scientific program. The MOSAiC's Scientific Plan and expedition publications by Markus Rex, the expedition leader, identified the polar drift of Nansen's *Fram* expedition as the central reference point for the yearlong journey across the central Arctic Ocean (MOSAiC, 2016; Rex, 2020). The web-based tracker of MOSAiC, for example, juxtaposed diary entries and daily locations of Nansen's journey with *Polarstern*'s progress and features of its scientific activities as part of the expedition's public outreach activities (Figure 4). Indeed, when placed within the context of nineteenth-century Arctic science, however, MOSAiC emerges as a distant cousin of the debates and controversies over the existence of an Open Polar Sea. When preparing for the 1879-81 *Jeannette* expedition to the Bering Sea, the American publisher James Gordon Bennett consulted with Petermann and his map collection in

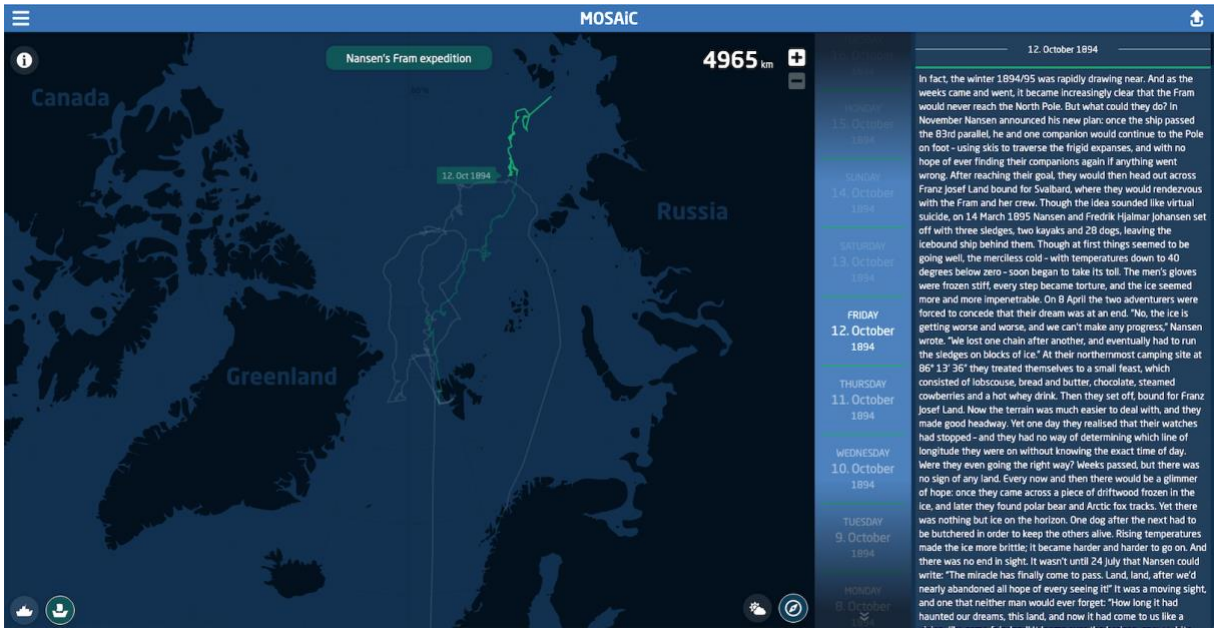

Figure 4. Web-based tracker of MOSAiC showing Fridtjof Nansen's 1893-96 polar drift with daily historical excerpts, MOSAiC Expedition, http://www.follow.mosaic-expedition.org, last accessed October 5, 2021.

Germany to return to the United States convinced of the existence of open water and its accessibility via the Bering Strait. It was debris and personal items of Bennett's abortive expedition that were found along Greenlandic shores years later that fuelled Nansen's theory of a transpolar drift and his plans for MOSAiC's historical precursor, the *Fram* expedition. The search for an Open Polar Sea and Petermann's maps, as a result, helped generate a new hypothesis of the physical geography of the Arctic Ocean that would ultimately inform the design of the MOSAiC expedition a century and a half later.

On its course to record 90°N latitude in August 2020, *Polarstern* indeed encountered large sections of open water, free of ice and easily navigable. For the researchers aboard the icebreaker, it constituted one more alarming indication of the accelerated transformations taking place in the Arctic as a consequence of a changing climate. As present-day science seeks to understand the processes and dynamics of these transformations, it is important to recognize knowledges and scientific categories not as self-evident but as products of a certain point in time. Cartography and science in the nineteenth-century generated new forms of describing the central Arctic region in the language of natural science. Understanding this historical dimension not only means acknowledging these forms as consequential in the ways they structure ways of knowing. It also means recognizing such knowledges and categories as transient and therefore amenable to building a more inclusive and equitable future for science and knowledge-making in the circumpolar world.

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