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A CONNECTED EFFORT? AMERICAN EDITORS PURSUE MATHEMATICAL JOURNAL PUBLICATION, 1804–1878

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Abstract. — The existing list of American periodicals that include mathematical content prior to the 1876 founding of *The American Journal of Mathematics* suggests a series of discrete attempts to start a specialized mathematical journal. This paper argues that a handful of mathematical practitioners in fact participated in far more sustained and contiguous efforts to start and sustain an elevated level of specialized mathematical periodical publication in the United States in the first three quarters of the nineteenth century.

Résumé (Un effort coordonné? Des rédacteurs américains se lancent dans la publication de revues mathématiques, 1804-1878)

La liste des périodiques américains comportant un contenu mathématique antérieurement à la fondation de *The American Journal of Mathematics* pourrait être interprété comme une série de tentatives isolées pour créer un journal spécialisé en mathématiques. Cet article soutient qu'une poignée de praticiens des mathématiques ont en fait fourni des efforts beaucoup plus soutenus et continus pour créer et maintenir une activité de publications périodiques

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mathématiques spécialisées d'un niveau élevé aux États-Unis au cours des trois premiers quarts du XIX^e siècle.

1. INTRODUCTION

Throughout the first three quarters of the nineteenth century mathematical practitioners in the United States worked together with geologists, physicists, and botanists to organize scientific societies, provide publication outlets, and develop employment opportunities for scientists generally. Those working to support these efforts often looked to Europe for ideas about useful professional infrastructure. Mathematical practitioners were among those who gradually began to adopt similar structures within their own scientific specialities. Initial attempts to create a specialized field through educational reform and mathematical publication in the United States characterized these years, which witnessed forays into specialized graduate education and great efforts towards new publications. These efforts parallel the common periodization of the history of science in the United States, where so-called gentlemen of science characterize the colonial and antebellum periods until the 1860s. The Morrill Act of 1862—enacted during the American Civil War—and its creation of land-grant colleges emphasizing agriculture and engineering marks a transition in the landscape of American higher education. Post-war Reconstruction revived national trends of exploration and economic development amid social changes. The late 19th century saw the rise of major firms and a blossoming of university-based research science with associated professional specialization.

In this context, the 1878 foundation of the *American Journal of Mathematics (AJM)* marked the first American journal exclusively focused on research-level mathematics, designed primarily for individuals employed as mathematicians. In 1876, Daniel Coit Gilman became the first president of Johns Hopkins University, which he fashioned as the first American graduate university for the advancement of research. University-supported specialized publications featured in this design. Gilman tasked the first professor of mathematics, James Joseph Sylvester, with editing the mathematics research journal. Prior to the *AJM*, American mathematical journals relied on a series of repeated grassroots initiatives from within a group of connected mathematician-editors. Those ambitious 19th-century editors had envisioned a mathematical periodical that would connect readers with

mathematical activity beyond the journal and, ultimately, communicate research-level mathematics. Their ongoing efforts to publish mathematical journals highlight persistent interest in sustaining a specialized mathematical publication in the United States, despite recurring obstacles to that goal. The experiences of these aspiring editors mirror entrepreneurial efforts with a range of science journals elsewhere. For example, The *Edinburgh Philosophical Journal*, the *Philosophical Magazine*, Silliman's *Journal*, and even *Nature*, have origin stories similarly subject to market vagaries. [1]

American mathematical journals before the *AJM* often involve peripheral figures, who are sometimes undocumented, anonymous or hard to identify based on limited sources. Little remains as archives from minor figures involved in the story. Copies of the publications themselves can be elusive, while evidence about finances, subscription data, and circulation is often sparse. Manuscript sources for this paper include correspondence, receipts, and notes from one small box in the Joel Hendricks Papers at the Des Moines Historical Society Archives, and the contents of the Charles Gill Papers at Cornell University's John M. Olin Library. There are also relevant manuscripts in the Harvard University Archives as well as the Benjamin Peirce papers from Houghton Library.

2. THE 19TH-CENTURY AMERICAN MATHEMATICAL PERIODICAL

The earliest outlets for mathematical publishing in the United States included a few general science journals—like the *Transactions of the American Philosophical Society* (f. 1771) in Philadelphia, the *Memoirs of the American Academy of Arts and Sciences* (f. 1785) in Boston, or *The American Journal of Science and the Arts* (f. 1819) in New Haven. Most mathematical papers involved surveying or astronomy in the *Transactions*, where ten articles about the transit of Venus filled forty-two percent of the first volume's pages [Hindle 1956]. Mathematics featured in the *Memoirs* mainly involved its applications to geography and navigation. Publications of the period exhibit a broad definition of mathematics, including a range of material from elementary arithmetic and algebra to pure mathematical investigations to scientific applications of all kinds.

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[1] For more on 19th century publication outside of the United States, see [Apple et al. 2012; Ausejo & Hormigón 1993; Baldwin 2015; Bidwell 2019; Crilly 2004; Despeaux 2002a;b; Gérini 2002; Schubring 1993; Secord 2014; Topham 2016; Verdier 2010].

With few exceptions, technical scientific or advanced mathematical training was rare and, especially early in the century, many among the educated American elite remained both dubious about the status of such education and skeptical about science as a profession or even, in some cases, as an activity. While a vocal minority maintained a strong interest in doing American science in an American way, even they still worked to formulate an understanding of what that might mean [Beach 1972, p. 118]. Consequently, there was at best a meager audience available for a scientific publication.

Todd Timmons' prosopographical study [Timmons 2004] indicates that between 1771 and 1834, eighty-four American authors published mathematics in the *Transactions of the American Philosophical Society*, the *Memoirs of the American Academy of Arts and Sciences*, or *The American Journal of Science and the Arts*. He estimates that between forty and fifty percent of these authors may have been college graduates, while the rest would have had at most a high school education. Of the eighty-four authors of contributions identified as mathematics, thirty-three served at one time or another as professors at American colleges, although the actual tenure of many was quite short. Ten of these were listed as professors of mathematics exclusively, and six of those worked at the military academy at West Point, where the mathematical curriculum initially consisted of geometry, arithmetic, logarithms, and algebra from Charles Hutton's *Course in Mathematics*. Professors had the option of including fluxions starting in 1816. By 1825 all cadets were learning some calculus from Sylvestre-François Lacroix, Jean-Louis Boucharlat, or Hutton, depending on their rank. In 1817, after his study of the École polytechnique, Superintendent Sylvanus Thayer focused on elevating the curriculum and using French mathematical texts including Lacroix's *Algebra*, Adrien-Marie Legendre's *Geometry*, and Boucharlat's *Calculus*. By 1818, mathematics occupied cadets for about 6 hours per day, six days a week. Content at that point consisted of arithmetic, algebra, surveying, and trigonometry as well as analytical and descriptive geometry [Rickey & Shell-Gellasch 2010]. West Point provided the most advanced technical education available in the United States at the time. Beyond the military academy contributors in Timmons' study, other authors of mathematical papers included a civil engineer, an astronomer, an actuary, several secondary school teachers, clergymen, and merchants [Timmons 2004, p. 435]. Mathematical contributions populating the pages of these early American general science journals came from little known and minimally documented figures.

The first American periodical dedicated to mathematics was a quarterly publication edited by George Baron called *The Mathematical Correspondent*, which appeared in 1804 [Hogan 1976]. Baron emigrated from England, where he was reportedly a colleague of Hutton at the Royal Military Academy in Woolwich.[2] The year before West Point officially became the United States Military Academy in March of 1802, Baron taught mathematics there in September of 1801. Shortly thereafter, Baron was court-martialed and disgracefully dismissed. He moved to New York City, from where he would launch *The Mathematical Correspondent* [Rickey & Shell-Gellasch 2010, pp. 4–5].

In his opening preface, Baron lamented that "exertions of learned men to disseminate mathematical information in other countries … [are] most shamefully neglected in the United States" [Baron 1804a, p. iii]. Baron looked to the British puzzle journal *The Ladies' Diary* for inspiration and believed the opportunity to publish results would provide a unique and powerful motivation for readers to elevate their mathematical skill. He and Hutton both believed *The Ladies' Diary* had done more to train mathematicians than all the mathematical authors in England. Broadly, *The Mathematical Correspondent* aimed to enrich "the common stock of mathematical knowledge" [Baron 1804a, p. iv].

Given Baron's view of mathematical learning in the United States, he proposed a graduated approach to a problem journal. Early volumes would include problems that could be solved with elementary mathematics, while later issues would "gradually ascend towards the higher regions of the sciences," being mindful to stay "adapted to the present state of learning in America" [Baron 1804a, p. iv]. To improve that state, Baron also printed explanatory notes about principles of arithmetic, and about applications of geometric propositions to navigation.[3] Each issue included a prize question, the best solution of which would be published in the following issue, and the contributor awarded a silver medal. Baron fully expected the enterprise to be profitable and planned to use income from journal sales to fund the prize medals.

Eight issues of *The Mathematical Correspondent* appeared between May 1804 and February 1806. The initial subscription list includes 347 names, with orders for a total of 487 copies.[4] Two booksellers in London and Quebec account for seventy total copies. Only three of the 347 subscribers had

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2 This is widely cited, but without solid evidence and contested by [Crackel 2002, p. 304]. Also, see [Rickey 2002].

3 See, for example, [Baron 1804b;c; Tagart 1804].

4 *Mathematical Correspondent* 1, pp. 241–248.

the title of professor, although many others taught school mathematics at some level. Unfortunately, Baron alienated many readers with his position on *The New American Practical Navigator*, a comprehensive manual by American astronomer, navigator, and mathematician Nathaniel Bowditch. Baron published sneering criticism of Bowditch and likewise gave public lectures refuting his "universally false and spurious principles." Baron additionally expressed contempt for mathematics instructors at West Point. [5] In late 1805, subscribers increasingly defaulted on their payments. This combination sabotaged Baron's publication in less than two years. [6]

This first foray into specialized mathematical publication in the United States involved editorial initiative, uneven readership, and financial woes—features that would reappear throughout nineteenth-century efforts to sustain periodical scientific publications abroad and in the US. Throughout the first three quarters of the nineteenth century, founding editors encountered subscribers and readers with limited mathematical training, who ranged from interested hobbyists to individuals associated with a range of academic institutions. The publications did not become self-sustaining, so the life circumstances and financial situation of each editor profoundly affected the nature, the contents, and ultimately the fate of these publications. The longevity of American mathematical periodicals started prior to the *AJM* ranged from just a few months to a decade.

Karen Parshall and David Rowe provide the following list of nineteenth-century specialized mathematics journals in the U.S. compiled from Cajori and appearing in [Smith & Ginsburg 1934]. [7] This standard list includes nineteenth-century periodical publications self-declared as mathematical.

The Mathematical Correspondent (1804–1806)
The Analyst or Mathematical Museum (1808)
The Monthly Scientific Journal (1818)
The Mathematical Diary (1825–1832)
The Ladies' and Gentlemen's Diary or United States Almanac and Repository of Science and Amusement, Intended for An Annual Magazine (1820–1822)
The Mathematical Companion (1828–1831)
The Mathematical Miscellany (1836–1839)

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5 Hart explains this as nationalistic prejudice against Americans by Irish editors [Hart 1875, p. 132]. Also see [Rickey & Shell-Gellasch 2010] for details about Baron's dismissal from West Point and "acerbic personality."

6 [Smith & Ginsburg 1934, pp. 85–86], [Parshall & Rowe 1994, pp. 42–43], [Zitarelli 2005, p. 6].

7 [Cajori 1890, pp. 94–97 and 277–286], [Parshall & Rowe 1994, p. 51].

The Cambridge Miscellany of Mathematics, Physics, and Astronomy (1842)
The Mathematical Monthly (1858–1860)
The Analyst: A Monthly Journal of Pure and Applied Mathematics (1874–1884)
The Mathematical Visitor (1878–1894)
The American Journal of Mathematics (1878–present)
Mathematical Magazine (1882–1884)
Mathematical Messenger (1884–1895)
The Annals of Mathematics (1884–present)
Bulletin of the New York (later *American*) *Mathematical Society* (1891–present)
The Mathematical Review (1896)
Transactions of the American Mathematical Society (1899–present)

Some of these publications exclusively print mathematics, while others, like the *Ladies' and Gentlemen's Diary* or *The Monthly Scientific Journal* include a mix of contents. Certainly, too, there are other nineteenth-century periodicals in the United States that also include mathematical material. For example, mathematical question and answer sections appeared in educational journals such as *The Schoolmaster* (1832–1833) edited by Rev. Timothy Clowes in Hampsted, New York or *Clark's School Visitor* (1870–1875) and the *Normal Monthly*, both edited by self-educated Artemas Martin in Erie, Pennsylvania. Martin also regularly contributed problems and solutions to *The Analyst*. His later editorial ventures included two specialized mathematical journals: *The Mathematical Visitor* (1878–1894) and *Mathematical Magazine* (1882–1884).[8] Each volume of *The Mathematical Visitor* had about 140 question and answer contributors, suggesting a wide circulation. The *Yates County Chronicle* newspaper likewise included mathematical questions and answers edited by Samuel Hart Wright in Penn Yan, New York from 1872–1880. *The Railroad Gazette* and *The New York Coach Maker's Magazine* are examples of trade publications printing mathematical material. *The Ladies' Repository* also included mathematics in the Notes and Queries.

The nineteenth century also featured a widely varied category of both commercial and government almanacs. These usually appeared once annually, and some posed mathematical problems and published solutions similar to those appearing in more self-consciously mathematical publications. Starting in 1818, for example, David Young edited question and answer sections for *The Maine Farmer's Almanac* and *Hutchins' Improved Family Almanac*. Samuel Hart Wright likewise edited similar material for *The Farmer's Almanac* and *The Knickerbocker Almanac*. *The American Ephemeris and*

8 [Allaire & Cupillari 2000; Finkel 1894; Hunter 1999].

Nautical Almanac (1852–1980) is the clearest example of an almanac with content of a mathematical nature that does not include a question and answer section. Nineteenth-century editors of this publication included Charles Davis, Simon Newcomb, and Benjamin Peirce among others in Washington, DC, and Cambridge, Massachusetts.

A comprehensive list of nineteenth-century periodicals containing mathematical content would indeed paint a fuller picture of the entire landscape, but to expand the list above to include the full range of all nineteenth-century American periodical publications printing any mathematical content exceeds the scope of this article. [9] Journals like *Nature* and publications from the American Association for the Advancement of Science—periodicals not specifically aimed at a mathematical audience—also continued to play a role in the dissemination of mathematical ideas. Despite these omissions, the above working list nonetheless illustrates the general plurality and tendency to brevity of self-declared mathematical publications in the nineteenth-century United States. It additionally demonstrates that a handful of connected editors generated recurring initiatives for periodical mathematical publication between the 1804 publication of *The Mathematical Correspondent* and the 1878 founding of *The American Journal of Mathematics*.

3. ROBERT ADRAIN'S PERSISTENT ENGAGEMENT

Born in Ireland, Robert Adrain (1775–1843) escaped to the United States after the Irish rebellion of 1798. He taught at an academy in Princeton, New Jersey before becoming principal of York County Academy in Pennsylvania, from where he began to contribute to Baron's *Mathematical Correspondent* and eventually won several prize medals [Hogan 1977, pp. 4–5] . After Baron stopped editing his journal, Adrain made an effort to revive the publication and a single late volume of *The Mathematical Correspondent* appeared in May of 1807. As editor, Adrain worked to elevate the content in Baron's publication [Zitarelli 2005, p. 6]. While Baron had included an excerpt from Francis Maseres' dissertation contesting the use of negative numbers, Adrain wrote about Diophantine algebra. [10]

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9 The current project *Circulations des mathématiques dans et par les journaux; histoire, territoires et publics* explores in greater detail the range of material circulating any sort of mathematical content. It also grapples with a definition of what constitutes a mathematical publication. See `https://cirmath.hypotheses.org/`.

10 [Maseres 1804]. Adrain's was the first article on Diophantine analysis published in the U.S. [Coolidge 1926, p. 66].

The preface to Volume 2 referenced Pascal, Leibniz, the Bernoullis, Huygens, Euler, Lagrange and others as eminent mathematicians who participated in problem journals. Looking to the prize problems of the French Academy of Sciences further to demonstrate potential for such a publication, it likewise called the readers to move beyond appreciating the great known discoveries, and to apply their own ingenuity to find new treasures. To aid this endeavour, readers could together learn "more completely what real additions are made to the general stock of mathematical knowledge." [11] Adrain would have to look elsewhere, though, to pursue these goals. No more issues of *The Mathematical Correspondent* ever appeared.

Undaunted, Adrain founded *The Analyst or Mathematical Museum* in 1808. The modest publication again contained mainly problems and solutions submitted by contributors. The first number, in fact, contained all of the material from the one issue he edited of *The Mathematical Correspondent* [Coolidge 1926, p. 66]. Since Adrain had moved to Reading, Pennsylvania, in 1805, the first number of The Analyst was published there. The available typesetting produced disappointing results, so Adrain ordered a republication at a more skilled printer in Philadelphia [Cajori 1890, p. 67]. This demonstrates Adrain's commitment to quality and correct mathematics. With thus reduced resources, he still put out four issues of *The Analyst* in 1808.

The final two numbers included some of Adrain's own work on the Principle of Least Squares, a method of constructing a best-fit line that minimizes the sum of the squares of the distances of the data points to the fitted line. [12] Although Legendre proposed this in 1805, Adrain appears to have been unaware of that work on the subject, so his two proofs and the principle alike seem original to him. Although Adrain developed these ideas in response to a problem posed in the second issue of *The Analyst*, the level of his investigations exceeded that of most contributions. In addition to Adrain's contributions, solutions to various problems were also submitted by Robert Patterson, University of Pennsylvania mathematics professor and director of the United States mint, Ferdinand Hassler, then West Point mathematics instructor and later first Coast Survey Superintendent, Alexander Fisher, a mathematics tutor at Yale College, and Melatiah Nash,

11 [Anon. A 1804].

12 For more on Adrain's work, see [Hayes 2002] and [Dutka 1990].

a New York-area polymath and translator. Finances nonetheless prevented Adrain from continuing publication beyond the first year. [13]

In 1809, Queen's College (now Rutgers) hired Adrain as a professor [Hogan 1977, p. 158]. He turned his editorial efforts to *The Gentleman's diary and almanac for the year 1811…: also a collection of mathematical questions for solution and many new and valuable receipts* [Adrain 1810]. Adrain accumulated honors—becoming a Fellow of the American Philosophical Society and of the American Academy of Arts and Sciences—and was hired by Columbia in 1813[Hogan 1977, p. 158]. While there, Adrain recruited the help of Ferdinand Hassler and Robert Patterson in one final—and unsuccessful—attempt to revive *The Analyst* in 1814 [Smith 1933, p. 279]. Adrain's engagement with mathematics in periodical publications resumed in 1818 with contributions to *The Monthly Scientific Journal*.

3.1. *William Marrat and* The Monthly Scientific Journal

A broadly self-educated Englishman with experience as a publisher and mathematics instructor, William Marrat moved to the United States in 1817. Marrat had edited *The Enquirer, or, Literary, Mathematical, and Philosophical Repository* during its brief run in Lincolnshire and hoped to try a similar publication on the American side of the Atlantic. The *Enquirer* was co-edited by bookseller Pishey Thompson and included a range of literary, philosophical, or mathematical prize problems for schools. Mathematics in the juvenile department included mensuration, algebra, and geometry. Miscellaneous correspondence lived up to its name. Some examples queried the origins of cock-fighting, the conductive properties of wax, conundrums of Biblical exegesis, economic competition between commerce and agriculture, philosophical quandaries, and poetry. The mathematical department included questions about compound interest, geometry, algebra, and some astronomical computations.

In February of 1818, the first issue of *The Monthly Scientific Journal* appeared, edited by Marrat in New York, where he taught mathematics and nautical astronomy. [14] Marrat knew his publication faced many obstacles to success and pledged himself to the work. He hoped his journal would "assist the student, rather than amuse the learned." [15] The content in areas of philosophy and chemistry were focused for use in class discussions, while

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13 Adrain to John Vaughan, 12 June 1810, in [Hogan 1977, p. 160].

14 In 1810, he had published a series of mechanics textbooks for use in schools [Marrat 1810].

15 *The Monthly Scientific Journal* 1-1, p. ii.

the aim in mathematics was to include essays and problems conducive to improving science. A specific stated objective was to support teachers in the business of scientific instruction [Marrat 1810, p. ii].

The first article in the opening issue demonstrates Marrat's commitment to faculty psychology. "On the Usefulness of Mathematical Studies" argued for mathematics as a means to cultivating mental discipline and strengthening mental training. [16] Alongside chemical experiments and a range of scientific articles—on topics from electrical facts to the domestic housecat— each issue of the *Monthly Scientific Journal* included both philosophical and mathematical questions to be solved in subsequent numbers. Between ten and fifteen individuals submitted answers monthly. One of these was Robert Adrain, who answered every question posed and submitted many, all under the pseudonym Analyticus. [17] Marrat's publication appeared monthly from February through September of 1818. After late issues appearing in July and October of 1819, the publication fizzled, mostly due to financial concerns and Marrat's anticipated return to Liverpool, [Smith 1933, p. 281].

3.2. *Melatiah Nash and* The Ladies' and Gentleman's Diary or United States Almanac

Before his departure, Marrat endorsed a new American periodical that first appeared the year after the final issue of *The Monthly Scientific Journal*. Marrat and fellow New York area mathematics teachers James Thompson, Edward Ward, R. Tagart, and William Forrest along with Robert Adrain, then a Professor of Mathematics and Natural Philosophy at Columbia College, all signed a recommendation letter included in the first volume of *The Ladies' and Gentlemen's Diary or United States Almanac and Repository of Science and Amusement* (1820–1822). The editor was Melatiah Nash, who lived in New York City where he identified as a "teacher of Navigation, Astronomy, and the Use of the Globes." [18] Nash's work with *The Ladies' and Gentlemen's Diary or United States Almanac and Repository of Science and Amusement: Intended for An Annual Magazine, Including a variety of Matter, chiefly original, on subjects of general utility, in the Arts, Sciences, Agriculture, Manufactures, etc., etc.* built on his earlier involvement with circulation and publication.

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16 *The Monthly Scientific Journal* 1-1, pp. 3–5; [D'Estimaville 1818].

17 *The Monthly Scientific Journal* 1-1, p. 23; 1-2, p. 48; 1-3, p. 72; 1-4, p. 96; 1-5, p. 120; 1-6, p. 152. Hogan identifies Adrain as Analyticus, [Hogan 1977, p. 159].

18 District Court submission letter. [Bruce 2015, p. 3].

In 1803, Nash published an *Explanatory Catalogue of M. Nash's Circulating Library*, detailing a subscription service that charged $3.50 per year for the privilege of borrowing two books at a time, subject to lending rules [Nash 1803, pp. 2–4]. Nash's collection included a range of titles in history, philosophy, medicine, travel, and theology, as well as logarithm tables and Euclid's *Elements*. His interest in circulating texts extended to mathematical periodicals, evidenced by his subscription and contributions to *The Mathematical Correspondent* in 1804 and *The Analyst* in 1808 [Zitarelli 2005, p. 11], [Hart 1875, p. 133]. Nash also supported American mathematical periodicals by launching his own.

In mid August of 1811, Nash began to prepare an ephemeris with a tide table and an astronomical diary. He aimed to produce a manual to help readers identify fixed stars and planets and also to assist coastal commerce [Nash 1812, p. 33]. In late October, Nash solicited advice and suggestions from "gentlemen, eminent in science," including recent past president Thomas Jefferson. [19] The ephemeris was nearly ready by early November, when "so may obstacles presented" that progress stalled and publication seemed uncertain [Nash 1812, p. 33].

Nash received a reply in November from Jefferson, who embraced the idea of a publication "holding a middle station between the Nautical and the common popular almanacs." [20] Jefferson referenced as a model the *Connaissance des tems*, which he had attempted to acquire from French contacts as early as 1805. [21] Jefferson recommended Nash add some articles and formulae, including the equation of time and the sun's declination, so readers could calculate the sunrise for themselves in any U.S. location, thus expanding the potential readership. Jefferson also suggested as a marketing tool that each annual edition include collectable versions of useful tables. [22]

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19 Melatiah Nash to Thomas Jefferson, 24 October 1811, *Founders Online*, National Archives, accessed April 11, 2019, `https://founders.archives.gov/documents/Jefferson/03-04-02-0195`, see [Jefferson 2007, pp. 213–214].

20 Thomas Jefferson to Melatiah Nash, 15 November 1811, *Founders Online*, National Archives, accessed April 11, 2019, `https://founders.archives.gov/documents/Jefferson/03-04-02-0219`, see [Jefferson 2007, pp. 243–245].

21 Thomas Jefferson to J. Phillipe Reibelt, 23 January 1805, *Founders Online*, National Archives, accessed April 11, 2019, `https://founders.archives.gov/documents/Jefferson/99-01-02-1026`.

22 Thomas Jefferson to Melatiah Nash, 15 November 1811, *Founders Online*, National Archives, accessed April 11, 2019, `https://founders.archives.gov/documents/Jefferson/03-04-02-0219`, see [Jefferson 2007, pp. 243–245].

As 1812 approached, Nash worried about devaluation of his date-specific work. Publication delays likely combined with Jefferson's advice resulted in a broader plan, one that added instructional articles and a compendium of astronomy. These and remaining ephemeris work were hastily assembled and 112 pages of the *Columbian Ephemeris* appeared in early 1812. Nash's letter of deposit to the City Clerk articulated his goal to make ideas of astronomy accessible to American youth while also providing resources for coastal commerce. Subsequent planned annual volumes would feature improvements and include new discoveries, eventually forming a valuable collection of astronomical and mathematical tables. Nash never realized this vision of annual volumes with the *Columbian Ephemeris*.

His experience with that publication nonetheless influenced his next editorial venture. Nash also looked to the well-established British publication *The Ladies Diary*, which offered a successful blend of scientific news, mathematical questions, and word puzzles alongside almanac information [Bruce 2015; Despeaux 2002a]. In the Preface to the first annual volume of *The Ladies' and Gentlemen's Diary or United States Almanac and Repository of Science and Amusement: Intended for An Annual Magazine, Including a variety of Matter, chiefly original, on subjects of general utility, in the Arts, Sciences, Agriculture, Manufactures, etc., etc.*, Nash explained his aim to create an excellent almanac "holding an intermediate station between the ephemerides of the highest order and the Almanacs in general circulation." He also invited reader participation through submitting questions and also answering posed questions, some of which offered the prize of free copies of the journal. [23]

Although Nash's almanac included calculations virtually identical to others in use, the letter, signed by Adrain, Marrat, and other supporters, endorsed his accuracy as superior. Nash's almanac, they said, was "a work of greater extent and higher views, formed with the design of giving more general information in the occurrences of Astronomy; that the Repository of Science and Amusement will be a convenient receptacle for the labours of Mathematicians in every part of the community." [24] Marrat, Bowditch, Nash and a few others formed the core of contributors to the three annual volumes. Extended family illness forced Nash to abandon his efforts as editor after the 1822 volume.

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23 *The Ladies' and Gentlemen's Diary* 1, 1820, p. 12.

24 Recommandations, 10 September 1819, *The Ladies' and Gentlemen's Diary* 1, 1820, n. p.

3.3. *Robert Adrain's sustained and ongoing involvement with mathematical periodicals*

Adrain had endorsed and contributed to each volume of Nash's *Diary*[25] and after it ended, he transferred his support and problem-submission to other periodicals.[26] He wrote an essay on methods for determining latitude and longitude ashore for the *New York American Monthly Magazine and Critical Review*[27] and also had a recurring presence in *The New York Mirror and Ladies' Literary Gazette.*

Samuel Woodworth and George Morris launched the *Gazette* in August of 1823. Adrain contributed two problems to the Arts and Sciences column in the first volume[28] and later clarified one of those problems in print, and he continued to submit problems for solution. *The New York Mirror* ran Arts and Sciences columns featuring mathematical problems In the first 86 numbers. In January of 1825, the column printed a notice that Adrain would be publishing a quarterly pamphlet with mathematical problems.[29] The Arts and Sciences column with its mathematical questions then disappeared from *The New York Mirror.*

In 1825, Robert Adrain indeed spearheaded efforts to found a mathematical periodical by starting *The Mathematical Diary.* He seemed to understand that the matter of content was fundamental to financial viability. Although Adrain had, by this time, investigated elliptic integrals, the *The Mathematical Diary* articulated no aspirations of communicating new results or furthering mathematical research. Perhaps Adrain viewed his aims with *The Analyst* as too lofty for most of the readership, so he modeled the new, problem-solving publication on the *The Lady's and Gentleman's Diary* [Despeaux 2002a;b].The content of Adrain's *Diary* included elementary problems like systems of equations for simultaneous solution, yet alongside some quite challenging problems in mechanics and pure analysis.

Four quarterly issues of *The Mathematical Diary* appeared during the first year. Over two hundred loyal subscribers expected the blossoming journal to continue indefinitely [Anon. B 1832, p. 25]. When Adrain accepted a position as professor at Rutger's College in 1826, he relocated and sur-

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25 *The Ladies' and Gentlemen's Diary* 1, p. 62; 2, pp. 54–55, 67; 3, p. 531.

26 See *Longworth's New York Directory*, 1803, p. 224; 1806, p. 273; 1830, p. 454; *New York Weekly Museum*, 5 Mar. 1803, 23 May 1807; *New-York Columbian*, 29 Nov. 1811, 21 Oct. 1817; *New-York Evening Post*, 5 August 1813, 24 July 1830.

27 2 , 1817, pp. 92–95.

28 2 August 1823, p. 3, col. 3.

29 *New York Mirror*, 8 January 1825, p. 191.

rendered the editorship to the publisher, James Ryan. The new editor's lack of mathematical skill generated some controversy, especially related to the selection of prize problem winners. Many previously regular contributors stopped participating due to Mr. Ryan's "injudicious management," as well as carelessness and conspicuous errors [Anon. B 1832, p. 25]. Ryan stopped offering prize problems and complained of financial losses, while the deteriorating journal began appearing only annually until 1829, when publication temporarily stopped.

Samuel Ward, an 1831 graduate of Columbia College, took on the editorial role for the next issue, which appeared in 1832. This issue of *The Mathematical Diary* boasted more pages than any previous, with clean editing, historical commentary, and more original mathematics than the *Diary* had yet published. This issue contained a biographical sketch of Lagrange, with a celebrated frontispiece illustration. Beyond the customary problems and solutions submitted from readers, the mathematics included an article by Benjamin Peirce proving that no perfect number has fewer than four prime factors, and some discussion of Diophantine problems by mathematician William Lenhart [Hogan 1990]. There were also reviews of scientific periodicals, and books, such as *On the Motion of Solids on Surfaces*, by Henry Anderson, a medical doctor and professor of mathematics and astronomy at Columbia College in New York. Nonetheless, the involvement of Sam Ward in the editorial process generated a heated disagreement among a readership already disgruntled about Ryan's work as editor. This acrimony caused the publication to collapse. [30]

On the cover of *The Mathematical Diary* for 1831, Adrain announced a new journal he proposed to edit [Smith 1933, p. 282]. The *American Diary of Mathematical and Physical Science*, as Adrain envisioned it, would include original research from American practitioners alongside substantial mathematical content gleaned from the best foreign mathematical publications. He specifically referenced periodicals from France and England, including the *Bulletin des Sciences Mathématiques*, Gergonne's *Annales de Mathématiques*, and the *Annals of Philosophy*. Adrain planned for semiannual publication of 150 pages of closely printed mathematical matter. In hopes of an adequate audience, Adrain mailed a prospectus of his proposed new journal to all subscribers of *The Mathematical Diary*. He acknowledged the discouraging track record of similar previous publications and asked his countrymen to patronize his journal that was scheduled to

30 For details, see [Hart 1875, p. 134–135].

appear the following July in place of *The Mathematical Diary*.[31] The fact that this never materialized suggests a lack of support for the scheme. Adrain continued to support American mathematical periodicals until his death in 1843.

4. EDITORIAL AMBITIONS DISCOURAGED

Following the final issue of *The Mathematical Diary* in 1832, American mathematical practitioners were without a new targeted publication until 1836. The population of potential contributors, subscribers, and readers for such a journal has been estimated to number at least 360 mathematical enthusiasts who at the time would mostly have been affiliated with high schools or fledgling rural colleges, and largely trained in other disciplines such as law or theology.[32] Even the few existing, widely-scattered professors of mathematics had little concept of fitting mathematical work into themes of current research topics, or even the idea of original research. College students meanwhile had inconsistent and often rudimentary secondary school mathematics education. The standard college mathematics curriculum consisted mostly of Euclid's *Elements* and some Newtonian mechanics [Cajori 1890]. Technical scientific or mathematical training was rare, available at West Point starting in 1802, Rensselaer Polytechnic Institute in 1823, Yale's Sheffield School in 1843, and the Lawrence School at Harvard in 1846. Given this prospective audience for a specialized mathematical periodical in the United States, it is perhaps little surprise that ambitious editors realized only short-lived publications.

4.1. *Charles Gill and* The Mathematical Miscellany *(1836–1839)*

Charles Gill—a practicing actuary turned mathematics instructor—had a reputation as an outstanding problem solver and a regular contributor to Adrain's *Mathematical Diary* [McClintock 1913a;b;c]. He also had prior experience with British puzzle journals before moving to the United States. In 1834, Gill founded the *Journal of the Institute of Flushing* in New York to "stimulate academic achievement among secondary school students." Two years later, he broadened his scope and started *The Mathematical Miscellany*

31 I found no number or evidence that Adrain's ambitious journal ever appeared.

32 [Zitarelli 2005] counted known subscribers and contributors to *The Mathematical Correspondent* and traced their involvement in later journals, to improve on the rough estimate of 100 in [Hogan 1985].

to benefit anyone "desirous to progress in the important study of mathematics."

Despite initial uncertainty, Gill moved forward in the belief that a miscellany of this kind could concentrate the mathematical talent of the country.[33] He referenced the "high estimation in which such works are held by the European mathematicians" and attributed developments in mathematics to discussions and investigations prompted by journal problems. Gill wanted his publication to perform a similar function. He also hoped it would provide a venue in which "the aspirant to mathematical distinction may try his strength with those of established reputation."[34] To create such a meeting ground for known and unknown mathematical minds, Gill secured the support and participation of the highest-caliber American mathematicians—like Harvard mathematics professor Benjamin Peirce, Rutgers College's mathematics professor Theodore Strong, and Orren Root, principal of the Syracuse Academy—who would lend credibility and expertise to the publication.

The Mathematical Miscellany followed the problem-solving format of many amateur journals. Gill introduced a division of problems into Senior and Junior divisions to accommodate various skill levels and entertained targeted hopes for stimulating research. The editor posed Diophantine problems and showed his own familiarity with mathematics of Laplace, Lagrange, Legendre, and Gauss. Despite Gill's efforts to steer American practitioners in the direction of European mathematical trends, only very few of his subscribers were prepared to take that road. Only about 10 of *The Miscellany*'s subscribers actively engaged mathematics at this level. Still, *The Miscellany* optimistically printed 250 copies of each volume in hopes of exceeding the 120 subscriptions at $5 per year required to sustain publication.[35]

In addition to financial pressures of publication, Gill faced "all kinds of crude conjectures thrust upon me which I am obliged to wade through, bring into order, and lick into shape."[36] Dealing with shabby submissions required substantial fortitude and Gill faced editorial exhaustion. A lack of able and available help resulted in a publication lag, causing an outcry from subscribers. Gill and others discussed transferring the editorship, but constraints of mathematical typesetting equipment, access to foreign pub-

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33 *Miscellany*, 1, Advertisement.

34 *Miscellany*, 1, Advertisement.

35 JOL, Charles Gill Papers 1444, 1 November 1838.

36 HU, Benjamin Peirce Papers, Gill to Peirce, 1 August 1836.

lications, and mathematical aptitude considerably narrowed the options. [37] The eighth and unexpectedly final volume of *The Mathematical Miscellany* appeared in November of 1839.

Subscribers had come to believe that fresh information—preferably from current foreign publications—would best improve them mathematically. They yearned for more than agreeably amusing problems and some also shared a concern about monitoring mathematical advancements in Europe. Yet unfamiliar with the concept of a specialized mathematical publication focused primarily on research rather than puzzle-cracking, subscribers *did* want to communicate with established mathematical practitioners in America. Gill's journal had promised them at least this.

4.2. *Benjamin Peirce, Joseph Lovering, and* The Cambridge Miscellany of Mathematics, Physics, and Astronomy *(1842)*

When Gill's journal crumbled, Benjamin Peirce's name circulated as a possible next editor. Prior to supporting Gill's publication, Peirce had been involved with some of Adrain's journals and had also established a reputation as an accomplished mathematician. In 1842, Peirce thoughtfully and deliberately undertook the project of starting a serious American mathematical journal with the help of his Harvard colleague Joseph Lovering [Kent 2008]. Peirce promptly asked the college library to order Liouville's *Journal de mathématiques pures et appliquées*, the *Comptes Rendus* from the Paris Academy of Sciences, Crelle's *Journal für die reine und angewandte Mathematik*, and Schumacher's *Astronomische Nachrichten*. [38] He planned to use these to fulfill the expectation among American mathematical practitioners—fueled by Gill's publication—that that editors of mathematical journals be abreast of European mathematics. [39] Peirce so insisted on these publications, that he volunteered personally to contribute half the combined subscription cost. [40] Both Peirce and Lovering held definite ideas about the future of American mathematics broadly defined and envisioned their publication playing an intentional role in shaping that future [Lovering 1842a;b].

Peirce knew that for the United States to join with Europe in modern scientific undertakings, the American practitioners needed to be aware of overseas research currents. The editors thus discussed which articles

37 JOL, Charles Gill Papers 1444, 6 December 1841.

38 HUA, UAI.5.131.10, Benjamin Pierce to Josiah Quincy, 8 February 1842.

39 HL, Charles Avery to Charles Gill, 11 July 1840.

40 HUA, UAI.5.131.10, Benjamin Pierce to Josiah Quincy, 8 February 1842.

from Liouville and Crelle's journals would be most advantageous. They included translated excerpts from Augustin-Louis Cauchy's optics and Joseph Liouville's integration as mathematical essays in addition to Junior problems and Senior challenge problems. The selected challenge problems suggest premeditated interdependence between challenge problems and articles. The challenge problems combined several issues central to mechanical investigations: Poisson equations, centers of gravity, and equations of motion. Peirce and Lovering hoped to equip their readership with foundational mathematical material to pursue mechanical problems. In addition to holding these perhaps unrealistic ambitions, Peirce and Lovering wanted to showcase American mathematical work [Lovering 1842a;b;c].

Their editorial selections reflect a vision for the journal to direct American mathematical efforts towards work in optics, astronomy, and mechanics. The first volume of the *Cambridge Miscellany* contained articles written almost exclusively by the editors. Subsequent volumes included foreign excerpts, such as works by René Dutrochet, Humphrey Lloyd, and Johann Franz Encke on astronomy; Johann Wolfgang Goethe and Gabriel Lamé on optics; and a M. Spencer and Heinrich Wilhelm Dove on meteorology. Not formally an editor, Gill still remained involved and offered to translate Liouville's integration of the heat equation and Cauchy's work on light. A sizeable gap nonetheless existed between such mathematical sophistication and the problems the *Cambridge Miscellany* readership could solve. About seventy percent of contributors responded exclusively to the Junior department problems. Even there, the level of editing required overwhelmed Peirce and Lovering, particularly given their growing responsibilities elsewhere.

After it became clear that another volume of *The Cambridge Miscellany* would not appear, Peirce received letters mourning the loss of student stimulation, not the potential stagnation of research. This correspondence demonstrates an understanding of the development, role, and needs of mathematics in America quite different from that of *The Cambridge Miscellany*'s editors. Some practitioners recognized either scientific or patriotic necessity to keep up on European work, while others considered elementary problems more beneficial to the advancement of American mathematics. Still, the Senior Department problems were mostly too difficult and the excerpts from the foreign journals likewise met with mixed reception. Peirce and Lovering's project encountered the common editorial challenges of financial instability and uneven readership,

which tempered their initial enthusiasm for publishing a mathematical periodical.

5. INFLUENTIAL CONNECTIONS

As individual efforts, *The Mathematical Miscellany* and *The Cambridge Miscellany of Mathematics* fit into a larger nineteenth-century effort to grow an American scientific elite by strengthening research and reforming higher education [Kent 2008, p. 103]. Charles Gill, Joseph Lovering, and Benjamin Peirce entertained editorial visions of advancing American mathematical practice in specific ways that would foster the pursuit of science as a legitimate profession in America [Kent 2008, p. 119]. Peirce, in particular, also pursued this goal by contributing to the formation and development of two institutions, the Lawrence Scientific School and the Nautical Almanac Office.

In 1847, industrialist Abbott Lawrence underwrote the Lawrence Scientific School at Harvard to support education in applied sciences. Benjamin Peirce was then Harvard's Perkins Professor of Mathematics and Astronomy and offered an ambitious course of mathematics to Lawrence Scientific School students. A few years earlier, Peirce articulated in *The Cambridge Miscellany* his vision for America's path to mathematical greatness through applied mathematics and astronomy. His Lawrence School curriculum thus included challenging material from Friedrich Wilhelm Bessel, Cauchy, Jean-Baptiste Biot, Laplace, and Carl-Friedrich Gauss. The year prior to Lawrence's bequest, Peirce had his own taste of international limelight related to Neptune's discovery, and he also lectured on related work of LeVerrier, Adams, and Airy.

An 1849 Naval Appropriations Act authorized the creation of an official national almanac so American scientists and navigators would no longer need to depend on foreign sources for astronomical data. The U.S. Nautical Almanac Office started to house the computation and publication of that data. Naval Lieutenant Charles Davis established the Nautical Almanac office not at the Naval Observatory in Washington, D.C, but in Cambridge, MA specifically to have access to Peirce's expertise and oversight for the calculating staff [Waff 1985, p. 64]. The co-location of the Lawrence Scientific School and the Nautical Almanac Office meant that the few students who studied mathematics with Peirce also worked as computers for the almanac.

John D. Runkle—later mathematics professor and then president of Massachusetts Institute of Technology—was one of these computers. In

1849, he started to compute ephemerides (for 1855) that would appear in the almanac's first volume, which was published in 1852. To many, this volume served as a symbol of emerging scientific expertise in America. Working closely with Peirce on a project of such magnitude, the computers likely would have absorbed some of his views on both the potential and the pitfalls of periodical mathematical publication. Runkle's involvement with the Nautical Almanac continued through 1884. Likewise, Simon Newcomb—later Professor of Mathematics and Astronomy at Johns Hopkins University—worked as a computer for the Nautical Almanac Office starting in 1857. He studied mathematics with Peirce at the Lawrence Scientific School, from which he graduated in 1858. Newcomb continued Almanac Office work through 1861, when he became Professor of Mathematics at the U.S. Naval Observatory and then, in 1877, director of the Nautical Almanac Office. Both Runkle and Newcomb would become centrally involved in publishing American mathematical periodicals.

5.1. *J.D. Runkle and* The Mathematical Monthly *(1858–1861)*

In February of 1858, John D. Runkle approached the challenge of periodical mathematical publication with what looks to modern eyes like a bit of marketing research. Runkle knew the experiences of most of the previous editors of American mathematical journals, so he circulated an open letter outlining a proposed journal for mathematics that would include notes and queries as well as reviews of American and European work. He intended to find a good blend for "the greatest usefulness and most permanent success." [41] Runkle explained that his publication would include the best talent—although would not be pitched "too high above the average attainments of mathematical students," lest too few be interested. [42] He hoped the content of his journal would provide both an example to students and a measure of mathematical ability in the United States. Runkle solicited views from eminent mathematicians and educators around the country: Was a mathematical journal necessary? If so, what character ought it to take? Who would be willing to contribute? Later editors echoed Runkle's strategy (see below).

Runkle received at least 300 replies endorsing his proposal, 62 of which "pledged constant and active cooperation." [43] The American Association for the Advancement of Science referred a committee to review Run-

41 *The Mathematical Monthly*, I, p. v.

42 *The Mathematical Monthly*, I, p. iv.

43 *The Mathematical Monthly*, I, p. ix.

kle's plan. In April of 1858, that committee—composed of Benjamin Peirce, AAAS President Alexis Caswell, and George Coaklay, a professor of mathematics, mechanics, and astronomy at St. James College in Maryland—deemed Runkle's mathematical journal "to be highly important to the mathematical progress of the country, and the advancement of science." [44] The New Hampshire State Teachers' Association and the Iowa State Teachers' Association both unanimously adopted resolutions expressing great interest and support for the project. This is a notable instance of professional societies endorsing a specialized mathematical periodical.

The first issue of *The Mathematical Monthly* appeared in October of 1858. Runkle introduced the work by explaining how mathematics publications could adopt one of two desired ends, "either be the *advancement* of the science, or the *elevation of the standard* of mathematical learning." [45] Runkle asserted the improbability of survival for a journal of high scientific character with "the former end solely in view" because it would only be interesting to "the few professed mathematicians." [46] The goal of elevating mathematical learning, Runkle claimed, would necessarily eventually involve the advancement of the science. He thus proposed a publication with "scope sufficiently comprehensive and elastic to embrace all grades of talent and attainment, and, therefore, corresponding elements of interest." [47] This meant his would not be a journal merely of problems and solutions.

The first issue announced prize problems for students and included a variety of essays on topics including a rule for finding the greatest common divisor and a proposition on the distribution of points on a line. *The Mathematical Monthly* received a warm welcome. *The Atlantic Monthly*, *Nouvelles Annales de Mathématiques*, and *American Journal of Science and the Arts* all reviewed it positively, as did other educational journals and newspapers. It was a winning combination: prize problems for students, reports on previous prize solutions, and essays on topics in mixed mathematics. The journal contained exposition on the mechanical construction of the area of a circle, on the compressibility of liquids, the elements of quaternions, the solution of cubic equations by logarithmic tables, and the trigonometric solution of equations, among other things. Each issue concluded with a list of foreign and American mathematical and scientific publications, with

44 *The Mathematical Monthly*, I, p. x.

45 *The Mathematical Monthly*, I, p. i. Runkle's emphasis.

46 *The Mathematical Monthly*, I, p. i.

47 *The Mathematical Monthly*, I, p. i.

reviews of those deemed most useful to teachers and students of mathematics. Within six months, the publication had at least 1100 subscribers at three dollars per year. [48]

In May of 1859, a collection of Harvard dignitaries—including Benjamin Peirce and his scientific colleagues Hollis Professor of Mathematics and Natural Philosophy Joseph Lovering, and Astronomer George Bond as well as administrators such as three former Harvard Presidents Edward Everett, Jared Sparks, and Josiah Quincy—contacted Runkle about the *Monthly*. These men saw the journal as "an instrument of great good," acknowledged the new impulse it gave to mathematical studies, and called for increased support to fund prizes and compensate the editor. [49] They expressed "conviction that the work deserves a wider patronage, and must secure it, in order to be *permanently* successful," because "the circle of strictly mathematical readers in this country is yet small." Until such time as the journal could support itself, they invoked "the aid of *all* true friends of Science". [50]

Runkle's publication continued to enjoy increasing subscriptions and dedicated contributors. He seemed to have found a viable balance between student outreach and more elevated mathematics. In *The Mathematical Monthly*, Runkle concocted a successful mixture of elementary and challenging material that generated support sufficient to sustain the publication until the national crisis of civil war intervened in 1861. The fact that something other than financial insolvency ended the journal indicates the success of Runkle's two-part plan to elevate the standard of mathematics through education *and* to advance the science. The subscription numbers for *The Mathematical Monthly* also indicate significant growth of a potential audience for a specialized mathematical periodical.

5.2. *Simon Newcomb and The Nautical Almanac Office*

In 1860, three years into his work at the Nautical Almanac Office, Simon Newcomb computed the path and crossing times for a total solar eclipse. This eclipse experience would later play a perhaps surprising role in the start of another nineteenth-century American mathematical periodical. In 1861, Newcomb received a commission into the U.S. Navy corps of pro-

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48 A $3 commodity in 1858 has a 2017 relative real price of $92.20 and a relative labor value of $632.00 (using the unskilled wage) or $1,300.00 (using production worker compensation), `https://www.measuringworth.com/calculators/uscompare/relativevalue.php`. Accessed 21 Sept 2017.

49 *The Mathematical Monthly*, 2-1, October 1859, p. 1.

50 *The Mathematical Monthly*, 2-1, October 1859, p. 1. Text emphasis.

fessors of mathematics. That same year a recent Rutgers graduate, George William Hill, started working at the Almanac Office after studying mathematics with Peirce. Hill and Newcomb both maintained a lifelong connection with the Nautical Almanac office. Hill did some of his most celebrated work in service of the Nautical Almanac Office [Burckhalter 1909]. Newcomb later became an influential Superintendent of the office [Dick 1999, pp. 20–27]. In 1866, the Nautical Almanac Office moved to Washington, D.C. It was from there that Newcomb led a eclipse expedition to Des Moines, Iowa, in 1869.

The 1869 eclipse event drew scientific observing parties to Tennessee, Kentucky, Illinois, Iowa, Alaska, and the Bering Strait. The group that convened in Iowa involved delegations from a curious mix of governmental offices. Personnel from the U.S. Coast Survey, the Surgeon General's Office, the Hydrographic office, and the Army Medical Museum joined Newcomb and his fellow professors of mathematics from the Naval Observatory, William Harkness, M. Yarnell, Asaph Hall and J.R. Eastman.[51] Faculty and students from universities and colleges from the midwest and east coast also joined observing parties. The first convoys left Washington, D.C., starting in late June for the three-day journey on newly-completed railroad to Des Moines. Newspaper reports and social events celebrated the visiting scientists, who met the mayor of Des Moines and other local dignitaries. These festivities likely connected local resident Joel Hendricks with Newcomb and others who had knowledge of and experience with publishing mathematical periodicals.

6. BUILDING A JOURNAL AT THE BORDERS OF CIVILIZATION

Joel E. Hendricks was a self-educated medical practitioner, turned school examiner and local politician in Ohio. In 1861, at the age of 43, Hendricks was assigned to a government survey in Colorado. He moved from there to Des Moines to work in railroad surveying. This "accumulated a comfortable fortune" for Hendricks and his family, whose place in the local elite meant they mixed and mingled with the eclipse delegations in 1869. Hendricks was elected to city council in 1872. Then, in 1874, a new mathematical periodical arose from this unexpected source.

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51 Observatory Report, 1869.

In 1873, Hendricks invited critical responses to a proposed publication. G.W. Hill replied in November of that year.[52] He said the 16 pages proposed by Hendricks were only adequate to print material "somewhat of a bore to the advanced mathematician." Hill conceded that governmental support enabled the imitable journals of Crelle and Liouville to print lengthy and "intensely interesting" memoirs. He nonetheless "would be delighted to see a Journal like these be established in the United States." Despite this aspiration, Hill warned Hendricks "that Des Moines is just not the place for it. It is too far west, on the very borders of civilization." Hill doubted the local skill and equipment could rise to the challenge inherent to the "printing of complex mathematical formulae." He also presumed Iowa had none of the "extensive mathematical libraries… very necessary for the able conduct of a periodical."

Hendricks acknowledged that his midwestern location—with its distance from any prominent educational institution—increased the challenge of sustaining a mathematical periodical.[53] Still undaunted, he printed the first volume of *The Analyst: A Monthly Journal of Pure and Applied Mathematics* in 1874. To overcome the obstacle of geography, Hendricks involved correspondents with access to libraries. Christine Ladd, a recent Vassar graduate who later qualified for a Ph.D. at Johns Hopkins University, submitted notes on articles in Crelle's journal. G.W. Hill himself regularly contributed short abstracts of recent mathematical publications. International correspondents included Carl Pelz, J.W.L. Glashier, Giovanni Schiaparelli, and Camille Flammarion. Hendricks bypassed the local shortage of skilled typesetters by enlisting his daughter to set the type at home and engrave plates for mathematical diagrams. Together, they developed creative approaches to logistical challenges. The Secretary of State included extra paper for Hendricks in the governmental orders.

Like Runkle, Hendricks aimed his publication at all interested readers, from high school and college students to professors. He envisioned a journal that included school mathematics, as well as "new and interesting discoveries in theoretical and practical astronomy, mechanical philosophy and engineering."[53] Against Hill's wishes, *The Analyst* posed problems and printed solutions, but it also included mathematical exposition. Topics included, for example, trigonometric series, solving first degree differential equations, the force of gravity, and a translation of the solution of the

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52 All quotes in this paragraph are from ISHS, G.W. Hill to J.E. Hendricks, 10 November 10 1873.

53 *Analyst* 1 (1874), p. 1.

general equation of the fifth degree. Hendricks sought subscribers who, like Hill, would be able to contribute, as well as those who desired to learn. The contributors numbered approximately 150.

An announcement in the November 1878 volume declared the publication a success. Hendricks recalled starting the publication "contrary to the advice of friends… nearly unanimous in cautioning us" [Hendricks 1878]. He was pleased by the unexpected reality that "neither the locality of its publication nor the obscurity of its editor has prevented the *Analyst* from receiving [such] patronage and support" [Hendricks 1878].

In September of 1883, Hendricks announced that the sixth and final issue of the tenth volume would be the last of *The Analyst* under his editorship [Hendricks 1883a, p. 159]. He assured readers that his own declining health entirely explained the discontinuance. Subscriber support and contributor interest remained strong. Hendricks received a flurry of inquiries about possible continuance and had, in fact, hoped to announce in the November issue a replacement publication. Despite expressed willingness from capable and esteemed potential editors, arrangements for continuing the publication had not been finalized when the last issue of *The Analyst* went to press. In correspondence, though, Hendricks remained confident "that the work will not be abandoned, but will be placed on a permanent basis, under a management that will insure its usefulness and success" [Hendricks 1883b]. The embers from Hendrick's *Analyst* did spark a new journal, *The Annals of Mathematics*, which appeared in 1884 at the University of Virginia [Anon. C 1898, p. iv].

In the *Analyst*, Hendricks paralleled Runkle's model of a well-blended combination of material for a variety of readers. This included some scant content for mathematics professionals, likely employed as such, in some college or university context or at a governmental agency in a scientific capacity. The *Analyst* also specifically articulated a desire for a permanent journal that could endure even if the editorship changed hands. *The Annals of Mathematics* would eventually realize this goal as it maintained continuous publication despite relocating from the University of Virginia, to Harvard, and then to Princeton, where it joined forces with the Institute for Advanced Study. Part of the recipe for longevity may have been the care of a *team* of editors, rather than a single individual. The pages of the *Annals* also evidence considerable change over time. Although it began as a heavily problem-based publication, by the 1930s the *Annals* had transitioned into an elite mathematics research journal.

6.1. *The Annals of Mathematics (1884–Present)*

In 1884, William Thornton, professor of engineering at the University of Virginia, and Ormond Stone, director of the Leander McCormick Observatory, undertook the task of editing a journal loosely considered as a continuation of Joel Hendrick's publication *The Analyst* [Anon. C 1898, p. iv]. Stone initially agreed to support the new *Annals of Mathematics* "from his private income" for ten years [Anon. C 1898, p. iv]. Six issues of the *Annals* appeared bimonthly from March of 1884 until January 1885. The next issue appeared in September of 1885, followed by an issue approximately every two months, interspersed with periods of irregular publication, perhaps explained by financial inconstancy. Stone and Thornton included a variety of articles—for example, describing conics, discussing the construction of flexible cables, and exhibiting solutions for quartic equations—as well as the familiar pairing of exercises and solutions of exercises, as had appeared in *The Analyst*. In 1895, though, the character of the publication changed when the University of Virginia assumed the expense of the publication. Meanwhile, Virginia mathematics professor William Echols joined Stone and Thornton on the editorial board. The tenth volume—the first to appear after Echols joined the editorial staff—contained the final set of solutions to exercises to appear in the journal.

In 1896, Echols was named editor-in-chief of the now University-funded publication. The next volume marked another fundamental transition for the journal. The *Annals* determined to be a research publication in the style of *The American Journal of Mathematics*. Assisted by seven associate editors, Echols continued to direct the *Annals* until June of 1899, when Harvard University assumed responsibility for the journal beginning with the first issue of the twelfth volume in October of 1899. At that time, Harvard mathematics faculty members W.E. Byerly, W.F. Osgood, and Maxime Bôcher joined the list of editors. For more than a decade, the *Annals* maintained a connected pool of five to six editors who increased the proportion of printed research results as the publication moved into the twentieth century. [54]

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[54] In 1911, Princeton University took on the journal. Stone continued as an editor, sharing the title with Bôcher, Oswald Veblen, George David Birkhoff, Luther P. Eisenhart, Elijah Swift and Joseph H.M. Wedderburn. In 1932, Einar Hille and Solomon Lefschetz took charge of the editorial roles, with cooperation from the entire Mathematics Department at Princeton, and nine additional faculty from Harvard and elsewhere. Starting in January of 1933, Princeton ran the *Annals* as a joint venture with the recently founded Institute for Advanced Study. John von Neumann joined Hille and Lefschetz as editors who would shape *The Annals* into an even more elite mathematical research journal.

7. INTRODUCING FORMAL SUPPORT AND AN EDITORIAL BOARD

In 1876, James Joseph Sylvester accepted a chair in mathematics at the newly-founded Johns Hopkins University, which had been established with a combination of goals new to American universities: teaching, conducting research, and training future researchers [Parshall & Rowe 1994, pp. 54–58]. As Hopkins' first President, Daniel Coit Gilman —who had served as President at the University of California from 1872—worked to foster an environment that would stimulate university research and promote research publication. Gilman realized that to mandate faculty and graduate student research as part of the institutional mission necessitated research-level publication outlets. Gilman's initial idea for a mathematical publication was to relocate the British *Quarterly Journal of Pure and Applied Mathematics* to Baltimore. Although Sylvester had served as an editor for the *Quarterly Journal*, he did not endorse Gilman's plan and the journal stayed put [Parshall & Rowe 1994, p. 88]. Sylvester knew of the history of mathematics publication in the United States, of the lack of resources, the editorial overwork, and the limited audience, and repeatedly refused to participate. Gilman eventually prevailed with assurance of editorial and financial support. Hopkins associate mathematics professor William Story would help Sylvester launch *The American Journal of Mathematics*. Gilman also recruited editorial assistance from Hopkins physicist Henry Rowland and Simon Newcomb, then a mathematics professor in the U.S. Navy.

In the fall of 1876, these men wrote an open letter to solicit input and gauge interest from mathematical scientists in the United States. They "believed that a periodical of a high class published in America, in which Mathematicians might interchange ideas and impart their investigations and discoveries has been long felt to be a desideratum, and that the want of such a medium of communication operates as a serious impediment to the propagation and advancement of mathematical knowledge in this country." They acknowledged earlier attempts to found such a journal, which had been "without permanent success–a result partly owing it may be supposed to the want of sufficient contributions of a nature to attract subscribers, but still more to the expense and risk unavoidably attendant on an undertaking in which only a limited portion of the public can be expected to take an interest." The Trustees of the Johns Hopkins University agreed to bear "for some time at least the expenses of publication in the event of it's [sic] not proving self-supporting." This financial support from the university freed the *American Journal* from relying entirely on subscription or the editor's own funds to maintain publication. For content, the

American Journal planned to rely on American contributions, although it would also accept foreign submissions. American mathematical practitioners responded favorably to the circulated letter. Sylvester and his fellow editors also received "promises of support from foreign mathematicians of eminence." [55]

Sylvester's main goal was to publish original work, although abstracts of relevant subjects would occasionally be included, too, particularly those those "developed in memoirs difficult of access to American students." [56] *The American Journal* also planned to include notice of important recent publications, both American and foreign, the latter particularly to eliminate readers' uncertainty about ordering mathematics books from abroad. Sylvester anticipated the journal to appear quarterly, adopting from European journals the practice of continuing articles from one issue to the next. The editors emphasized that "there will be *no problem department* in the Journal." [57] Contributors who did not have a full article could submit "important remarks, however brief" as notes, but problems posed would *not* be printed. [58] Sylvester recommended *The Analyst* and *The Mathematical Visitor* to all persons ''desirous of offering to the Public mathematical problems for solution." [58] He thus established the *American Journal of Mathematics* as a different type of publication in the new context of a research university. The university-supported publication was designed for mathematicians to communicate their original findings in article form rather than posing and solving mathematical problems. *The American Journal of Mathematics* still continues as a mathematical research journal in this format.

The early issues of *The American Journal of Mathematics* contained results from Sylvester and his students on invariant theory and matrix algebra. Arthur Cayley published a paper on the abstract theory of groups in which he posed the question of finding all groups of a given order. Benjamin Peirce's classification of linear algebras with dimensions one through six also appeared, with editorial comments from his son, logician and philosopher, Charles Peirce illuminating a correspondence of linear algebras and matrix algebras. *The American Journal of Mathematics* also featured articles communicating new work on lunar motion and elliptic function theory, in addition to other mathematical research topics. [59]

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55 Quoted in [Parshall & Rowe 1994, p. 89].

56 *American Journal of Mathematics*, 1 (1878), p. iii.

57 *American Journal of Mathematics*, 1 (1878), p. iv. Their emphasis.

58 *American Journal of Mathematics*, 1 (1878), p. iv.

59 For a detailed overview of mathematical content in the *The American Journal of Mathematics*, see [Parshall & Rowe 1994, pp. 99–146].

When it appeared in 1878, the *The American Journal of Mathematics* included in its first number a list of the first 100 subscribers "[t]o give an idea of the class of persons whom it is expected the Journal will reach."[60] This list included major institutions, such as the U.S. Coast Survey and the Smithsonian Institution. Subscribers included university libraries abroad—at the École polytechnique and Cambridge University—as well as colleges and universities in the United States, such as Yale, Princeton, Harvard, the University of California, Washington & Lee, Albion and Colby Colleges. Internationally eminent mathematicians such as Charles Hermite and James Whitbread Lee Glaisher subscribed individually, as did many American mathematicians, like Benjamin Peirce, his son, Charles, and Christine Ladd, who received her mathematical training at Johns Hopkins University. The "class of persons" the *The American Journal of Mathematics* aimed to reach were those who identified themselves in some way as professional mathematicians. For this audience, the editors planned to publish original mathematical work at the highest possible level.

From the start, *The American Journal of Mathematics* intended to be a research journal. It defined itself as an outlet for original investigations and a medium for communication between American and foreign mathematicians, designed to foster the study of mathematical science throughout North America. Sylvester suggested that mathematical problems be directed elsewhere leaving *The American Journal of Mathematics* to those with original results to share. Sylvester's solicitation of feedback from potential readers confirmed the existence of a number of American mathematicians desirous of communicating high-level mathematics with each other. He nonetheless worried there wouldn't be enough content to fill the journal. To alleviate this concern, Sylvester drew on his European connections and contributed extensively to the journal himself. Initial financial support from Johns Hopkins likewise relieved the publication from the concern of popular appeal sufficient to fund survival. A system of shared editorial burden similarly strengthened the project as an exclusively research publication. The fact that *The American Journal of Mathematics* persisted indicates changes in the organization of specialized mathematical publication and the audience for mathematical periodicals in the United States, both reflective of the changing context of American higher education and the role of science in it.

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60 *The American Journal of Mathematics*, 1 (1878), p. v.

8. CONCLUSION

In 1876, prior to the founding of *The American Journal of Mathematics*, Simon Newcomb lamented that "the facilities for the publication of any kind [of scientific literature in America] are extremely restricted, and have increased but little during the last fifty years" [Newcomb 1876, p. 110]. This situation did not result from lack of effort. The standard list of American mathematical periodicals prior to 1878 suggests a series of sporadic, disconnected efforts to start and sustain a specialized journal. While mathematical content did appear in other nineteenth-century outlets, such as educational journals, newspapers, trade publications, almanacs, and textbooks, the focus here is on the efforts of editors to produce self-declared mathematical publications. In particular, throughout the first three quarters of the nineteenth century, a handful of American mathematical practitioners participated in persistent and ongoing work to produce a specialized mathematical periodical publication in the United States. Personal ties, institutional affiliation, and the pages of their publications connected Robert Adrain, Melatiah Nash, William Marrat, Charles Gill, Benjamin Peirce, John Runkle, Joel Hendricks, Simon Newcomb, and James Joseph Sylvester. Although the specifics of each individual publication depended largely on the personal abilities and life circumstances of each editor, they all envisioned some version of a specialized American mathematical periodical. They also shared a sense of the publication enterprise as an experiment.

For journals from Baron's *Correspondant* until the *American Journal*, editors in the United States faced a common set of questions likewise faced by aspiring editors in other places and times: Was it possible to sustain a periodical mathematical publication? If so, what blend of content was commercially viable? What did the readers want? To what would they subscribe? And, even with optimal content and frequency, would there be enough readers to stabilize journal finances? To be capable of initiating a specialized nineteenth-century American mathematical periodical required not only mathematical expertise, but also a combination of editorial savvy and good marketing skills.

The eagerness with which American mathematical practitioners embraced the idea of a specialized publication throughout the nineteenth century reveals a real desire to encourage and develop mathematical talent in a nation experiencing political, structural, geographical, and educational transitions. The level of mathematical education among most readers, combined with the often diversionary or pedagogical role of

mathematics in their lives, did not foster receptivity to Adrain's unrealized scheme, or to the nationalistic research agendas of Gill, Peirce and Lovering. Adrain subdued his ambition in 1825 when he modelled the *Diary* on a British puzzle journal, intentionally including more elementary mathematics. Perhaps as a direct consequence, *The Mathematical Diary* lasted for seven years and gave every indication that it would have continued if not for the unfortunate squabble. Three years in, the *Diary* gave rise to a competitor journal, *The Mathematical Companion*, which exclusively valued ingenious problem-solving. [61] It appears that commercial interests motivated the editor, John D. Williams. [62] Perhaps for Williams in 1828, the relative success of *The Mathematical Diary* painted a well-pitched journal of mathematical problems as a potentially profitable commercial endeavor. Later the *Analyst* likewise enjoyed a greater degree of popularity and longevity partly because it was also suited to the mathematical taste of the existing audience, a growing audience that was also increasingly accessible by expansions of railroads and postal services. Recurring attempts to sustain question and answer journals indicate ongoing interest and an increasingly viable climate for such specialized mathematical publication in nineteenth-century America.

The repeated efforts to establish and nurture a specialized American mathematical periodical speak also to the difficulty of the task. Finances aside, editorial demands required a substantial investment of personal time and energy. The process of polishing sloppy or sometimes incorrect submissions eventually overcame Gill, for example. When Peirce and Lovering continued his project, they did so as a team to help distribute the work of creating journal content, corresponding with subscribers, correcting solutions, and editing submissions. It was not always easy to find someone willing to tackle the challenging constraints of periodical mathematical publication in the American context. In the Nautical Almanac Office, both Runkle and Newcomb likely would have absorbed some of Peirce's perspective on mathematical publication within his

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61 Samuel Hubbard Scudder, a widely published American insect paleontologist, references this publication in the *Catalogue of Scientific Serials of All Countries, 1633-1876*. Scudder compiled and published this as librarian of the Boston Natural History Society. Scudder describes Williams' journal verbatim to the description of Adrain's *Mathematical Diary*, suggesting that it, too, was a mathematical puzzle journal [Scudder 1879, p. 280]. Eight issues of *The Mathematical Companion* appeared over a three year period and the journal ended shortly before *The Mathematical Diary* did [Hart 1875].

62 Little is known about Williams, other than his involvement in the textbook business.

larger vision of defining and directing American national scientific and educational infrastructure in the mid-19th century. With the advantages of steady employment with access to graduate-level training, mathematical community, and editorial help in the Nautical Almanac Office, Runkle and Newcomb benefitted from collective wisdom earned through prior publication efforts.

The creation of editorial teams—rather than reliance on a singular editor—would prove beneficial in sustaining a mathematical periodical. When Hill cautioned Hendricks about the difficulties of editing a journal, he did not account for Hendricks' employment of a network of essentially editorial contributors. Hendricks utilized national and international contacts with access to foreign periodicals and awareness of European centers of mathematical activity. He also delegated some editing of some solutions to more skilled mathematicians. The *Analyst* benefitted from the support of Hendricks' own family as well as local government paper acquisition. This division of labor enabled Hendricks to maintain a mathematical periodical for ten years against the incredible odds of his peripheral location and meagre mathematical training. Independent wealth, creativity, persistence, and personal connections allowed Hendricks to overcome the challenges of typesetting, contributors, subscriptions and finances. The *American Journal* enjoyed institutional solutions to these impediments. Gilman's recruitment of an editorial board lightened the editorial load for Sylvester. Johns Hopkins also provided institutional support for a journal more narrowly focused on research-level mathematics. Likewise, the University of Virginia eventually sponsored the *Annals* as it transitioned from Des Moines to Charlottesville. These journals established precedent for institutionally-based mathematical publications designed for the communication of original results with critical reviews of relevant work. The alleviation of financial concerns facilitated more elite publications while the evolution of academic institutions increased the number of like-minded and capable mathematical readers.

All of the specialized American mathematical journals predating *The American Journal of Mathematics* relied on either personal fortune or subscription support. The longevity of each publication thus depended on appealing to a critical mass of readers for income and for contributions sufficient even to fill the pages. The varied priorities of an uneven readership also complicated decisions about content. Great distances separated hopeful mathematicians, and the small number of accomplished practitioners challenged mathematical periodicals. Throughout the first three quarters of the nineteenth-century, attempts to produce and sustain a specialized

mathematical periodical in the United States faced common challenges resulting in episodic publication and often abrupt ends. Experience suggested the same constellation of reasons: editorial exhaustion, publication constraints, insufficient participation, and financial unviability. Despite what appears to modern eyes a grim landscape for supporting a specialized journal, the editors of early mathematical periodicals nonetheless persisted. The determined efforts of a small group of connected editors highlight the central roles of financial stability, editorial teams, and, eventually, institutional support in the persistence of specialized mathematical publication.

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