# A FORGOTTEN NINETEENTH CENTURY MATHEMATICS JOURNAL

Leon M. Hall

**Abstract.** *Scientiae Baccalaureus* was a scientific journal, mostly mathematics, published in Rolla, Missouri, USA in 1890–1891. Largely forgotten today, it nevertheless had the distinction of being the first to publish English translations of the principal works of Lobachevsky and Bolyai on non–Euclidean geometry. This paper provides a brief overview of *Scientiae Baccalaureus* and some of the people associated with it.

After being extensively remodeled, the oldest building on campus, indeed the first building used by the institution when it opened over 130 years ago, recently became my department's new home. Although the most extensive, this was certainly not the first renovation since 1871, and I was curious about what the original interior of the building had been like. While looking through our Library's collection of historical items, I did find several old pictures of the building, both inside and out, but the most interesting thing I found was not directly related to the building. In the Library's vault was a copy of the first and only volume of a scientific journal, primarily mathematics, published at the Missouri School of Mines (M. S. M. , now the University of Missouri–Rolla) in 1890–91. The journal was called *Scientiae Baccalaureus, A Quarterly Journal of Scientific Research* [13], was published under the auspices of the Missouri School of Mines, and was edited by "The Senior Classmen". Fewer than ten libraries now own *Scientiae Baccalaureus,* and even here at its home institution it is not kept in the regular stacks, so the journal is unknown to most people, including historians of mathematics.

Looking through the journal, two things caught my attention. First, undergraduates were encouraged to contribute. Sometimes we think that getting undergraduates involved in research is a new idea, but the notion clearly goes back at least to the nineteenth century. Second, *Scientiae Baccalaureus* was the first to publish English translations of two famous and important pieces of mathematics research. These translations will be discussed in detail later, but first let's return to the purpose and intended audience of the journal. Here is an excerpt from the Prospectus:

> There is a considerable amount of scientific investigation going on at the present day which is of no contemptible order of merit, and which really deserves the name of research. This class of work is being done by the younger men, who are working earnestly and honestly; for the love of their subject, and for the love of the work itself. These are the men

> upon whose shoulders, in the coming years, as the masters pass away their mantles fall. These are the men from whose ranks in maturer time, will be called those who are to inherit the mighty responsibility of developing scientific truth, to grope in the darkness further on, to feel the way to clearer thought, to show the way to higher reason, to throw light upon the mists of doubt and clear away the error.
>
> It is for this class of younger workers that this publication has its being, it is for them to give it success or let it fail. The selection of its name is not from pedantry, but because it has in its sense a twofold meaning. Its pages are open to work in Mathematics, Pure and Applied; to Physics and to Chemistry, the exact sciences of the Bachelor's degree. On the other hand the name suggests the status of the workers, for it is not intended to be an undergraduate's plaything, nor yet does it aspire to the more powerful thought of the master workman.
>
> Its object is to encourage and foster the spirit of investigation and original thought. Its pages are to show research and originality in results which are new. The propounding and solution of questions, which by their novelty are interesting, is also invited.

Thus, as mentioned earlier, the niche for which this journal was intended included undergraduate mathematics and science, but not at the plaything level. Undergraduates were encouraged to read and contribute to the journal, and some did, but the entire scientific community was invited to lend its support. The Prospectus concludes with this paragraph:

> We hope and we also believe that the masters in scientific thought will not ignore us altogether; but will encourage us from time to time by appearing in our modest pages, for the purpose of encouraging and suggesting lines of thought to younger men, whose earnestness and honest work commands respect, albeit they fall into error in their efforts and need correction: for younger hands must yet take up the torch and spread the light which older minds are now preparing.

As will be seen, during its short life the pages of *Scientiae Baccalaureus* were indeed graced by the work of "masters in scientific thought," probably to an extent beyond the most ambitious dreams of its founders.

The driving force behind the journal was William Holding Echols, Director of M. S. M. from 1888–1891, and afterwards Professor and Chair of Mathematics at the University of Virginia, and editor of *The Annals of Mathematics.* Echols did not come to M. S. M. as a mathematician, but served one year as Professor of Engineering and Graphics and then three years as Director. While Director, he also held the chair of Civil and Mine Engineering, later renamed simply Engineering.

Echols contributed seven articles to *Scientiae Baccalaureus.* In 1890 the Professor of Mathematics at M. S. M. was W. B. Richards, who was assisted by an Instructor, G. R. Dean, still a student at the time. Richards later became Director of the school, and Dean joined the faculty proper in 1897, replacing Richards as the Professor of Mathematics, a position he held until his retirement in 1935. Authors in the first number of *Scientiae Baccalaureus* were all from M. S. M. , and one, Dean, was a student. Dean's paper was part of his senior thesis for the bachelor's degree Civil Engineer, which he received in 1890. He stayed an additional year for another bachelor's degree, in Mathematics and Physics. Several other M. S. M. students contributed to the Exercises section. In the last three numbers, *Scientiae Baccalaureus* exhibited a wider scope, with contributions from William B. Smith and H. C. Williams of the University of Missouri, George B. Halsted of the University of Texas, Artemas Martin of Washington, DC, Levi W. Meech of Norwich, CT, and Annie MacKinnon of the University of Kansas (a master's degree student). Contributors to the Exercises included Frank Morley, then at Haverford College, W. E. Heal of Marion, IN, G. H. Harvill, editor of the *Mathematical Messenger,* H. B. Newson of the University of Kansas, probably MacKinnon's mentor and an active supporter of women in mathematics [8], and William Hoover of Ohio University, who contributed problems and solutions to *The American Mathematical Monthly* for over 40 years.

The main reasons *Scientiae Baccalaureus* should be remembered as more than a minor short–lived mathematics periodical are two pieces by Halsted. Vol. 1, No. 3 contains his translation of N. Lobatschewsky's [spelled here as in the journal] work on parallel lines, and Vol. 1, No. 4 contains his translation of J. Bolyai's famous appendix to the book written by his father. Their publication in *Scientiae Baccalaureus* was the first English language appearance of either of these seminal works on non–Euclidean geometry, in which each man independently, showed that a consistent geometry was possible by negating Euclid's fifth postulate (equivalent to saying that exactly one parallel to a given line may be drawn through a point not on the line). E. T. Bell [2] considers the work of Bolyai and Lobachevsky one of the major revolutions in all thought, comparable in significance to the ideas of Copernicus. Indeed, by the eighteenth and early nineteenth centuries, Euclid's geometry had taken on almost a religious authority and was widely considered the only possible mathematics of space. The Jesuit G. Saccheri, in 1733, published *Euclid Freed from Every Flaw* [14], in which he believed that he had proved Euclid's parallel postulate and thus had secured for Euclid's geometry the status of Truth, with a capital T. Actually, Saccheri proved several results in non–Euclidean geometry without realizing what they were, but this was not recognized until the 1880s. Bolyai and Lobachevsky demonstrated that geometric truth was not confined to Euclid, and neither knew of Saccheri's work.

Because of the short life and relative obscurity of the journal, and because Halsted later published his translations through the University of Texas, *Scientiae*

*Baccalaureus* is not always given as a source for these translations by historians and in bibliographies. Smith [14] credits Halsted with both translations in 1891, but does not specify where they appeared. Bonola [3] lists Halsted's translation of Lobachevsky as "English translation by G. B. Halsted (Austin, Texas, 1891)." The translation itself appears as an appendix in the 1955 Dover edition of Bonola's book, and the Translator's Preface, identical to the *Scientiae Baccalaureus* version, is dated May 1, 1891. In that Preface Halsted claims, "Of the immortal essay now first appearing in English ...". The date of Vol. 1, No. 3 of *Scientiae Baccalaureus* is February, 1891. On the other hand, Sommerville's bibliography [16] lists the May, 1891 Texas Univ. Bull. as the 2nd ed. of the English translation of Lobachevsky, and does cite the February publication in *Scientiae Baccalaureus.* The situation with Bolyai's paper is similar. In Bonola, we find, "See also the English translation by Halsted, *The Science Absolute of Space,* (Austin, Texas, 1896)." As with Lobachevsky, Halsted's translation of Bolyai is included as an appendix, but the Translator's Introduction in Bonola is quite different from the one in *Scientiae Baccalaureus,* showing evidence of much revision and updating. For example, in the revised version, Halsted says, "And even today, 1895, in the vast system ...," and at the end of the introduction, "In 1894 a monumental stone was erected on his [John Bolyai's] long–neglected grave ...." Clearly, references to 1894 and 1895 were not possible in *Scientiae Baccalaureus,* the last number of which appeared in June, 1891. Also, in his Translator's Introduction in *Scientiae Baccalaureus,* Halsted states, "It is this Appendix which we now give for the first time in English.", a sentence which does not appear in the appendix to Bonola. The entry in Sommerville for John Bolyai cites *Scientiae Baccalaureus* as the earliest English source. As an additional check, I was able to obtain, through interlibrary loan, the earliest edition published in Austin of Halsted's translation of Bolyai, and it turned out to be simply a reprint of the *Scientiae Baccalaureus* article, complete with the journal name and volume information on the title page.

The works of Bonola and Sommerville are quite extensive, and were initially done within twenty five years of the time *Scientiae Baccalaureus* was published. Other late nineteenth and early twentieth century sources exhibit similar variation. For instance, in the *American Mathematical Monthly* article by Aley [1], *Scientiae Baccalaureus* appears on his periodical list, and in the 1905 Yale dissertation of Withers [17], both of the Halsted translations are recognized, but only the translation of Bolyai is attributed to *Scientiae Baccalaureus.* Most recent historians of mathematics, such as Boyer [4] and Eves [7], refer primarily to Bonola and to Smith on the subject of non–Euclidean geometry. In the anthology edited by Calinger [5], a selection from Lobachevsky's *Theory of Parallels* is included, with the source given as the 1914 Open Court edition of Halsted's translation. In their 1962 bibliography on Bolyai, Pálffy and Pálffy [12], refer only to the Austin publication. Thus, knowledge of even the existence of *Scientiae Baccalaureus* gets buried a little deeper as the years go by. Halsted himself wrote many articles which mention Bolyai and

Lobachevsky, but he usually simply referred to "my translation(s)" without giving any specific source. All this supports the conclusion that Halsted did not intentionally ignore *Scientiae Baccalaureus,* but it is reasonable to assume that when he was asked for reprints of his translations, he sent the ones published in Austin simply because those were the ones to which he had ready access. When Halsted died in 1922, his obituary notice in the *Monthly* [11] pushed *Scientiae Baccalaureus* even further into obscurity, saying,

> His most important work was the translation of writings on non–Euclidean geometry. Lobachevski's *Researches on the Theory of Parallels* and Bolyai's *Science Absolute of Space* were first published at Austin, Texas, in 1891, as parts of "Neomonic Series." They are now published in Chicago.

To help, in the words of the Prospectus, "clear away the error," we note that the word "first" in this quote is not correct.

The decision to discontinue publication of *Scientiae Baccalaureus* was announced in an Editorial Note in Vol. 1, No. 4, June 1891, which was signed "W. H. E. " Coincidentally, in the spring of 1891 Echols had decided to leave M. S. M. and return to Virginia, where he began a long career in the mathematics department at the University of Virginia. In fact, both of his articles in Vol. 1, No. 4 of *Scientiae Baccalaureus* give his affiliation as University of Virginia. Echols was 32 years old in 1891. Because the *Annals of Mathematics* was already being published at Virginia, there was little chance for him to be able to continue *Scientiae Baccalaureus* there; in fact, he became an associate editor, and then, in 1896, editor of the *Annals of Mathematics,* a position he held until the *Annals* was moved to Harvard under the editorship of M. Bôcher in 1899. The full text of Echols' editorial note follows, and gives additional evidence of the primacy of the English translations of Lobachevsky and Bolyai.

> It has been decided to discontinue the publication of this Journal and its issue ceases with this number, which closes the first volume.
>
> We close the first volume and cease the publication with considerable regret, yet with no small degree of satisfaction, believing as we do, that as a Journal of Elementary Mathematics it has accomplished fairly well the object which it had in view.
>
> Had it done nothing more than to put into English words the papers of Bolyai and Lobatschewsky its life had been well lived. We believe that the time will yet come when the seed thus sown will bear its share of fruit in the advancement of sound geometrical teaching in America.

Even including the translations, which, after all, were of work sixty years old at the time, the articles in *Scientiae Baccalaureus* were not at the cutting edge of mathematics research, but this was in keeping with the stated purpose of the journal, and the general quality of the articles was comparable to other journals of the time, such as *The American Mathematical Monthly* (which began publication in 1894 in Kidder, Missouri, a place even more obscure than Rolla). There were several expository articles, and also some articles which today would be called mathematical modeling. Geometry was prominent, and Halsted's article, "The Two–Term Prismoidal Formula" is listed in [15] among the "more important" American papers in geometry during 1875–1900. The refereeing/editing process was not up to today's standards, but was typical for the time. One handicap faced by the journal was the isolation of Rolla, and the difficulty of checking on results using local resources. At least three articles were later either corrected, extended, or placed in historical context. In No. 4, Echols published an article correcting errors in his earlier article in No. 1, "The Railway Transition Curve." Halsted's prismoidal formula article in No. 3, mentioned earlier, is both a critique and an improvement of Echols' article on the same topic in No. 2, and mentions correspondence between the two men regarding the problem. In the article by Smith in No. 2, "A New Elementary Demonstration of the Pythagorean Theorem," there is an editorial footnote discussing the claim of newness; more historical information, indicating that the proof was indeed not new, is given by Artemas Martin in No. 3. These examples are not given to belittle the editorial work, but rather to indicate that *Scientiae Baccalaureus* was actually read by a nontrivial subset of the American mathematics community.

Of the M. S. M. students initially involved with *Scientiae Baccalaureus,* at least one, Dean, went on to have a respectable mathematical research career, and some of the others [6, 10] taught mathematics at various levels. Also notable among the young contributors was Annie MacKinnon, a student at the University of Kansas and a teacher in the Lawrence schools when she contributed to *Scientiae Baccalaureus.* In 1894 she became the second woman to earn a Ph. D. in mathematics from Cornell University and the third American woman to get a Ph. D. [8]. Her dissertation [9], and a later paper as well, appeared in the *Annals of Mathematics.* The names of some of the other contributors to the journal, including Heal, Meech, Newson, and W. B. Smith are listed in the "Trend of Important Branches" section of [15] for the period 1875–1900.

As true today as it was in 1891, being introduced early to research and scholarship, and thereby becoming acquainted with the work of leaders in the field is bound to foster the "spirit of investigation and original thought" and have a positive effect on "the younger men [and women], who are working earnestly and honestly." Almost forgotten today, *Scientiae Baccalaureus* advocated, and during its short life achieved, a purpose still considered desirable more than a century later.

Here are the tables of contents from all four numbers of *Scientiae Baccalaureus,* followed by a list of proposers and solvers of Exercises.

Vol. 1, No. 4

| | |
|---|---|
| The Science Absolute of Space | John Bolyai |
| Translated by George Bruce Halsted | |
| Note on the Transition Curve | W. H. Echols |
| Number, Discrete and Continuous | George Bruce Halsted |
| Geometric Inversion | Annie L. MacKinnon |
| The Pneumatic–Hydraulic Sand–Lift | W. H. Echols |
| Editorial Note | W. H. E. |
| Solutions of Exercises 21, 23 | |
| Exercises 28–37 | |

Proposers of Exercises: Geo. R. Dean: 4; W. H. Echols: 1, 2, 5, 6, 12, 13, 14, 15, 24, 25, 26; H. B. Hall: 33; Elmo G. Harris: 3, 11; G. H. Harvill: 23, 32, 35; Annie L. MacKinnon: 37; Sallie Millard: 27; Frank Morley: 7, 8, 9, 28, 31, 34; H. B. Newson: 30, 36; W. B. Richards: 29; T. U. Taylor: 21, 22; W. O. Whitescarver: 10; Selected Constructive Problems in Elementary Geometry: 16, 17, 18, 19, 20.

Solvers of Exercises: Frank Bolles: 7; Geo. R. Dean: 8; Charles P. Echols: 5; W. H. Echols: 1, 4, 6; G. B. Halsted: 27; G. H. Harvill: 23; Elmo G. Harris: 3; Wm. E. Heal: 14; George Herdman: 10; Wm. P. Holman: 8, 1; William Hoover: 21; J. C. Nagle: 21; Charles Puryear: 3; C. B. Spencer: 27; A. J. Stewart: 10; T. U. Taylor: 8, 11; W. O. Whitescarver: 3.

## *References*


1. R. J. Aley, "Bibliography of the History of Geometry; Also a List of Mathematical Periodicals," *American Mathematical Monthly,* 1 (1894), 42–47.

2. E. T. Bell, *The Development of Mathematics,* second ed., McGraw–Hill, New York, 1945.

3. R. Bonola, *Non–Euclidean Geometry,* with a supplement containing the Dr. George Bruce Halsted translations of *The Science of Absolute Space* by John Bolyai and *The Theory of Parallels* by Nicholas Lobachevski, Dover, New York, 1955, reprint and translation of the original Italian publication.

4. C. B. Boyer, *A History of Mathematics,* John Wiley & Sons, New York, 1968.

5. R. Calinger, editor, *Classics of Mathematics,* Prentice–Hall, Englewood Cliffs, New Jersey, 1995.

6. *Catalogue of the Missouri School of Mines and Metallurgy,* Rolla, Missouri, *circa* 1892.

7. H. Eves, *An Introduction to the History of Mathematics,* sixth edition, Saunders, Fort Worth, Texas, 1990.

8. D. D. Fenster and K. H. Parshall, "Women in the American Mathematical Research Community: 1891–1906," *The History of Modern Mathematics,* ed. Eberhard Knobloch and David E. Rowe, Vol. 3, Academic Press, Boston, 229–261.

9. A. MacKinnon, "Concomitant Binary Forms in Terms of the Roots," *Ann. of Math.,* 9 (1894–1895), 95–157.

10. C. V. Mann, *The History of Missouri School of Mines and Metallurgy,* Phelps County Historical Society, Rolla, Missouri, 1941.

11. "Notes and News," *American Mathematical Monthly,* 29 (1922), 187.

12. I. Pálffy and M. Pálffy, *Bibliographia Bolyaiana, 1831–1960,* Országos Széchényi Könyvtár, Budapest, 1962.

13. *Scientiae Baccalaureus,* Missouri School of Mines, Rolla, Missouri, 1890–1891.

14. D. E. Smith, *A Source Book in Mathematics,* McGraw–Hill, New York, 1920.

15. D. E. Smith and J. Ginsburg, *A History of Mathematics in America Before 1900,* Mathematical Association of America, Washington, D. C., 1934.

16. D. M. Y. Sommerville, *Bibliography of Non–Euclidean Geometry,* Harrison and Sons, London, 1911.

17. J. W. Withers, *Euclid's Parallel Postulate: Its Nature, Validity, and Place in Geometrical Systems,* Open Court, Chicago, 1905.

Leon M. Hall
Department of Mathematics and Statistics
University of Missouri–Rolla
1870 Miner Circle
Rolla, MO 65409–0020
email: lmhall@umr.edu