

Tales of Triumph through Hardship

Imperial College London

Great scientific breakthroughs as a result of shifts within scientists caused by physical, mental and religious events

Ramanujan - Unlikely Friendships

India, 1900s. You have been afflicted by various diseases such as mumps and yet must work tireless hours for food and shelter - none of which are easy to come by. The obvious way to build a career is to enrol in university but unfortunately, you are too weak from your illnesses and only passed (flawlessly) in one subject, mathematics. Despite your brilliance and ambition in the subject, society does not allow it to be nurtured. Through a combination of luck and networking, an opportunity arises one day when a brilliant mathematician by the name of Professor G. H. Hardy of Cambridge University replied to one of your many letters and shows interest in your work. Now you find yourself on a ship, heading into the endless expanse of the ocean towards England, a nation currently ruling your own country. Despite your religion forbidding you to travel, you have left everything behind for a future riddled with uncertainty.

This was the predicament Srinivasa Aiyangar Ramanujan found himself in. He taught himself mathematics at an early age from a series of outdated books and did not have a formal university degree. However, the originality of his work on infinite series and elliptic integrals caught Hardy's attention, ultimately leading to the collaboration and friendship between the two of polarising backgrounds.

"I have not trodden through the conventional regular course which is followed in a university course, but I am striking out a new path for myself"
- Ramanujan

The Taming of the Shrew

Albeit the abundance and pioneering nature of Ramanujan's work, he lacked the crucial formal training in proving theorems rigorously. He needed to "tame" his creativity, so that his bountiful ideas could be meticulously set in stone. This shift into a drastically new environment, so radically different from his culture and religion provided challenges to both mind and body. As an orthodox Brahmin and hence a strict vegetarian, his diet and nutrition were a constant struggle, one exacerbated by the outbreak of WWI. This led to a continuous battle with poor health. Furthermore, he experienced constant social challenges, such as racist beliefs, envy and culture clashes with other students. All of these factors contributed to shaping his career and scientific mindset.

"Every positive integer is one of Ramanujan's personal friends" - John Littlewood



Figure 1: Srinivasa Aiyangar Ramanujan (left) and Godfrey Harold Hardy (right)

With the help of Hardy and Professor J.E. Littlewood, Ramanujan's contributions within number theory led to over a hundred theorems involving divergence series. Together, they developed a formula for whole number partitions (a method of writing a number as a sum of positive integers), and touched upon many other areas of mathematics. Some incredible consequences of his work involve aiding in computing black hole entropies and in calculating partition functions in statistical mechanics.

Ingenuity beyond compare

To illustrate the staggering complexity of his mind, Ramanujan casually contrived the property of 1729 being the smallest number that can be written as the sum of two cubes in two different ways when Hardy came to visit him at the hospital in a taxi with the same number. This number is later found to be special when studying elliptic curves, an important component of quantum physics.



Figure 2: A taxi with the number 1729, similar to the one Hardy was arrived in when visiting Ramanujan at the hospital

"An equation has no meaning for me unless it expresses a thought of god" - Ramanujan

Success through mental/physical shifts

There are many scientists who have had considerable challenges in their lives, and have made very important breakthroughs not in spite of their conditions, but because of them. What could have easily destroyed more than one career instead became a mental and physical push to overcome challenges, some going as far as declaring what others would consider a handicap, a loss or distraction. When Leonard Euler became almost completely blind, he channelled his energy into his other senses such as mental arithmetic and memory and after the loss of his eyesight proclaimed "Now I will have less distraction". Stephen Hawking made ground-breaking theoretical advances in black holes and wrote several books despite being afflicted with amyotrophic lateral sclerosis, showing that hindrances in communication are no obstacles for a brilliant mind. John Forbes Nash continued working on game theory despite his struggles with schizophrenia, work which eventually won him a Nobel prize. Albert Einstein suffered from a learning disability, Ralph Braun was afflicted by muscular dystrophy, and Geerat Vermeij was blind since the age of 3. These names are today held in highest esteem across the globe, the incredible innovation and quality of their work forever earning them a place in the hall of fame of scientists. For them, their work was worth overcoming every obstacle, even ones set by their own minds and bodies, a lesson many struggling scientists should aim to remember today.

"Now I will have less distraction"
- Leonard Euler

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Shifts in religious faith

The reconciliation of religion and science has been a subject of debate and study since the classical periods of the ancient Greeks and Romans. Questions such as "What is the meaning of life?" or "Who created the universe?" have ultimately become the Holy Grails of philosophy, science and religion. Many scientists treat the two as separate, but there are those whose lives and scientific contributions have been shaped by the shift in their view of the world. While attending medical school, Dr Francis Collins was asked the question "What do you believe, doctor?" by a hospital patient. This simple question was the stepping stone that led the man of science, one who dedicated his youth to the stringent framework of the physical sciences, to delve into religion. He later led the well-known research group which carried out the Human Genome Project and is now the director of the National Institute of Health.

"The God of the Bible is also the God of the genome. God can be found in the cathedral or in the laboratory" - Francis Collins



Figure 3: Francis Collins

There are many scientists similar to Francis Collins who went on to achieve great things after reckoning with divinity. George R. Price was a formerly militant atheist, but converted to Christianity in 1970 and later in life pioneered the amalgamation of game theory and evolutionary biology, by showing that altruism was genetic. During his life, Price struggled with mental and physical health issues, but achieved a sense of order in his life after turning to God and finding satisfaction in his work again. It was as if the concoction of religion and his ground breaking work in altruism and evolutionary biology had given him a sense of order in his chaotic life.



Figure 4: George Robert Price

"Sometimes you develop a passion for something because of some personal experience" - Francis Collins

In short ...

The question of whether religious shifts and scientific contributions are mutually exclusive is a debate that will last as long as humanity does, but it is certain that major events in one's life - whether it be profound religious experiences or physical and mental hardship - pave the path to one's future. The outlook of that future depends on how they respond, whether one lets it make or break you.

We must not forget that although the term genius is used to describe Ramanujan and many others like him, their scientific breakthroughs come from extreme dedication and hard-work. This is often forgotten as many associate the term "genius" with a predestination for greatness rather than hours of slaving by books and in labs. This highlights the importance of carefully nurturing budding scientists, as behind every breakthrough is a mere human, one whose ideas and beliefs can be moulded through social, physical and environmental influences.