A Baffling Mind
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COMMENTARY

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Ramanujan's Goddess-inspired genius spanned diverse branches of mathematics

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In the spring of 1994 I found myself in erode, Tamil Nadu, India, boarding a train with my wife for a trip to Madras. We had been staying in Bhavani, a village nearby, for eight months during a year's sabbatical from teaching mathematics to immerse ourselves in Hinduism. We shared our second-class sleeping cubicle with a gentleman from Madurai, a mechanical engineer. When our new friend realized I was a student of mathematics, he told me that Srinivasa Ramanujan was born in Erode, just ten miles from where we were living. It seemed an amazing coincidence, but as anyone who has spent time in India knows, coincidences do not exist. Nine years later, at the same time that Hinduism Today decided to include a review of "Partition, " a play on Ramanujan (see preceding pages), one of the best number theorists who ever lived, I had finished this article explaining why he was both unique and important in the field of mathematics.

I describe math as an art form, and not as a science, because my students so often ask, "What is the practical value of it?" While there is a whole field of applied mathematics, which is eminently practical, much of math is completely abstract, or at least at the present time has no practical application, and these are just the areas of math Ramanujan contributed to. Most mathematicians develop a single area of expertise, so specialized it is often understood only by other mathematicians in the same area. Ramanujan, in contrast, stated nearly four-thousand theorems in wide ranging areas of math. He was like a physician who simultaneously mastered cardiovascular surgery, obstetrics, oncology and

neurology.

Unlike most mathematicians, he was intensely religious. He often united mathematics and spirituality together. He felt, for example, that zero represented Absolute Reality, and that infinity represented the many manifestations of that Reality. Ramanujan felt that each mathematical discovery was a step closer to understanding the spiritual universe. He once told a friend, "An equation for me has no meaning unless it expresses a thought of God."

While growing up, he lived the life of a traditional brahmin with his forehead shaved and wearing a topknot. He often prayed to his family Deity, the Goddess Namagiri of Namakkal, and followed Her advice. He pilgrimaged all over Tamil Nadu. He quoted the Vedas, interpreted dreams and was regarded by his friends to be a mystic. Throughout his life, Ramanujan worshiped at the Sarangapani Vishnu temple in Kumbakonam.

Ramanujan's genius appeared when he was just learning arithmetic. A teacher explaining division said, "If three bananas were given to three boys, each boy would get one banana. If 100 bananas were given to 100 boys, each boy would get one banana." Then the teacher said that this worked for all numbers. Ramanujan astutely asked, "Sir, if no banana is distributed to no student, will everyone still get a banana?" Put another way, the teacher had explained that any number divided by itself is one. So, asks Ramanujan, does that mean zero divided by zero is one?

This is an excellent question, though its import was likely lost on the teacher. It might be hard to believe, but calculus was created by Sir Isaac Newton and Baron Gottfried Wilhem von Leibnitz to answer this very issue, zero divided by zero. It is the only way they could determine instantaneous velocity and the slope of a tangent to a curve--both, incidentally, with very practical applications.

By 13, Ramanujan mastered Trigonometry, by S. L. Loney, an advanced text requiring a background in calculus. Classmates ahead of him brought him difficult problems, which he would solve immediately. At 15, he came across the book, A Synopsis of Elementary Results in Pure and Applied Mathematics. It is mostly thousands of theorems listed without proofs. With no formal education in math, he set about proving them. At age 16, in 1904, he was awarded the K. Ranganatha Rao

prize for mathematics. The school headmaster, Krishnaswami Iyer, told the audience that Ramanujan could not be graded with an A+ or 100 percent, for he was truly off the scale. Ramanujan took no interest in other subjects, and failed exam after exam. When he finally wrote to the eminent English mathematician G. H. Hardy in 1913, he was working for the Port Trust Office in Madras. This historic event was described by the famed philosopher and mathematician Bertrand Russell, a colleague of Hardy, "I found Hardy and Littlewood [a fellow mathematician] in a state of wild excitement, because they believe they have discovered a second Newton, a Hindu clerk in Madras living on twenty pounds a year."

Fortunately for us, the short-lived Ramanujan (he died at 33) kept copious notebooks which mathematicians continue to mine today. His first notebook was on hypergeometric series, continued fractions, singular moduli, and many branches of number theory. Often he would state things without proof, preferring instead to record his every discovery. This is where his true genius was apparent.

For example, he worked on finding natural number solutions (1, 2, 3, etc.) to a kind of equation involving squares and higher powers, one of which is x2 + 7 = 2n. The smallest solution is x = 1 and n = 3. That is, 12 + 7 = 23 or, 1 x 1 + 7 = 2 x 2 x 2, or 8 = 8. The next solution is x = 3 and n = 4. Ramanujan stated that there are five and only five solutions to this equation: x = 1, 3, 5, 11, 181 when respectively n = 3, 4, 5, 7, 15. Just finding the solutions is an impressive feat, especially the last one. But how did he know there were only five solutions? He didn't offer any proof, and it wasn't until many years later, in 1948, that Tyrgve Nagell proved that this is true. So now we know that Ramanujan was correct, but we haven't a clue as to how he knew it. And this is just one very simple example of his intuitive mentality.

Ramanujan was totally self confident in his mathematical abilities. He did not follow others, but explored fearlessly on his own, sometimes duplicating work done centuries before. His process of discovery confounds mathematicians, who still cannot follow his thought processes. But Hindus understand that he was guided by Goddess Namagiri whispering in his ear.

Iraja Sivadas, 53, has taught mathematics at the University of Hawaii and Shasta College. He specializes in infinite series and combinatorics. He and his wife, Nilani, converted to Hinduism in 1990.