Philosophia Scientiæ
Travaux d'histoire et de philosophie des sciences

19-2 | 2015
Circulations et échanges mathématiques

"Increasing the Utility of the Society": The Colloquium Lectures of the American Mathematical Society

Karen Hunger Parshall

Electronic version
URL: http://journals.openedition.org/philosophiascientiae/1099
DOI: 10.4000/philosophiascientiae.1099
ISSN: 1775-4283

Publisher
Éditions Kimé

Printed version
Date of publication: 25 May 2015
Number of pages: 153-169
ISSN: 1281-2463

Electronic reference
Karen Hunger Parshall, « "Increasing the Utility of the Society": The Colloquium Lectures of the American Mathematical Society », *Philosophia Scientiæ* [Online], 19-2 | 2015, Online since 19 June 2015, connection on 06 November 2020. URL : http://journals.openedition.org/philosophiascientiae/1099 ; DOI : https://doi.org/10.4000/philosophiascientiae.1099

"Increasing the Utility of the Society": The Colloquium Lectures of the American Mathematical Society

Karen Hunger Parshall
Departments of History and Mathematics,
University of Virginia (USA)

Résumé : Cette étude retrace l'évolution de la série de « Colloquium lectures » de l'American Mathematical Society (AMS) dès sa création en 1896 jusqu'au début de la deuxième guerre mondiale. Ces cours constituent une importante innovation dans l'échange mathématique aux États-Unis. Ils ont servi à la fois à porter la communication mathématique à un haut niveau et à organiser plus efficacement une communauté nationale de mathématiciens.

Abstract: This study traces the creation—in 1896—and evolution—through the outbreak of World War II—of the Colloquium lecture series of the American Mathematical Society (AMS). It documents how this innovation fostered a new sort of mathematical exchange and, in so doing, allowed the AMS to serve more effectively both as an agent of research-level mathematical communication and as a more truly national mathematical organization.

A research-level community of mathematicians had emerged in the United States during the last quarter of the nineteenth century thanks to the development of several key graduate programs in mathematics—at the Johns Hopkins University under James Joseph Sylvester (1814-1897) in Baltimore, Maryland on the East Coast, at the University of Chicago under Eliakim Hastings Moore (1862-1932) in the Midwest, and at Harvard University under William Fogg Osgood (1864-1943) and Maxime Bôcher (1867-1918) in the Northeast (see [Parshall & Rowe 1994]). While Sylvester, an imported Englishman, left the United States in December 1883, Moore, Osgood, and Bôcher were American-born mathematicians who each had influential careers at their respective institutions and who worked to train the next generation of American mathematical

Philosophia Scientiæ, 19(2), 2015, 153–169.

researchers. Moore, a "home-grown" mathematician, had earned his doctorate at Yale University, but Osgood and Bôcher had been trained in Germany and had brought back to the United States a strong sense—which Moore, thanks to his own post-doctoral study abroad, shared—of what a graduate program in mathematics should look like and of how students should be trained. These men and their colleagues also shared a commitment to establishing lines of communication that would foster a true mathematical research community.

The American Mathematical Society (AMS), created as the New York Mathematical Society in November of 1888, was envisioned as just such a medium for exchange. In the words of its founders, the organization would serve "the purpose of preserving, supplementing, and utilizing the results of [the] mathematical studies" of its members, facilitate "the discussion of mathematical subjects, the criticism of current mathematical literature, and the solution of problems proposed by its members and correspondents", and provide a venue for the presentation of "original investigations to which members may be led".[1] Initially, these exchanges took place in face-to-face meetings in New York City, but by 1891, the Society had also begun publishing its *Bulletin* in order to effect a farther-reaching and more permanent exchange in print. After just three more years, the American Mathematical Society had emerged to reflect its national ambitions, had begun hosting a meeting each summer at venues outside New York City, and had grown from its sixteen charter members to over 250 strong. Although concentrated along the coast of the Northeast, these members were also to be found in the Midwest, especially in Chicago and its environs, on the West Coast, particularly in Berkeley, and at isolated places in between. The AMS defined this far-flung community. It aspired to promote research-level mathematics in North America in terms of the "usual" sorts of exchanges—face-to-face meetings and publications—that had come to characterize professional societies internationally.[2] By 1896, however, there was a sense that the AMS could do more. This paper explores the Society's efforts—through its so-called Colloquium lectures—to foster a new sort of mathematical exchange and, in so doing, to serve more effectively as an agent of research-level mathematical communication and as an actual *national* mathematical organization.

The germ of the idea for the Colloquium lecture series appeared in a letter of 23 February, 1896 from Henry Seely White (1861-1943), Professor of Mathematics at Northwestern University in Evanston, Illinois, to Thomas Fiske (1865-1944), then Adjunct Professor of Mathematics at Columbia University in New York City and one of the AMS's co-founders. There, White proposed what he termed a "scheme" "for increasing the utility of the Society".[3]

1. Open letter of November 1888 signed by Thomas Fiske, Edward Stabler, and Harold Jacoby as quoted by Raymond Clare Archibald in [Archibald 1938, 4].

2. On this point, see, for example [Parshall 1995].

3. Henry White to Thomas Fiske, 23 February, 1896 as quoted in [Archibald 1938, 67]. The quotes that follow in this paragraph are also on this page.

It was well known that the usual meeting format consisted of short talks as well as papers read by title only. As White acknowledged, those in attendance generally "found two or three papers out of the whole program of high interest", but longer, more structured lectures delivered over the course of several days "would give space for developing quite large topics, before such an audience as would attend". Why not, White wondered, provide for this kind of advanced, post-graduate seminar under AMS auspices?

White's idea apparently struck a chord. Less than a month later, seven of the AMS's leading members—White and Fiske among them—had circulated an open letter in which they declared that thirty- or twenty-minute talks, while serving as an immediate exchange of ideas, "are forgotten almost before they are finished".[4] "On the other hand", they continued, "the courses of lectures in our best universities [...] do give exact knowledge and furnish a substantial basis for reading and investigation". Those "best universities", arguably the University of Chicago and Harvard in 1896, offered a curriculum during the 1896-1897 academic year that rivaled those of programs in both Germany and France.

At Chicago, graduate-level courses and seminars were offered on then-recent work of Leopold Kronecker, the theory of groups, Galois theory, higher plane curves, algebraic surfaces, number theory, projective geometry, differential geometry, the theory of functions of a complex variable, linear differential equations, the calculus of variations, and analytic mechanics,[5] while at Harvard the offerings included celestial mechanics, algebraic plane curves, quaternions, analytic mechanics, Fourier series, spherical harmonics and the potential function, the theory of surfaces, elliptic functions, the theory of equations and of invariants, modern geometry, number theory, the theory of functions, and Bessel functions [Anonymous 1896b, 277]. By way of comparison, the University of Berlin announced courses during the winter semester of 1896-1897 on the theory of algebraic equations, elliptic functions, linear differential equations, least squares, the theory of surfaces and curves in space, the calculus of variations, number theory, partial differential equations, the kinetic theory of gases, fluid motion, potential theory, and the integration of differential equations [Anonymous 1896c, 33–34]. Across the Rhine in France, the Faculté des Sciences in Paris offered advanced courses during the first semester of the 1896-1897 academic year on the theory of triple systems of orthogonal surfaces, the theory of algebraic functions of two independent variables, celestial mechanics, electrodynamics, and fluid dynamics [Anonymous 1896c, 33]. From these listings, it is clear that the best programs on each side of the

4. In addition to White and Fiske, the other signatories of the open letter were: E. H. Moore (Chicago), William Osgood (Harvard), Frank Cole (Columbia), Alexander Ziwet (Michigan), and Frank Morley (Haverford and then after 1900 Johns Hopkins). For this and the quotes that follow in this paragraph, see [Fiske 1896, 49].

5. See [Anonymous 1896b, 277–278], as well as The University of Chicago Register July 1, 1897 with Announcements for 1897-1898 (Chicago: University of Chicago Press, 1897), 274–276.

Atlantic were roughly comparable, even if it is not possible actually to gauge from mere course listings the depth to which the material was explored. The problem that White and his colleagues sought to address, however, was that not all of their number could take advantage of the mathematical environments at a Chicago, a Harvard, a Berlin, or a Paris. How could the AMS foster the continued professional growth of its far-flung constituency?

Their answer? The AMS could sponsor a week-long series of Colloquium lectures that would follow the annual summer meeting and that would consist of six, two-hour talks by an "expert lecturer".[6] The talks would focus on one particular mathematical area and would aim to present "some new matter" at the same time that they "mingled" "much that is old" and presented "digests of recent or too much neglected publications". In this way, Colloquium attendees would be introduced to an area of mathematics and exposed to its open research problems. The Colloquium lectures would thus function as a kind of high-level "short course", to use their phrase, designed both to introduce trained mathematicians to areas outside their own and, potentially at least, to stimulate higher-level teaching as well as future research by indicating promising lines for inquiry.

There was a precedent, as White well knew, for this kind of event. In 1893, the German mathematician Felix Klein (1849-1925) had given a successful two-week-long series of lectures before twenty-four auditors that White, Klein's former student, had hosted in Evanston.[7] Perhaps not surprisingly, then, the reaction to White's open letter was positive. From 2-5 September, 1896, two young members of the emergent American mathematical research community, Maxime Bôcher and James Pierpont (1866-1938), delivered two independent series of lectures immediately following the AMS's summer meeting in Buffalo, New York in what were the first official AMS Colloquium lectures. A modest thirteen people—among them, the two speakers and two young women students—were in attendance.

Bôcher introduced the audience to "Linear Differential Equations and Their Applications", a topic he had learned at the feet of his *Doktorvater* Klein in Göttingen and one that was not ordinarily taught, especially in a Kleinian fashion, in the United States.[8] One year Pierpont's junior, Bôcher had earned his doctorate in 1891 and had returned to take a position at Harvard. He opened his six lectures with a cautionary tale. He insisted, like his German advisor, "on the necessity, in the study of differential equations, of *proving everything* and not allowing oneself to be misled into thinking that anything

6. For this and the quotes that follow in this paragraph, see [Fiske 1896, 49–50].

7. See [Klein 1894]. For an overview of the lectures and an analysis of their particular mathematical perspective, see [Parshall & Rowe 1994, 331–354].

8. Klein's former student, Heinrich Maschke, did teach a course on linear differential equations in that style at the University of Chicago in 1896-1897, as noted above. On Klein's influence on American mathematics, see [Parshall & Rowe 1994]. Bôcher's book was published as [Bôcher 1894], and his Buffalo Colloquium lectures drew from the material presented there.

is proved in the ordinary text-books on the subject".[9] As an example of how *not* to treat the subject, Bôcher singled out what was perhaps the leading English-language textbook on the topic, *A Treatise on Differential Equations*, by the Cambridge University mathematician, Andrew R. Forsyth [Forsyth 1885]. Bôcher warned his listeners that "all that is there done" is

> to explain a series of devices by which more or less general solutions of certain special differential equations can be obtained, while the general theorems (for instance, the theorem concerning the number of arbitrary constants in the general solution) are not proved and are frequently stated in a misleading manner. [Fiske 1896, 52][10]

In his lectures, Bôcher first sought to introduce his American audience to the German—as opposed to the English—standard of rigor in the field and so demonstrated how to use power series to establish the existence of solutions in the neighborhood of non-singular points of a differential equation. He then moved to a discussion of fundamental systems of solutions and linear dependence before surveying selected French and German results. He closed with "various questions which, although referring, in part at least, to the case of complex variables, [had] found no place in the classical text-books" up to that time [Fiske 1896, 54]. He aimed to expose his American audience to the "non-classical" or, in his view, the "not yet" classical aspects of the subject, that is, the cutting edge as reflected, for example, in the then-recent work of the Dutch mathematician, Thomas Stieltjes (1856-1894) [Fiske 1896, 52–53]. As he recognized, that was where new and exciting research problems in the field would be found.

For his part, Yale's Pierpont laid out the basics of the "Galois Theory of Equations". He had pursued this topic for the doctoral degree that he had earned at the University of Vienna in 1894, and while students at, for example, the University of Chicago could gain exposure to it, it was not a subject that was then widely taught in the United States.[11] The six lectures he gave in Buffalo opened with preliminaries like definitions of a resolvent and of the group of an equation over a given field and proceeded to work through a series of theorems and corollaries that allowed him to establish the result, due to the Norwegian mathematician Niels Henrik Abel (1802-1829), that a general equation of degree greater than four does not possess an algebraic solution. Following this historical introduction, Pierpont moved on to survey

9. [Fiske 1896, 52, my emphasis]. The quotations that follow in this paragraph are also on this page.

10. Forsyth's textbook had gone into a second edition in 1888 and would go into a third in 1903, despite Bôcher's warnings.

11. It merits noting, however, that Oskar Bolza, who taught the course at Chicago, had not only taught it at the Johns Hopkins University in 1889, but he had also written up an account of those lectures that was published in the *American Journal of Mathematics* in 1891 [Parshall & Rowe 1994, 201]. For more on Bolza, see below.

more contemporary results by mathematicians such as Kronecker and Heinrich Weber (1842-1913), and he "regretted that time did not permit him to develop the theory of finite groups from this abstract standpoint and to touch upon some of the beautiful results obtained by [Georg] Frobenius, [Otto] Hölder, [Frank Nelson] Cole and others" [Fiske 1896, 59].

Pierpont and Bôcher had thus produced exactly the sort of lectures that White and his supporters had envisioned. Unlike Klein in his earlier Evanston Colloquium lectures, they had provided focused introductory surveys of just two broad areas of mathematics, yet like him, they had carefully indicated possible courses for further research. Both recently returned to the United States after doing their doctoral work abroad, they were also in a position to bring a highly-sought-after European perspective to their American auditors.

The actual effectiveness of their exchange is difficult to assess, however. Three of the attendees—White, E. H. Moore, and Alexander Ziwet (1853-1928) of the University of Michigan—had been present at Klein's lectures in Evanston. These three, together with William Osgood, had been signatories of the open letter proposing the creation of the Colloquium lectures. It was thus more than natural for them to participate in the Colloquium experiment that they had so heartily endorsed, although none of them moved into lines of research suggested by either of the lecturers. While the same was true of the other attendees (Pierpont and Bôcher excepted, of course), the Colloquium lectures did serve to unite professors and students of mathematics from nine different states—Connecticut, Massachusetts, Pennsylvania, and New York in the Northeast; Kentucky in the South; and Illinois, Michigan, Minnesota, and Wisconsin in the Midwest—in an educational environment supplemental to what they could experience at their home institutions (see fig. 1).[12] Moreover, four-page synopses of both sets of lectures were published in the *Bulletin* as part of the overall report on the Colloquium, AMS members who had been unable to attend could thus at least get the flavor of the material Pierpont and Bôcher had presented.[13]

The second and third Colloquia were held at Harvard University in Cambridge, Massachusetts in 1898[14] and at Cornell University in Ithaca, New York in 1901, respectively, with attendance figures twice as large as those for the Buffalo Colloquium. At Harvard, favorite son Osgood spoke "On Some Methods and Problems in the General Theory of Functions", while Arthur Webster (1863-1923), a member of the physics faculty at Clark University in Worcester, Massachusetts, lectured on "The Partial Differential Equations

12. For the demographic information, see [Anonymous 1896a].

13. These lectures were not published in full, but were summarized in [Fiske 1896, 52–55] (for Bôcher's lectures) and [Fiske 1896, 55–59] (for Pierpont's).

14. Because the British Association for the Advancement of Science met in Toronto in the summer of 1897, it was decided to hold the second Colloquium the following year so as not to conflict or compete with such a major international meeting.

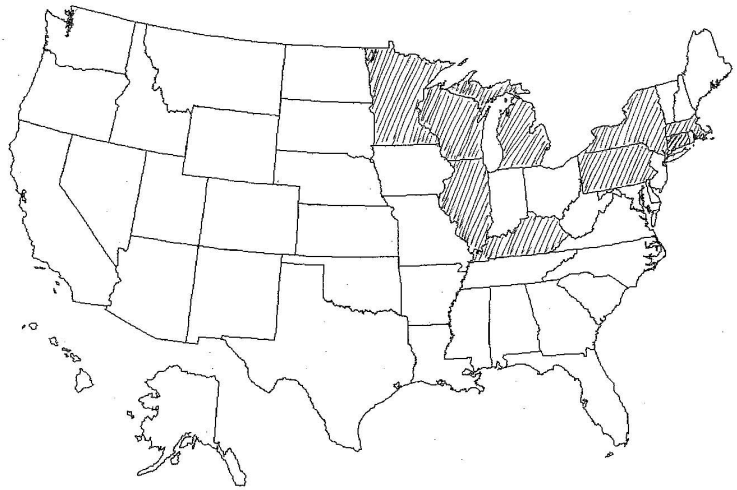

FIGURE 1

Connected with Wave Propagation".[15] Osgood, who had earned his doctoral degree under Max Noether in Erlangen after having spent time in Felix Klein's lectures in Göttingen, continued the importation of European, and particularly German mathematics, to the United States that his compatriot Bôcher had begun in Buffalo. Webster's invitation, however, represented an effort on the part of the Colloquium organizers to widen America's mathematical horizons by opening a dialogue between mathematicians and physicists. Three years later in Ithaca, those same objectives were still in evidence when Chicago's German-born and German-trained Oskar Bolza (1857-1942) explored "The Simplest Type of Problems in the Calculus of Variations" and Haverford College's mathematical astronomer, Ernest W. Brown (1866-1938), talked about "Modern Methods of Treating Dynamical Problems and in Particular the Problem of Three Bodies".[16] The Colloquium lectures thus continued to round out the ever-widening landscape of modern mathematics for the American research-level audience.

While these two Colloquia followed the same basic format as the first, a new precedent was set with the fourth Colloquium, held in Boston

15. A short announcement of the Cambridge Colloquium appeared as [White 1898]. Osgood's lectures were published in extenso as [Osgood 1898], while Webster's remained unpublished.

16. Again, a short announcement of the Colloquium appeared in the *Bulletin*, this time as [Kasner 1901]. A précis of Brown's lectures appeared as [Brown 1901]. Bolza's appeared as [Bolza 1904], one of the University of Chicago's decennial publications.

2-5 September, 1903 and hosted by the Massachusetts Institute of Technology (MIT). This time, three speakers, all of whom had earned doctoral degrees under Klein at Göttingen, covered three quite different areas of mathematics in their short courses [Archibald 1938, 68] (see also [Van Vleck, Woods, & White 1905, v]). Henry White of Northwestern dealt with "Linear Systems of Curves on Algebraic Surfaces", Frederick Woods (1864-1950) of MIT treated "The Connectivity of Non-Euclidean Space", and Edward Van Vleck (1863-1943) then of Wesleyan University surveyed "Selected Topics in the Theory of Divergent Series and of Continued Fractions". What was most precedent-setting about this Boston Colloquium, at least in the context of the now official AMS Colloquium series, was that, for the first time, the lectures were collected together and published in book form, thereby creating a permanent, printed record of the complete lecture series and making it accessible to many more than the thirty-one people who had actually heard it. Klein's lectures, which had been published in book form in 1893, thus served as the prototype for this innovation, too.

In reviewing the Boston Colloquium volume in the *Bulletin* in 1906, Cornell University's John Hutchinson (1867-1935) assessed the situation matter-of-factly:

> [I]t is not only a convenient form in which to preserve these valuable lectures, but it is a most welcome addition to the meager catalogue of English works on the higher mathematics. [Hutchinson 1906, 85][17]

The Colloquium lectures, both in oral but perhaps especially in published form, were thus perceived as playing a critical role in the American mathematical community. That this was also recognized by the AMS leadership is clear from the fact that it resolved to see all subsequent Colloquium lectures published in hard covers as well.

In the beginning, however, this new publication venture was on rather shaky financial ground, and the leadership was cautious. It managed to secure the publication of the Boston Colloquium lectures through the commercial firm of Macmillan & Company in London with the publisher assuming financial responsibility for the venture. The fifth Colloquium, held at Yale in 1906, was also published on an ad hoc basis, "[t]he expense incurred" this time being "defrayed by a grant from Yale University" [Moore, Wilczynski *et al.* 1910, v]. Given that two of the three speakers had a Yale connection—Chicago's E. H. Moore had earned his doctoral degree there in 1885 and Max Mason (1877-1961) was then on the faculty of Yale's Sheffield Scientific School—this subvention had perhaps not been too difficult to arrange. The third speaker, Ernest Wilczynski (1876-1932), represented the West Coast, given his position at the University of California at Berkeley. Each gave a series

17. For more on the complex issues surrounding the publication of research-level mathematics in the United States, see [Siegmund-Schultze 1997].

of four lectures with Moore speaking "On the Theory of Bilinear Functional Operators", Wilczynski on "Projective Differential Geometry", and Mason on "Selected Topics in the Theory of Boundary Value Problems of Differential Equations".

On the occasion of the sixth Colloquium hosted by Princeton in 1909,[18] however, the AMS decided simply to publish the proceedings itself. With this, the die was seemingly cast. The seventh Colloquium was held in 1913 in Madison, Wisconsin. There, Leonard Dickson of the University of Chicago and Osgood, in a repeat performance, gave two courses of five lectures each. Dickson spoke on "Certain Aspects of a General Theory of Invariants, with Special Consideration of Modular Invariant and Modular Geometry", while Osgood lectured on "Selected Topics in the Theory of Analytic Functions of Several Complex Variables". When the Madison Colloquium volume appeared in 1914, it was announced that "the Society will henceforth regularly publish the Colloquia, and thus the present volume appears as Volume IV in the series".[19]

World War I intervened in those plans, even though the United States did not enter into the conflict until 1917. Griffith Evans (1887-1973), then of Rice University in Houston, Texas, and Oswald Veblen (1880-1960) of Princeton gave the eighth Colloquium lectures at Harvard in 1916 to an audience of sixty-nine, "a number considerably exceeding that of any previous colloquium" [Snyder 1916, 82]. Evans, who had earned his doctorate under Bôcher at Harvard in 1910, lectured on "Topics from the Theory and Applications of Functionals, Including Integral Equations", while Veblen, a 1903 Ph.D. of E. H. Moore at Chicago, spoke on what was fast-becoming the American specialty of "Analysis Situs", the area now known as topology. Although brief synopses of their lectures were published in the Colloquium report that appeared in the *Bulletin* shortly after the fact, the lecture series were not published in book form until after the war, with Evans's volume appearing in 1918 and Veblen's only in 1922 [Evans 1918]; [Veblen 1922].[20] Both men had been distracted by their service in World War I from producing the final manuscripts of their talks, with Evans on active duty as a Captain in the Army's Ordnance Division in France and Veblen serving as a Major ultimately at the Aberdeen Proving Ground in Maryland.[21]

The AMS resumed its series of Colloquium lectures in 1920 two years after the Armistice, but a five-year hiatus followed as the Society worked to

18. Gilbert Bliss of the University of Chicago spoke on "Fundamental Existence Theorems", and Edward Kasner of Columbia College lectured on "Geometric Aspects of Dynamics".

19. See [Cole 1914, 170]. For the publication, see [Dickson & Osgood 1914, iii].

20. Veblen published a second, revised and updated edition of his lectures as *Analysis Situs* [Veblen 1931]. See below.

21. On the war service of these and other Americans (see [Archibald, Dumbaugh, & Kent 2014]).

establish itself on a firmer financial footing.[22] For the two calendar years 1923 and 1924, Veblen served as the AMS's seventeenth President, taking as one of his goals the task of professionalizing the Society in the sense of legally incorporating it and of actively working to raise an endowment fund to support especially its publication ventures, among them the Colloquium lecture series. His initiatives, continued by his successor as AMS President, the Harvard mathematician George Birkhoff (1884-1944), were remarkably successful. By 1925 when the Colloquium lectures resumed, Veblen, Birkhoff, and others had succeeded in convincing the General Education Board (GEB) of the Rockefeller Foundation not only of the importance of but also of the critical need for high-level mathematical publication in the United States. In fact, Veblen reported that when he

> spoke [to the GEB] of the Colloquium and the plan for publishing one book a year, this was very favorably received by the Committee. There was no suggestion that such an enterprize [sic] would be outside the domain of the fund, and I am strongly convinced that it would be worth while [sic] to lay the project before the Committee.[23]

Veblen's optimism was well-founded. From 1925 to 1930, the GEB provided over $21,000 for the support not only of the AMS's publications—the *Bulletin*, the *Transactions*, and the Colloquium lecture series—but also of the *American Journal of Mathematics*, a publication begun in 1878 by Sylvester and underwritten from the beginning by the Johns Hopkins University [Archibald 1938, 32].[24]

This infusion of funds had an immediate impact on the Colloquium series. In 1925, the AMS formed a free-standing Colloquium Editorial Committee, which further institutionalized the Colloquium lectures and their publication in book form. Not surprisingly, perhaps, Veblen was appointed chair of that committee with Birkhoff and Chicago's Gilbert Bliss (1876-1951) his fellow members [Richardson 1926, 119–120]. The three men soon issued a statement of what would be the enlarged purview of the Colloquium series. While the lectures of invited Colloquium speakers would continue to be published,

> [i]n the future it is intended [...] also to include, if possible, in the series a number of monographs and expositions of new mathematical developments which may be submitted by their authors

22. On this point, see [Feffer 1998].

23. Oswald Veblen to George D. Birkhoff, 3 June, 1925, George David Birkhoff Correspondence, Harvard University Archives (HUA) 4213.2, Box 5 "1924/1925 A-Z": Folder "S-V".

24. For more on the role of the GEB, in particular, and the Rockefeller Foundation in general, in supporting American mathematics, see [Siegmund-Schultze 2001]. In 2013 U.S. dollars, $21,000 is equivalent in "economic status" (considering the money as income or wealth) or in "income value" (considering the money as a commodity) to an endowment of some $1,360,000 based on the nominal gross domestic product per capita. For more, see `http://www.measuringworth.com`.

> on their own initiative without special invitation from the Council. [Birkhoff, Bliss, & Veblen 1926, 100]

The committee also announced the new policy "that all proceeds from the sales of old Colloquia shall go to the Colloquium Fund and be used to defray the expenses of the publication of new Colloquia" [Birkhoff, Bliss, & Veblen 1926, 100]. This reconceived Colloquium Publication series was, in fact, the AMS's first foray into the publication of research-level monographs, and Veblen and his committee had devised a financial scheme, thanks partly to funding from the GEB, to make such an expanded venture financially viable.

In 1927 alone, in addition to the Colloquium lectures given by Birkhoff in 1920, by Princeton's Luther Eisenhart (1876-1965) in 1925, and by Eric Temple Bell (1883-1960) of the California Institute of Technology in 1927, the AMS published its first volume in the Colloquium publication series not associated with actual Colloquium lectures, namely, Griffith Evans's second book in the series, *The Logarithmic Potential: Discontinuous Dirichlet and Neumann Problems* [Evans 1927]. With four books in one year, the AMS had far exceeded the "one book a year" that Veblen had predicted in his initial discussions with the Rockefeller Foundation's GEB. In fact, between 1927 and the United States's entry into the Second World War in 1941, the AMS published twenty Colloquium volumes or an average of two per year.[25] Of these, ten were volumes that had been submitted for the consideration of the Colloquium Editorial Committee independently of the actual Colloquium lectures. This level of monographic publication was also spurred by the fact that in 1928, the format of the Colloquium lectures themselves changed to take place every summer and to highlight just one area of mathematics, that is, to feature a series of lectures by just one mathematician.

Interestingly, too, demand for the Colloquium volumes had been so steady that the AMS also began to issue new editions of prior Colloquium publications, a financial proposition it could undertake thanks largely to its new policy of rolling the proceeds from prior volumes into the Colloquium Fund. Since 1909, when the AMS had decided to publish the Colloquium lectures itself, it had produced volumes in print runs that had ranged from 500 in the early years of the venture to over 1000 for those printed in the 1930s and 1940s, and several of those volumes—among them Dickson and Osgood's Princeton Colloquium of 1909 and Veblen's Harvard Colloquium of 1916—had actually sold out.[26] As early as 1929, Birkhoff, who had succeeded Veblen as chair of a Colloquium Editorial Committee that then consisted of himself together with University

25. For the full list of Colloquium publications, see `http://www.ams.org/bookstore/collseries`.

26. "American Mathematical Society: Study of Finances of Colloquium Publications 1896-1944", Gordon T. Whyburn Papers, Accession #13096, Special Collections, University of Virginia Library, Charlottesville, VA, folder "American Mathematical Society: Committee on Colloquium Publications (1944)". See also [Archibald 1938, 72–73].

of Texas topologist Robert L. Moore (1882-1974) and Dartmouth geometer John W. Young (1879-1932), had encouraged Veblen to consider bringing out a new edition. In his letter to Veblen dated 26 June, 1929, Birkhoff remarked that "[y]our $1000 for the Colloquium is a real gain".[27] In essence, the money that the first edition of Veblen's *Analysis Situs* had earned contributed significantly to the cost of publication of its second edition of over 800 more volumes in 1931. Its sales, as well as the sales of the Colloquium volumes in general, testify to the consistent, even brisk demand for these research-level publications among the members of the American mathematical community. As Fiske had hoped, the Colloquium lectures had, indeed, "increase[d] the utility of the Society" by giving its members ready access to whole fields of mathematical research.[28]

By the interwar period, the Colloquium lectures had also evolved to play key honorific as well as political roles within the growing community of mathematical researchers. As University of Kansas but soon-to-be Princeton professor, Solomon Lefschetz (1884-1972), put it in a 1925 letter to his fellow members of the Colloquium Editorial Committee, the Colloquia had become a "means of recognizing eminence".[29] But Lefschetz realized more. Choosing the site for the Colloquium had also come to have important political implications. In debating the venue issue in 1925, Lefschetz reasoned this way:

> Considering location, I vote definitely thus: Madison sans Colloquium in 1926, thus giving the Middle West its chance. Ohio State with Colloquium in 1927. It is East and West, and we would thus give recognition to a young and growing department which really is in need of it.[30]

What had begun solely as a means of exchange had evolved into an instrument critical in the establishment and maintenance of a delicate political balance nationwide.

Over the course of the forty-five years between the first Colloquium lectures in Buffalo and the twenty-fourth lectures held in Chicago on the eve of the United States's entry into World War II, seventeen different institutions in thirteen different states had been chosen through the careful deliberations of the AMS Colloquium Committee to host the event.[31] By taking into account issues like geographical and institutional balance, gender, and

27. See Birkhoff to Veblen, 26 June, 1929, The Papers of Oswald Veblen, Library of Congress, Container 2: Folder "Birkhoff, George D".

28. Recall note 3 above.

29. Solomon Lefschetz to John Kline and Arnold Dresden, 10 March, 1925, George David Birkhoff Correspondence, HUA 4213.2, Box 5 "1924/1925 A-Z": Folder "H–J". The quote that follows is also from this letter.

30. In fact, the Colloquium went back to Madison in 1927.

31. Massachusetts hosted the most at four; New York hosted two; and the following states hosted one each: California, Colorado, Connecticut, Illinois, Michigan, Minnesota, New Hampshire, New Jersey, Pennsylvania, Rhode Island, and Wisconsin.

speaker and host availability and willingness, that committee did its best to spread high-level mathematics across the continent. By far, the greatest number of Colloquia—eleven—were held in the Northeast, but although four were held in the Boston area, others took place in more remote and harder-to-reach cities like Williamstown, Massachusetts in the Berkshire Mountains and State College, Pennsylvania in the Alleghenies. Four Colloquia were held in the upper Midwest, one in Colorado in the Rocky Mountain region, and one on the West Coast in California (see fig. 2). The academic affiliations

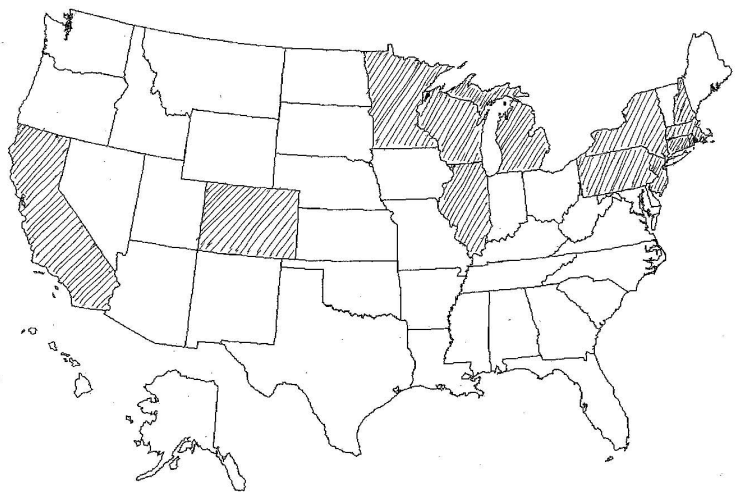

FIGURE 2

of the Colloquium speakers largely mirrored these numbers percentage-wise with twenty-one in the Northeast, ten in the Midwest, and two from the West Coast, but four of the speakers held academic positions in the South, three in Texas, and one in Virginia (see fig. 3).[32] While these data reflect the general population demographics of the United States before the Second World War, they also attest to the presence—outside the major, recognized mathematical centers of Chicago, Boston, and, by the 1920s, Princeton—of mathematicians viewed as leaders in their field and, therefore, to the consolidation and growth of the American mathematical community particularly during the interwar years.[33] Mathematicians worthy of a Colloquium invitation were to be found at the full range of American institutions of higher education, not just at the

32. Ten speakers were affiliated with institutions in Massachusetts, eight in Illinois, four in New Jersey, three in Connecticut and Texas, two each in California, New York, and Pennsylvania, and one each in Iowa, Minnesota, and Virginia.

33. On this notion of periodization, see [Parshall & Rowe 1994, 427–453].

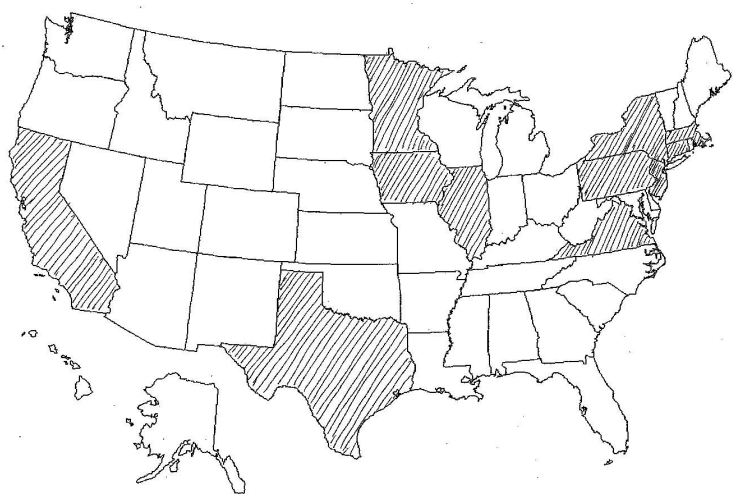

FIGURE 3

elite universities. Pennsylvania's Haverford College, a small undergraduate institution, supported the work of mathematical astronomer Ernest Brown at the time he gave his lectures in Ithaca, New York in 1901. Pennsylvania's Bryn Mawr College, a women's college which also boasted graduate programs in mathematics as well as several other areas, fostered the research of one of the ninth Colloquium speakers, Anna Pell Wheeler (1883-1966), while the California Institute of Technology, a small private university, provided a fruitful research environment for the other, Eric Temple Bell. State-supported universities like the University of Minnesota and the University of Virginia fostered the work of Dunham Jackson (1888-1946) and Gordon T. Whyburn, the tenth (1925) and twenty-second (1940) Colloquium speakers, respectively. Reflective of yet another aspect of the consolidation and growth of mathematics in the United States, the 1937 Colloquium lecturer, John von Neumann (1903-1957) of the Institute for Advanced Study in Princeton, had emigrated to the United States in 1931 just in advance of Hitler's rise to power in Europe and had quickly established himself among American mathematicians. The AMS's Colloquium lecture series thus represented an interesting microcosm of the Society's broader membership—and of that membership's evolving mathematical interests—especially during the interwar years.[34]

From an institutional perspective, then, the AMS Colloquium lectures also provided a means for what Lefschetz termed "recognizing eminence", as well

34. For an overview of the American mathematical research community in the interwar period, see [Parshall 2015].

as for acknowledging and supporting regional advances in mathematics. In so doing, they served as an interesting innovation in the quest—by E. H. Moore, Veblen, Birkhoff, and others—to strengthen the research-level mathematics community in the United States in the first half of the twentieth century. They also provided a vehicle both for the oral exchange of mathematical ideas—as initially envisioned in 1896—but also for the expansion of the AMS's publication efforts—printed exchanges—from journals into research-level monographs.

Archival Sources

George David Birkhoff Papers, Harvard University Archives, Pusey Library, Cambridge, MA. The Papers of Oswald Veblen, Library of Congress Manuscripts Division, Washington, D.C. Gordon Thomas Whyburn Papers, Accession #13096, Special Collections, University of Virginia Library, Charlottesville, VA.

Bibliography

Anonymous [1896a], List of members, *Bulletin of the American Mathematical Society*, 2, 5–21, doi:10.1090/S0002-9904-1896-00296-2.

—— [1896b], Notes, *Bulletin of the American Mathematical Society*, 2, 276–279, doi:10.1090/S0002-9904-1896-00348-7.

—— [1896c], Notes, *Bulletin of the American Mathematical Society*, 3, 30–34, doi:10.1090/S0002-9904-1896-00377-3.

Archibald, Raymond Clare [1938], *A Semicentennial History of the American Mathematical Society, 1888-1938*, New York: American Mathematical Society, Reprint Ed., New York: Arno Press, Inc., 1980.

Archibald, Thomas, Dumbaugh, Della, & Kent, Deborah [2014], A mobilized community: Mathematicians in the United States during World War I, in: *The War of Guns and Mathematics: Mathematical Practices and Communities in France and Its Western Allies around World War I*, edited by C. Goldstein & D. Aubin, Providence: American Mathematical Society, HMATH, vol. 42, 229–271.

Birkhoff, George D., Bliss, Gilbert A., & Veblen, Oswald [1926], The Colloquium publications, *Bulletin of the American Mathematical Society*, 32, 100, doi:10.1090/S0002-9904-1926-04156-2.

Bôcher, Maxime [1894], *Über die Reihenentwicklungen der Potentialtheorie*, Leipzig: Teubner Verlag.

Bolza, Oskar [1904], *Lectures on the Calculus of Variations*, Chicago: University of Chicago Press.

Brown, Ernest W. [1901], Modern methods of treating dynamical problems and in particular the problem of three bodies, *Bulletin of the American Mathematical Society*, 8, 103–113, doi:10.1090/S0002-9904-1901-00862-2.

Cole, Frank N. [1914], The October meeting of the Society, *Bulletin of the American Mathematical Society*, 20, 169–176, doi:10.1090/S0002-9904-1914-02455-3.

Dickson, Leonard Eugene & Osgood, William Fogg [1914], *The Madison Colloquium*, New York: American Mathematical Society.

Evans, Griffith C. [1918], *The Cambridge Colloquium, 1916: Part I: Functionals and Their Applications: Selected Topics Including Integral Equations*, New York: American Mathematical Society.

—— [1927], *The Logarithmic Potential: Discontinuous Dirichlet and Neumann Problems*, New York: American Mathematical Society.

Feffer, Loren Butler [1998], Oswald Veblen and the capitalization of American mathematics: Raising money for research 1923–1928, *Isis*, 89, 474–497.

Fiske, Thomas S. [1896], The Buffalo Colloquium, *Bulletin of the American Mathematical Society*, 3, 49–59, doi:10.1090/S0002-9904-1896-00374-8.

Forsyth, Andrew R. [1885], *A Treatise on Differential Equations*, London: Macmillan.

Hutchinson, John I. [1906], The Boston Colloquium: Lectures on mathematics, *Bulletin of the American Mathematical Society*, 13, 85–87, doi:10.1090/S0002-9904-1906-01420-3.

Kasner, Edward [1901], The Ithaca Colloquium, *Bulletin of the American Mathematical Society*, 8, 22–25, doi:10.1090/S0002-9904-1901-00850-6.

Klein, Felix [1894], *The Evanston Colloquium Lectures on Mathematics*, New York: Macmillan, Reprint Ed., New York: American Mathematical Society, 1911.

Moore, Eliakim Hastings, Wilczynski, Ernest Julius, & Mason, Max [1910], *The New Haven Mathematical Colloquium*, New Haven: Yale University Press.

Osgood, William Fogg [1898], Selected topics in the general theory of functions, *Bulletin of the American Mathematical Society*, 5, 59–87, doi:10.1090/S0002-9904-1898-00568-2.

Parshall, Karen Hunger [1995], Mathematics in national contexts (1875-1900): An international overview, in: *Proceedings of the International Congress of Mathematicians: Zürich*, Basel; Boston; Berlin: Birkhäuser, vol. 2, 1581–1591.

—— [2015], A new era in the development of our science: The American mathematical research community, 1920-1950, in: *A Delicate Balance: Global Perspectives on Innovation and Tradition in the History of Mathematics: A Festschrift in Honor of Joseph W. Dauben*, edited by D. E. Rowe & W. S. Horng, Basel: Birkhäuser.

Parshall, Karen Hunger & Rowe, David E. [1994], *The Emergence of the American Mathematical Research Community, 1876-1900: J. J. Sylvester, Felix Klein, and E. H. Moore*, HMATH, vol. 8, Providence, RI; London: American Mathematical Society & London Mathematical Society.

Richardson, Roland G. D. [1926], The thirty-second annual meeting of the Society, *Bulletin of the American Mathematical Society*, 32(2), 115–131, doi:10.1090/S0002-9904-1926-04161-6.

Siegmund-Schultze, Reinhard [1997], The emancipation of mathematical research publishing in the United States from German dominance, *Historia Mathematica*, 24, 135–166, doi:10.1006/hmat.1996.2132.

—— [2001], *Rockefeller and the Internationalization of Mathematics between the Two World Wars*, Basel: Birkhäuser.

Snyder, Virgil [1916], The Cambridge Colloquium, *Bulletin of the American Mathematical Society*, 23, 81–88, doi:10.1090/S0002-9904-1916-02870-9.

Van Vleck, Edward, Woods, Frederick, & White, Henry [1905], *The Boston Colloquium: Lectures on Mathematics*, Macmillan.

Veblen, Oswald [1922], *The Cambridge Colloquium, 1916: Part II: Analysis Situs*, New York: American Mathematical Society.

—— [1931], *Analysis Situs*, New York: American Mathematical Society.

White, Henry [1898], The Cambridge Colloquium, *Bulletin of the American Mathematical Society*, 5, 57–58, doi:10.1090/S0002-9904-1898-00566-9.