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Jeremy Gray. *Henri Poincaré: A Scientific Biography*.

Henri Poincaré: A Scientific Biography by Jeremy Gray

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Questionnaires and postcards were mailed to volunteers from across the country, which was divided into seven regions, each of them under a geologist's guidance: this was an example of scientific democracy, which perhaps reflected Swiss political traditions. In Imperial Austria, from the 1880s, scientists took up the Swiss example to develop collaborations with local people, especially in seismic regions, like the Adriatic coast and the Balkans: for the geologist Edward Suess, promoting such involvement also aimed to prevent panic and to educate people in the scientific attitude. In the United States, after the great San Francisco earthquake of 1906, people became organized in networks and "co-ops": Harry Wood, a Berkeley instructor in mineralogy, drew up a set of instructions for observers, insisting on the necessity to combine, in the approach to earthquakes, "knowledge of geology, the built environment, and human perceptions" (p. 242). In these different contexts, observers became able to translate their sensations and observations into data that were useful to science, thus participating in the creation of a standardized language for earthquake description and quantification: Richter's scale of earthquake magnitude, established in the 1930s and still in use today, relied in part on this accumulation of data.

Coen also studies the Romantic age's "fashion" of earth tremor experience, which eventually became a kind of rite of passage. She describes and analyzes a whole "culture of earthquakes," from "seismic tourism" to "earthquake collecting" and "seismic anthropology," and a whole array of emotions and attitudes, from pride to curiosity, from humor to self-indulgence, from panic to indifference: she explores newspapers, novels, and travel diaries, quoting the testimony of anonymous men and women but also of great scientists and writers whose writings record their more or less voluntary involvement in earthquake observation. She also notes how such existential experiences came to shake people's prejudices and categories: thus European travelers in South America ended up admiring the natives of these "savage regions" for their sangfroid when facing the "incredible instability of nature" (p. 111).

*The Earthquake Observers* seeks to weave a cultural and emotional history of earthquakes with a history—or prehistory—of seismology. However, one should not expect to find here a thorough study of the history of early seismology. Coen's work is full of interesting and picturesque details on the observers' practices, but it is more elusive on theoretical debates that contributed to the making of scientific seismol-

ogy during the period she studies. Japanese and Italian contexts are virtually absent from the picture, even though the study of earthquakes in these countries played a crucial role in the making of seismology as a science at the turn of the twentieth century. One also regrets finding here only scattered comments about connections between early seismology and related scientific disciplines such as physics, geology, and geophysics during the same period.

But, obviously, Coen's interest lies elsewhere: her argument clearly points to concerns about how we deal with disasters today. Recent major catastrophic events, such as the Fukushima earthquake and tsunami, have shown that they are all the more terribly threatening and destructive as they combine telluric upheavals and technological hazards. Coping with these disastrous events today is not only a necessity for science and technology. It is also a necessity for the people who live through them and suffer from them. In this context, "disaster science" has developed in recent decades as a "human science," an interdisciplinary endeavor to connect geophysics and seismology with economics, engineering, urbanism, and architecture—but also with psychology, sociology, and ethics.

Relying on her nineteenth-century models, Coen tells us that the role of the public in these circumstances should be recognized and valued today: observations, feelings, and fears must be taken into account, at least as much as scientific expertise or technological and quantitative evaluation of risks, in a time when electronic communications and exchanges open new ways for collecting and sharing a wealth of individual expressions and experiences. This should make people's observations and testimony not only a useful source of information and knowledge, but also a valuable resource for prevention as well as for action in responding to disasters and recovering from them.

CLAUDINE COHEN

**Jeremy Gray.** *Henri Poincaré: A Scientific Biography.* xiii + 392 pp., illus., apps., bibl., index. Princeton, N.J./Oxford: Princeton University Press, 2013.

It must have taken some courage to undertake the task of writing a scientific biography of a towering figure like Henri Poincaré. Jeremy Gray took on the challenge and has delivered a wonderful book. Poincaré (1854–1912) is considered one of the most influential mathematicians of the late nineteenth and early twentieth centuries. His *oeuvre* is vast and formidable.

The young Poincaré was recognized as a mathematician of prominence in the early 1880s. The recognition was due mainly to his discovery of the so-called Fuchsian and Kleinian functions, a feat that integrated earlier concepts from complex function theory, group theory, and non-Euclidean geometry in a novel and far-reaching way. This work was done in response to a challenge put forward as a prize competition by the Parisian Academy to advance the theory of linear differential equations. It did not receive the prize—only honorable mention—but it induced Poincaré to publish a number of papers on the subject in Gösta Mittag-Leffler's newly founded *Acta Mathematica* that helped establish this journal's reputation for excellence.

Poincaré's subsequent work soon radiated out to areas of mathematical physics. He tackled problems of astrophysical importance like the stability of rotating fluid masses and the long-term stability of the solar system. By taking a new look at the problem of integrating Newton's equations of motion, he advanced significantly the theory of the three-body problem. His astronomical investigations resulted in his three-volume *Méthodes nouvelles de la mécanique céleste*, a classic of mathematical physics that inspired astronomers and mathematical physicists of later generations in fields as diverse as quantum mechanics and chaos theory.

As Gray's biography shows, Poincaré was also a physicist by any standard, the author of the first French textbook exposition of Maxwell's electrodynamics and a scientist deeply interested in and closely following contemporary developments of cutting-edge electro-technology. His interest in the dynamics of the electron brought him close to the co-discovery of special relativity; in particular, he realized the physical significance of the invariance of Maxwell's equations under the Lorentz group, only to shy away from drawing the radical conceptual consequences that Einstein did. The episode has raised heated arguments about priority to the present day and is presented by Gray in an agreeably calm and sober manner. Indeed, later generations would perhaps have remembered Poincaré first and foremost as a theoretical physicist if the campaign to award him the Nobel Prize had been successful before his untimely death in 1912.

Not an experimentalist himself, he nevertheless kept a close eye on key experimental developments. He even encouraged a side-by-side repeat of two realizations of a crucial experiment on the role of conduction currents that had produced contradictory results. If Poincaré rightly called for an experimental decision on this issue, his expecta-

tions turned out to have been on the wrong side, as did his initial sympathetic curiosity about the infamous N-rays, allegedly discovered in his hometown of Nancy but soon shown to be an illusion in what turned into a major embarrassment for French experimental science. More successful, in any case, were Poincaré's mathematical investigations, such as that of the telegraphers' differential equation.

But if the boundaries of Poincaré's mathematical work toward physics are blurred, he was also an influential philosophical thinker. Reflecting on the physical significance of non-Euclidean geometry, Poincaré advocated a position of geometric conventionalism, a stance that suggests more general, if also more problematic, interpretations as well. Poincaré was a powerful essayist, and his reflections on the nature of knowledge, on mathematical creativity, and on other epistemological questions were original and captivating. They were also presented in an intriguing but sometimes not very lucid style of writing, a feature of Poincaré's work that also points to characteristics of his mathematical style. The latter—so people have often complained—often lacks rigor, resting content with sketching the basic idea and leaving it to others to fill in the details.

Gray's book masters the task of writing a scientific biography of this mathematician, mathematical physicist, philosopher, and essayist, whose work illuminates the transition to mathematical modernity, in a competent and commanding way. The biography approaches its subject by discussing the more broadly known essayist in a first chapter, then giving the external biography in a second one. The following chapters are organized by topic, ranging from the early prize competition over the three-body problem, cosmogony, physics, function theory and mathematical physics, and topology to his interventions in pure mathematics. Two final chapters discuss the professional physicist and the philosopher. Gray succeeds admirably in presenting both the conceptual and the historical context necessary to appreciate Poincaré's contributions.

Although written in a fluid narrative, *Henri Poincaré: A Scientific Biography* is technical in character, as befits its subject matter. It addresses an educated reader who is knowledgeable about basic as well as some advanced mathematics, although a number of technical terms and concepts are concisely and expertly explained in a glossary.

As a genre, scientific biographies present a considerable challenge—and even more so when they deal with a mathematician of Poincaré's caliber. The historian needs to navigate

between the Scylla of being attracted to the merely personal, resisting the siren call that tempts him or her to simple admiration of the subject of study, and the Charybdis of constructing a conceptual history without appreciating the biographical contingencies and foibles of the historical actors. Gray's masterful biography may well serve as a standard example for future endeavors of this kind.

TILMAN SAUER

**David Hochfelder.** *The Telegraph in America, 1832–1920.* viii + 250 pp., illus., tables, bibliographic essay, index. Baltimore: Johns Hopkins University Press, 2012. \$55 (cloth).

Does technology shape society or does society shape technology? For about thirty years now, historians of technology have made it their duty to fight technological determinism by revealing and insisting on the socially constructed nature of our technological tools. Outside the academy, blithe determinism has never been vanquished; but among historians of technology, the concept of social construction has been so useful and transformative that it eventually became unfashionable to ascribe almost any social impacts to technology at all. Today, however, the pendulum is swinging back. We can see the outlines of a new history of technology, one that transcends the thirty years' war between technological determinism and social construction, in David Hochfelder's insightful and original book, *The Telegraph in America, 1832–1920*.

Hochfelder gives us both sides of the equation. He carefully documents the social and especially the political construction of telegraphy in the nineteenth-century United States, showing all the choices and contingencies that shaped its growth. But Hochfelder is also drawn to questions of impact. What did the telegraph do to nineteenth-century Americans? How did this revolutionary technology help produce our modern age? These are big questions that some scholars might shy away from. Hochfelder's answers are not sweeping generalizations but thoughtful and measured investigations. His research is meticulous; his bibliographic essay alone will be indispensable for future students of the telegraph and related topics.

*The Telegraph in America* is a little less comprehensive than the complete history its blunt title might suggest. But in five strong thematic chapters, Hochfelder follows the wire wherever it takes him, writing intelligently and persuasively about business strategy, political economy, social psychology, and finance capitalism.

His first chapter describes how the Civil War drastically accelerated the growth and consolidation of telegraph networks and how the Western Union Telegraph Company capitalized on the war to dominate its industry. A second chapter explores the political battles around telegraphy in the Gilded Age and the failure of regulators and activists to bring Western Union to heel.

The second half of the book turns from the construction of telegraphy to some of its effects. Chapter 3 explores the telegraph's impact on American journalism. Hochfelder is skeptical of claims that the technology created a new "telegraphic" style in American prose, but he shows how the consolidation of the wire services changed the structure of news reporting and how the speed of the telegraph changed the very psychology of news consumption. His fourth chapter, one of the book's most vivid, links the rise of modern finance to the stock ticker and the bucket shop—a printing telegraph that rattled off market movements in real time and a kind of shadow stock market where gamblers placed bets on the fluctuations of the ticker. These inventions helped financial markets, always hungry for information, become markets in information in a concrete and lasting way.

One theme of the book that resonates with our present moment is the failure of the telegraph to become a true mass medium or to live up to many of the utopian predictions it inspired. Many Americans hoped that the telegraph would be run by the government for the people, that it would reduce financial speculation, or that it would democratize the flow of news and information. But these hopes were dashed at almost every turn. Under Western Union's control, the telegraph in America served big business, increased stock market manipulation, and consolidated control of news and information to an unprecedented degree. "As a telegraph for the people, it is a signal failure" (p. 48), declared would-be reformer Gardiner Hubbard in 1883.

"Federal abandonment of electrical communication to the private sector," Hochfelder writes, "might well be the origin of today's cheapened political debate and impoverishment of the public sphere" (p. 72). James Carey once observed, and David Hochfelder's fine book reminds us, that the telegraph liberated communication from transportation. Yet it also yoked communication to big business. That outcome was both social and technological, and its effects have been lasting and profound.

ROBERT MACDOUGALL