

Mott T. Greene

Alfred Wegener. Science, Exploration, and the Theory of Continental Drift. Baltimore: Johns Hopkins University Press, 2015, xvi + 675 pp., 44.95 \$, ISBN: 978-1-4214-1712-7.

Mott T. Greene has written a comprehensive, accurate, and extremely rich biography that depicts the multi-faceted scientific contributions of Alfred Wegener and vindicates his importance and role in twentieth-century science. He has moreover delved into the history of each discipline touched and inquired by Wegener: polar exploration; meteorology and techniques and instruments of meteorological investigation; astronomy, cosmic physics, and geophysics; palaeoclimatology, palaeogeography, and palaeontology; seismology, tectonics, geology, and geodesy. The result is a fascinating and riveting book that compels the reader to reach the very last page.

The structure of the book – articulated in twenty chapters – is quite customary: the story begins with a portrayal of Wegener’s family, youth, and education (1880–1904); it follows his path towards science through meteorology and Arctic exploration (1905–1908), then focusing on his innovative research on the physics of the atmosphere (1908–1911), analysing his first writings on the theory of continental drift (1912–1915) and describing his scientific endeavour as officer of the German army during the Great War (1914–1918). The book continues by scrutinising Wegener’s transition from geophysics to palaeoclimatology and how such a shift was intertwined with the growing discussion around continental drift (1919–1924). It concludes with Wegener’s university years as professor in Graz (1924–1928) and his tragic last expedition to Greenland (1929–1930), where he died probably by mid-November 1930.

Nonetheless, such a conventional narrative is never pedantic or tedious. It is complemented by the ambition to display events, encounters, and activities that filled Wegener’s life and moulded his scientific achievements. The extensive and apt exploitation of both Wegener’s diaries, correspondence, and documents collected in several archives, and his own readings and sources gives substance and vitality to the detailed description of the scientific and social contexts that surrounded Wegener’s activity and nurtured his scientific ideas. The historical inquiry into the disciplines touched by Wegener’s willingness to either innovate or revolutionise science leads Greene to a refined analysis of how Wegener thought and processed information while creating science.

It is worth quoting how the biographer describes Wegener’s reflective and imaginative style at the time of the birth of the hypothesis of continental displacements: “an article ‘falls into his hands’ which contains information on a problem with which he is already concerned, but which does not contain the conclusion that he would draw from the same data. A quick survey of the

relevant literature at hand provides ‘surprising or astonishing simplifications and corroborations.’ A conviction of the ‘fundamental correctness’ of the intuition forms in his mind well in advance of a detailed survey of the evidence and sends him off on an enthusiastic pursuit of further confirmatory evidence, but not before leading him to assert a bold new working hypothesis that reorganises the data in a novel way [...]. Wegener was decidedly an ‘enthusiast’” (p. 236).

Wegener’s enthusiastic approach and ability in “integrating uncorrelated ideas into a unified picture capable of producing an explanation that others might and ought to have seen but had not” (p. 187) guided him to less famous but not less important research, often providing theories and discoveries – investigation into the tropopause (1906); the notion of atmosphere as structured in layers separated by well-defined boundaries (1910); the so-called Wegener-Bergeron-Findeisen theory of precipitation in cold clouds (1910–1911); the seminal book on atmospheric thermodynamics (*Thermodynamik der Atmosphäre*, 1911), which “contained well-confirmed results suitable to a textbook [...] as well as frontline results” (p. 210); the book on tornadoes and waterspouts (1917); a mathematical theory of mirages (1918); phenomenology of sounds and colours of meteors (1918); the fundamental contribution – through ingeniously designed experiments – to the view that lunar craters originate mainly from meteor impacts (1919–1921); the “extraordinary research effort and imaginative tour de force” of the book written with Wladimir Köppen on palaeoclimatology (*Die Klimate der geologischen Vorzeit*, 1924).

The reason why this is a must-read book comes from the fact that while learning about all of Wegener’s scientific enterprises one can equally gain a substantial understanding of both the history of the different disciplines involved and the quantity and quality of Wegener’s work. It is a compelling description of the “human factor” that reaches its summit in the pages that chronicle the expeditions to Greenland in 1906–1908, 1912–1913, and 1929–1930. The prose is vivid, and one can almost feel the strenuous difficulties experienced by polar explorers one century ago. Some details are unexpected and do not lack humour: “July [1907] brought warmer weather, more flowers, and millions of mosquitoes [...]. Breeding 50 million to the hectare, they made every outdoor activity a considerable challenge, and [the members of the expedition] found themselves dreaming of the winter as they had just finished dreaming of summer, more or less proving that the one constant of a polar trip is discomfort” (pp. 140–141). The same can be said of the “lessons” given by experience: “they learned that you need to carry enough fuel to melt snow so that you are not constantly dehydrated, and they learned that without this additional fuel you must wait to eat until your beard thaws, because it freezes so hard that you can’t

open your mouth. It is for the latter reason that most polar explorers learned to stay clean-shaven or to have very short beards" (pp. 221–222).

Last but not least, Greene has done an excellent job in the detailed analysis of Wegener's writings on continental drift and their refining – by appreciating how new research and the scientist's colleagues contributed to ameliorate the hypothesis for the editions of the book on the origin of continents that followed the first one in 1915 (*Die Entstehung der Kontinente und Ozeane*: 1920, 1922, and 1929). The detailed scrutiny of the many aspects of criticism encountered by the theory is also worth mentioning. After reading Greene's pages dedicated to the continental drift one can really appreciate how its process of assessment was complicated and tormented. Greene is able to trace elements that contributed to the controversy that have usually been overlooked, like the representation of continental displacements on maps. In his publications, Wegener drew maps showing the continental displacements in the past using the Lambert azimuthal equal-area projection; however, starting from the second edition of his book (1920) he did not miss to make it explicit that his drawings differed from any reproduction of land masses on a Mercator map. In fact, severe criticism of Wegener's palaeogeographical maps in 1915 came from the Austrian geologist and palaeontologist Carl Diener, who – as Wegener himself observed – had visualised the ancient positions of continents having in mind the Mercator projection (p. 402). In fact, as Greene underlines, at that time geologists used to visualise tectonic features as depicted by a Mercator map.

More general considerations about the controversy are worth noting, like when Green underlines the strong opposition by geologists. It is generally acknowledged that Wegener's case was weakened by the lack of a convincing geophysical mechanism explaining continental drift – he himself was aware that the "question of forces" remained without a satisfactory answer. But Greene is convincing when describing the persistent hostility that came from geologists – quite surprisingly, considered that Wegener presented quantitatively and qualitatively impressive geological evidence supporting his theory. But as Greene recalls by quoting a participant at the 1923 Cambridge forum on continental drift, geologists "tend to 'work small' [...] and are unaccustomed to dealing with hypotheses of large scope and scale. [Moreover, they] are faced with the paradox that while the published literature represents the official record of their science, they tend to be distrustful and even contemptuous of geological writers who 'work by book' [as Wegener] rather than with 'boots on the ground'" (p. 483).

To sum up, Greene's book is much more than a biography and can attract the interest of historians of science that are curious about the "scientific revo-

lutions” of the first quarter of the twentieth century. As a biography, however, it is a beautiful contribution that demystifies “later characterizations of Wegener as a rebel, an outsider, a loner, a maverick, or an isolated genius figure” and convincingly explains how “Wegener was a well-trained, experienced, highly competent physicist [...]. He was professionally well-placed, well known and widely published” (p. 276) and his legacy is in a range of scientific notions that goes well beyond the continental drift theory.

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