



## FILM REVIEW

# *The Man Who Knew Infinity:* A Report on the Movie

by George E. Andrews

### **The Man Who Knew Infinity**

*The Man Who Knew Infinity* (Animus Films, Edward R. Pressman Film, Exit Strategy Productions (Music Services), Firecracker Entertainment, in association with Zeitgeist Entertainment Group). Matthew Brown (director), Jeremy Irons (as G. H. Hardy), Dev Patel (as Ramanujan).

In September 2015, *The Man Who Knew Infinity* was shown on three successive days at the Toronto International Film Festival. The movie tells the story of the Indian genius, Ramanujan. I had the good fortune to be able to attend each showing.

I will begin with a brief summary of Ramanujan's life for those who are not familiar with the details. Ramanujan was born in poverty in southern India in 1887. He was a mathematical prodigy. After success in high school, he lost his scholarship at the Government College at Kumbakonam because he cared only about mathematics and neglected some of his other subjects. On his own, he discovered (and rediscovered) amazing theorems. He eventually contacted G. H. Hardy in 1913, in a letter that began as follows:

Dear Sir,

I beg to introduce myself to you as a clerk in the Accounts Department of the Port Trust of Madras on a salary of only L20 per annum...After leaving school I have been employing the spare time at my disposal to work at Mathematics...I am striking out a new path for myself...I would request you to go through the enclosed papers. Being poor, if you are convinced that there is anything of value I would like to have my theorems published...Yours truly, S. Ramanujan

George E. Andrews is Evan Pugh University Professor in Mathematics at Pennsylvania State University. His email address is gea1@psu.edu.

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Photo courtesy of Pressman Films.

**Math consultant Ken Ono (left) coaches Dev Patel as Ramanujan.**

The letter did include many results (all without proof) including:

$$\frac{1}{1+} \frac{e^{-2\pi}}{1+} \frac{e^{-4\pi}}{1+} = \left\{ \sqrt{\left(\frac{5+\sqrt{5}}{2}\right)} - \frac{\sqrt{5}+1}{2} \right\}$$

and

$$\frac{1}{1+} \frac{e^{-2\pi\sqrt{5}}}{1+} \frac{e^{-4\pi\sqrt{5}}}{1+} = \left[ \frac{\sqrt{5}}{1 + \sqrt[5]{5^{\frac{3}{4}} \left(\frac{\sqrt{5}-1}{2}\right)^{\frac{5}{2}} - 1}} - \frac{\sqrt{5}-1}{2} \right] e^{\frac{2\pi}{\sqrt{5}}}$$

Years later in writing about Ramanujan [2, p. 9], Hardy stated of these two results: "I had never seen anything in the least like them before. A single look at them is enough to show that they could only be written down by a mathematician of the highest class. They must be true

because, if they were not true, no one would have had the imagination to invent them. Finally (you must remember that I knew nothing whatever about Ramanujan and had to think of every possibility) the writer must be completely honest, because great mathematicians are commoner than thieves or humbugs of such incredible skill."

Hardy arranged for Ramanujan to come to England in 1914. The resulting collaboration transformed much of number theory. In 1918, Ramanujan became very ill. In 1919, his health improved somewhat, and it was felt that he might benefit from a return to India. Unfortunately his health then deteriorated, and he died in 1920.

Hardy, in his Twelve Lectures on Ramanujan [2, p. 1], begins by describing the difficulty in unraveling the mystery of Ramanujan:

I have set myself a task in these lectures which is genuinely difficult...I have to form myself, as I have never really formed before, and to try to help you to form, some sort of reasoned estimate of the most romantic figure in the recent history of mathematics; a man whose career seems full of paradoxes and contradictions, who defies almost all the canons by which we are accustomed to judge one another, and about whom all of us will probably agree in one judgment only, that he was in some sense a very great mathematician.

While the enigma of Ramanujan's genius may never be fully understood, Ramanujan's life story is told in *The Man Who Knew Infinity*, the excellent biography by Robert Kanigel [3]. Now Matthew Brown has made a movie of the same name based on Kanigel's book.

There have been a number of documentaries on Ramanujan's Life. Channel 4 in Britain produced "Letter From an Indian Clerk" in 1987. An extended version of this program was presented by NOVA under the title, "The Man Who Loved Numbers". More recently the Indian Institute for Science Education produced "The Genius of Ramanujan", and an Indian movie, *Ramanujan*, appeared

in 2014. A play, titled *A Disappearing Number*, based on Ramanujan's life, toured in professional theaters and was presented at the International Congress of Mathematicians in Hyderabad in 2010. However, *The Man Who Knew Infinity* is the first major American/British movie devoted to the story of Ramanujan.

There are many good things to say about the film. Matthew Brown, who both wrote and directed the movie, relied on expert mathematical advice from Ken Ono and Manjul Bhargava. Consequently, the mathematical portions of the movie ring true. If one is looking for a mathematical message, I would say that "the importance of proofs in mathematics" plays a major, convincing role. You might require the students in your class to attend for this reason alone.

However, what makes this such an appealing movie is the development of the relationship between the unsophisticated Indian genius, Ramanujan, and the very aloof British academic don, Hardy. On top of this, we have several underlying themes that complicate and intensify their interaction. There is the tension produced by the fact that Ramanujan's wife remained in India. World War I breaks out after Ramanujan arrives in Cambridge. The passions of war lead to racism directed at Ramanujan, to hostility toward the pacifist Hardy, and to the dismissal of Hardy's friend and fellow pacifist, Bertrand Russell, from Cambridge. It is a monumental task to weave these disparate threads into a seamless screenplay. Matthew Brown has beautifully managed to do just that.



Photo courtesy of Pressman Films.

Jeremy Irons (left) playing G. H. Hardy and Dev Patel, playing Ramanujan.

The finale of the movie chooses to emphasize Ramanujan's triumphs. Prior to his return to India, he was elected a Fellow of the Royal Society and a Fellow of Trinity College. Ramanujan's premature death after returning to India is handled softly with Hardy receiving the tragic news in a letter. I found these choices for the ending of Ramanujan's life to be exactly right. It would have been easy to dwell on Ramanujan's slow demise back in India, and this would have been an unnecessarily jarring conclusion.

Since I am writing this article for mathematicians, many of whom will know much of Ramanujan's story, I must



Photo courtesy of Pressman Films.

Left to right: Producer Edward Pressman, Jeremy Irons (Hardy), Dev Patel (Ramanujan), Ken Ono (math consultant), Matthew Brown (director), and actress Sorel Carradine.

stress that this is not a documentary. Some characters are older than they were in real life—e.g., Janaki (Ramanujan’s wife) and Hardy. Certain time compressions occur. What is important to me in a biographical movie is whether the story is true in general terms. There are no moments in this movie when one feels that a person or event is being seriously distorted.

As an explicit example of acceptable poetic license, consider the famous 1729 story told by Hardy:

I remember once going to see him when he was lying ill in Putney. I had ridden in taxi-cab No. 1729, and remarked that the number seemed to me rather a dull one, and that I hoped it was not an unfavorable omen. ‘No,’ he replied, ‘it is a very interesting number; it is the smallest number expressible as a sum of two cubes in two different ways.’

The movie, in choosing not to dwell on Ramanujan’s lengthy convalescence in England, inserts this story in a scene where both Hardy and Ramanujan are out in the street with Hardy arriving in cab 1729. Subsequently 1729 reemerges in an amusing exchange between Hardy and Littlewood.

The pioneering combinatorial analyst, Major P. A. MacMahon, has an important part in the movie. Since I edited MacMahon’s *Collected Papers* for the MIT Press [4], I watched this role with great interest. Actually I was delighted by the first seemingly implausible interaction between MacMahon and Ramanujan. MacMahon challenges Ramanujan to give the square root of a quite large integer. Ramanujan responds correctly after some hesitation and has to correct his result with a few added decimal places. Ramanujan then asks MacMahon to square the original number which he does with lightning speed. MacMahon is triumphant at having won the contest.

Surely you are wondering why this story would please me. After all, this must be pure fantasy and unlike any interaction of serious mathematicians. In fact, this is a fairly accurate account of history. According to Gian-Carlo Rota in his introduction to Volume I of MacMahon’s *Collected Papers*: “It would have been fascinating to be present at one of the battles of arithmetical wits at Trinity College, when MacMahon would regularly trounce Ramanujan by the display of superior ability for fast mental calculation (as reported by D. C. Spencer, who heard it from G. H. Hardy). The written accounts of the lives of these characters, however, omit any mention of this episode, since it clashes against our prejudices.”

In closing, I have to confess that I am hardly a disinterested observer. Ramanujan’s mathematics has been of central importance in my career. I wrote my PhD thesis on Ramanujan’s mock theta functions. This, in turn, eventually led to my stumbling onto Ramanujan’s *Lost Notebook* in 1976 [5]. I have spent the last decade collaborating with Bruce Berndt on five volumes providing proofs of the results in the *Lost Notebook* [1]. I attended the Toronto screenings with my daughter Amy, who is writing a children’s picture biography book about Ramanujan forthcoming from Candlewick. My direct connection to the movie is minimal. I had a lengthy conversation with

Matthew Brown via Skype, and, as a result, my name appears in the “Thanks Also To” list in the credits. For these reasons, I have termed this article a “report” rather than a “review.” I sincerely hope that every mathematician goes to see this movie, and I hope you enjoy it as much as I did.

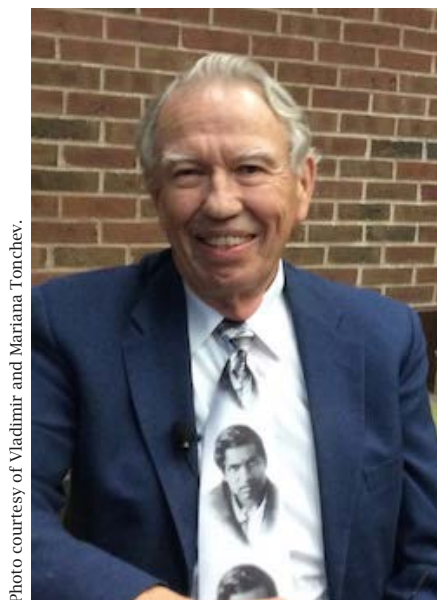


Photo courtesy of Vladimir and Mariana Tonchev.

George E. Andrews

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- [4] P. A. MACMAHON, *Collected Papers*, Vol. 1, G. E. Andrews ed., MIT Press, Cambridge, 1978.
- [5] S. RAMANUJAN, *The Lost Notebook and Other Unpublished Papers*, Narosa, New Dehli, 1988.

**Editor’s Note:** See also the story about Ken Ono’s experiences helping with the film, as told by Adriana Salerno in the AMS blog *PhDplus*: [blogs.ams.org/phdplus/2014/09/01](https://blogs.ams.org/phdplus/2014/09/01).