American Mathematics 1890–1913: Catching Up to Europe

Reviewed by Deborah Kent

In 1994, the AMS published *The Emergence of the American Mathematical Research Community, 1876–1900: J. J. Sylvester, Felix Klein, and E. H. Moore*, written by Karen Parshall and David Rowe. This now classic work laid carefully documented groundwork for subsequent study and articulated a periodization for American mathematics. By targeting the years 1876–1900, Parshall and Rowe explicitly structure two

other periods in the history of American mathematics—one from 1776 to 1876 and at least one after 1900. Such periodization is frequently utilized as a helpful analytical framework in historical scholarship, and justifications for the selected start and end dates become part of a work's historical argument.¹

Deborah Kent is an associate professor of mathematics at Drake University. Her email address is deborah.kent@drake.edu.

Communicated by Notices Book Review Editor Stephan Ramon Garcia.

¹Historical periodization sometimes presents challenges, particularly in cross-cultural contexts. For an example, see work of Bernard Lewis, <https://www.gatestoneinstitute.org/323/the-periodization-of-history---excerpts> or <https://www.youtube.com/watch?v=OS7-ZRFwVxM>. For an overview of the postmodernist position on periodization, see especially Chapter 1 in Lawrence Besserman, ed., *The Challenge of Periodization: Old Paradigms and New Perspectives*, 1996. A sampling of other perspectives is available in J. H. Bentley, "Cross-Cultural Interaction and Periodization in World History," *American Historical Review* (June 1996), 749–770; and L. Grinin, "Periodization of History: A theoretic-mathematical analysis." In: *History & Mathematics, Moscow: KomKniga/URSS*, pp. 10–38, 2007.

For permission to reprint this article, please contact: reprint-permission@ams.org.

DOI: <https://dx.doi.org/10.1090/noti2072>

The Emergence of the American Mathematical Research Community begins with an overview of American mathematics during its first one hundred years. During this period, American mathematics evolved in the context of general scientific structure building. Mathematical practitioners in the United States worked alongside geologists, physicists, botanists, and other self-identified scientists to organize societies, develop employment opportunities, and provide outlets for scientific publication. The notion of research in academic disciplines emerged as practitioners looked to Europe as a model for scientific achievement. Specifically, German educational institutions introduced seminar-style instruction to train graduate students as future researchers.

The foundation of The Johns Hopkins University in 1876 marked a major change in American higher education. Before that, American colleges were designed primarily for undergraduate instruction and did little to encourage faculty research. Johns Hopkins, though, adopted the German vision for a university faculty charged to educate undergraduate students, conduct independent research, and train graduate students to be future researchers. This influential German model likewise informed Clark University when it started in 1889 and the University of Chicago, which opened for classes in 1892. The quarter century of central consideration in Parshall and Rowe thus begins in the year shared by the US centennial and the start of a new kind of academic institution in America. In the detailed discussion in the meaty middle eight chapters, Parshall and Rowe focus on James Joseph Sylvester at Johns Hopkins; Felix Klein at Leipzig, then Göttingen; and Eliakim Hastings Moore (see Figure 1) at the University of Chicago. The authors articulate how their focus on students and research from these schools illustrates "the process of maturation of an American mathematical research community which had fully emerged by 1900" [Parshall and Rowe, p. xv].

In an epilogue chapter, Parshall and Rowe sketch developments in the American mathematical research community during a period of consolidation and growth from 1900 to 1933. The bookend year of 1933 marks an influx of European mathematicians escaping the Nazi regime. Parshall and Rowe describe how, when scholars like Hermann Weyl and Albert Einstein joined the original faculty at the Institute for Advanced Study, they entered a mathematical community of similar quality to the one they'd left behind in Europe.

In title and content alike, *The Emergence of the American Mathematical Research Community, 1876-1900*: J. J. Sylvester, Felix Klein, and E. H. Moore invited subsequent studies concerning the development of American mathematics influenced by people beyond these “big three,” in places outside of Hopkins, Göttingen, and Chicago, as well as in times before and after the delineated quarter century.

American Mathematics 1890–1913: Catching Up to Europe aligns itself as exactly such scholarship. From the outset, Batterson states very accurately that his book “has a nontrivial overlap” with the one by Parshall and Rowe [Batterson, p. xii]. Batterson’s closing acknowledgments further note that “[r]eaders familiar with their work will undoubtedly recognize its impact” [Batterson, p. xii]. Such familiar readers might also wonder why so much similar material is revisited in this work. Batterson explains that his “1890–1913 periodization provides a different window for distinguishing the heroes” involved in “the coming of age of American mathematics” [Batterson, p. xiii]. Batterson especially wants to frame William Osgood and Maxime Bôcher as “intellectual pioneers” who “overcame the obstructions to change that were imposed by institutional culture and economic conditions at American universities” [Batterson, xii]. Batterson starts his periodization when he does because Osgood began an instructorship at Harvard in 1890, and Bôcher joined him the following year. Then E. H. Moore moved to the University of Chicago in 1892 and, says Batterson, “American mathematics began an exponential rise” [Batterson, p. 89].

Building a historical argument is not unlike writing a mathematical paper. One frames a research question in the context of existing scholarship, then provides substantial evidence for a sustained and focused argument that builds to the stated conclusion, a claim that will advance the boundary of knowledge in the field. To add a contribution to historical scholarship, one first must be conversant with

ELIAKIM HASTINGS MOORE. PRESIDENT, 1901–1902

Figure 1. Eliakim Hastings Moore, 1902.

a range of existing literature, especially relevant recent work, and then either provide contextualized, carefully documented critical analysis of previously unstudied primary source material or articulate new, conclusively argued insights or perspective on known sources. Reviewing a work of historical scholarship, then, involves considering to what extent the work adds to the existing scholarship and how effectively the author builds a historical argument in support of stated claims.

With the title *American Mathematics 1890–1913: Catching Up to Europe*, Batterson implies two claims. First, that his book will justify this particular periodization in the history of American mathematics. Why choose *these* particular dates? What makes 1890 and 1913 uniquely significant within the larger picture of American

mathematics? Second, the title indicates that the text will demonstrate that American mathematics reaches what Batterson calls “parity with European nations” within the delineated period [Batterson, p. 197]. The preface confirms these expectations by stating that the book “examines the 1890–1913 transformation in American mathematics” [Batterson, p. xii] and claiming that American mathematics achieved “international standing” between the years 1900 and 1913 [Batterson, p. xiii]. If a *transformation* occurred, then there must be a *before* circumstance that is somehow demonstrably different from the situation *after* said transformation. So any thoughtful review of *Catching Up to Europe* must take into consideration the degree to which the author situates his claims in the context of related literature and how effectively evidence is marshaled in support of these claims.

Some precedent exists for using Batterson’s chosen dates as significant timestamps in the development of American mathematics. At one end, AMS president Thomas Fiske gave a periodization of the development of pure mathematics in America in an address at the AMS meeting in 1904. Like Parshall and Rowe, Fiske drew a line at the establishment of Johns Hopkins University in 1876 to demarcate the first attempt made to “stimulate in a systematic manner research in the field of pure mathematics” [Fiske, p. 3].² He ends the second, and thus begins the third, period in 1891, when the New York Mathematical Society (this would become the American Mathematical Society in 1894) assumed a broader scope and began to publish the *Bulletin*. On the

²Smith and Ginsberg also drew a line at the foundation of Johns Hopkins [Smith and Ginsberg, 1934].

other end, Garret Birkhoff described the year 1912 as “a milestone marking the transition from primary emphasis on mathematical *education* at Harvard to primary emphasis on *research*” [G.D. Birkhoff in Duren, p. 27]. It is too bad that Batterson seems unaware of both Fiske’s and Birkhoff’s perspectives, when an appeal to either could have helped his cause and connected his work to foundational scholarship in the history of American mathematics.

The opening chapter, “An American Colony in Göttingen,” revisits narratives told elsewhere about the group of American graduate students who studied in Europe (many with Felix Klein in Göttingen) in the 1880s. The second chapter is a somewhat uneven discussion labeled “19th-Century American Notions of Scholarship.” Presumably, the purpose of this chapter is to articulate a picture of American mathematics *before* the transformation Batterson intends to highlight. A tighter narrative rooted in existing scholarship could have sketched the contours more efficiently to allow more space and focus on the primary stated argument of the book. For one example, in describing the well-known Neptune controversy, Batterson ignores work that focuses on how American mathematicians seized on this event as an opportunity to assert their competence at a time of perceived European scientific superiority [Kent, 2011]. The long digression instead becomes unnecessarily detailed and loses the point about American involvement in the story [Batterson, pp. 30–36]. Batterson’s passages on Harvard and Yale similarly exclude most of the voluminous literature on nineteenth-century higher education in America. For one example, Batterson seems not to have consulted Roger Geiger’s masterful treatise on the metamorphosis of American research universities into world leaders in scientific research between the years 1900 and 1940 [Geiger, 2004]. Any relevant subsequent work, such as *Catching Up to Europe*, would stand firmer on the solid scholarly foundation provided by Geiger’s work.

This trend of omitted sources continues in the third chapter, which focuses on the academic institution building

of Charles Eliot, president of Harvard from 1869 to 1909, and Daniel Coit Gilman, president of Johns Hopkins from the founding in 1876 until 1901. Again, for minimal examples, Batterson references neither a directly relevant 2013 book on the history of mathematics at Harvard [Nadis and Yau, 2013] nor a standard source with a critical perspective on Gilman’s contributions to American higher education [Cordasco, 1960]. Much like mathematical knowledge, historical scholarship is built up by researchers who tackle open questions—they find and fill gaps in existing work or illuminate entirely new directions, perhaps with new sources or new methodologies. Overall, Batterson adds little to the existing coverage of the efforts and impacts of both Eliot and Gilman. It is clear that he has conducted extensive archival work, although unfortunate that such effort and expense was not applied more uniformly to new material. There is no shortage of open questions or unmined archival material relevant to the history of American mathematics.

Not until Chapter 4 does *American Mathematics 1890–1913: Catching Up to Europe* turn to the events on which Batterson based the start date for his periodization. This “Harvard and Chicago Hire Osgood, Bôcher, and Moore” chapter offers a few new insights into the Harvard careers of Osgood (see Figure 2) and Bôcher, expanding a bit on Batterson’s own previous work [Batterson, 2009]. It is unfortunate that in his efforts to champion Osgood, he includes no reference to Diann Porter’s recent biography, *William Fogg Osgood at Harvard. Agent of a Transformation of Mathematics in the United States*, even the title of which indicates this could be a rich source of evidence untapped by Batterson [Porter, 2013]. Whatever Batterson’s analysis of Porter’s work, current standards of historical scholarship dictate at least *some* mention of such closely aligned contemporary

work, if for no other reason than to demonstrate the author is aware of it.

The most original part of the book comes in Chapter 5, where Batterson delves into the archives of astronomer

WILLIAM FOGG OSGOOD, PRESIDENT, 1905–1906

Figure 2. William Fogg Osgood, 1896.

Figure 3. George David Birkhoff, 1913.

Simon Newcomb and mathematician Henry White to explore discussions about the possibility that the AMS might take over the *American Journal of Mathematics*. J. J. Sylvester, the first professor of mathematics at Johns Hopkins, had founded the *American Journal of Mathematics* in 1878 in keeping with Gilman's research university mandate. After almost seventy-five years of sporadic private publication of mathematical periodicals in the US, the *American Journal of Mathematics* was the first mathematical journal designed to circulate original research and backed by institutional support. It rapidly became the top publication outlet for increasingly research-minded American mathematicians. After Sylvester left America in 1883, "stories of sloppy editing and poor refereeing" demoralized a young cohort keen to publish original work [Batterson, p. 126]. In this well-written and carefully documented chapter, Batterson details how the politics and personalities in this situation led to a new research journal, the *Transactions of the American Mathematical Society*. A revised version of this chapter also appeared as an article in the May 2019 issue of the *Notices*.

The sixth chapter focuses on the preceptor program at Princeton. Woodrow Wilson introduced this program in 1905 to improve undergraduate education by introducing some research-oriented instructors to the Princeton faculty. Oswald Veblen, Luther Eisenhart, and Joseph Wedderburn all started as Princeton preceptors. The former two later were particularly influential in establishing mathematics as a strength at Princeton, especially after National Research Council Fellowships in mathematics started in 1923. In the seventh chapter, Batterson examines events that moved George Birkhoff (see Figure 3) from his Princeton preceptorship to his longtime Harvard faculty position in 1913. This final chapter title, "The Verge of Parity with Europe," seems like a bit of a disclaimer. Those words belong to Veblen, who did not give a time frame or definition for parity with Europe [Batterson, p. xi].

Indeed, it is also not clear what Batterson means by "reaching international standing" [Batterson, p. xiii]. The evidence he presents for the claim that this happened for American mathematics by 1913 likewise invites closer examination. The main claims of having "caught up" to Europe seem to be Birkhoff's publication of his proof of Poincaré's Geometric Theorem,³ James Alexander's proof that different constructions of the same manifold must have the same Betti numbers and torsion coefficients [Batterson, p. 187], the 1912 ICM plenary speaking invitations for Osgood and Bôcher, and a memory from Courant that in 1913 mathematicians in Göttingen looked admirably across the Atlantic *for the first time*. These claims invite a more nuanced and critical analysis than what is provided.

³Poincaré's Geometric Theorem can be stated as follows: If T is an area-preserving and boundary-component-preserving homeomorphism of an annulus that rotates the inner boundary and outer boundary in opposite directions, then T has at least two fixed points [Batterson, p. 182].

There is no question that both the American-educated Birkhoff and Alexander achieved significant mathematical results. Even so, are two big results enough to "catch up" with Europe? It seems not, based on Veblen's correspondence during the period that depicts Hilbert alone at the pinnacle of mathematics [Barrow-Green, 2011]. It must be noted, too, that the 1912 ICM was hosted in Cambridge, UK. Perhaps invitations to speak at a meeting in English-speaking Britain might not say much about the perception of Osgood and Bôcher and American mathematics more generally within continental Europe. Prior to those 1912 invitations, Simon Newcomb gave an invited plenary lecture in applied mathematics and had been a vice president at the ICM in Rome in 1908.⁴ Batterson's statement about how American mathematics appeared "to European eyes" heavily relies on a reference to a biography [Reid, 1976] in which the author provides no actual attribution to Courant himself [Batterson, pp. 184–185]. Hence a key piece of Batterson's claim is not substantiated by documented evidence. More, and more reliable, data would likely have presented a more accurate picture of the European perception of American mathematics. For example, it may have been helpful to include reports from Poincaré or Darboux during a 1904 visit [Zitarella, 2011] or some other documented firsthand accounts.

There is a striking lack of data in the book overall. Some quantification related to numbers and types of publications, PhDs granted, and academic trajectories might have helped Batterson fortify his argument that a new era in American mathematics indeed began in 1913. Rich material along these lines is available in recent articles publishing data about participants in the American mathematical community, their educational attainments, and scholarly output [Fenster and Parshall, 1994; Zitarella, 2001]. Modern search engines make it fairly straightforward to get a sense of data for years that may be missing in these studies. Considered as a whole, work on the history of American mathematics known to this reviewer still suggests that, in fact, American mathematics had "earned standing" by the time of the *Second* World War rather than the First as Batterson claims to prove [Batterson, p. xi].

The *Catching Up to Europe* book jacket claims that by the First World War, not only had the gap between mathematical research in European and American universities "largely closed" but also that "[i]t would remain so." Reality is not so tidy. The twenty years from 1913 to 1933 brought internal tensions within the American mathematical community, significant institutional transitions, and a major world war, all of which resulted in a trajectory that is not strictly monotone increasing. To demonstrate that parity had, in fact, been sustained from 1913 onwards would

⁴Other invited American speakers at the Rome ICM included David Eugene Smith and L. E. Dickson. Dickson had also been invited to speak at the Paris ICM in 1900. Americans Artemas Martin, Harris Hancock, and Irving Stringham were also invited to speak in Paris.

involve acknowledging, addressing, and minimizing known evidence to the contrary. Significant work by Reinhard Siegmund-Schultze includes many sources that contradict the claim of parity by 1913 [Siegmund-Schultze, 2001 and 2009]. Batterson neither addresses these counterexamples nor much discusses the impact of World War I on either American mathematical research or Europe's view of it. The 2014 book *The War of Guns and Mathematics: Mathematical Practices and Communities in France and Its Western Allies around World War I* could have shed some light on these matters [Aubin and Goldstein, 2014]. Work completed since the publication of *Catching Up to Europe* likewise reveals rich archives that also support the much more complex picture suggested by earlier scholarship on American mathematics during the first third of the twentieth century.

As a contribution to historical scholarship, *Catching Up to Europe* leaves some things to be desired. A broader familiarity with relevant scholarship, both classic and current, could have both enriched and focused the significant archival endeavors of this project. Connecting with descendants of historical actors of interest can be a thrill for many historians—Batterson notably accomplished contact with a grandson of Osgood and a great-grandson of Bôcher. Beyond these efforts, more careful attention to building a historical argument may have altered the outcome of insufficient evidence necessary to justify the claim that American mathematics had indeed caught up to Europe by 1913. Or it might have altered the claim. As it stands, readers unfamiliar with much of the history of mathematics in the United States may nonetheless find in this well-written book some items of interest about “how life has evolved for research mathematicians in the United States” [Batterson, p. xiii].

References

- David Aubin and Catherine Goldstein (eds.), *The war of guns and mathematics: Mathematical practices and communities in France and its western allies around World War I*, History of Mathematics, vol. 42, American Mathematical Society, Providence, RI, 2014. MR3308762
- June Barrow-Green, *An American goes to Europe: three letters from Oswald Veblen to George Birkhoff in 1913/1914*, Math. Intelligencer 33 (2011), no. 4, 37–47, DOI 10.1007/s00283-011-9248-x. MR2865297
- Steve Batterson, *Bôcher, Osgood, and the ascendance of American mathematics at Harvard*, Notices Amer. Math. Soc. 56 (2009), no. 8, 916–928. MR2554178
- Francesco Cordasco, *Daniel Coit Gilman and the Protean PhD: The Shaping of American Graduate Education*, E. J. Brill, Leiden, 1960.
- Della Dumbaugh Fenster and Karen Hunger Parshall, *A profile of the American mathematical research community: 1891–1906*, The history of modern mathematics, Vol. III, Academic Press, Boston, MA, 1994, pp. 179–227. MR1282505
- Roger L. Geiger, *To Advance Knowledge: The Growth of American Research Universities, 1900–1940*, Transaction Publishers, 2004.

- Deborah Kent, *The curious aftermath of Neptune's discovery*, Physics Today 64 (2011), 12, 46.
- Steve Nadis and Shing-Tung Yau, *A history in sum: 150 years of mathematics at Harvard (1825–1975)*, Harvard University Press, Cambridge, MA, 2013. MR3100544
- Diann R. Porter, *William Fogg Osgood at Harvard: Agent of a transformation of mathematics in the United States*, Docent Press, Boston, MA, 2013. MR3135333
- Constance Reid, *Courant in Göttingen and New York: The story of an improbable mathematician*, Springer-Verlag, New York-Heidelberg, 1976. MR0532647
- Reinhard Siegmund-Schultze, *Mathematicians fleeing from Nazi Germany: Individual fates and global impact*, Princeton University Press, Princeton, NJ, 2009. MR2522825
- Reinhard Siegmund-Schultze, *Rockefeller and the internationalization of mathematics between the two world wars: Documents and studies for the social history of mathematics in the 20th century*, Science Networks. Historical Studies, vol. 25, Birkhäuser Verlag, Basel, 2001. MR1826906
- David Eugene Smith and Jekuthiel Ginsburg, *A history of mathematics in America before 1900: Three Centuries of Science in America*, Arno Press, New York, 1980. Reprint of the 1934 original. MR749578
- David E. Zitarelli, *The 1904 St. Louis Congress and westward expansion of American mathematics*, Notices Amer. Math. Soc. 58 (2011), no. 8, 1100–1111. MR2856141
- David E. Zitarelli, *Towering figures in American mathematics, 1890–1950*, Amer. Math. Monthly 108 (2001), no. 7, 606–635, DOI 10.2307/2695269. MR1862099

Deborah Kent

Credits

Figures 1–3 are courtesy of the American Mathematical Society.
Author photo is courtesy of Radina Droumeva.