The 1904 St. Louis Congress and Westward Expansion of American Mathematics

David E. Zitarelli

The emergence of a professional cadre of mathematicians in the midwestern part of the United States in the 1890s has been well documented. (See Chapter 7 of [1] for details.) One of the primary factors in this development was the Chicago Congress of 1893. A similar transformation took place the next decade centered on the 1904 St. Louis Mathematics Congress (StLMC). This time the AMS played a central role in formulating the mathematics program, as well as in conducting its annual summer meeting in conjunction with the Congress, thus reflecting the growth and consolidation of the American mathematics research community that had occurred in the intervening eleven years.

Just as the Chicago Congress signaled the movement of American mathematics to the Midwest, the StLMC extended this expansion to what was then considered the southwestern part of the United States. The StLMC serves as a developmental milestone in the westward expansion of an emerging community of American mathematicians during the years 1900–1910. The advances in both parts of the country were spearheaded by a few key figures from one or two universities. For the StLMC, this meant Washington University and the University of Missouri, whose histories reveal an evolving mission from teaching to teaching plus research. A spinoff of both congresses was the formation of sections within the AMS that permitted individuals in areas distant from New York City to engage actively with others of similar interests.

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The Louisiana Purchase Exposition

St. Louis was teeming with activity a century after having gained fame as the starting point for the Lewis and Clark expedition in 1803. To commemorate the centennial of the Louisiana Purchase, the city hosted a World's Fair that attracted almost twenty million visitors during its seven-month run. The 1904 Olympic Games were also held in St. Louis in conjunction with the Fair, but the Games were only nominally international due to the prohibitive cost of sailing from Europe, and as a result 525 of the 681 athletes were American.

Like the well-known Columbian Exposition of 1893, the Louisiana Purchase Exposition hosted a series of academic congresses, and an administrative board was established in the latter part of 1902 to plan and coordinate all activities. This six-person committee was chaired by Nicholas M. Butler, the president of Columbia University in New York City, and included three other university presidents: William R. Harper (Chicago), R. H. Jesse (Missouri), and Henry S. Pritchett (MIT). After holding several meetings, the administrative board settled upon 156 separate congresses that attracted more than 100,000 delegates.

The largest assembly, the International Congress of Arts and Science (ICAS), boasted a "participating attendance…in the neighborhood of ten thousand" [2, p. 546]. The ICAS sponsored a series of lectures on scientific and literary topics connected around the theme "Progress of Man since the Louisiana Purchase" during the week of September 19–24, 1904. Because of its size, the ICAS required all twenty-nine lecture halls and meeting rooms on the campus of Washington University.

The Canadian-born Simon Newcomb (1835–1909) was selected as president of the ICAS. Described

as "the dean of American scientific circles, whose eminent services to the Government of the United States and whose recognized position in foreign and domestic scientific circles made him particularly fitted to preside over such an international gathering of the leading scientists of the world" [3, p. 12], Newcomb devoted twenty months to the ICAS. The classification scheme placed mathematics with philosophy. Mathematics was divided into three sections: 1) algebra and analysis, 2) geometry, and 3) applied mathematics.

The ICAS explicitly sought to inject an international flavor by supplying "funds sufficient to secure the participation of the leading scientists of the world" [2, p. 545]. As early as November 1901, when William Harper was the preferred candidate to head the administrative board, he was informed, "You will be permitted to travel as you may deem it necessary, at home and abroad…If in your opinion it shall be necessary, in order to secure the participation in the Congresses of certain noted delegates, their expenses will be paid from their homes to St. Louis, and return, and borne while they are in St. Louis in attendance upon the Congresses."[1] It was suggested that $200,000 be set aside for this purpose, an impressive sum that underscores the desire to offer an internationally attractive program.

Once Columbia President Nicholas Butler was installed as chair of the administrative board, the three paid executive officers—Newcomb plus two vice-presidents—sailed to Europe to invite leading scholars to participate. Newcomb was charged with securing such scientists, mostly from France, in mathematics, physics, astronomy, biology, and technology. This predates what the Rockefeller Foundation charged G. D. Birkhoff to do some twenty years later for an entirely different reason.

It was arranged for international delegates to be welcomed in New York City by a special reception committee that facilitated the clearance of luggage and provided fitting entertainment. Several speakers proceeded to St. Louis at once, but the great majority went directly to the University of Chicago, where they were entertained during the week preceding the Congress by President Harper. In St. Louis foreign participants were greeted by a reception committee whose charge was "to meet all incoming trains and conduct the members of the Congress personally to their stopping-places, and assist them in all matters of detail" [3, p. 22]. Individuals were housed in a university dormitory, but those with families were placed in homes.

Once international participation was settled, the ICAS moved to the domestic component: "The

Simon Newcomb (center) and ICAS officers.

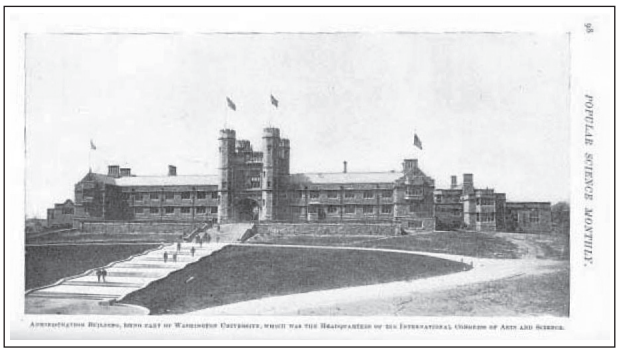
necessity was now very evident that our strongest men of science must be induced to take part, in order to compare favorably with the leading minds which Europe is sending" [3, p. 18]. Such a prideful charge may have applied to other areas of study, particularly the earth sciences, but surely the state of mathematics in America trailed behind that in Europe in 1904. Furthermore, an ICAS memo read [3, p. 10]:

> The Committee deems it of the utmost importance to secure the advice and assistance of learned societies in this country in perfecting the details of the proposed plan, especially the selection of speakers and the programme of work in each section. It will facilitate the latter purpose if such societies be invited and encouraged to hold meetings at St. Louis during the week immediately preceding…the General Congress.

For mathematics, that could only mean the AMS—it was then the only American professional organization of mathematicians. Communication between the ICAS and AMS was abetted by the fact that AMS President Thomas S. Fiske was a faculty member at Columbia University, whose president was chair of the administrative board.

The *Bulletin of the AMS* served as a beacon for alerting the rapidly increasing community of North American research mathematicians to the event beforehand, beginning with a note in the December 1903 issue [4]. One month later the journal revealed that Gaston Darboux, Ludwig Boltzmann, and Henri Poincaré had accepted invitations to deliver addresses [5]. Émile Picard was soon added to the roster. The June 1904 issue of the *Bulletin* heralded the complete list of eight invited speakers, adding Maxime Bôcher (Harvard), Edward Kasner (Columbia), Heinrich Maschke (Chicago), and James Pierpont (Yale) [6]. This list provides

[1] *David R. Francis to William R. Harper, November 23, 1901. Office of the President. Harper, Judson and Burton Administrative Records, Box 42, Folder 16, "Expositions 1903 Louisiana Purchase Exposition, St. Louis, 1899-1905."*



Administrative Building, Washington University.

insight into those perceived as among the leading mathematicians in the country at the time. It is notable that Edward Kasner was the only speaker with a doctorate from an American institution.

As requested, the AMS held its annual summer meeting in conjunction with the Congress, with AMS headquarters located at the Inside Inn on exposition grounds.

AMS Meeting

As requested, the burgeoning AMS, whose membership of 464 had nearly doubled since the Chicago Congress, held its eleventh annual summer meeting on the Friday and Saturday before the Congress opened on Monday. Altogether, thirty-nine AMS members attended, a figure that did not count Henri Poincaré or Gino Fano, who were "present by special invitation" [7, p. 55]. In addition, another ten presenters who did not belong to the Society were in attendance, as were perhaps five others who attended the St. Louis Congress.

Henri Poincaré headed a program of twenty-one different speakers who delivered twenty-four lectures in two-hour sessions held at 10 a.m. and 2 p.m. both days. In contrast with modern meetings, no two addresses ran concurrently, as all lectures were delivered in the library at Washington University. Poincaré's talk was an investigation into the geodesics on a convex surface that was one in a series of important papers on his research into periodic solutions of the three-body problem. Per his custom, he asserted a conjecture: there must be at least three such geodesics. (At the time it was known only that a minimum of one must exist.) Also following his custom, Poincaré provided geometric insight that emboldened such a pronouncement. Maurice Fréchet (France) and Francis S. Macaulay (England) submitted papers but did not attend, so E. H. Moore read both.

Five highly regarded Americans submitted papers for the AMS meeting, three associated with Chicago and two with Harvard. Leonard Dickson and Oswald Veblen were two of E. H. Moore's earliest Ph.D. students; both were on his staff during 1904–05. Dickson delivered two lectures on group theory. Gilbert Bliss, the third member of the Chicago group, read Veblen's paper outlining a proof of the Jordan curve theorem. Veblen had only recently completed his dissertation under Moore but remained behind in Chicago. Bliss had graduated under Oskar Bolza four years earlier; he was on the faculty at Missouri for only the year 1904–05. At the AMS meeting he also presented his own results in a lecture that listed necessary and sufficient conditions for a certain function from the calculus of variations to be integrable. The two Harvard mathematicians, both holding doctorates from German universities, Maxime Bôcher (Göttingen) and E. V. Huntington (Strasbourg), read papers on the foundations of mathematics.

There were three mathematics professors at Washington University in St. Louis in 1904–05, yet none participated actively in the AMS summer meeting. Alexander Chessin attended but did not deliver a paper, even though he had published regularly up to that time. His colleagues Calvin Woodward and George James were probably present but were not yet AMS members so were not listed in the AMS report. On the other hand, mathematicians from the University of Missouri were actively engaged in organizing the meeting and delivering papers. Earle Hedrick, a Ph.D. student of David Hilbert who had come to Missouri from Yale one year earlier, was intimately involved in almost all aspects of the tandem AMS and Congress events. In addition to lecturing twice on distinct topics at the AMS meeting, Hedrick publicized his university's collection of models. See [7] for more details on this exhibit.

The set of physical models had been constructed mostly by the little-known Louis Ingold (1872–1935), who had obtained a bachelor's degree from Missouri in 1901 and a master's in 1902 for the thesis "Geometry of four dimensions". He spent the next year taking courses at the University of Chicago, rejoined the Missouri faculty from 1903 to 1905, and took a leave of absence for 1905–1906 that resulted in a Ph.D. under Heinrich Maschke in 1907.

Another speaker at the AMS meeting from the University of Missouri was Lewis Darwin Ames (1869–1955), who lectured on topics related to the Jordan curve theorem. Ames had been an undergraduate student at Missouri before enrolling in the graduate program at Harvard. He joined the Missouri faculty in 1903 while completing his dissertation under William Fogg Osgood shortly before the St. Louis Congress began, becoming Osgood's first Ph.D. student. Another notable American mathematician to present a paper was Henry White, the Klein protégé who spoke on quartic and quintic surfaces that admit infinitesimal collineations.

Four speakers addressed the American specialty of group theory: G. A. Miller (then at Stanford, later a mainstay at Illinois) spoke about a theorem of

Burnside on subgroups of abelian groups, W. B. Fite on successive commutator subgroups, and J. W. Young on congruence subgroups of modular groups. John Wesley Young (1879–1932), associated with Dartmouth from 1911 to 1932, probably wrote his dissertation under William Benjamin Fite (1869–1932), who was then at Cornell but later moved to Columbia. Ida May Schottenfels (1869–1942), whose activity at the turn of the century was second only to that of Charlotte Angas Scott among women mathematicians in America [8], spoke about generators for substitution groups and Galois field groups.

There were two other American speakers. James Byrnie Shaw (1866–1948, Millikin University), who discussed linear associative algebras, had received his Ph.D. in 1893 from Purdue University, which did not award another doctorate in mathematics until 1939. He was ranked among the top ten most active members of the Chicago Section up to the time it was subsumed by the AMS in 1923 [9]. Finally, Harry Schultz Vandiver (1882–1973), then a twenty-one-year-old high-school dropout (from the celebrated Central High School in Philadelphia), had already established a reputation based on research carried out with another prodigy, G. D. Birkhoff. The first degree Vandiver ever earned was an honorary doctorate that Pennsylvania bestowed upon him in 1946 (at age sixty-three). His paper at the AMS meeting was on reduction algorithms for the solution of linear equations over a finite field. Details of all these works can be found in the *Bulletin* report of the meeting [7].

St. Louis Congress

Although no mathematics *per se* took place during the opening ceremonies of the International Congress of Arts and Science on Monday, two presentations are germane. Jean Gaston Darboux, the perpetual secretary of the Academy of Sciences in Paris, spoke briefly in his capacity as honorary vice-president for France. His remarks recalled an American statesman from an earlier era. "Since the time of Franklin, who received at the hands of France the welcome which justice and his own personal genius and worth demanded, most affectionate relations have not ceased to unite the scientists of France and the scientists of America" [3, p. 28].

Simon Newcomb delivered the initial scientific address in his role as ICAS president. Although he was sixty-nine years old at the time, Newcomb's vitality could be attested by his hiking trek to a chalet high up the side of the Matterhorn the following year. His talk, "The evolution of the scientific investigator", drew upon a lifetime of experience in the sciences that included one stint as president of the AMS (1897–1898) and another as founding member and first president (1899–1905) of the American Astronomical Society. Newcomb described his remarks as an "inquiry into the logical order of the causes which have made our civilization what it is to-day" [10, p. 136]. In order to compare the inventor with the investigator, he called upon the analogy between an oak tree and its acorn—the qualities of the great oak are wonderful to behold, but the real wonder lies concealed in the acorn. "While giving all due honor to the great inventors, let us remember that the first place is that of the great investigators" [10, p. 137].

The formal program of lectures began the next morning at 10 o'clock when Division A, Normative Science (consisting of mathematics and philosophy), assembled for a joint session. The plenum lecture by mathematical philosopher Josiah Royce, "The sciences of the ideal", began, "I am required to explain what scientific interests seem to me to be common to the work of the philosophers and of the mathematicians…. The mathematicians are becoming more and more philosophical. The philosophers, in the near future, will become, I believe, more and more mathematical" [11, p. 151]. Royce's remarks appeared two weeks later in *Science*, the popular weekly journal published by the American Association for the Advancement of Science [11].

Immediately following Royce's lecture, the two disciplines separated, with mathematicians moving to a nearby lecture hall for the first of the four sessions. Henry S. White (Northwestern), chair of the first one, introduced the two speakers in turn, Maxime Bôcher (Harvard) and James Pierpont (Yale), both of whom presented forty-five-minute addresses of a highly general character, Bôcher on "The fundamental conceptions and methods of mathematics" and Pierpont on "The history of mathematics in the nineteenth century". The addresses were published in tandem two months later in the *Bulletin* [12], [13].

While this session was devoted to an overview of mathematics, each of the other three considered specific subfields. A sidebar lists the program of speakers and officers for all four sessions. The sessions on subfields included a secretary responsible for taking detailed notes that would form the basis for the formal *Proceedings* of the Congress, which stated, "Great care was exerted in selecting the chairmen … as they must be men of international reputation and conceded strength. For the secretary-ships younger men of promise and ability were selected, chiefly from university circles" [3, p. 19]. This quotation shows an early recognition of the critical importance of advancing the careers of young workers such as G. A. Bliss and Thomas Holgate by linking them with established scholars such as E. H. Moore and M. W. Haskell.

Each session devoted to a subfield was allotted three hours: a forty-five-minute address on fundamental conceptions and methods, a fifteen-minute period for questions and comments, a forty-five-minute address on the present state of the specialty,

Émile Picard with E. H. Moore and Heinrich Maschke.

another fifteen-minute period for audience response, and an hour for "supplementary papers". (A sidebar lists all supplementary papers.)

Whereas Tuesday's session had featured American speakers by design, the other three included international celebrities. The session on algebra and analysis, held two days later, was chaired by E. H. Moore, whose participation provided a direct link to his own Chicago Congress eleven years earlier. Émile Picard (Sorbonne) opened the program with a lecture delivered in French, "Sur le développement de l'analyse mathématique et ses rapports avec quelques autres sciences"; it appeared in two parts that October and November [14]. An authorized translation by G. B. Halsted (then at Kenyon College), "On the development of mathematical analysis and its relations to some other sciences", appeared in *Science* one month after the Congress ended [15].

The other principal address, "On present problems of algebra and analysis", was delivered by Klein protégé Heinrich Maschke, who had been on the faculty at the University of Chicago since its opening in 1892. According to the AMS report he delivered "an extended survey of the present state of the theory of invariants of quadratic differential forms in n independent variables, an intensive study of differential parameters or the Biegungsinvarianten of surfaces, and included an overview of [his] papers in the *Transactions* of this Society" [16, p. 359]. The entire address is reproduced as [17].

The official report from the Congress waxed enthusiastic about this session: "The Section of

Speakers and Officers

Division A—Normative Science
Hall 6, September 20, 1904, 10 a. m.–11 a.m.

Speaker: JOSIAH ROYCE, Harvard University
"The sciences of the ideal"

Department 2—Mathematics
Hall 7, September 20, 11:15 a. m.–1 p.m.
Chairman: Henry S. White, Northwestern University

Speakers: Maxime Bôcher, Harvard University: "The fundamental conceptions and methods of mathematics"; James P. Pierpont, Yale University: "The history of mathematics in the nineteenth century"

Section A. Algebra and Analysis
Hall 9, September 22, 10 a.m.–1 p.m.
Chairman: E. H. Moore, University of Chicago;
Secretary: G. A. Bliss, University of Missouri

Speakers: Émile Picard, The Sorbonne, Member of the Institute of France: "Sur le développement de l'analyse mathématique et ses rapports avec quelques autres sciences" ("On the development of mathematical analysis and its relations to some other sciences"); Heinrich Maschke, University of Chicago: "On present problems of algebra and analysis"

Section B. Geometry
Hall 9, September 24, 10 a.m.–1 p.m.
Chairman: M. W. Haskell, University of California
Secretary: Thomas J. Holgate, Northwestern University

Speakers: Gaston Darboux, Perpetual Secretary of the Academy of Sciences, Paris: "Étude sur le développement des méthodes géométriques" ("A study of the development of geometric methods"): Edward Kasner, Columbia University: "The present problems of geometry"

Section C. Applied Mathematics
Hall 7, September 24, 3 p.m.–6 p.m.
Chairman: Arthur G. Webster, Clark University
Secretary: Henry T. Eddy, University of Minnesota
Speakers: Ludwig Boltzmann, University of Vienna: "The relations of applied mathematics"; Henri Poincaré, The Sorbonne, Member of the Institute of France: "L'état actuel et l'avenir de la physique mathématique" ("The principles of mathematical physics")

Supplementary Papers

Section A. Algebra and Analysis

1. G. A. Miller (Stanford), "Bearing of several recent theorems on group theory"
2. James Byrnie Shaw (Millikin), "Linear associative algebra"
3. M. W. Haskell (Berkeley), "The reduction of any collineation to a product of perspective collineations"
4. M. B. Porter (Texas), "On functions defined by an infinite series of analytic functions of a complex variable"
5. Edward V. Huntington (Harvard), "A set of postulates for real algebra comprising postulates for a one-dimensional continuum and for the theory of groups"
6. J. I. Hutchinson (Cornell), "Uniformizing of algebraic functions"
7. E. R. Hedrick* (Missouri), "Generalization of the analytic functions of a complex variable"

Section B. Geometry

1. Harris Hancock (Cincinnati), "Algebraic minimal surfaces"
2. H. F. Blichfeldt (Stanford), "Concerning some geometrical properties of surfaces of revolution"
3. George Bruce Halsted (Kenyon), "Non-Euclidean spherics"
4. Arnold Emch (Colorado), "The configuration of the points of inflexion of a plane cubic and their harmonic polars"
5. H. P. Manning (Brown), "Representation of complex variables in space of four dimensions"
6. G. A. Bliss* (Missouri), "Concerning calculus of variations"
7. L. W. Dowling (Wisconsin), "Certain universal curves"

Section C. Applied Mathematics

1. Henry T. Eddy* (Minnesota), "The electromagnetic theory and the velocity of light"
2. Alexander Macfarlane (Ontario), "On the exponential notation in vector analysis"
3. James McMahon (Cornell), "On the use of N-fold Riemann spaces in applied mathematics"

* Submitted but not read.

Algebra and Analysis attracted wide interest and caused many supplementary papers on various topics to be submitted" [3, p. 531]. Henry White's AMS report supplied abstracts of five of the seven shorter communications in this meeting and provided a bibliographic reference for another [16].

The final two sessions on mathematics were held on Saturday, beginning with one on geometry. Curiously, Gaston Darboux's address was translated into English in two different versions and published in two different venues: "A study of the development of geometric methods", translated by G. B. Halsted and published in *Popular Science Monthly* [18] and "A survey of the development of geometric methods" by Henry Thompson and published in the *Bulletin* [19]. We have been unable to determine why different translations were undertaken by two different mathematicians. Darboux's work had previously appeared in the original French version [20].

The other chief address on geometry was delivered by Edward Kasner (1878–1955), who was only twenty-six years old at the time but had earned his Columbia Ph.D. five years earlier. After obtaining his doctorate Kasner followed the prevalent American custom of sailing to Göttingen for a year of postgraduate study, chiefly so he could attend lectures by David Hilbert and Felix Klein. Upon his return to the United States he remained at Columbia for the rest of his life. One of his best known works is the coauthored book (with former student James Roy Newman) in 1940, *Mathematics and the Imagination*, which surveyed the entire field of mathematics. Newman wrote, "I had the good fortune to attend several of his courses as a graduate student, and, like many others, I owe to him a true awakening of interest in mathematics and an appreciation of its rare excellence" [21, p. 1994]. Kasner's paper at the St. Louis Congress, "The present problems of geometry", was described by future Fields medalist Jesse Douglas as "a comprehensive summary and formulation of the status of the subject at that time" [22, p. 190]. The paper examined several major unsolved problems [23].

The concluding session on applied mathematics ran from 3 p.m. until 6 p.m. Given the penchant in North America for pure mathematics, it is not surprising that both lectures on applied topics were delivered by Europeans. The chair, Arthur G. Webster (Clark University), and the first speaker, Ludwig Boltzmann (Vienna), were physicists. Boltzmann's lecture was translated from German by Saul Epsteen (Chicago) as "The relations of applied mathematics". In his opening remarks Boltzmann lamented the gulf separating theoretical physicists such as himself from experimentalists [24, p. 591].

Henri Poincaré, the final speaker, drew the largest audience. His lecture, "L'état actuel et l'avenir

Henri Poincaré

Photo courtesy of the Smithsonian Institution Libraries, Washington, D.C.

de la physique mathématique" [25], was translated in two separate versions: "The principles of mathematical physics" in the conference proceedings by G. B. Halsted [26] and "The present and the future of mathematical physics" in the *Bulletin* by J. W. Young [27]. Once again we have no explanation for seemingly duplicate efforts. Pages are cited from the *Bulletin* because it is more easily accessible.

Poincaré opened his remarks with four questions. "What is the present state of mathematical physics? What are its problems? What is its future? Is it about to change its orientation?" [27, p. 240]. Regarding these questions he stated, "It is easy to ask; difficult to answer" [*Ibid.*]. With Einstein's *annus mirabilis* less than a year away, the answer to the third question was somewhat different from what Poincaré might have imagined, although his remarks at the St. Louis Congress attest to the fact that he came very close to discovering the theory of special relativity. Darrigol [28] provides a recent, balanced account of the controversy surrounding the discovery of special relativity.

This time the official account reported merely, "Three short papers were read in the Section on Applied Mathematics" [3, p. 622]. Moreover, Henry White's AMS report [16] listed only one of the three short papers that followed Poincaré's address.

Official activities for the overseas participants did not end with Saturday's sessions. After the Congress concluded on Sunday, the foreign speakers boarded a train for Washington, D.C. to attend an official reception hosted by President Theodore Roosevelt and another reception at which Simon Newcomb held court. From there they hopped aboard another train for Boston, where Congress vice-president Hugo Münsterberg hosted a reception at Harvard. Finally, the exhausting itinerary called for the celebrities to proceed to New York for a farewell dinner at Columbia hosted by the Association of Old German Students. Only then did the speakers set sail for home.

Washington University and the University of Missouri

The AMS meeting and the St. Louis Mathematics Congress took place on the new campus of Washington University, and mathematicians from the University of Missouri were instrumental in both gatherings. Here we outline the histories of these institutions through the first decade of the twentieth century to illustrate the southwestern movement of the change in the primary mission of leading institutions from low-level teaching to upper-level mentorship *plus* research.

Washington University was founded in 1853 by Unitarian minister William Greenleaf Eliot Jr. and one of his parishioners, Missouri State Senator Waymon Crow. Though quite different individuals, Crow and Eliot shared a desire to establish an educational enterprise to provide "powerful civilizing forces that could tame the diverse, fast-growing population" of St. Louis [29, p. 7]. Ads for the new school reflected an early emphasis on mathematics, promising a course of instruction that "will embrace mental and written Arithmetic, Algebra, Reading, Grammar, Declamations, and if desirable writing and spelling" [29, p. 11]. Before daytime classes started in 1856, the Board of Trustees appointed Joseph J. Reynolds (1822–1899) as Eliot Professor of Mathematics, Mechanics, and Civil Engineering. An 1843 graduate of West Point, Reynolds later gained distinction as a combat veteran of the Mexican War and the U.S. Civil War.

But mathematics gained a much stronger foothold in the fledgling university when its first chancellor was brought aboard in 1859. Joseph Gibson Hoyt (1815–1862) was a Yale graduate and Greek scholar who had been professor of mathematics and natural philosophy at the exclusive Phillips Exeter Academy from 1840 to 1858 before taking up his post at Washington University. His choice for the chair of mathematics and astronomy was William Chauvenet (1820–1870), an 1840 Yale graduate who became the principal founder of the Naval Academy in 1845 at age twenty-four. Chauvenet remained at Navy until being recruited by his Yale classmate Hoyt. Described as someone who "had a charming personality, was a skilled musician and was so broadly cultured in all things that he filled well his position as leader of a humanistic institution" [30, p. 1], Chauvenet wrote seminal works on geometry, spherical trigonometry, and astronomy that were especially known for clear exposition. As a result, when the Mathematical Association of America established a prize for exposition in 1925, it named the award in his honor. (To date three Washington mathematicians have won the Chauvenet Prize—Guido Weiss (in 1967), Kenneth I. Gross (1981), and Steven G. Krantz (1992)—the most of any university in the country.)

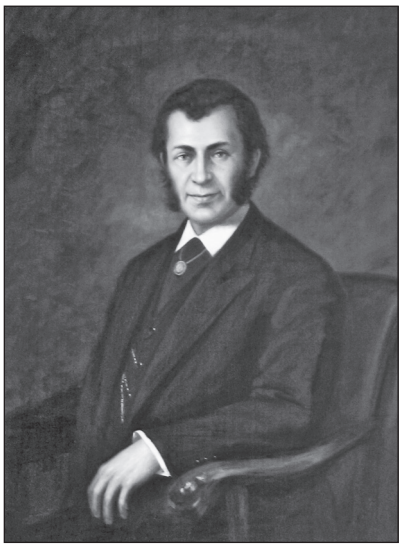
Washington University reeled with decreasing enrollments and financial support during the U.S. Civil War but rebounded under the leadership of Chauvenet until his untimely death in 1870. Harvard graduate Calvin Milton Woodward (1837–1914) was then hired as Nathaniel Thayer Professor of Mathematics and Applied Mechanics, as well as Washington's first dean, but he

became so actively involved in the development of vocational education in the school's Polytechnic Institute that he contributed very little to mathematics. The subject then languished for the next six years until the appointment of John Krom Rees (1851–1907), who put the university on the map by establishing (with Woodward) standard time for that region. But their collaboration was short-lived, as Rees remained at Washington only five years before returning to his alma mater, Columbia. In 1888 he was one of the six charter members of the New York Mathematical Society.

The departure of Rees in 1881 was the catalyst for hiring two mathematicians who would become leading administrators at other institutions, Henry Smith Pritchett (1857–1939) and Edmund A. Engler (1856–1918). The new additions made extensive use of a small observatory on campus to collaborate with the U.S. Coast and Geodetic Survey in sending time signals to towns and rail lines from the Appalachians to the Rocky Mountains. Pritchett left Washington in 1897 to become head of the U.S. Coast and Geodetic Survey. He then accepted the presidency of MIT, a post he held until 1906; as noted above, he was one of six members of the administrative board. Engler was awarded a Ph.D. in mathematics by Washington University in 1892. The department did not bestow another doctorate until the mid-1930s, when the émigré Gabor Szegö directed four dissertations; it would be another twenty years before Ph.D.s were produced on a regular basis. Engler left Washington in 1901 to accept the presidency of Worcester Institute. Many of the plaster-and-string models he constructed were exhibited in Washington's mathematics department through the middle of the twentieth century and are now stored in the Engineering School.

Along with a rapidly increasing population in St. Louis during the 1890s, there emerged a group of inhabitants the university courted: "Part of the original vision of the institution was that it was to be a place for the wealthy mercantile class of the city to send their children for refinement and erudition" [31, p. 1]. So in 1899 the decision was made to move the campus from its downtown location to a large tract of land that ultimately resulted in the present Hilltop Campus. Funding was secured to erect several buildings over the next three years, but a sudden financial crisis squashed plans for construction of a new library, physics building, athletic grounds, and gymnasium. The University needed an immediate infusion of $600,000. And that is when the World's Fair came to the rescue.

David Rowland Francis (1850–1927), an 1870 graduate, was president of the Louisiana Purchase Exposition. Mayor of St. Louis from 1885 to 1889, governor of Missouri from 1889 to 1893, and U.S. Secretary of the Interior from 1896 to 1897, Francis saw the opportunity to extend the fairgrounds beyond its Forest Park location while helping his alma mater at the same time. He arranged for the Exposition to lease the land and new buildings and to set aside funding for constructing three more buildings. Moreover, the contract stipulated that if the intended start date of the World's Fair was postponed beyond its intended time of 1903, the Exposition would provide additional funds toward construction of a fourth new building. David Francis remains an example of a highly successful political figure who negotiated in a way that benefitted the city of St. Louis, the World's Fair, and Washington University.



William Chauvenet

Portrait of William Chauvenet, anonymous, n.d., 30" x 40", Mildred Lane Kemper Art Museum.

In the meantime, the face of Washington mathematics had changed perceptibly with the 1901 hiring of G. O. James and A. S. Chessin. Little is known about either one. George Oscar James (1873–1932) received his Ph.D. from Johns Hopkins in 1899; although no official dissertation advisor is listed, the blending of differential equations with hypersurfaces suggests that it was written under Thomas Craig. James served as chair at Washington from 1918 to 1932.

Alexander Sawéljevitsch Chessin was the more accomplished of the two. Born in St. Petersburg, Russia (in either 1865 or 1866 according to different sources), Chessin received a Doctor of Philosophy degree from the University of St. Petersburg and was then sent by the Russian government to Italy on a special mission. A few years later he earned a civil engineering degree from the Polytechnic School in Zurich. Chessin came to the United States to attend the Chicago Mathematics Congress in 1893. After offering a course at Harvard and assisting Simon Newcomb with planetary tables in Washington, D.C., he joined the Johns Hopkins University faculty. However, a note in the July 1898 *Bulletin* revealed, "Professor Simon Newcomb has resumed his professorship of mathematics at the Johns Hopkins University. Associate Professor A. S. Chessin has resigned his position" [32, p. 555]. Chessin returned to Russia from 1899 to 1901 yet maintained a New York City address with the AMS before succeeding Edmund Engler at Washington University in the fall of 1901.

Chessin has proved to be an elusive character. He published at least eighteen papers between 1894 and 1905 and was one of three founders of the Southwestern Section of the AMS in 1906, but he left Washington University after the spring 1907 semester. Notes in the *Bulletin* indicate that he lectured at three eastern colleges after that

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and attended AMS meetings in New York through October 1912. The 1910 census cites his "birth about 1867" and lists an address in New York City, but, curiously, he was not included in the next decennial census even though a court document from 1922 ruled against him in a patent suit over the gyroscope. That is the last we hear about Chessin, with no mention of him and no paper by him in any subsequent mathematical publication.

At the time of the World's Fair, then, the mathematics department at Washington University consisted of A. S. Chessin, George James, and Calvin Woodward. Now we turn to the University of Missouri, located in Columbia, about 125 miles from St. Louis. Like Washington University (WU hereafter), the University of Missouri (UM) started out as a private college, dating its founding from 1839, when the private Columbia College was converted to the public University of the State of Missouri. UM thereby became the first public university in the United States west of the Mississippi River. UM's mathematics fortunes began with its first president, John Hiram Lathrop (1799-1866), a former professor of mathematics. During the antebellum period mathematics was taught by William W. Hudson, who was also in charge of astronomy. Hudson contributed no new mathematics, rather devoting his time to administrative tasks that included two stints as president of the institution, the first in an acting capacity. In the meantime UM also hired mathematics tutors to teach introductory courses.

During the period of Reconstruction, 1865–1877, both UM and WU recovered from dwindling enrollments and financial support caused by the Civil War. Whereas the WU faculty included C. M. Woodward, J. K. Rees, H. S. Pritchett, and E. A. Engler through the 1880s, UM made only one appointment in mathematics, Joseph Ficklin (1833–1887), who headed the department from 1865 until his death in 1887. Although Ficklin's primary interest was astronomy, he wrote numerous low-level textbooks for American schools.

The change in the mission at UM came from Richard H. Jesse (1853–1921), whose tenure as president of the university, 1891–1908, was described in the authoritative history of UM as follows [33, p. 355]:

> President Jesse's discrimination in the recruiting of new members of the faculty so as to secure men of intellectual competency as well as teaching and administrative ability became so well known that in future years people looked back upon his presidency as the Golden Age of the University.

Jesse inherited a respectable mathematician, William Benjamin Smith (1850–1934), who had come to UM with a Ph.D. from Göttingen in mathematics and physics. However, Smith left within the first two years of Jesse's presidency.

Jesse's appointments in mathematics over the next ten years were hardly "golden", but that changed in 1902 when he brought Arthur Byron Coble (1878–1966) to campus with a fresh Ph.D. from Johns Hopkins under Frank Morley. Coble returned to Hopkins after only one year, but Jesse trumped even this defection by appointing Earle Hedrick and L. D. Ames in 1903, G. A. Bliss in 1904, O. D. Kellogg and W. D. A. Westfall in 1905, and Otto Dunkel in 1907. This faculty ranked among the very best in the country! Earle Raymond Hedrick (1876–1943), Oliver Dimon Kellogg (1878–1932), and Wilhelmus David Allen Westfall (1879–1951) had all earned Ph.D.s under David Hilbert at Göttingen, and Gilbert Ames Bliss (1876–1951) had obtained his Chicago Ph.D. under Oskar Bolza and Otto Dunkel (1869–1951) his Harvard Ph.D. under Maxime Bôcher. This means that the UM mathematics department at the time of the St. Louis Congress in 1904 included Hedrick, Ames, and Bliss. In addition, Louis Ingold, whose work on constructing physical models for the Congress has already been cited, was an instructor at the time; his Chicago Ph.D. under Heinrich Maschke provided yet another link between UM and Göttingen. Bliss was recruited to Princeton the next year, 1905, in connection with the preceptorial scheme devised by Woodrow Wilson and carried out by Henry Fine. Yet, when the third section of the AMS was founded, the UM faculty included Hedrick, Ames, Kellogg, Westfall, and Dunkel.

Southwestern Section

The founding of the Southwestern (SW) Section of the AMS can be viewed as the culmination of a decade of the western expansion in the American mathematical landscape. The idea of a section of the AMS emerged in 1896 when a group of mathematicians in the Chicago area led by E. H. Moore petitioned the AMS to hold two official meetings annually. This induced the Council of the AMS to approve the formation of the Chicago Section in 1897. That idea resonated with a group of West Coast mathematicians who had been attending meetings of the San Francisco Academy of Sciences and founded the San Francisco Section in 1902.

The idea for a third section seems to have been planted when a half dozen mathematicians from the St. Louis area attended the April 1906 meeting of the Chicago Section with the aim of establishing their own group within the national organization.

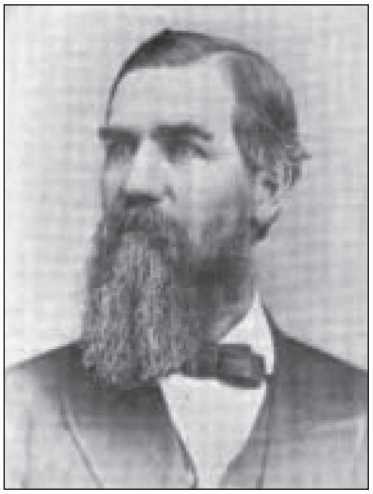
The minutes from that meeting record, "A resolution was introduced by E. H. Moore and unanimously carried, expressing the very earnest hope of the Chicago Section that it may be found possible to establish a strong section of the Society which shall hold meetings at some convenient center in the Southwest" [34, p. 435]. In December 1906 this resolution and presentations made by Earle Hedrick impelled AMS leaders to authorize the formation of the Southwestern Section [35]. Therefore it seems that E. H. Moore not only originated the notion of a section but played a pivotal role in helping his Missouri colleagues spread it to other parts of the country.

The groundswell of support for the Southwestern Section encouraged its leaders to launch activity even before gaining official approval. Minutes from the annual AMS meeting held December 1906 in New York City record briefly, "The organization of a new Section, to be known as the Southwestern Section of the Society, was authorized by the Council" [36, p. 262]. However, four weeks before official authorization, the section sponsored a "preliminary meeting" at the University of Missouri. To underscore the continuing connection with Chicago, "Professor E. H. Moore was asked to preside as honorary chairman of the meeting for the afternoon session…. At the conclusion of the meeting a motion was passed expressing the thanks of the members to all who had assisted in the formation of this section, especially to Professor E. H. Moore" [37, p. 218].

The SW Section held its first regular meeting in November 1907 in St. Louis. (Today's Central Section of the AMS is essentially a union of the Chicago and SW Sections.) The enthusiasm for this initial southwestern endeavor can be seen by comparing its attendance of thirty AMS members with the thirteen who were listed for the San Francisco Section meeting in September as well as the thirty-three and thirty who attended the spring Chicago Section meetings in 1907 and 1908, respectively. For further evidence, twenty-eight members attended the meeting in New York in October 1907, whereas, the attendance at the AMS annual summer meeting held the previous month at Cornell had been forty-seven.

With the University of Missouri and Washington University serving as the section's initial focal points, it is not surprising that its first two meetings were held on their campuses and that their departments were the best represented. Chicago Section leaders continued active participation in the new Section, with Herbert Slaught attending the second meeting. He and three others from that meeting—B. F. Finkel (Drury College), Earle Hedrick and Otto Dunkel (both at Missouri)—would play critical roles when the MAA was founded in 1915.

Another sign that Missouri and Washington University supplied the SW Section's initial leadership can be seen in the slate of officers. Earle Hedrick was elected chair at the preliminary meeting; in our view he should be regarded as the principal founder of the SW Section. Alexander Chessin was elected secretary at this meeting and chair at the regular meeting, where Oliver Kellogg (Missouri) was elected secretary. Kellogg held this position from 1907 to 1918, ending only when he was assigned to teach at the U.S. Coast Guard Academy in Connecticut during World War I; at the end of the war he was appointed to a lectureship at Harvard, where he remained for the rest of his life.



Joseph Ficklin

Conclusion

Was the St. Louis Mathematics Congress a success? On the one hand, the *Proceedings* reported, "not financially, nor was there ever a thought that it would be. Probably not more than seven thousand persons outside of St. Louis came primarily to attend the Congress, and their admission fees were a bagatelle" [3, p. 42]. On the other hand, those same *Proceedings* boasted, "the Congress was an unqualified success and of enduring reputation" [3, p. 42]. The "enduring reputation" was due to the prompt publication of the *Proceedings* and the worldwide journals in which individual papers appeared. Unlike the organizers of the Chicago Congress, the St. Louis directors had made arrangements beforehand for Houghton, Mifflin and Company to publish the *Proceedings*. The official final report from the St. Louis World's Fair concluded, "The Exposition of 1904 was a brilliant success in every respect. … The papers of these congresses …will find their way into the libraries of the world and will be treasured there" [2, p. 552]. Seven of the eight papers from the mathematics sessions were published within six months of the Congress, and two journals produced special issues devoted to the international exposition. The *Bulletin des Sciences Mathématique*s published the original papers of all three French speakers in the first part of its volume for 1904, and *The Popular Science Monthly* devoted its November 1904 issue to scientific papers presented at the meeting, including an edited version of Simon Newcomb's opening address [10].

Henry White's official report on the St. Louis Congress for the AMS included abstracts for most of the supplementary papers and supplied bibliographic details for others. It too was upbeat. "One purpose of the directors of the Congress was certainly realized—the conceptions of science as an organic whole, and of the community

of interest, the necessary interdependence, of all special divisions of science were fitly expressed and strikingly enforced by this unique gathering" [16, pp. 360–361].

Three elements differentiate the Chicago and St. Louis Congresses. One was the participation—indeed, the very existence—of a national professional organization of mathematicians, the AMS. Another was participation by foreign scholars. Both congresses featured leading international figures, but only the St. Louis Congress explicitly supported speakers from abroad with attractive financial inducements. A third distinguishing characteristic was the publication of the proceedings. Although the 1893 event helped launch the New York Mathematical Society into a national organization that published its proceedings because no private publisher could be found, just eleven years later at least a dozen publishing houses vied to bring the papers into print. However, whereas the 1893 World's Fair exerted critical influence on the mathematics department at Chicago and ultimately throughout the United States, its 1904 successor seems to have had limited effect.

Nonetheless, the nine-day combined AMS meeting and St. Louis Congress was the centerpiece of the (south)-westward expansion of mathematics in America. Henry White reported, "The auditors … numbered between 60 and 70" [16, pp. 358–359]. Along with the emergence of research universities and the founding of an AMS section, these meetings paint a picture of an American community of mathematicians that was moving westward with increasing numbers and prestige.

We end with two sets of open questions that seem worthy of further investigation:

1) What list of mathematicians was considered for inclusion in the St. Louis Congress, both domestic and international? Why was German participation so minimal?

2) What, if any, lasting effect did the StLMC have on its participants? Were the published papers cited in subsequent works by established researchers or young workers?

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Photo credits

Simon Newcomb and ICAS officers and Administrative Building, Washington University: *Congress of Arts and Science: Universal Exposition, St. Louis, 1904*, Howard J. Rogers, author, Houghton, Mifflin and Company, 1905; Émile Picard with E. H. Moore and Heinrich Maschke: *Popular Science Monthly* **66** (November 1904); Henri Poincaré: Courtesy of the Smithsonian Institution Libraries, Washington, D.C.; William Chauvenet: Anonymous, Portrait of William Chauvenet, Mildred Lane Kemper Art Museum, gift of Dr. and Mrs. Benjamin Strong, 1988; Joseph Ficklin: *A Genealogical History of the Ficklin Family*, compiled by Walter Homan Ficklin, The W. H. Kistler Press, Denver, CO, 1912; William Hudson: Plate 3 of *A History of the University of Missouri*, Frank Stephens, author, University of Missouri Press, 1962.

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