Boyai, Farkas (Wolfgang) | Encyclopedia.com

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(*b*. 9 February 1775, Bolya [German, Bell], near Nagyszeven [German, Hermannstasdt], Transyulvania, Hungary [now Sibiu, Rumania]; *d*. 20 November 1856, Marosvásárhely, Transylvania, Hungary [now Târgu-Mureş Rumania])

mathematics.

Farkas Bolyai was the son of Gáspár (Kasper) Bolyai and Christina Vajna (von Páva) Bolyai. Bolya was the hereditary estate of the noble family of Bolyai de Bolya, which was mentioned as early as the thirteenth and fourteenth centuries. By the time of Gáspár it had been reduced to a small holding, but Gáspár added another holding (which belonged to his wife's family) in Domáld, near Marosvásárhely. He enjoyed a reputation as an industrious and intelligent landholder of strong character.

Young Farkas received an education at the Evangelical-Reformed College in Nagyszeven, where he stayed from 1781 to 1796. He excelled in many fields, especially in mathematics, and showed interest in theology, painting, and the stage. In 1796, he traveled to Germany, going first to Jena and then, with a fellow student at Nagyszeven, Baron Simon Kemény, entered the University of Göttongen, where he studied until 1799. Among his teachers were the astronomer Felix Seyffer and the mathematician Abraham Gotthelf Kästner. It was at this time that Bolyai began his lifelong friendship with Carl Friedrich Gauss, also a student at Göttingen, who already was intensely engaged in mathematical research. From this period dates Bolyai's interest in the foundations of geometry, especially in the so-called Euclidean or parallel axiom, to which Kastner and Seyffer, as well as Gauss were devoting attention. Bolyai maintained a correspondence with Gauss that, with interruptions, lasted all their lives.

After his return to Transylvania, Bolyai became a superintendent in the house of the Keménys in Koloszvár (German, Klausenburg; now Cluj, Rumania). In 1801 he married Susannan von Árkos, the daughter of a surgeon. His wife was talented but sickly and nervous, and the marriage was not a happy one. The couple settled in Domáld, where Bolyai farmed from 1801 to 1804. In 1802 their son, János, was born, at the von Arkos home in Koloszvár.

In 1804, Farkas accepted the position of professor of mathematics, physics, and chemistry at the Evangelical-Reformed College at Marosvásárhely, where he taught until his retirement in 1853. During this half century he was known as a patient and kind teacher, but one who lacked the faculty of easily transmitting to others his own scientific enthusiasm, despite the emphasis he placed on correct mathematical education. Meanwhile, he continued his research, concentrating on the theory of parallels. He sent a manuscript on this subject, *Theoria parallelarum*, with an attempt to prove the Euclidean axiom, to Gauss in 1804. The reasoning, however, satisfied neither Gauss nor himself; and Bolyai continued to work on it and on the foundations of mathematics in general.

The Euclidean axiom, which appears as the fifth postulate in Book 1 of Euclid's *Elements*, is equivalent to he statement that through a given point outside a given line only one parallel can be drawn to the line. It is also equivalent to the statement that there exists a triangle in which the sum of the three angles is equal to two right angles and hence, that all triangles have this property. Attempts to prove this axiom—that is, to deduce it from other, more obvious, assumptions—began in antiquity. These attempts were always unsatisfactory, however and the nature of the axiom had remained a challenge to mathematicians. Bolyai, working in almost total scientific isolation, often despaired while trying to understand it.

During such moments of discouragement, he sought consolation in poetry, music, and writing for the stage. In 1817, his *Ot Szomorujatek, Irta egy Hazafi* ("Five Tragedies, Written by a Partriot") was entered in a contest. The following year, another play, *A Párisi Par* ("The Paris Process"), appeared. Bolyai's wife died in 1821, and in 1824 he married Theresia Nagy, the daughter of an iron merchant in Marosvásárhely. They had one son, Gregor.

Farkas began to interest himself in mathematics again when his son János evinced unusual mathematical talent. In 1829 Bolyai finished his principal work, but because of technical and financial problems it was not published until 1832–1833. It appeared in two volumes, with the title *Tentamen juventutem studiosam in elementa matheseos purae, elementaris ac sublimioris, method intuitiva, evidentiaque huic propria, introducendi, cum appendice triplici* ("An Attempt to Introduce Studious Youth Into the Elements of Pure Mathematics, by an Intuitive Method and Appropriate Evidence, With a Threefold Appendix"). While writing the *Tentamen*, Bolyai had his first difficulties with his son János. In spite of warnings from his father to avoid any preoccupation with Euclid's axiom, János not only insisted on studying the theory of parallels, but also developed an entirely unorthodox system of geometry based on the rejection of the parallel axiom, something with which his father could not agree. However, despite misgivings, Bolyai added his son's paper to the first volume and thus, unwittingly, gave it immortality. In 1834, a Hungarian version of Volume I was published.

The *Tentamen* itself, the fundamental ideas of which may date back to Bolyai's Göttingen days, is an attempt at a rigorous and systematic foundation of geomentry (Volume I) and of arithmetic, algebra, and analysis (Volume II). The huge work shows the critical sprit of a man who recognized, as did few of his contemporaries, many weaknesses in the mathematics of his day, but was not able to reach a fully satisfactory solution of them. Neverthless, when it is remembered that Bolyai worked in almost total isolation, the *Tentamen* is a most remarkable witness to the sharpness of his mind and to his perseverance. In many respects, he can be taken as a precursor of Gottlob Frege, Pasch, and Georg Cantor; but, as with many pioneers, he did not enjoy the credit that accrued to those who followed him.

The *Tentamen* was almost totally unappreciated by Bolyai's contemporaries, although Gauss expressed his pleasure at finding "everywhere throughness and independence." Disappointed and again a widower, the sensitive man found little consolation in the equally disappointed János, who after his retirement from military service had come to live in Marosvásárhely. The two men often clashed. In 1837 both entered a contest on complex numbers sponsored by the Jablonow Society in Leipzig. The elder Bolyai's contribution was taken essentially from his *Tentamen*. When no prize was awarded to either of them, their disillusionment grew; but whereas the son sank more and more into melancholy, the father—poetic, musical, and venerable— remainded an outstanding, although somewhat eccentric, citizen of the provincial town, who was often consulted on technical questions. Both men also wrote much on a theoryof salvation for mankind, and both returned occasionally to mathematics. Besides some elementary books, Bolyai published a summary of his *Tentamen* in German as *Kurzer Grundriss eines Versuches*(1851); after retiring from college teaching, and after having heard of Gauss's death, he wrote *Abschied von der Erde*. He died after suffering several strokes.

BIBLIOGRAPHY

I. Original Works. Among Bolyai's works are *Azarithmetica Eleje* ("Elements of Arithmetic," Marosvásárhely, 1830); *Ürtam elemei kerdóknek*("Elements of the Theory of Space for Beginners," Marosvásárhely, 1850–1851). His major work, the *Tentamen*, was published in Latin in 2 vols. (Marosvásárhely, 1832–1833); 2nd ed., Vol. I (Budapest, 1897), Vol. II (Budapest, 1904), with an additional volume of figures.

II. Secondary Literature. For information of Bolyai, *see* P. Stäckel, W. *und J. Bolyai, Geometrische Untersuchungen*, 2 vols. (Leipzig, 1913): the first volume is biographical; the second contains German translations of the theory of parallels of 1804, parts of the *Tentamen*, and the *Kurzer… Versuches*. The correspondence between Bolyain and Gauss is found in *Briefwechsel zwischen C.F. Gauss und W. Bolyai* (Leipzig, 1899). Further biographical material may be found in L. David, *A Két Bólyais élete és munkássága* ("Life and Work of the Two Bolyais," Budapest, 1923) and "Die beiden Bolyai," supp. to *Elemente der Mathematik*, no, 11 (1951). A memorial work, *Bolyai Farkas 1856–1956*, was published in Târgu-Mureş in 1957. A stage play by Laszlo Nemeth, "A két Bólyai" ("The Two Bolyais") was first produced in 1962, and is collected in the author's *Változatok egy témara* (Budapest, 1961). See also K.R. Biermann, "Ein Brief von Wolfgang Bolyai," in *Mathematische Nachrichten*, **32** (1966), 341–346.

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