Godfrey Harold Hardy, one of the finest pure mathematicians of the last century, was born on 7th February 1877 in Surrey, England. His father Isaac Hardy was bursar and an art teacher at a local school and his mother a teacher at a teachers’ training school. Hardy was very good at mathematics in his school days but did not appear to have a passion for it at that stage. Hardy himself said later that he thought mainly in terms of examinations and scholarships and found mathematics an easy way to beat other students. Even today in India many bright students who do well in mathematics often think in such terms.

Hardy entered Trinity College, Cambridge in 1896 at the age of nineteen. One of his teachers at Trinity, Professor Love, opened the doors to serious mathematics for Hardy. He introduced him to Analysis, the subject that starts with calculus in a rigorous fashion, i.e., every concept is defined and every assertion is given a proof based on logic. Professor Love advised Hardy to read Jordan’s *Course d’Analyse* and Hardy was hooked onto mathematics. This experience of Hardy, that of one teacher in his early days making a crucial difference, has happened to many of us.

Hardy took the famous *Mathematical Tripos*, a set of tough mathematics examinations in 1898 and was placed as a “Wrangler” but only as the 4th in rank. This bothered him even though he thought the whole system to be silly. How often have we heard that some of our Indian scholars who were sent to England by their parents in the last century were also wranglers, often the top ones.

Hardy’s early research was on infinite series and integrals and related topics. Recall that an infinite series is an expression of the form $a_1 + a_2 + a_3 + \ldots$ (written as $\sum_{j=1}^{\infty} a_j$), where $\{a_n\}_{n \geq 1}$ is a sequence of real or complex numbers and the sum of infinite series $\sum_{j=1}^{\infty} a_j$ is defined as the limit of the sequence $\{s_n\}_{n \geq 1}$, where $s_n = \sum_{j=1}^{n} a_j, n \geq 1$.

Recall also that a sequence $\{s_n\}_{n \geq 1}$ of real or complex numbers is said to have a limit $s$ or converge to $s$ as $n \rightarrow \infty$, if for every $\epsilon > 0$, there exists a $n_\epsilon$ such that for all $n \geq n_\epsilon$, $|s_n - s| < \epsilon$.

Hardy’s first major contribution to mathematics in England and its colonies such as India and Australia was, besides his research in analysis, his book *A course of*
pure mathematics written in 1908 [1] and its many later editions. In this book Hardy gave a rigorous exposition of the concepts of a real number (rationals, Dedekind cuts, etc.), the notion of sequences and their limits, infinite series, real-valued functions on the real line, etc. It must be pointed out that mathematics teaching and research in Europe, especially France, Poland, Hungary, Germany and Russia, was considerably ahead of England at that time. But Hardy’s book A course of pure mathematics transformed the teaching of mathematics at the college level in England and was responsible for producing several generations of good mathematicians in England. This book was introduced in India a little later and had a big impact on Indian mathematics. Almost half a century later, in the late fifties, I recall using it during my mathematics honours course in Loyola College, Chennai. While at Cambridge University, Hardy started to collaborate with J E Littlewood in 1911 and continued to do so till the end of his life. This was a most fruitful collaboration in mathematical analysis.

In India, Hardy is known as the person who helped the recognition of the Indian genius Srinivasa Ramanujan. Indeed, as is well known, Ramanujan, who was working as a clerk in the Port Trust office in Madras (Chennai now) was advised by some local mathematicians, who recognized his brilliance in mathematics to write to Hardy and let Hardy know about his various mathematical ideas. Ramanujan did so in 1913. At first Hardy could not make out if the author was a genuine mathematician or not. After some thought Hardy was convinced that in order to even think of the results of the kind that Ramanujan sent him, Ramanujan must be a first rate mind. So Hardy arranged for Ramanujan to go to Cambridge in 1914 just after World War I started. The next four years turned out to be very productive for Ramanujan and Hardy. They wrote five remarkable papers together. For a beautiful account of Hardy’s impact on Ramanujan’s life and career, see the excellent book The man who knew infinity by Robert Kanigel [2]. (For a review of the book see [3]).

During World War I, Hardy was not willing to support England’s war with Germany. He had a lot of respect for German science and culture. This put him at odds with colleagues in Cambridge. He left Cambridge for Oxford in 1919, but did return to Cambridge in 1931 and stayed there till his death in 1947.

Hardy’s interests covered many areas of pure mathematics such as the distribution of primes, Riemann zeta function, normal numbers, divergent series and Diophantine analysis. He and Littlewood produced some really first rate research on these topics.
Hardy has written that he rated his collaboration with Ramanujan and Littlewood as a high point in his mathematical career and was very proud of this. Hardy also collaborated with a number of other great mathematicians of that time such as George Pólya of Hungary, Rogosinski of Poland, F Riesz, Edmond Landau and Titchmarsh of England.

Hardy considered himself a pure mathematician who pursued mathematics for its own sake and not to solve any real world problems. He even expressed a hope that his results would never be applied. However, very early in his career, in 1908, he worked on a problem in genetics involving the distribution of dominant and recessive genetic traits in a large population and published a paper. This has been recognized by researchers in the area of population genetics as a major result and is referred to as the Hardy–Weinberg law. (See Amitabh Joshi’s article in this issue of Resonance.)

Outside of mathematics, Hardy’s interest was mainly in cricket. During the cricket season in England, it is said, Hardy worked on mathematics in the morning and spent part of the afternoon watching cricket. Many in India can relate to this passion of Hardy as is evidenced by an overdose of cricket that we have been seeing with a never-ending series of ODIs, Twenty-Twenty, Test cricket, etc., both on the cricket grounds and on TV. Unlike Hardy, who had the discipline and talent to get something done each day, it is an unfortunate fact of life in India today that this excess of cricket in the media is a serious impediment to the productivity of our nation.

To Hardy mathematics was beautiful. He has said in his book written in 1940, A mathematician’s apology [4] that “The mathematician’s patterns, like those of the painters or the poet’s must be beautiful and the ideas, like the colours or words must fit together in a harmonious way. There is no permanent place in the world for ugly mathematics”.

Hardy received many honours during his life. He was elected Fellow of the Royal Society in 1910, and was awarded the Royal Medal of the same society in 1920, De Morgan Medal from the London Mathematical Society in 1929, Sylvester Medal in 1940 for his contributions to pure mathematics, Copley Medal in 1947 (a few weeks before his death) for his part in the development of mathematical analysis in England. He was president of the London Mathematical Society during 1926–1928 and 1939–1941. Hardy passed away in Cambridge, England on December 1, 1947.
To many generations of mathematicians in India, Hardy’s book *A course of pure mathematics* was the first introduction to serious mathematics, especially analysis. It is only fitting that *Resonance* honours this mathematician who was a great researcher and teacher combined. An account of Hardy’s research in mathematics will be presented in a future issue of *Resonance*.

**Suggested Reading**


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