JÁNOS BOLYAI

János Bolyai (December 15, 1802 – January 27, 1860) was a Magyar, born in Transylvania, at that time a part of Hungary in the Austrian Empire and now part of Romania. His father Farkas was professor of mathematics, physics, and chemistry in the college at Marcos-Vasashely. By the time János was 13; he had mastered the calculus and was an accomplished violinist. He studied at the Royal Engineering College in Vienna from 1818 to 1822. He then joined the army engineering corps in which he spent 11 years. He gained a reputation as the best swordsman and dancer in the Austrian Imperial Army. He was an accomplished linguist speaking nine foreign languages including Chinese and Tibetan. As had his father before him, János Bolyai became interested in the Parallel Postulate problem. Despite his father's appeal: "For God's sake, please give it up. Fear it no less than the sensual passion, because it, too, may take up all your time and deprive you of your health, peace of mind and happiness in life," János persevered.

The Euclidean system of geometry rests on a number of independent axioms and postulates. Among these is one on parallel lines, which is usually stated in the form: "… if a straight line meets two straight lines, so as to make the sum of the two interior angles on the same side of it taken together less than two right angles, then these straight lines being continually produced will at length meet upon the side on which the angles are less than two right angles." For those who view axioms and postulates as self-evident truths, this so-called Fifth or Parallel Postulate doesn't seem to meet the criterion. From earliest times it was believed that Euclid had somehow been mistaken. Surely this was a theorem, not a postulate, and as such it should be possible to prove it by an argument based on the other postulates and axioms. For some two thousand years very competent mathematicians tried to prove the Parallel

Postulate. Each attempt introduced assumptions that turned out to be equivalent to the postulate. Then, in the 19th century, three mathematicians from three different countries came to the conclusion that Euclid had not been mistaken in postulating the statement.

Between 1820 and 1823, János Bolyai prepared a tract, in which he in essence created a non-Euclidean geometry. The 24-page article was published as an appendix to his father's two-volume work *Tentamen* on elementary mathematics. János Bolyai chose to regard the Parallel Postulate in the equivalent form referred to as "Playfair's Axiom," which states: "Through a given point one and only one line can be drawn through the point parallel to a given line." The denial of this postulate then implies either that no parallel to the line can be drawn through the point or that more than one such parallel can be drawn. Bolyai assumed the second version and went about developing the propositions that could be derived from this denial of the Parallel Postulate and the other postulates and axioms of Euclid. He was impressed with the number of propositions, which were common to all geometries regardless of what assumptions were made about parallels. He regarded such propositions as the basis of an *absolute geometry.*

Young Bolyai was in for two major disappointments. When Farkas wrote to his old friend and classmate at Göttingen, Carl Friedrich Gauss, about his son's work, the latter replied that he had made the same discoveries many years earlier, but had not published his results. Then in 1848, János learned that the Russian mathematician Nikolai Lobachevsky had also discovered the new geometry and had published his results in an obscure journal in 1829. Today, the three share credit for the invention of non-Euclidean geometry.

By all accounts János Bolyai was something of an odd duck. He neither smoked nor drank, not even coffee. He once accepted a challenge to duel thirteen of his fellow cavalry officers on the condition that

after each duel he would serenade the loser with a piece on his violin. He won all thirteen duels, but whether his opponents enjoyed his fiddling is not known. Reportedly he was promoted to captain on the condition that he resign his commission and accept a pension. An alternative explanation for his leaving the military was that he was tormented by a horrible fever that frequently disabled him. After retiring he moved to his father's house in Targu Mures, where he spent a year constantly quarreling with the older man. He even challenged his father to a duel, which caused Farkas to ban his son from his home. János had his own funeral card printed with a blank date and built his own coffin. Still alive six years later, he printed a new funeral card to replace the unused one. In his will he left instructions that an apple tree be planted on his grave in remembrance of Eve, Paris, and Newton. In 1911 his ashes were exhumed and laid into his father's tomb.

The invention of non-Euclidean geometries and the discovery that they are as consistent as is Euclidean geometry has affected the basic notion of truth in mathematics. What was once considered a source of absolute truth has been recognized as a creation of mathematicians in much the same way that its writer creates a story. It becomes meaningless to ask, "Which is the true geometry?" in the study of mathematics. Instead, it makes more sense to ask which geometry is most convenient for a particular application. Neither Euclidean geometry nor any other geometry completely describes the world in which we live, but each in a certain way approximates it. While there is only one Euclidean geometry there are other non-Euclidean geometries besides the one developed by Bolyai and Lobachevsky. Bernhard Riemann invented a whole class of non-Euclidean geometries, which were used by Albert Einstein in developing his general theory of relativity.

Quotation of the Day: "Out of nothing I have created a strange new universe." – János Bolyai.