

## A mathematical passage, from Imphal to Sheffield.

**Dr. Jayanta Manoharmayum,**  
School of Mathematics and Statistics,  
University of Sheffield,  
United Kingdom



My first introduction to Mathematics was through the books used for the Matric exam in Manipur till the mid 1980s. There were three books: Algebra by K P Basu, Geometry by Hall and a book on numerical calculations (most likely titled Arithmetic). There were multiple copies of these around my extended household, in use by my older siblings and cousins. I distinctly remember trying to copy down what one of my cousin's schoolwork, sat across the *man-gol phak*. It wasn't that I understood what they were working on: I just found the mix of symbols and numbers utterly compelling!

As I grew older, I found more incomprehensible books around the family home. My father, Manoharmayum Brajamani Sharma (late), was one of the first engineering graduates from Manipur, and my oldest brother was already studying for an engineering degree. That meant my fascination with incomprehensible symbols progressed from basic algebra to multivariable calculus.

So my informal conditioning to Mathematics began, wittingly or not, from a very early age. For the formal side, I suppose I ought to begin with my school education: up to Class IV at Little Flower School (as one of the last mixed batches there), and then up to Class X at Don Bosco School (DBS), Chingmeirong, sitting HSLC (Matric) Examination in 1986.

Manipur in the eighties was a troubled place; it was the time when insurgency exploded. School closures, late exams, bandhs and shutdowns, were a common theme; sadly, many of the same troubles remain to this day. Nonetheless, the teachers at DBS gave us an outstanding all round education; I cannot help but admire the commitment and sacrifice the Salesian staff made, and continue to make, for the betterment of society.

At school, I began to realise that I was quite able in Mathematics, in the sense that I had no issues with the textbooks we were following and would often teach myself ahead of the class schedule. However, my proper introduction to mathematical thinking came from a completely different source: doing puzzles! What happened was this: we used to get at home a magazine called the Illustrated Weekly of India. Amongst other things, the Weekly had a regular puzzles corner (Mindsports, if I remember correctly) run by Mukul Sharma. The puzzles ranged from classic chestnuts to modern mathematical puzzles, and even the odd Mathematical Olympiad problem. Here is an example:

*Given twelve identical coins except that one of is a counterfeit and has a different weight. The task is to find the fake coin, and determine whether it is lighter or heavier, using only a simple balance and no more than three weighings.*

Although I did not realise at that point, this was when I learnt the joy of problem solving and, in some sense, what doing mathematics was about: a lot of frustration, and ecstasy when you finally see the light!

Allow me to reminisce about school days in Imphal in the eighties. We cycled, picking up friends on the way and ending up with a posse of ten or so bicycles when we got to school. At break time, we climbed the first hillock of Chingmeirong (the one nearest to the school), running down to get back before the bell to avoid *chei chaba*. After getting home, there was at least an hour of play time: cricket, football, hockey with sticks made from bamboo roots. Some studying before dinner, and perhaps work till ten (specially when I was class IX and X).

I gave my HSLC exam in March/April of 1986. At that point, moving forward I thought I wanted to work as a scientist or even an engineer in something mathematical, but I was not really sure. In any case, the long wait before the Matric results came out provided the perfect opportunity to embark on a journey to learn the guitar. I was not alone of course: my two best friends from school were there on this particular journey, and we had visions of forming a band. To this day, the guitar remains a constant source of welcome distraction.

After the results came out, I enrolled myself at DM College of Science for the Pre-University course (equivalent of Class XI and XII) choosing Physics, Chemistry, Mathematics and Additional Mathematics as my subjects. I had my first introduction to proper Mathematics in the form of Group Theory, and absolutely loved it.

My commitment to a life with Mathematics was sealed by an event of great significance: the centenary celebrations of the birth of Srinivasa Ramanujan. Newspapers and magazines not only ran articles about Ramanujan, but also showed snippets of his work, the magical integral and series identities he sent to G H Hardy. This was my childhood revisited; I was falling in love with something beyond my comprehension! My future was now clear: BSc, MSc in Mathematics, progressing to a PhD.

My family was justifiably concerned at my decision to not consider Engineering degree options. An Engineering degree meant a scholarship (so less financial burden) and better, well defined career prospects. Foregoing that for a standard Bachelor's degree was a huge risk. Fortunately, they came to my side. In particular, my sister, Ranjana Manoharmayum, became my rock, guiding me through my undergraduate studies.

The first test came with the declaration of Pre-University results. While I did very well in the exam, the timing of the results (late July/early August 1998) meant that I had missed deadlines for the Universities we had in mind. Rather than commit to a weaker option, my sister advised me to wait for the year and apply to St Stephen's College, University of Delhi, for the 1989 session. Iche was right, of course.

So I enrolled at D M College for the BSc programme, waited for the next academic year, and spent the intervening period learning Mathematics on my own. (And practising the guitar as well.)

## St Stephen's College, Delhi. 1989—1992.

I left Imphal for Delhi with a childhood friend, Surendranath Laimayum, towards the end of June 1989 as the admissions process for Delhi University colleges opened. Surendranath and I met as kids in Little Flower, and then were together for some time in Don Bosco before he moved on to complete his schooling at St. Paul's, Darjeeling, and Delhi Public School. We flew to Guwahati, and then took the North East Express to Delhi, completing the journey three days later. I mention this to indicate the trust our families had on us: two boys, in their teens, travelling couple of thousand kilometers to set their future.

Couple of anxious weeks later, I was all set to become a *residential junior member* of St. Stephen's College. That is just another way of saying that I got admission and a hostel place! The first few days, perhaps weeks, went in a blur but I settled in without any issues (seniors from the North-East took collective responsibility of looking after freshers from our part of the country).

I had originally enrolled for BSc Mathematics, but quickly decided to switch to the BA Mathematics programme after talking to my seniors. Or rather, they advised that the prudent option was to change to BA if my sole aim was to study Mathematics beyond College. Am I thinking of applying to universities in the US? An enhanced undergraduate degree at Oxford or Cambridge? I had very little idea of what these were, or what would be involved, but it was an invigorating environment: discussing life changing matters late in the evenings by the College dhaba; seminar talks by visiting research mathematicians; informal chats with recent graduates who were pursuing graduate studies in universities around the world. And, of course, the pastoral care and guidance provided by our teachers was simply exceptional.

In many ways, the applications process for studying abroad (UK and US) is quite rigid and easy to follow: you just have to do certain things by certain times, and this is precisely where being at Stephen's was a definite advantage. Not sure about graduate programme at some US University, or about funding? Just ask one of the professors, or knock on a colleague's door! By October/November 1991, few months into my third year, the process was in full swing. I applied for accelerated second BA degrees at Oxford and Cambridge in the UK, and graduate programmes at a couple of universities in the US. Obtaining funding was the key: US universities would normally offer funding through teaching assistantships; Oxbridge funding would have to come from India, and there are standard sources for these.

My professors at Stephen's recommended that I apply for an **Inlaks Shivdeshani Foundation Scholarship** to study at Cambridge. There was a two stage interview process: one around

October, focussing on the academic subject, and then a final interview in December/January. I was fortunate to be an awardee, obtaining a full scholarship to read a second BA in Mathematics at Trinity College, Cambridge.

### **Cambridge, 1992—1999.**

Saturday, 2 October, 1992. I remember the date because a friend joked that I was being unpatriotic by choosing to leave the country on Gandhi Jayanti; I told him I had no say as Inlaks Foundation made all the arrangements.

I got out of London Gatwick Airport in the afternoon after a ten hour flight and manoeuvring immigration checks. My immediate task was to look for the coach to Cambridge, and as I stepped out of the airport building I could not help but notice how chilly it felt: a few hours back, I was enjoying temperatures in the high thirties, and then to be transported to what must be mid teens (although it felt like freezing weather to me). The second shock occurred when I asked for directions to the coach stop: I was pretty sure the gentleman replied in English, but I had no idea what he was talking about! Four hours or so later, around 8 in the evening, I pushed open the heavy wooden entrance door of Trinity College, collected my keys from Porter's Lodge, and went to bed with nervous exhaustion.

The following morning, around 8.30 or so, I set off from my room for various orientation meetings in the main part of the college. As first impressions go, it was memorable: cut through Trinity gardens, past the University Library, across the river Cam with weeping willows and punts on the banks, and up through Trinity Lane; cold watery sunshine with slight autumnal mist, and all those English poets we studied as kids in high school made sense. And then the College itself: the lawns of Great Court, the Cloisters, Wren Library; some of them were more than four hundred years old! Of course I looked for the apple tree which inspired Sir Issac Newton (allegedly); the building where Srinivasa Ramanujan would have stayed; where Hardy and Littlewood would have discussed a letter from an unknown Hindu clerk.

Term started a few days later. In fact, lectures always begin on the first Thursday of October. Eight weeks later, and just like that, it was the end of the first term. To this day, I find it absolutely astonishing how much material is packed into these eight week terms. Add on to this all the various clubs and societies that one could join, and one can pencil in an activity for every hour during term. Myself, I kept it quite modest: I joined the Archimedean (Mathematics club, talks about mathematical things every other week or so), Trinity College chess club (weekly meetings 8-11 in the evening, play inter college league, refreshment from the College bar), and the Rock Society (weekly meetings in a pub with other rock music aficionados). I also started learning to cook out of necessity: there are only so many days you can survive without rice and *enshang*.

The two years went, and I did well enough to clear the **Cambridge Mathematics Tripos** as a **Wrangler**. In less elaborate language, it just means that I now have a First Class BA degree and an MA from Cambridge University. It also meant that **Inlaks** would extend my funding to cover Part III of the **Mathematical Tripos**, leading on to a Certificate of Advanced Study in Mathematics. Concretely, Part III is an intense one year programme where one learns Mathematics required to start a PhD. But perhaps more importantly, one needs to do well in the Part III exam to secure a place for a PhD at Cambridge. Thankfully, it all worked out for me: I obtained a *Distinction*, which meant that I got a place, and my PhD would be fully supported by Trinity College.

The next three years went in a flash. I worked under the direction of Fred Diamond, who was a student of Andrew Wiles, and is one of the leading figures in Galois representations (an area of Number Theory). Fred was travelling around a bit, and so I got a chance to follow him (in Princeton and then at MIT). Apart from Mathematics, there was plenty of cricket: we had a Maths Department team, and a Trinity BA team, different abilities but all with a love for the game (and a pint or two after the game).

So it came to pass: I completed my thesis on *Pairs of mod 3 and mod 5 Galois Representations associated to Elliptic Curves and Abelian Varieties*, and obtained a PhD from Cambridge in July 1999.



By Senate House after the graduation ceremonies. The picture on the left is after the Tripos; the right one, with Iche and Sumi, is after receiving my doctoral degree.

### Sheffield, to present day:

I moved base to London after my PhD, and then joined the Swiss Federal Institute of Technology (ETH), Zurich, as a post-doctoral fellow. Zurich, just like the rest of Switzerland, is a place of great natural beauty, and I absolutely loved living there. It was a pleasant change moving to a place with hills and lakes, having lived the preceding decade in flatland!

After Zurich, I moved back to the UK and took up a two year post-doctoral position at the University of Sheffield to work with Frazer Jarvis on modularity and Fermat's Last Theorem over quadratic real field. When that got over, I got offered a permanent position and became a full time member of staff at the School of Mathematics and Statistics, University of Sheffield. Home now is Sheffield, and this is where I have settled down.

So that is my story. To the younger reader, I hope you find it (or at least some bits of it) encouraging, hope that you will engage beyond the textbooks, and have fun pursuing your dreams!

