Robert Adrain and the Beginnings of American Mathematics

Robert Adrain was born in Ireland on September 30, 1775. He married Ann Pollock; they had seven children. In 1798, he was involved in an uprising that resulted in him being shot and left for dead. His friends nursed him back to health, and then arranged for him to escape to America. He became a teacher at Princeton University, but after a few years, he moved to York, PA, to become the principal of an academy. Over the next few years, he taught at Rutgers and Columbia. In 1812, he was elected a Fellow of the American Philosophical Society. In 1826, he left Columbia to teach at University of Pennsylvania. However, his classes became "noisy and disorderly" (Coolidge, p. 64), and he soon lost his job. He returned to Columbia's grammar school to teach, but failed there as well. He died in New Brunswick in 1843.

What makes Robert Adrain so remarkable for his time period, however, is his mathematics. He was one of the first published American mathematicians in 1804 in the *Mathematical Correspondent*, America's first mathematics journal. In it he published a paper on Diophantine equations. He became the second editor of the journal after George Baron retired. In this journal, he was also the first American mathematician, and possibly the first globally, to discuss elliptic integrals. Adrain also did work on polar coordinates, and wrote a paper on the spiral given by $r = \frac{\sin\theta}{\theta}$. (This is not the famous Archimedean spiral that had previously been discovered; that curve is simply $r = \theta$.) He proved geometrically that the area enclosed is finite, but the length is infinite (Coolidge, p. 66). One of the most interesting developments is his attempt to create the exponential law of error, of which credit is usually given to Gauss, despite the fact that Adrain discovered it first. This law says that if a measurement of a value is made, the probability that the real value is off by an amount h decreases exponentially with increasing h. Adrain discovered this in response to a problem submitted by Robert Patterson which gave measurements of the sides of a polygon that were impossible (because they would violate the triangle inequality). He constructed the law of error in order to justify his corrections to the side lengths. In 1822, Adrain wrote an important essay on descriptive geometry.

In 1814, Adrain wrote an essay in *The Analyst* that attempted to prove that the mouth of the Miscopy River is farther from the center of the earth that the source of the Mississippi River. Four years later he calculated the ellipticity of the earth, and found errors in the great French mathematician Laplace's calculation (Coolidge, p. 72). In 1822, he wrote a paper showing how to minimize the time required to cross a river if the current is dependent on position. This is "a perfectly straightforward question in the calculus of variations" (Coolidge, p. 73), indicating that Adrain was fully aware of that subject.

In addition to his many published papers, he left much unpublished work, some of which is still being analyzed today. We cannot fully appreciate the mathematics of this great American mathematician until his entire work is published. Had he been living in Europe, with access to superior facilities, he may well have been as famous as Cauchy, Abel, and Gauss (Coolidge, p. 75). As it stands, Robert Adrain is unquestionably the first great American mathematician.

Source:
Julian L. Coolidge, Robert Adrain and the beginnings of American mathematics, *American Mathematical Monthly* **33** (1926), 61-76.

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