# Editorial

***B Sury, Associate Editor***

Email:surybang@gmail.com

We, in India, are aware of the romantic (hi)story of the brilliant Ramanujan and his "discovery" by the British mathematician G H Hardy. Not many may know the third side to this "triangle of collaboration" – the presence of J E Littlewood, who is featured in this issue of *Resonance*.

Perhaps the most prolific mathematical partnership in history is between Hardy and Littlewood; their 35-year collaboration produced nearly 100 joint research papers. Their collaboration was so prolific that, in a 1947 lecture, the Danish mathematician Harald Bohr said, "To illustrate to what extent Hardy and Littlewood in the course of the years came to be considered as the leaders of recent English mathematical research, I may report what an excellent colleague once jokingly said: 'Nowadays, there are only three really great English mathematicians: Hardy, Littlewood, and Hardy–Littlewood.'"

At a conference, Littlewood met a German mathematician who said he was most interested to discover that Littlewood really existed, as he had always assumed that Littlewood was a name used by Hardy for lesser work which he did not want to put out under his own name!

The mathematical physics of Stokes, Maxwell, and Kelvin had been the prime British mathematical area in the latter half of the 19th century. Alongside continental contemporaries such as Poincaré, Klein, or Hilbert, the overall state of British pure mathematics was at a low ebb by 1900. The beginning of the 20th century saw a revival of sorts, when Hardy and Littlewood established one of the most outstanding schools of mathematical analysis.

Hardy and Littlewood established one of the most outstanding schools of mathematical analysis.

The article by Ram Murty chronicles some of Littlewood's mathematical contributions – mostly with Hardy and some by himself.

The importance of the Hardy–Littlewood collaboration should also be seen in the historical context; the 20th century saw mathematics become a major profession, involving thousands of new PhDs each year and jobs in both teaching and industry, and the development of hundreds of specialized areas and fields of study.

Hardy himself considered Littlewood a superior in mathematical talent. According to Paul Erdös, Hardy's personal ratings of mathematicians on the basis of pure talent on a scale from 0 to 100, gave himself a score of 25, Littlewood 30, Hilbert 80 and Ramanujan 100 (albeit, Hardy is known for his hyperbole).

In *A Mathematician's Apology*, G H Hardy says: "I still say to myself when I am depressed, and find myself forced to listen to pompous and tiresome people, "Well, I have done one the thing you could never have done, and that is to have collaborated with both Littlewood and Ramanujan on something like equal terms"."

Littlewood wrote the interesting *The Mathematician's Miscellany* that has since been published as *Littlewood's Miscellany* which contains many interesting anecdotes. There is a review of this book by Srinivas Bhogle in this issue of *Resonance*. In this book, an adage, known now as 'Littlewood's law' has been formulated, which asserts that an average individual can expect to experience one 'miracle' every month. He defines a miracle as an exceptional event occurring at a frequency of one in a million. Assuming that during the (say, eight) hours in which she is awake, a human will experience one event each second, she would have experienced about a million events in 35 days. With this definition of a miracle, one can expect to observe one miracle every 35 days, on the average!

Known for his dry humour; Littlewood writes at one place that, "The higher mental activities are pretty tough and resilient, but it is a devastating experience if the drive does stop. Some people lose it in their forties and can only stop. In England they are a source of Vice-Chancellors."

The importance of the Hardy–Littlewood collaboration should also be seen in the historical context; the 20th century saw mathematics become a major profession, involving thousands of new PhDs each year and jobs in both teaching and industry, and the development of hundreds of specialized areas and fields of study.

The other articles featured in this issue include an extremely interesting one on applications of analytical geometry to a real world engineering problem. Starting with Euler's observation that smooth uniform motion between meshing curves can be obtained when the teeth are shaped in the shape of an invloute of a circle, V G A Goss discusses the 'Antikythera mechanism' which could even be used to predict eclipses.

K N Joshipura's intriguing article examines dfferent ways of assigning the radius of an atom. The most probable radius and the average radius are derived from a direct application of quantum mechanics to available atomic wave functions.

In the second of a series of articles on the theme of circadian clocks, K L Nikhil and V K Sharma discuss insights mostly gained from components of *Drosophila's* circadian clockwork. As the authors point out, barring minute differences and details, the architecture and functional principles driving molecular clocks in all organisms ranging from algae to mammals remain quite similar.

For young students to understand physics, it is essential to observe physical concepts and laws by constructing and performing experiments. In a very nice classroom note, A R Morarka and C Dixit describe a cost effective technique to fabricate and demonstrate a small setup to observe the bending of the path of the charged particles using ionized air and a permanent magnet.

When the plant Sitka willow is attacked by insects, it produces compounds that reduce its leaf quality making it less acceptable to the insects. Along with this, the attacked plant also produces signals that inform the nearby willows of the impending danger. As the process of co-evolution maintains, insects have also developed such defenses in retaliation. In a lucid article, S V Eswaran and A Jindal discuss how the grasshopper senses the toxic compounds in plants and how they have evolved various mechanisms to detoxify some secondary compounds in their diet.

In this issue, we have gripping articles: classroom demonstration of the change of path of a charged particle in a magnetic field; mechanisms developed by grasshoppers to protect themselves from the chemical defenses of plants; gear wheels and the involute of a circle; analysis of the concept of assigning radius to an atom; and the second in the series on circadian rhythms.