

A Geophysical Entrepreneur

Appropriating the Weather. Vilhelm Bjerknes and the Construction of a Modern Meteorology. ROBERT MARC FRIEDMAN. Cornell University Press, Ithaca, NY, 1989. xxii, 251 pp., illus. \$34.95.

Vilhelm Bjerknes (1862–1951), meteorologist and *éminence grise* of the Bergen school, is familiar, at least by name and reputation, to most atmospheric scientists. This is largely due to the major transformation of meteorological theory and practice, emanating from Bergen, Norway, after World War I, which brought the world, among other things, a new cyclone model, the polar front theory, air mass analysis, and a host of active, aggressive, and creative young meteorologists. Almost unknown today, however, is Bjerknes the failed classical physicist, opportunist, disciplinary entrepreneur, manager, and propagandist.

According to Friedman, Bjerknes originally turned to atmospheric studies to avoid professional decline as a theoretical physicist. As a youth at the 1881 Paris International Electric Exhibition, Bjerknes amazed such international celebrities as Hermann von Helmholtz and Lord Kelvin with demonstrations of his father's work in hydrodynamics. Later, after studying with Heinrich Hertz (himself a student of Helmholtz's), Bjerknes found his earlier career dominated by the desires of his father, who was relying on him to complete and publish his early work. Bjerknes, pursuing the twin grails of perfect filial loyalty and the unification of mechanical physics through hydrodynamics, found himself without a viable research program of his own, increasingly isolated from the mainstream of continental physics, and on the verge of a nervous collapse.

He was rescued from his "arduous, almost thankless efforts in theoretical physics" (p. 46) by his "conversion" at age 36 to a research program in geoscience, which soon brought him the international attention, reputation, and authority he craved. His program included redefining, reclassifying, and restructuring meteorological science. First, he announced a plan for creating an exact physics of the atmosphere, then (as had his mentor Hertz) he devised graphic methods for analyzing atmospheric processes. By involving himself with the growing fields of aeronautics and aerology, Bjerknes gained not only the data he needed but, more importantly, the leadership of a new institute for geophysics in Leipzig in 1913.

Returning to Norway during the war, Bjerknes solicited and obtained government support for practical weather forecasts useful to aviators, farmers, and fishermen. The West Norway Weather Bureau, located in the Bjerknes family residence in Bergen (in style not unlike Bohr's institute for theoretical physics at his home in Copenhagen), became the center of a new school of non-mathematical meteorological analysis. This was an ideal situation for Bjerknes, who was not particularly good at math and was most productive when surrounded by skilled assistants. Believing that their system of air mass analysis could best satisfy the problems facing postwar meteorology, "apostles" and "missionaries" of the Bergen school traveled far and wide in their efforts to "convert" their foreign colleagues (p. 197) and redefine the Norwegian periphery as a new international center—not, ironically, of atmospheric physics, but of new methods for practical forecasting. Thus Bjerknes and his assistants appropriated the weather "as professional property that could be exchanged for authority, resources, and prestige within the world of science and in society" (p. xiii).

Friedman goes out of his way to tell us what the book is not: it is not a biography—we learn little of Bjerknes's early or later life, or how he came to be interested in studying the atmosphere. It is not a comprehensive history of the meteorology of this period—although occasionally Bjerknes himself mentions, usually disparagingly, the work of

others. It is not a history of the Bergen school's endeavors—the accomplishments of Jacob Bjerknes, of Bergeron, Rossby, Solberg, and others are presented only as they relate to Vilhelm's career. Nor, according to Friedman, is it a case illustration of any particular model or theory of scientific change—although he does express well-formulated views on this subject, concluding that the "emergence of the Bergen meteorology illustrates new knowledge arising through changes in practice. . . . Hard facts were not waiting in nature to be uncovered. Bergen scientists constituted their new concepts and models by drawing upon analogy, metaphor, existing theory, and ad hoc construction" (p. 243). Finally, the book is not at all polemical, even though Friedman has "perspectives and interpretations that conflict with some received ideas on the history of this particular chapter of meteorology" (p. xiv).

In essence the book is a carefully crafted narrative analysis of the interconnected history of Bjerknes's career and the construction of a new meteorology. By at least three criteria Friedman's effort rates five stars: his book is solidly based on archival sources; the career of Bjerknes, the rise of the Bergen school, and the development of scientific theory in meteorology are all placed in their contemporary social setting; and the book avoids using today's understanding of the atmospheric sciences to comprehend the history of early-20th-century meteorology.

Beginning with his 1978 dissertation on Bjerknes (a copy of which is available, by the way, in the Francis W. Reichelderfer Papers in the Library of Congress), Friedman the historian has appropriated Bjerknes the meteorologist as professional property. The history of Bergen meteorology, like meteorology itself after World War I, has been greatly enriched by this.

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Vilhelm Bjerknes

Broken Symmetries

CP Violation. C. JARLSKOG, Ed. World Scientific, Teaneck, NJ, 1989. x, 723 pp., illus. \$84. Advanced Series on Directions in High Energy Physics, vol. 3.

Symmetry has always fascinated scientists, especially physicists. From the ancient theories of circular orbits for the planets to modern superstring theory, we tend to build our theories using ideas and mathematics based on symmetry. However the existence in nature of broken symmetries or near