

Book Review: Robert Kanigel's  
*The Man Who Knew Infinity—  
A Life of the Genius Ramanujan*

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Even if the name “Ramanujan” is unfamiliar to you, the words “infinity” and “genius” in the title of this biography, by award-winning, Johns Hopkins University professor of literary journalism, Robert Kanigel, will suggest that Ramanujan (pronounced Rah-MAH-na-jun) was a mathematical genius. His name is, perhaps, little known to Westerners outside of the restricted circle of professional mathematicians, but, in Kanigel's words:

In South India today, everyone has heard of Ramanujan. College professors and bicycle rickshaw drivers alike know his story, at least in sketchy outline, just as everyone in the West knows of Einstein. Few can say much about his work, and yet something in the story of his struggle for the chance to pursue his work on his own terms compels the imagination, leaving Ramanujan a symbol for genius, for the obstacles it faces, for the burden it bears, for the pleasure it takes in its own existence. (p. 359).

It is this story which Kanigel tells, both with exacting scholarship and considerable literary adeptness. It is my hope that, having read this review, the reader will be tempted to read the book itself.

Ramanujan was born to a poor, but respectable, Brahmin family on December 22, 1887 in Erode, India, a small town about 250 miles southwest of Madras. Ironically, his giftedness for mathematics was almost his undoing. Like many others to whom the word "genius" has been applied, Ramanujan was singularly preoccupied with one narrow field of study, to the neglect of his general education. In his case, his obsession, beginning when he was quite young, was with numbers and formulae (both those of his own discovery and those which he encountered in the books on Western mathematics, such as George Shoolbridge Carr's *A Synopsis of Elementary Results in Pure and Applied Mathematics*, which Ramanujan first read when he was around fifteen). He largely neglected his other studies at two different colleges which he attended, losing a much needed scholarship at one, and failing his final examinations at both, thereby disqualifying himself for a degree, the possession of which was indispensable for his finding any but the most menial sort of employment.

Fortunately, his parents did not force him to seek work, nor discourage him from pursuing his solitary studies in mathematics; Ramanujan used this freedom from the responsibility to earn his living to produce a set of "notebooks" of original mathematical theorems. But after his marriage (to a child-bride who had not even reached the age of puberty, as was the custom), he reluctantly decided that it was time to seek employment. He presented his "notebooks" as his "calling card", but, again ironically, his ideas were so difficult and advanced

that even the qualified mathematicians to whom he showed them were unable to judge their merit. Finally, however, after a long and discouraging search, at the age of twenty-five, he found employment as a clerk in the accounts section of the Madras Port Trust, earning a small salary of thirty rupees a month.

Ramanujan might have languished in this job without much hope of advancement (he did not, after all, possess a university degree), if not for the fact that he possessed both stubborn ambition and a strong sense of confidence in his abilities, which led him to seek validation of his mathematical discoveries from higher sources, at first inside and later outside of India, namely, from three leading British mathematicians at Cambridge University: H. F. Baker, E. W. Hobson, and G. H. Hardy. His purpose in sending samples of his work to these eminent and established mathematicians was simply to get a positive evaluation from them which would help to establish his own credibility in India, thereby easing the way for him to a better position, hopefully an academic one, which would allow him greater freedom to pursue his mathematical explorations.

Professors of mathematics are accustomed to receiving many letters and papers from “unknowns”, and are quick to recognize them as the work of amateurs, or worse yet, of crackpots or hoaxers. Without receiving even a second glance, such papers are quickly disposed of in the trash. Such was almost the fate of Ramanujan’s handwritten manuscripts; both Baker and Hobson replied that they could be of no help to him, nor could they give him any advice. Hardy, however, proceeding cautiously, showed the manuscripts to one of his colleagues, J. E. Littlewood:

The more they looked, the more dazzled they became. "Of the theorems sent without demonstration, by this clerk of whom we had never heard" one of their Trinity colleagues, E. H. Neville, would later write, "not one of them could have been set in the most advanced mathematical examinations in the world." Hardy would rank Ramanujan's letter as "certainly the most remarkable I have ever received," its author "a mathematician of the highest quality, a man of altogether exceptional originality and power."

And so, before midnight, Hardy and Littlewood began to appreciate that for the past three hours they had been rummaging through the papers of a mathematical genius. (p. 169)

It is a commonly held notion that mathematicians around the world "speak the same (symbolic) language." While this may be more or less the case today, in 1913 instantaneous communications and annual gatherings of mathematicians at international congresses had not yet had a standardizing effect. Having been largely self-taught, and with little exposure to the mainstream of Western mathematics in his little backwater in India, Ramanujan's handwritten manuscripts employed many non-standard symbolic notations which, when coupled with the profundity and originality of his ideas, presented considerable difficulties for interpretation, even by experts such as Littlewood and Hardy. Another troublesome point, especially in Hardy's

eyes, was that many of Ramanujan's claims, to having discovered a general theorem, for example, were not backed up with rigorous mathematical proof; they were "...without demonstration...":

*Proof.* It wasn't the first time the word had come up in Ramanujan's mathematical life. But it had never before borne such weight and eminence. Carr's *Synopsis* had set out no proofs, at least none more involved than a word or two in outline. That had been enough for Carr, and enough for Ramanujan. Now, Hardy was saying, it was *not* enough. The mere assertion of a result, however true it might seem to be, did not suffice. (p. 173)

Nevertheless, Hardy and Littlewood recognized that Ramanujan's theorems were not the work of a crank, and prior to their working out the proofs for themselves, Hardy generously conceded: "They must be true because, if they were not true, no one would have the imagination to invent them." (p. 168.)

Ramanujan's petition succeeded. As a result of a series of letters from Hardy to various people in positions of authority back in India, regulations were breached, and Ramanujan was granted a scholarship to the Presidency College in Madras which "set him free to do mathematics, to attend lectures at the university, to use its library...to practice as a virtue that singleminded devotion to mathematics which had been a vice in Kumbakonam nine years earlier." (p. 179).

Next followed a period in which Hardy and Ramanujan corres-

ponded about mathematics; they did not, however, always see “eye—to—eye”. Hardy, a major figure in the reform movement to base mathematical discoveries on methods of rigorous, analytical proof, continued to harp on Ramanujan’s lack of such. But still, either because such methods were, as yet, unknown or unfamiliar to him, or because his discoveries sprang from such deeply intuitive sources within him that, coupled with his extreme confidence in their truthfulness, he saw no further need to explain to others how he had obtained them, Ramanujan refused to satisfy Hardy’s requests for proofs. In Hardy’s mind, too, were some doubts about certain of Ramanujan’s mathematical conclusions. Perhaps, Hardy thought, if he could work together and directly with Ramanujan, rather than through the mails, both he and others could gain greater understanding of Ramanujan’s mysterious theorems. So, Hardy invited Ramanujan to come to England.

At first, while flattered by Hardy’s invitation, and perhaps secretly longing to accept, Ramanujan refused—orthodox Brahmins were not permitted to travel abroad, as this was considered to cause “spiritual pollution”. However, at a temple to which he had gone to deliberate further on the invitation, Ramanujan had a dream which he interpreted as an “*adesh*, or command, to bypass the injunction against foreign travel.” (p. 189). On March 17, 1913, Ramanujan sailed for England on a ship called the *Nevasa*.

For the next five years, while living at Trinity College of Cambridge University, Ramanujan collaborated with Hardy, Littlewood and other mathematicians, and, after receiving the benefit of Hardy’s careful editing, published a series of significant papers in mathematical journals, which brought his name to the attention of scholars in the field. At last, in spite of the severe handicaps attendant upon his ear-

ly life, he was in the mainstream of mathematical research, earning attention and respect for his unique gifts. Kanigel dubs Ramanujan's career a story of "rags—to intellectual—riches" (p. 334), but also as one which, at numerous points in his life, "hung on a knife edge" (p. 354). But, despite his successes, all was not well.

The period of Ramanujan's stay in England corresponded almost exactly with that of World War I. Although largely sheltered from danger and the direct effect of the war at Trinity, the war had several indirect effects which were of great consequence to Ramanujan. Hardy became very much involved in numerous war (more correctly "anti-war") activities, and could no longer spend as much time with Ramanujan, leaving him to make out the best he could in what was, for him, quite a foreign and inhospitable country, with a climate that was terribly cold and, for most of the year, devoid of sunlight. Further, the war brought with it food rationing, and Ramanujan, a strict vegetarian, was unable to obtain sufficient quantities of the kinds of food he permitted himself to eat. Lack of sunlight can cause vitamin D deficiency; lack of nutritious, satisfying food can cause general vitamin deficiency, and prolonged lack of warmth can also have a debilitating effect. The result of these various deficiencies led to a deterioration of Ramanujan's defense systems, and he was diagnosed as having contracted tuberculosis. Various treatments by a number of doctors at different sanatoria did little to stop the progress of the disease. Although he had always been somewhat corpulent, reports of him during the later stages of his disease describe him as having been reduced to "skin and bones."

With no significant improvement in sight, Ramanujan finally yielded to the opinions of his English doctors, and made plans to re-

turn to India. Prior to his departure from England, however, Hardy and his colleagues made arrangements for Ramanujan to be elected as a member of the Cambridge Philosophical Society, as a Fellow of Trinity College, and what is perhaps the greatest possible honor, even today, short of receiving the Fields Medal (which is the equivalent, for mathematicians, of the Nobel Prize), as a Fellow of the Royal Society. This latter honor gave Ramanujan the privilege of appending the letters F. R. S. after his name, and put him into the company of such luminaries as Sir Isaac Newton, F. R. S., Ivan Pavlov, F. R. S., Albert Michelson, F. R. S., and G. H. Hardy, F. R. S. Five years after his arrival in England as an unknown accounts clerk with an undistinguished academic past, he returned to India having (just barely) survived the inclemencies of the English climate and the inconveniences of a world war, with his works known to and highly appraised by many in the field of mathematics, and wearing numerous "medals of honor", as S. Ramanujan, F. R. S.

During his stay in England, Ramanujan's wife, Janaki, had remained in India. Kanigel speculates that, if she had been with him to prepare his food and to attend to his mundane needs, perhaps Ramanujan might not have fallen ill. At one point, Ramanujan had requested that she be allowed to join him, but his request had been rejected by his obstinate and domineering mother, Komalatammal. Ever the stubborn and self-willed mother-in-law, Komalatammal waged a continuous war against Janaki, and it was to this new scene of battle that Ramanujan returned. Although his disease was so advanced that probably no treatment could have cured him, the adverse circumstances of his family life in India contributed to its progress, and, on April 26, 1920, Ramanujan died. He was 32 years old.

Sometime in the summer of 1936, G. H. Hardy, nearing the age of sixty, gave a lecture on Ramanujan at Harvard University before a large audience of some of the world's most distinguished scientists and scholars, in which he said:

I have set myself a task in these lectures which is genuinely difficult, and which, if I were determined to begin by making every excuse for failure, I might represent as almost impossible. I have to form myself, as I have never really formed before, and to help you form, some sort of reasoned estimate of the most romantic figure in the recent history of mathematics; a man whose career seems full of paradoxes and contradictions, who defies almost all the canons by which we are accustomed to judge one another, and about whom all of us will probably agree in one judgement only, that he was in some sense a very great mathematician. (As quoted by Kanigel, p. 373).

By its very nature, a biography appeals to the reader's curiosity about the intimate details of the life of someone great and famous, and, if done successfully, allows the reader to identify with the person whose life is "under the microscope". As the biography comes to a close, a kind of "catharsis" occurs, and the reader regains her or his own identity, much enriched, however, for having momentarily and vicariously entered into the other's life and times. For this to happen,

however, the biographer must not only be able to command a long list of dry, factual data—the historical particulars—but must also be able to swathe the facts with sufficiently suggestive description as to make the main subject, related persons, and the historical setting assume a living, breathing vividness—no less a task than creating, through the power of words, a whole human being, and of presenting that person's entire life in all of its drama and complexity. Robert Kanigel has done just this. Despite the fact that he is, as he himself claims, neither a professional mathematician (yet his treatment of the mathematical details necessary to a full account of his subject is far from amateurish), nor a South Indian (yet he is able to evoke a very readily apprehensible portrait of the country and the culture) Kanigel manages, through the thoroughness of his research and the evocative power of his writing, to overcome the difficulties presented by his subject and to succeed in giving us a very moving, intelligent and complete picture of a remarkable human being and mathematician, Srinivasa Ramanujan.

## 無限を知った男—天才ラマヌジャン伝

ロバート・カニゲル

米国メリーランド州, ボルティモア市ジョンズ・ホプキンス大学, グラディ・スタック賞 (Grady Stack Award) 受賞文学ジャーナリズム教授, ロバート・カニゲル著のこの本は, インドの数学の天才スリニワサ・ラマヌジャンの魅力的な, しかも, その短い生涯の感動的物語である。取材にあたって, 著者はインド, イギリス, それから米国を広くかけめぐると, 並々ならぬ努力を重ねた。

ラマヌジャンは生れつき数学の神秘に対して, 深い理解をもっていた。かれが青春を過ごしたインドの教育環境は, かれの数学的才能を励ますどころか, 微々たる理解さえも示さなかった。かれは大学も卒業していなかったのである。大学卒業証書のないかれを待ちかまえていた運命は, 給料のあまりにも低い取るに足らない仕事ばかりであった。幸い, かれには強い名誉心, 不屈の努力, そして数学に対する真の愛情があった。苦しい独学を通じて才能を磨きあげ, とうとうイギリスの名門, オクスフォード大学トリニティ・カレッジの著名な数学教授, G. H. ハーディ先生の注目を引くことに成功した。ハーディ先生の招きでオクスフォードに渡ったラマヌジャンは, 数学の研究に没頭し, ハーディ教授, リトルウッド教授やオクスフォードのほかの教授等とともに数々の論文を発表した。これらの論文は, 主に整数論の分割論 (Theory of Partitions) 分野に関するものであった。五年間のイギリス滞在中, ラマヌジャンはケンブリッジ哲学協会の会員に推され, 又, トリニティ・カレッジと英国学士院の特別会員にも選ばれた。不幸にも, かれがイギリスに着いてからまもなく, 第二次世界大戦が勃発し, 栄養失調や厳しい気候のせいか, とうとう結核にかかってしまった。治療も利かず, かれはインドへ帰り, それからしばらくして, わずか三十二歳でその短い生涯を終えた。

カニゲル教授は, ラマヌジャンの心理的素質や学究的業績に, 豊富な歴史的文化的

な詳細を巧みに織り込むことができたからこそ、この著作は学術的伝記物の輝かしい例となっている。