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Weather by the Numbers: The Genesis of Modern Meteorology

Jennifer Ferng

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Weather by the Numbers: The Genesis of Modern Meteorology

Reviewed by Jennifer Ferng, Department of Architecture, Massachusetts Institute of Technology. E-mail: jferng@mit.edu.

Farmers sometimes relied upon the intuition of wind direction, the natural instincts of animals, imminent storm clouds and heavy rainfall to predict how the weather would influence the prosperity of their forthcoming harvest. The U.S. Weather Bureau during the early 1920s, partially composed of several thousand unpaid volunteers who collected and transmitted local observations for regional forecasts that affected crop and road services, was, at the time, an ineffective government bureaucracy that envisaged how extreme heat temperatures would impact the transport of livestock and published empirical data on fruit frost for tobacco and alfalfa seed districts. Placing the Weather Bureau as one of the many strategic organizations at the heart of meteorology’s expansion into a theoretically sophisticated science, Kristine Harper traces from World War II into the 1960s the tribulations and successes of American and European scientists who introduced numerical computing techniques to the art of forecasting the weather as part of the Meteorology Project based at the Institute for Advanced Study in Princeton, New Jersey. She shifts the spotlight away from the better-known contributions of mathematical prodigy John von Neumann and instead accentuates the daily decisions made by American meteorologists collaborating with external Norwegian experts who possessed more theoretical training and time-tested experience. Harper challenges some historians’ interpretations of von Neumann’s central role in developing numerical weather prediction, represented by such works as Frederik Nebeker’s Calculating the Weather: Meteorology in the 20th Century (1995) and William Asprey’s John von Neumann and the Origins of Modern Computing (1990). Computational modeling during World War II—though widely prevalent in chemistry and physics—became defined in meteorology, in Harper’s view, through the pursuit of a mathematics-based theory of general circulation in the earth’s atmosphere. By pursuing the “control of nature,” American scientists attempted to master a new technology that would demonstrate a different style of scientific practice from that of their Norwegian counterparts.

Harper’s claim stresses that von Neumann’s development of the “electronic brain,” which would eventually take only 90 minutes to make a 24-hour forecast, was influenced by a cadre of mathematicians and physicists who were responsible for the majority of the tedious advancements as part of an international effort that transformed the computer into a feasible instrument for weather prediction. This book is shaped as an institutional history, since Harper closely focuses on the interactions of the “military industrial academic complex” that developed between the Air Force, the Navy, the Weather Bureau and the Big Five schools that were among the first to instigate academic programs in meteorology, including Caltech, MIT, New York University, University of California at Los Angeles, and the University of Chicago. This type of approach in studies of the sciences during World War II has also been predominant among scholars such as Paul Edwards, who defines the relationship between computer models, data and reality in his seminal work The Closed World: Computers and the Politics of Discourse in Cold War America (1997); Stuart Leslie, who writes about the research and development contracts acquired by MIT and Stanford in The Cold War and American Science (1994); and Jessica Wang, who analyzes scientists’ reactions to Cold War anti-communism in American Science in an Age of Anxiety (1998), to name a few.

In chapters 5 through 7, the reader is quickly immersed into the staffing shortages, funding discrepancies and ideological conflicts that surface between the strong personalities of von Neumann, Jule Charney, Philip Thompson and Carl-Gustav Rossby, who along with Arnt Eliassen were known as the “Scandinavian Tag Team.” In the face of dwindling financial funding for advanced research and a dearth of academically qualified practitioners, Rossby remained an essential mediator in disseminating concepts between various team members who closely mentored many of his students while founding the Meteorological Institute in Stockholm, Sweden, in later years. During the initial exercises for the electronic digital computer, “canned” data was employed rather than live data in order to correlate historic patterns to what had been calculated, and Charney, in becoming a “servant to the machine,” became conversely fluent with the prototypical models entered into the computer. In 1952, Thompson’s underhanded attempt to secure control of the direction of the Meteorological Project ironically accelerated the gradual progression toward operational forecasting by forcing those from the Weather Bureau to consolidate their manpower and information with those from the von Neumann-Charney research group.

The fact that meteorology as a type of geophysical science became more theoretical in nature and less reliant upon analogue techniques seems self-evident, perhaps too much so, but since many scientific disciplines are a combination of human skills, subjective evaluation and technological computation, to say that meteorology moved from being an art to a full-fledged “science” with the sole assistance of numerical weather prediction seems slightly drastic. Providing more examples of the forecasters’ skills or “tacit knowledge” (non-quantifiable or non-transferable aspects of research assessment) that were given over to computational techniques could have alleviated this overstatement on the part of the author. To her credit, Harper does profile many other researchers recruited for the IAS Meteorology Project, divided between theorists and those who had a sense of the
“physical factors” that influenced the weather, and it is clear that the “sanity check” provided by forecasters’ knowledge of a model’s biases and strengths informed the accuracy and temporal range of weather predictions for operational meteorology. Despite these minor drawbacks, the full cast of personalities that Harper portrays in this book nevertheless defies the conventional expectation that a groundbreaking scientific development belongs only to the labors of an individual genius.

SYSTEMATICS AS CYBERSCIENCE: COMPUTERS, CHANGE, AND CONTINUITY IN SCIENCE
Reviewed by Amy Ione, Director, The Diatropie Institute. E-mail: <ione@diatropie.com>.

I was drawn to Christine Hine’s Systematics as Cyberscience: Computers, Change, and Continuity in Science because the synopsis of the book suggested it was a study of the ways that biologists working in this field have engaged with new technologies as the field sustained its heritage and changed to accommodate new possibilities. While some information about research techniques and practices was included, I was disappointed to find that the book’s concern was not with the practices that advance the field but, rather, the dynamics of the community as its tools change. More to the point, as Hine acknowledges in the final pages, the project paid “less attention to the detail of scientific practice and more to the varied sites in which the discipline [systematics] was manifested” (p. 260). As a result, in my view, Hine missed a real opportunity to educate the public in a meaningful sense about a field that is increasingly a part of the current ecological debates. In focusing on the discipline as a community, rather than on the change and continuity within the scientific practices employed, the book seemed more interested in the field’s veneer than the substance of what the people who drive the field’s accomplishments do.

For those who are not familiar with the term, systematics is a discipline that focuses on the classification and naming of organisms and the exploration of evolutionary relationships. Interest in this discipline, which we can trace back to ancient thinkers such as Aristotle, has recently re-surfaced as ecological analysis has raised concerns about threats to the diversity of life on the planet Earth, which has in turn renewed our interest in relationships among living things over time. Simultaneously, as is the case in all fields today, systematics is integrating its long-established practices with the new field of information and communication technologies (ICTs). How this integration is coming about sociologically is Hine’s concern as she explores the parameters of ICTs as discussed with biologists working in systematics. This discussion expands on her earlier book Virtual Ethnography, wherein she looked at the social dynamics surrounding the Internet in the late 1990s. In investigating how systematics has become a cyberscience, the author employs what she defines as an ethnographically informed style both to question some of the assumptions in current science policy as it relates to systematics and to offer a study that contributes (more broadly) to the sociology of science.

Researchers in systematics will no doubt relate to her narrative of the field’s efforts to integrate the new ICT options more than the general reader will. As someone who came to the book with only a vague notion of what systematics is and what systematists do, I found myself wishing the author had paid more attention to the fact-finding side of the discipline each time she offered nuggets of information that drew on research and the study of specimens. This is not to say that the sociological study is not interesting. Some topics captured my imagination. I was intrigued by her discussion of the idea that virtual settings are both cultural sites in their own right and cultural artifacts subject to ongoing processes of interpretation. I was also fascinated by her discussions on how balancing historical approaches with the introduction of cyberspace created a need to seek a balance between automation and expertise. I was quite taken with the sections that detailed the difference between material and virtual samples, although I would have liked more information on this topic. The paragraphs where she mentioned what systematists do and/or compared their goals with those of other branches of science (e.g., genetics) were particularly informative. Indeed, these comparative sections convinced me that the writing would have communicated better to generalists had Hine introduced the field initially and stressed scientific practices more than the sociological aspects of the field.

Similarly, a different approach to the examination of the use of computers in science as a topic in policy circles, including the appeal of efficiency, data sharing and collaboration within the debates, might have served her better. As an outsider, I was left with many questions and disappointed to find that parts of the book I found most informative were outside the scope of the study. Some of my questions were as well. For example, I wondered about the connections between systematics and evolutionary theory. To my mind, the book’s overall organization undermined the depth of its research and background. Hine opens with a quite interesting vignette of her personal history to explain what led her to write what she sees as a somewhat idiosyncratic ethnographic study. I was actually quite enthusiastic about what would follow because she clearly articulated her fascination with the field and that she had looked at it from the inside, as an undergraduate, before stepping into the ethnographic role and adopting a sociological perspective. Her second chapter was intended to flesh out what claims are made for ICTs in science and how we think about technologies more broadly, particularly in terms of policy. Although I assume this discussion was intended to show a broader connectivity among fields, it did not accomplish this goal because the discussion came off more as a literature review intended to place her study within the sociological arena. She really does not offer an in-depth introduction.