

AN ACADEMIC PILGRIMAGE TO SRINIVASA RAMANUJAN'S KUMBAKONAM

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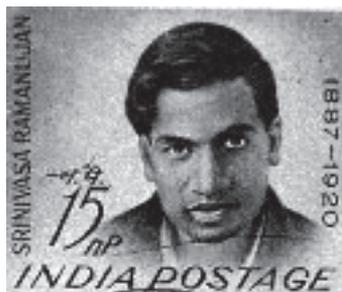
“One of the most amazing and wonderful mathematicians of all time is Srinivasa Ramanujan. He provides a shining example for each of us in at least two important ways. First, his magical genius has provided mathematicians for the last one hundred years with wonderful research directions that have greatly enriched our understanding of many areas of Mathematics. Second, he has shown us that someone born in poverty can achieve success beyond our wildest dreams. The world is a better place because he lived”. - **George E. Andrews, The Pennsylvania State University, USA.**

Srinivasa Ramanujan was born at his maternal grandfather's house at Erode on 22nd December, 1887 at 6.20 pm with birth star Uttarabhadra (Uthrattathi - in Malayalam). His father, K. Srinivasa Iyengar, hailing from the district of Thanjavur worked as a clerk in a sari shop. His mother, Komalathammal was a housewife who also sang at a local temple.

He had spent his school days at Kumbakonam - a place flanked by the Cauvery river and one of its tributaries, close to Thanjavur, famous for its Brihadeswara Temple (It is said that there are more

than four hundred temples in and around Kumbakonam). Srinivasa Ramanujan was a mathematician so great that his name transcends jealousies, the one substantively great mathematician whom India has produced in the last 1000 years. A boy who was born and brought up in the traditional Iyengar style, in a small house with narrow corridors in the Sarangapani Sannidhi Street of Kumbakonam could contribute to the 'divine' subject -

Mathematics, which could later on find applications even in String theory of Physics, Polymer Chemistry, and the Theory of black holes! One of the recent connections is with the notion of 'Ramanujan





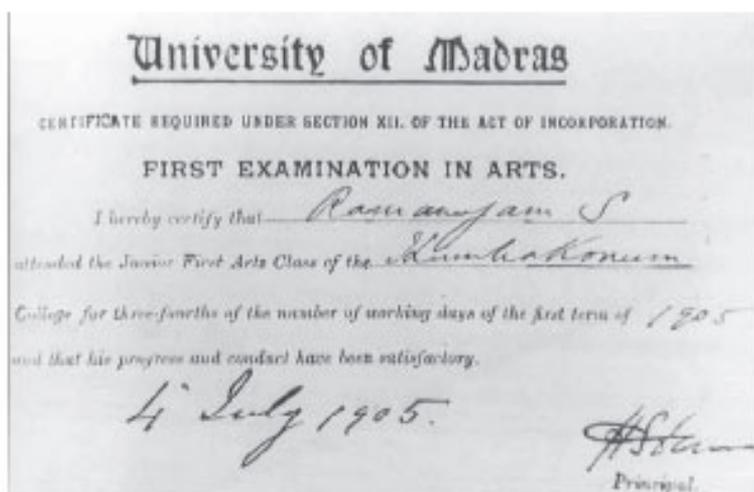
Graphs' which finds its applications in coding theory. This seem to be quite an impossibility, but turned out to be a simple reality.

The author of this article was fortunate to visit his house, Town school where he studied and the 'Ramanujan Museum' of SASTRA University, Srinivasa Ramanujan Campus, Kumbakonam on 28th October, 2014. This article is prompted by the 'electrifying' effect of this academic pilgrimage, that I have been longing for since many years. Volumes have been written on the life and works of Ramanujan from Kumbakonam days to Trinity days. Hence this article is expected to be of different flavor.

During the 125th birth year of Ramanujan in 2012, the then Prime Minister Dr. Manmohan Singh announced the decision of Government of India to declare the year 2012 as the National Mathematical Year and 22nd December of

every year as the National Mathematics Day. This was announced in a befitting function held at Chennai in the presence of Robert Kanigel. Prof. M.S. Reghunathan, the then President of the Ramanujan Mathematical Society, Prof. R. Balsubramanian, the Chairman of the National Board for Higher Mathematics and many other luminaries were present. It was also decided to translate the book by Robert Kanigel to all the official languages of India.

I had the opportunity to know more and deeper about the life and works of Srinivasa Ramanujan when last year I was given the responsibility of being the consultant for the translation into Malayalam of the book "The Man Who Knew Infinity" by Robert Kanigel. (Robert Kanigel, a graduate in Mechanical Engineering is a Professor of Science writing at the Massachusetts Institute of Technology). This book so far has been



The First Examination in Arts, FA degree (Intermediate eluded Ramanujan, who failed in 1905 and again in 1907



translated into six Indian languages and published by the National Book Trust, including the one in Malayalam “Ananthathe Arinja Aal” published by the Kerala Language Institute. To be frank, I then realized that even a serious college student have only a very little knowledge of the great, unimaginable, contributions of Srinivasa Ramanujan. I also felt that this is mainly due to the lack of proper and timely exposition of his works in the syllabi of courses in Mathematics. Apart from the story of ‘1729’ - the ‘taxicab number’ that G.H. Hardy, the mentor and collaborator of Srinivasa Ramanujan had narrated and found in the school text

books also, no in-depth study of his various theories is made even in the universities of India.

I could see a copy of his horoscope and most of the earlier correspondence with the authorities of Madras Port Trust, District Collector, the Registrar of Madras University, marklist of FA degree which he failed, photos of his parents, his wife Janaki, letters to Hardy and many other precious and rare documents in the ‘Ramanujan Museum’ at SASTRA University, Kumbakonam campus. Though the astrologers, his parents and relatives described the horoscope as quite perfect and auspicious, his mother Komalathammal was quite upset as, for the first three years he scarcely spoke. But, after the performance of ‘Akshara Abhishekam,’ the process of initiating the Goddess of Vidya by writing Tamil alphabets in a thick bed of rice, his dumbness dispelled and started learning most of the Tamil alphabets.



The author of the article at Town High School, Kumbakonam



**SRINIVASA RAMANUJAN
THE LOST NOTEBOOK
AND
OTHER UNPUBLISHED PAPERS**

Introduction
by
George E. Andrews

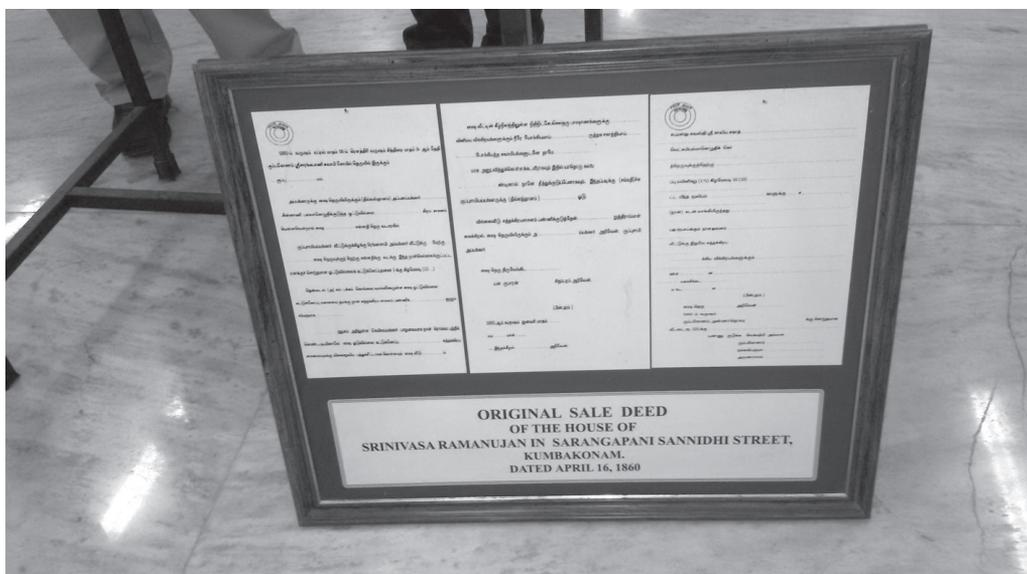


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In 1894, Srinivasa Ramanujan joined the Town High School at Kumbakonam. I could visit this school where a bust of Srinivasa Ramanujan is erected in its front yard. One of its class rooms is named as 'Ramanujan Hall' and its library has an enlarged photo of him, with an

appearingly obese face, but actually due to malnutrition. In 1897, he topped the list of successful candidates of the primary examination in the whole district. Interestingly, he was in his school days, quite curious to know the 'highest truth' in Mathematics. Some of his seniors had mentioned to him, the 'Pythagoras Theorem' (The sum of the squares of the sides of a right angled triangle is equal to the square of the hypotenuse) as the highest truth.

C. Rajagopalachari (1878 -1972), popularly called Rajaji was the last Governor-General of India. He was among the first recipients of the 'Bharat Ratna' along with the Nobel Laureate Physicist, C.V. Raman and former President of India Dr. S. Radhakrishnan, in 1954. He became a friend of Ramanujan when he solved in just two minutes the two simultaneous equations in two unknowns, $\sqrt{x} + y = 7$ and $\sqrt{y} + x = 11$, giving the solution as $x = 9$ and $y = 4$. Such solutions often came



to his mind without the help of books and teachers. Rajaji had grown up in the same town, visited the same temple and studied in the Town High School with Ramanujan.

Another interesting document that I found in the Ramanujan Museum was the original sale deed of his house in Sarangapani Sannidhi Street, dated 16th April, 1860. As also, a copy of his famous 4 x 4 magic square. The first row was actually representing his date of birth, 22.12.1887. It had a magic sum of 139, which also has a special property that, it is the sum of the five consecutive primes 19, 23, 29, 31 and 37 (You also could create your own birth day magic square!).

22	12	18	87
88	17	09	25
10	24	89	16
19	86	23	11

The journey of Ramanujan by a ship named Nevada on 17th March, 1913 to reach London on 14th April became a historic one. In Cambridge he had the good company of Prasantha Chandra Mahalanobis who later in 1930 founded the Indian Statistical Institute in Kolkata. The collaboration he had with G.H. Hardy, B.M. Wilson and P.V. Seshu Iyer, the President of Indian Mathematical Society during 1932-34 (it is reliably learnt that he was a native of a small village Peruvamba of Palghat District, Kerala) culminated in the awarding of B.A. degree by research by the Cambridge University in 1916 for his outstanding original work on 'Highly Composite Numbers' which appeared in the Proceedings of the London

Mathematical Society. (A highly composite number(HCN), the term coined by Ramanujan is a positive integer with more divisors than any smaller positive integer. He showed that there are infinitely many such numbers. The integer 24 has 8 factors, 1,2,3,4,6,8,12 and 24. But all the composite numbers less than 24, namely 4,6,8,9,10,12,14,15,16,18,20 and 21 have less than 8 factors. Other examples are 4,6,12,36 etc. Ramanujan had listed all HCNs with up to 13 digits and having 10080 factors, while he was in London).

Srinivasa Ramanujan had to spend the first 23 years of his life in acute poverty. So, when the Trinity College offered him a fellowship of 250 pounds per year, he was quite embarrassed and worried. He even asked G.H. Hardy, "How do I deserve it?" ! The words of Pandit Jawaharlal Nehru in the book 'Discovery of India' on the plight of Ramanujan is worth mentioning. "Ramanujan's brief life and death are symbolic of conditions in India. Of our millions how few get any education at all; how many live on the verge of starvation".

Incidentally, a renowned Mathematician Terence Tao of University of California, Los Angeles, USA, a Fields Medalist, a Fellow of Royal Society, London, and a recipient of the Break through Prize in Mathematics-2014 in his article 'Mathematical Perspectives' (Bulletin of American Mathematical Society, 44, 2007) has mentioned some personal thoughts and opinions on what 'good quality mathematics' is. He says that there are many different types of



Mathematics which could be designated as 'good' and could refer to. For example good math discovery where in the revelation of an unexpected and intriguing new mathematical phenomenon, connection or counter example is provided, good meta-mathematics dealing with advances in foundations, philosophy, history, scholarship or practice of math. In this list, he puts the amazing identities of Ramanujan as 'Beautiful Mathematics' which are easy and pretty to state but not to prove.

Various results, such as a closed formula for the number of partitions $P(n)$ of an integer is indicative of his great intuition (The partition of an integer 'n' is a division of 'n' into any number of positive integral parts. For eg. $4 = 3 + 1 = 2 + 2 = 2 + 1 + 1 = 1 + 1 + 1 + 1$. In symbols, we write it as $P(4)=5$. Nothing much was known about the function $P(n)$ called the 'partition function'. Ramanujan's prediction that $P(14031)$, which is a huge number with 127 digits, would be divisible by 114, turned out to be true !).

Another number theorist, Prof. Ken Ono of Emory University, USA remarks (Scientific American, May 2014) that Ramanujan had noticed that every 5th partition number is divisible by 5 and every 7th partition number starting with $P(5)$ is divisible by 7 etc. Along with Prof. J. Bruinier of Technical University of Darmstadt, Germany, Ono has recently constructed a formula for computing large partition numbers quickly and exactly. Ken Ono calls this calculator as "the ORACLE". It could be used to study 'elliptic curves', an important notion used by modern

cryptographers. Cryptography is popularly known as the Science of Secrecy. Ono's work also has unveiled one of the Ramanujan's mathematical legacy, namely the Mock theta functions and modular forms.

He attributed all his abilities to the blessings of the Goddess of Namakkal near his home village and his usual answer as to how he could derive all the formulae and prove theorems - 'It came to my mind, Sir', suffices to testify and justify his unique position in the world of Mathematics, comparable even to that of the great Swiss Mathematician Leonhard Euler (1707-1784) and Carl Gustav Jacob Jacobi (1804 -1851).

At the suggestion of Prof. K. Chandrasekharan of TIFR and the visionary scientist Homi J. Bhabha - the then Director of TIFR, the Tata Trust brought out a photostat edition of the three 'note books' recovered from Trinity College in 1957. Profs. George Andrews (of Penn State University, USA, a very good friend of mine who had visited CUSAT in 1981), Richard Askey (University of Wisconsin-Madison, USA) and Bruce C. Berndt (University of Illinois, USA) had edited many works of Ramanujan and compiled it as the 'Lost Note Books'.

During his five year stay in Cambridge, Ramanujan published 21 research papers containing theorems on definite integral, modular equations, Riemann's zeta function, infinite series, summation of series, analytic number theory, asymptotic formulae, modular functions, partitions and combinatorial analysis. His

paper entitled Highly Composite Numbers, is 62 pages long and contains 269 equations. This is his longest paper. Five of these 21 research papers were in collaboration with Hardy. Ramanujan also published five short notes in the Records of Proceedings at meetings of the London Mathematical Society and six more in the Journal of the Indian Mathematical Society. 110 papers have been published on Ramanujan in various journals published from various countries, the Journals of IMS and Indian Academy of Science from India. He was elected as a Fellow of the Royal Society in 1918.

After completing nearly five years at Cambridge, when Ramanujan appeared to have recovered sufficiently to withstand the rigours of a long voyage to India, he left England on 27th February, 1919 by S.S. Nagoya. Four weeks later he arrived at Bombay and soon after at Madras, thin, pale and emaciated, but with a scientific standing and reputation that no Indian enjoyed ever before. Ramanujan breathed his last on 26th April, 1920 at Chetpet in Chennai. His orthodox relatives stayed away from his funeral, because he had crossed the waters and was suffering from an illness. It is a surprising part of the history that the cremation was arranged by Shri Ramachandra Rao, who was then the District Collector of Nellore, through his son-in-law Rajaji.

Let me conclude this article with the following quote:

“Sheer intuitive brilliance coupled to long, hard hours on his slate made up for most of his educational lapse. This ‘poor and solitary Hindu pitting his brains

against the accumulated wisdom of Europe’ as Hardy called him, had rediscovered a century of mathematics and made new discoveries that would captivate mathematicians for next century.” - **Robert Kanigel in The Man who Knew Infinity : A Life of the Genius Ramanujan**

Suggested Reading:

- Bruce C. Berndt and Robert A. Rankin (1995) - Ramanujan Letters and Commenary. American Mathematical Society, Lodon Mathematical Society, Providence.
- du Sautoy, Marcus (2003) - The Music of the Primes: Searching to Sole the Greatest Mystery in Mathematics, Harper Collins.
- George E. Andrews and Bruce C. Berndt (2008) - The Top Ten Most Fascinating Formals in Ramanujan’s Lost Note Book, Notices of the AMS, January.
- K. SreenivasaRao (1989) - SrinivasaRamanujan: A Mathematical Genius, East West Books.
- Krishnaswamy Alladi, (Editor). Srinivasa Ramanujan: Going Strong at 125, Part I and Part II, Notices of American Mathematical Society, December 2012 and January 2013.
- G.H. Hardy (1940) - A Mathematicians Apology, CUP.
- Paul Erdos, Ramanujan and I (<http://www.renyi.hu/~peros/1989-29.pdf>).
- Robert Kanigel (1992) - The man who knew infinity: A life of the genius Ramanujan, Abacus Books.
- S.R. Ranganathan (2009) -Ramanujan- The Man and the Mathematician, Ess Ess Publications.
- Suresh Ram (1989) - Srinivasa Ramanujan, National Book Trust of India
- T.M. Sankaran (2006) - Srinivasa Ramanujan, Kerala Sastra Sahitya Parishad.
- A. Vijayakumar (2008) - Srinivasa Ramanujan - A Tribute to A Natural Geneus, Science Reporter, December 2008.
- Wazir Hasan Abdi (1996) - Toils and Triumphs of Srinivasa Ramanujan, National Publishing House.

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