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Weather by the Numbers: The Genesis of Modern Meteorology. By Kristine Harper. (Cambridge, Mass.: MIT Press, 2008. ix + 308 p., notes, bibl., index. ISBN 978-0-262-08378-2 hc. $40.00)

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States, where there is a history of gendering nature study as feminine sentimentalism, in Germany the love of nature was viewed as a national character trait. Perhaps more to the point, in the US women dominated teaching in the late nineteenth century, especially elementary education; in Germany, men dominated the profession, including at the elementary level (p.362-3). Despite this, one of the only women mentioned in this book, Helene Sumper, co-founder of the German Women Teacher's Association, extolled the virtues of the living community (p.182). Here is an area where much work remains to be done.

The worries about modernism, *Heimat*, identity and industry strongly suggest that the biological perspective could be deeply insidious. One suspects that it must have found its way into discourses of race and heredity that were becoming every more prominent in early twentieth century Germany (and elsewhere). But these are matters for other books. Nyhart has, wisely, chosen to avoid a simple, unidirectional reading of history. The biological perspective had many trajectories and has "left behind a legacy of multivalency, accommodating diverse ways to appreciate and live with nature" (p.368). Anyone doing the history of nineteenth and twentieth century German science, culture or ideas who ignores *Modern Nature* does so at their peril.

Modern Nature is also required reading for historians of ecology, museums, zoos and popular science, really for any historian of science, including those who study the history of science in Canada. Geography and place are crucial part of *Modern Nature*, as they are in Canadian history, and I warmly recommend this book to all readers of *Scientia Canadensis*.

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***Weather by the Numbers: The Genesis of Modern Meteorology*. By Kristine Harper**. (Cambridge, Mass.: MIT Press, 2008. ix + 308 p., notes, bibl., index. ISBN 978-0-262-08378-2 hc. $40.00).

Harper's book sheds light on a critical chapter in the history of meteorology, as numerical weather moved from the realm of theory to practice, thanks to the rapid development of computer technology and the post-war mood in the United States. Scholars will undoubtedly welcome Harper's contribution to the history of meteorology and climate science, an area where, despite several important works in the past five years, well-defined case studies and focused analyses are still relatively sparse. The book also provides critical new insight into the inner workings of military-civilian partnerships and into the professionalization of a scientific discipline.

While the majority of Harper's research focuses on the years of the development and implementation of numerical weather prediction, she begins by presenting the backdrop of American weather prediction capacity before World War II (Chapters 1 and 2). The portrait is familiar: meteorology in the U.S. suffers from a lack of resources (human and financial) and poor standing within the scientific community, despite several initiatives (e.g. related to training forecasters) aimed at support this new "interdisciplinary" field of study. In Europe, on the other hand, the situation was more promising, particularly from the perspective of new ideas and theories being developed. Unsurprisingly, the eventual development of modern meteorology in the post-war United States relied heavily on these ideas and on cross-Atlantic migration. It should be noted, however, that the state of meteorology in Europe and the mechanisms for the movement of people and dissemination of ideas across the Atlantic are not a primary focus of Harper's study.

The war years (Chapter 3) naturally saw a sudden high demand for meteorologists, leading to the training of thousands of new recruits. Perhaps almost as significant as this demographic increase, the war effort greatly increased the perception of meteorology as an important endeavour for the United States. As a new research agenda for meteorology was forged at the end of the war, influential scientists also saw great potential for applying developments in computer technology to weather prediction. Unlike Nebeker's focus in *Calculating the Weather*,[1] Harper's narrative is not centred on John von Neumann's contributions to numerical weather prediction, although she clearly acknowledges the relative importance of meteorology in von Neumann's post-war endeavours. Indeed, von Neumann's interest in meteorology, combined with a push from civilian and military sectors to improve weather prediction, led to the establishment of the Meteorology Project at the Institute for Advanced Study at Princeton (Chapter 4).

Initial numerical weather prediction efforts were modest, but the arrival of scientists from Europe with greater theoretical expertise meant that the project could take important steps forward, despite von Neumann's much anticipated new computer still not being ready. This also meant that some concerns as to the overall numerical weather prediction approach could be allayed. During these few years, building resilient national and international networks within the scientific community and within the civilian and military bureaucracies was crucial in moving the project forward. In Chapter 5, Harper contrasts the Meteorology Project at Princeton with Philip Thompson's Atmospheric Analysis Laboratory of

1. Frederik Nebeker, *Calculating the Weather: Meteorology in the 20th Century* (San Diego: Academic Press, 1995).

the Air Force Cambridge Laboratories, a "parallel" (though not entirely unconnected) endeavour, which differed from the Meteorology Project in several ways, most notably its links with the military and its relationship with the larger scientific community.

Numerical weather prediction pursued its advances in the early 1950s, using the limited computer resources available and continuing to hone the models, with Carl Gustav Rossby, the main protagonist, continuing to battle criticism of the Meteorology Project's work, often coming from Thompson and the Air Force (Chapter 6). The Princeton Institute for Advanced Study computer was finally operational in 1952, marking the beginning of numerical weather prediction attempting to prove its worth, first by using the models to "predict" past weather events. But even this step was far from straightforward. Moreover, "territorial" disputes and challenges related to both equipment and human resources continued even as the more centralized Joint Numerical Weather Prediction Unit became a reality, with the Weather Bureau now as the coordinator. As Harper points out, "in 1955, the [Joint Numerical Weather Prediction Unit] was an operational entity in only the loosest sense [...]" (p. 226). Important advances had been made to atmospheric models, which could then serve as the "forecaster's assistant," but the establishment of the functional unit did not instantaneously lead to "practical" forecasts. Not only did technical difficulties persist, but it was difficult to produce forecasts that could satisfy the needs of both civilian and military clients (Chapter 7).

One of the main threads of Harper's work is the passage of meteorology from an art to a science. There are many distinctions to be made between how the craft of meteorology became "scientific" and how meteorology became a legitimized and recognized as a field of research and meteorologists as members of a scientific profession. Harper's contribution is more focused on the latter facet, explaining the institutional and interpersonal dynamics that provided the context for, and ultimately determined, the development and implementation of numerical weather prediction. The routine of "calculating" the weather versus previous "subjective" forecasts also reveals the deep changes to the practice of meteorology brought in by theoretical and computational advances. Strictly speaking, however, the changes in practice are more related to meteorology becoming an institutionalized discipline rather than a profession. At several moments in the story, the reader catches a glimpse of how the practice of meteorology is connected (or not) to that of other natural sciences or technical fields, but while the notion of meteorology as a craft or practice is present throughout the book, an in-depth analysis of it is absent. Nevertheless, Harper's tale of formidable technical and institutional obstacles preventing so-called "objective" forecasts from actually becoming useful is truly fascinating, not primarily from an epistemological

perspective *per se*, but mostly as an important "part of the history of the rise of modeling in the natural sciences" (p. 239). Indeed, this work should be of great interest to the growing number of historians, sociologists and philosophers of science interested in modeling.

The importance of numerical weather prediction in the evolution of meteorology is well known, but Harper's work provides crucial new insight into how this came about, taking apart the programs to reveal complex bureaucratic structures, rich—and, according to Harper, extremely successful—military-civilian dynamics and strong personalities that played defining roles. Charismatic figures such as that of the ambitious Philip Thompson contribute to a rich narrative in which intrigue is interwoven with the more mundane—but perhaps more significant in terms of the ultimate outcomes—human resource, technical and logistical issues that characterized the early years of numerical weather prediction. It becomes increasingly clear that closely following these key actors and their institutions leads to a better grasp of the interfaces (theoretical/computational, military/civilian, etc.) that characterized the genesis of this new type of meteorology.

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***Measuring the New World: Enlightenment Science and South America*. By Neil Safier**. (Chicago: The University of Chicago Press, 2009. xviii + 387 p., ill., notes, bibl., index. ISBN 978-0-226-73355-5 $49.00).

Enlightenment naturalists aspired to produce knowledge about nature that was universal and definitive, that would transcend personalities, politics, and other vulgar local concerns. In practice, they seldom—if ever—achieved those aspirations. Neil Safier focuses in particular on the scientific work of the French/Spanish geodetic expedition to the Spanish province of Quito (modern-day Ecuador) in the 1730s and 1740s. *Measuring the New World* is not, however, primarily a history of this expedition; rather, it is a history of this expedition's findings; about how knowledge was produced and reproduced, and critically received, both in the Americas and in Europe. Safier explores the rhetorical strategies that European naturalists used to construct this putatively authoritative knowledge about the New World. This authority was always tenuous: Safier shows the many compromises and contingencies that shaped the production of texts, maps, and monuments. Nor did critics in Europe ever accept these texts as authoritative. *Measuring the New World* is also an innovative history of science and imperialism. Rather than taking political