A Mathematical Pilgrimage: RAMANUJAN YATRA

VINAY NAIR

All of us have heard anecdotes from the life of Srinivasa Ramanujan through books, friends and teachers. Robert Kanigel presents very beautifully the life of Ramanujan in his book *The Man who Knew Infinity*. A lot about the life of Ramanujan became known after Hollywood brought out the biopic on Ramanujan. Despite this, we felt that it would be worth taking some Math enthusiasts for a tour where they could get immersed in the life of Ramanujan for a few days. The idea took seed sometime in September 2017 while I was talking to Rajith who heads a culture and heritage tour company – *The Traveling Gecko* – and we thought, why not do an experiential tour on the life of Ramanujan? A detailed account of the 5-day *Yatra* (Chennai – Thanjavur – Kumbakonam – Chennai) from 12th to 16th November 2018, which I called *A Mathematical Pilgrimage | Ramanujan Yatra*, is put up on my blog https://vinayrnair.wordpress.com/2018/11/19/ramanujan-yatra-diaries-day-1/ . Hence, I am not writing a travelogue again. What I would like to share in this article are some stories, discussions and thoughts about Ramanujan and the lives of people that revolved around him during and after his time.

Day 1: First halt in Ramanujan Yatra: Ramanujan Museum in Chennai

P. K. Srinivasan (better known as 'PKS') (1924-2005) was a very inspiring Math teacher who dedicated a great part of his life towards popularising the life and works of Ramanujan. It was his dream to start a museum that would depict the life and works of Ramanujan. So with the available resources that he had, which included his own house, he created a museum. The ground floor is an auditorium (where we had our introductory session about the life of Srinivasa Ramanujan) and upstairs was the museum.

Keywords: Mathematicians, experiential learning, common goals, career in mathematics, encouragers and inspirers

PKS was immensely passionate about Ramanujan and he went around talking and writing to people, from top officials to ordinary people. In his own words, "I got 99% appreciation and 1% action." In short, no one offered any help for his idea of starting a Ramanujan museum. At the end he, along with a few of his students, went to Kumbakonam where Ramanujan was born and the students asked every person they met on the road whether they knew anything about Ramanujan. After much searching, somebody told them the address of the house where Ramanujan had lived. (Remember, this was the time before SASTRA University took up the task of preserving Ramanujan's house as a monument.) PKS found the house but by then, it belonged to someone else. The house is now preserved in honour of Ramanujan.

Our Yatris spent a good amount of time going through everything preserved in the museum and getting loads of stories and information from Mrs. Meena Suresh. The museum is a must visit for every Math lover and one can see the hard work done by a one-man army (PKS) in bringing together a huge amount of information about Ramanujan and popularising his work during times when we didn't have the internet.

Day 2: Marabu Foundation, Thanjavur

Marabu is an initiative to promote and preserve old Carnatic musical compositions which are not very well known today; it is run by Dr. Kausalya, a 70-year old musicologist. Our sessions in her 150-year old house started with the first letter Ramanujan sent to Hardy, which starts with the famous words, "I beg to introduce myself as a clerk from the Accounts department." We started with the famous claim made by Ramanujan that the sum of all natural numbers is -1/12 and tried to see why it could be true. The focus was also to read carefully the words that Ramanujan chooses in his letter where he writes, "… under my theory, this is true…" which prompts us to question whether what we have understood is the same as what he refers to as his 'theory.' After some questioning and analysing, we moved on to the topic that might look scary for many – the Nested Radicals[1]. The participants loved the topic and ways to approach solving the nested radicals using simple algebraic identities. The last part of the session was to look at another area in which Ramanujan worked – Continued Fractions[2]. This was very interesting for students as it didn't require knowledge of higher level mathematics. We ended with a story-telling session about *Ramanujan's Lost Notebook*.

In 1918, after Ramanujan left England for India owing to ill health, he started writing down his discoveries on loose sheets of paper which were sent to Hardy after Ramanujan passed away. Hardy worked on this material and later sent it to a mathematician named Watson who worked with another mathematician on Ramanujan's works, named Wilson. Wilson died in 1935 and Watson seemed to have lost interest in the work after some time and left the material somewhere among his papers. British mathematician J. M. Whittaker found the papers in a mess sometime after Watson's death in 1965. He sent them to the Wren library in Trinity College. American mathematician George Andrews learnt about this lost material in the early 1970s but he wasn't able to travel to Europe until 1976. All this material was published as *Ramanujan's Lost Notebook* on 22nd December 1987 to commemorate Ramanujan's birth centenary.

Now, this is a story that is not as popular as the taxicab number 1729 or some of the other popular stories. Many of our *Yatris* were full of questions after the story-telling session. It was hard to believe that a great work of Ramanujan may well have been lost forever had it not been for people like Whittaker and George Andrews. Remember, this work was almost lost *after* Ramanujan's genius had been recognised.

To recognise his genius (which was missed by mathematicians like Baker and Hobson to whom

1 & 2: To learn more, read the article by Utpal Mukhopadhyay in AtRiA March 2018.

Ramanujan had earlier written), there had to be a Hardy to make his work known. We read about great people but seldom do we know about those who were responsible and who played a vital role in making such people great.

Day 3: Town High School, Ramanujan Museum and Ramanujan's house, Kumbakonam

'Great knowledge often comes from the humblest of origins.' Littlewood to Ramanujan, from The Man who knew Infinity.

Ramanujan studied in Town High School, Kumbakonam, a school that has produced many great minds. It is a school where most students come from very humble backgrounds. What I loved was that their alumni support the schooling of many students who cannot afford it.

It was a big day for us as we set foot on the same ground where Ramanujan had walked. We were received with a lot of love by the Headmistress and the mathematics teachers. Following the greetings, we went into the oldest block – the Ramanujan block, which has been there since the time of Ramanujan. While there, we had some interactive sessions with the students of Town High who explained some of the traditional games played in rural areas. Many of these involved strategy and skill. After the session, one of our participants (Hetvi, 9th grade girl from Mumbai) did a session for the young Ramanujans of Town High. The session was on the Theory of Partitions in Numbers, an area in which Ramanujan had made a phenomenal contribution and one of the reasons why he was awarded a Fellowship of the Royal Society. Her presentation was simple and easy to understand and the audience enjoyed working out the questions that she posed.

After Hetvi's presentation, there was a Q & A session between the students of the school and our Yatris. They asked each other questions like, "How does it feel to be studying in the school where Ramanujan studied?" "What aspect of Ramanujan has inspired you?" "How did Ramanujan arrive at the property of 1729?" And so on.

Following lunch, we took a round of the school and it was time to leave. We found it hard to leave the school. The people there were just lovely and they were so happy that we were on this Yatra to study the life and work of Srinivasa Ramanujan. With a heavy heart, we bade good bye to the place and left for the Ramanujan Museum at SASTRA University, Kumbakonam. The museum is very well maintained and has many letters, notes and findings of Ramanujan. After an hour, we left for the house at Sarangapani Street where Ramanujan had lived.

How would someone feel who has waited all their life to visit the religious place closest to their heart and now has arrived at that place? Our feeling was nothing less. All of us went inside the typical Brahmin home. The first room in the left has a window that faces the road. It was written there that Ramanujan used to look out of the window, lost in thought for long hours when he was a child. I tried looking outside just to see if I could feel or see something that Ramanujan saw when he gazed outside. All the Yatris came inside to check out the small house. I could see some of them walking inside quietly, moved by the experience and with an indescribable feeling sinking into their hearts.

Figure 1. Yatris browsing through the Ramanujan Museum

We wondered where Ramanujan sat to have his food, how he worked on mathematics while his mother put into his mouth the rice balls she made for him, and how he continued working on mathematics as he grew up in that house. We stepped out after our hearts overflowed with contentment. As we got out, something suddenly struck me. The lane would have been an *Agraharam* earlier as the plots of land could be seen as elongated rectangles. But there was hardly any traditional house to be seen on the lane, except for Ramanujan's. Had it not been for PKS, would Ramanujan's house have survived today?

We left Kumbakonam after having some *pakodas* and filter coffee and reached Thanjavur to board the bus to Chennai. The faces of all the Yatris were lit throughout the day, for, they had visited their Kashi and Ganga! As pilgrims carry back Ganga water with them, some of us had taken a handful of sand from the ground in the Town High School where Ramanujan's footsteps would have fallen some time.

Day 4: IMSc and CMI, Chennai

'Golf is my life. I get to play golf all day. And I get paid for that. What more do I want?' Tiger Woods, one of the top golf players in one of his interviews.

If you are a math-lover, how would it be to get to 'do mathematics' the whole day and get paid for that? Many students who love mathematics do not know what mathematicians do for a living or whether they can earn a living by pursuing mathematics. As a result, we find many students not pursuing mathematics in college even if they love the subject the most. To get a first-hand experience of what mathematicians do and how *cool* it is to follow one's deepest interest, we visited two premier institutes for mathematics in India – Institute of Mathematical Sciences (IMSc) and Chennai Mathematical Institute (CMI) – and had interactive sessions at both places.

At IMSc, the session was organised by Prof. Ramanujam (popularly known as 'Jam,' who often writes articles for AtRiA). He impressed the Yatris with the library at IMSc which has a collection of more than 75000 books. As the Yatris were mostly school students, they had never seen such a huge library. They were so thrilled when they got to the mathematics section that they refused to come out of the library! Some of them had to be almost threatened and dragged out of the library! The next session was an interaction with Jam, his colleagues and some PhD students. The interactions started with a puzzle posed by Jam and continued with discussions on what researchers do. The professors shared some details about what they were working on and tried to bring down their work to the level of high school students. The research scholars shared their experiences of how they got into research and how wonderful life has been for them after their decision to pursue mathematics. Post the session, we could see some Yatris around some research scholars asking them questions.

After a delicious meal, all of us headed to CMI for the next session. On the way, when I asked the Yatris how they felt about the interactive session, all of them said that it was one of the best sessions that they had attended. I was surprised because I wasn't sure how much they had understood from the session, but later I figured out that the fact that Mathematicians were *cool* and the Math they did was still cooler is what the Yatris really loved.

At CMI, we got an opportunity to interact with three professors: Priyavrat Deshpande, Krishna and Manoj. They were very patient and explained how the courses are generally offered at CMI. The Yatris once again had a great chance to clarify their queries regarding undergraduate studies in places like CMI. One of the first year students of CMI, Sundarraman, shared his experience of being at CMI.

Now, here's something that is commonly seen. When math-lovers are asked in middle school what they want to pursue, many of them say that they want to do something in math. At high school, there's hardly anyone still saying that, even though they still love math the most.

There's a big chunk who aim to do something in engineering. Not that any course is better than the rest, but it could also be that because there is a lot of advertising that happens on coaching for engineering entrance exam, students get so influenced that they fail to see the options available in the pure sciences and mathematics. I feel that visits to places like IMSc and CMI and interactions with the professors and research students there can be very useful in countering this pressure.

Day 5: Closing

Draw parallels between the lives of Hardy and Ramanujan. What are the positives and negatives that you see in the personalities of Hardy, Ramanujan and Komalatammal (Ramanujan's mother)? Come up with three hypotheses on what might have happened if Ramanujan had lived a longer life.

These were some questions that were given to the Yatris to discuss and come out with their thoughts. The discussion and presentations were excellent. The movie screening of *The Man who knew Infinity* the previous night helped the Yatris connect the dots between the different people who played a role in his life. What kind of a person would have Narayana Iyer been, the person who recognised Ramanujan's genius? How much do we owe to Hardy for the credit he brought to Ramanujan? These were questions that sunk into the minds of all the Yatris at the end of the Yatra.

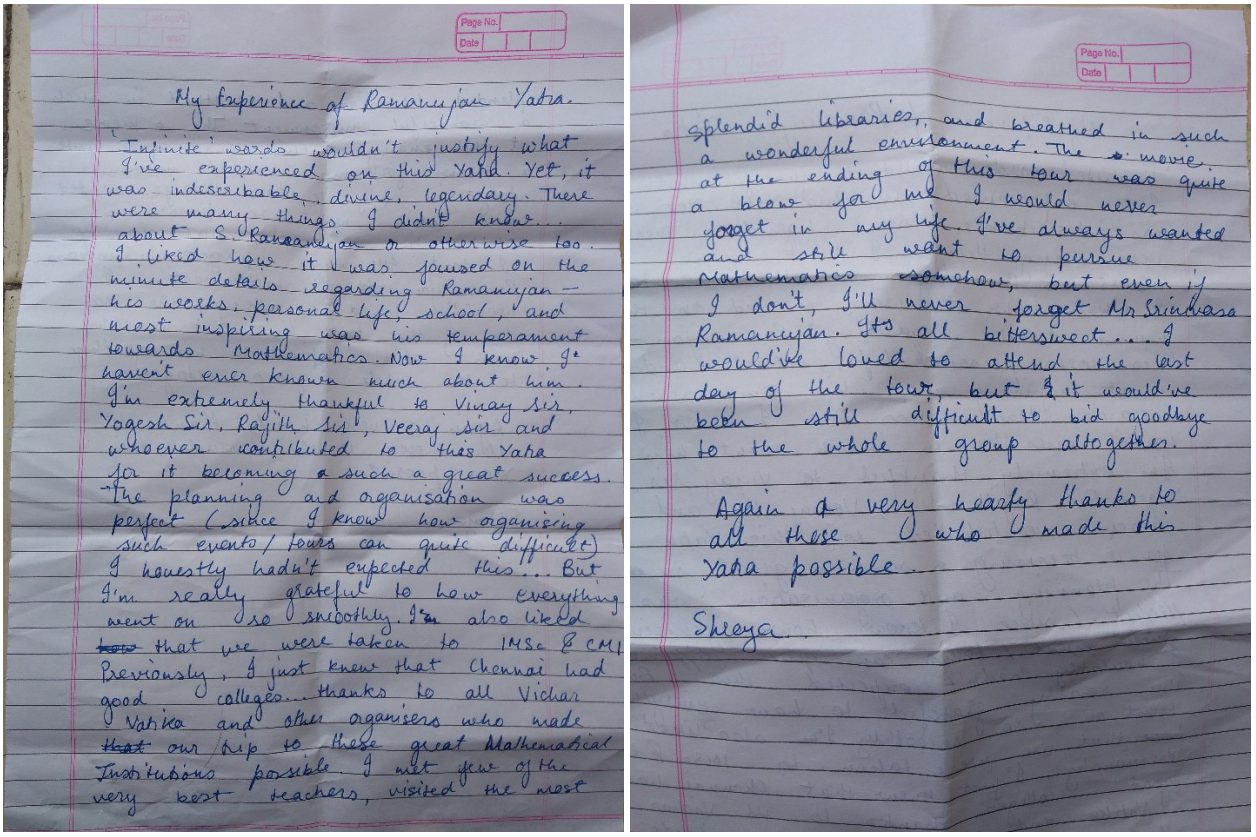
A friend of mine, Sriram, who interacted with the participants on the last day beautifully pointed out something very profound after the participants drew parallels between Hardy and Ramanujan. He said, 'Even though Hardy was an atheist and Ramanujan highly religious, with Hardy coming from a diametrically opposite culture to Ramanujan's, both of them never allowed their personal differences to come in their way. They had great respect for each other and that's a kind of friendship that we need to look up to. There are many stories of great people developing jealousy and enmity amongst them for the sake of pride and glory, and here we have Hardy who took all the risk, put his goodwill at stake, to bring an unknown Indian clerk all the way to Cambridge. He didn't stop there, did he? Hardy took pains to convince an entire band of mathematicians as to why Ramanujan deserved to be a *Fellow of the Royal Society*. Again, from Ramanujan's side, he was willing to sacrifice his personal belief systems and his family for the sake of mathematics and go to England to work with someone whom he had hardly known.' More than mathematics, perhaps it is the stories revolving around mathematicians that can inspire young minds.

During the 5-day tour, all the Yatris lived, thought and talked only about Ramanujan. This happens only in a Pilgrimage. And that is why we felt, despite all the information about Ramanujan being readily available, having a Yatra would be worth it.

Food for thought

Before we concluded the valedictory, there were three questions thrown to the Yatris which might be of interest to the readers of this article.

1. Whom should we thank for Ramanujan's works that we have today? Should it be his wife Janaki, who let him go to England despite all odds and who struggled to live as a widow till her 90's? Should it be Prof GH Hardy? Should it be Narayana Iyer who gave directions and encouraged Ramanujan to go to England? Is it Whittaker? George Andrews? PKS? Bruce Berndt who took the trouble to publish the works of Ramanujan?
2. If Ramanujan's life has been an inspiration to you, how would you want to spread this inspiration?
3. PKS had a dream that every city in India should have a museum dedicated to the life of Ramanujan. Do you think you can contribute in any way to make the dream come true? If so, how?



My Experience of Ramanujan Yatra.

'Infinite' words wouldn't justify what I've experienced on this Yatra. Yet, it was indescribable, divine, legendary. There were many things I didn't know about S. Ramanujan or otherwise too. I liked how it was focused on the minute details regarding Ramanujan — his works, personal life, school, and most inspiring was his temperament towards Mathematics. Now I know I haven't ever known much about him. I'm extremely thankful to Vinay Sir, Yogesh Sir, Rajith Sir, Veeraj sir and whoever contributed to this Yatra for it becoming a such a great success. The planning and organisation was perfect (since I know how organising such events / tours can quite difficult) I honestly hadn't expected this... But I'm really grateful to how everything went on so smoothly. I'm also liked ~~too~~ that we were taken to IMSc & CMI. Previously, I just knew that Chennai had good colleges... thanks to all Vichar Vatika and other organisers who made ~~that~~ our trip to these great Mathematical Institutions possible. I met few of the very best teachers, visited the most splendid libraries, and breathed in such a wonderful environment. The movie at the ending of this tour was quite a blow for me. I would never forget in my life. I've always wanted and still want to pursue Mathematics ~~somehow~~, but even if I don't, I'll never forget Mr Srinivasa Ramanujan. Its all bittersweet... I would've loved to attend the last day of the tour, but if it would've been still difficult to bid goodbye to the whole group altogether.

Again a very hearty thanks to all these who made this Yatra possible.

Shreya.

Figure 2. Handwritten letter from one of the Yatris.

VINAY NAIR is a Math educator and works mainly with students of middle and high school who are passionate about Math. He is a part of a few educational initiatives viz., *Raising a Mathematician Foundation, Vichar Vatika, School of Vedic Maths*, through which they try to work with talented students. He can be contacted at vinay@vicharvatika.org.