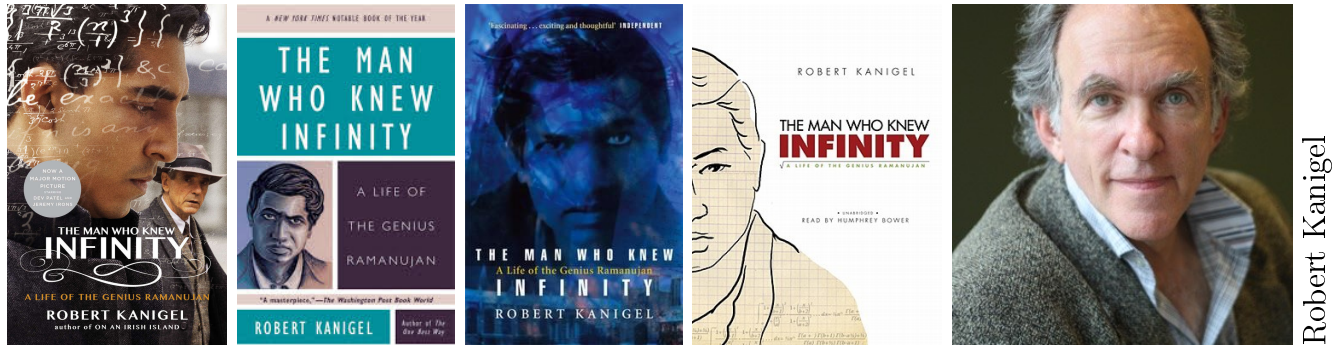


The man who knew infinity (book), *Robert Kanigel*, Charles's Scribner's Sons, (1991) ISBN 978-0-062-36359-6 (hbk), 368 p.

The man who knew infinity (film), Matt Brown (director), Pressman Film Xeitgeist Entertainment, 2015, 108 min.



Robert Kanigel, born in 1946, was a mechanical engineer but at his 24th he decided to become a freelance writer. His book on Ramanujan from 1991 was his second major publication that confirmed his fame as a biographer and science writer. In 1999 he became a professor of science writing at MIT, from which he retired in 2011.

The book. I reviewed before the 2008 novel *The Indian clerk* by David Leavitt¹ about the life of Ramanujan. It is only now that the film was released that I also read the original biography written by Kanigel in 1991.

The story of Ramanujan is well known and it has been covered in my review of *The Indian clerk*. Ramanujan, a poor Brahmin from Southern India discovers as a teenager a mathematical synopsis book written by G.S. Carr which contains a collection of formulas and theorems without proofs. Being mathematically gifted, he discovers many formulas on his own by intuition, or he being very religious, revealed by the goddess Namagiri Tayar. He excels in mathematical tests but fails in English and other exams. Not being admitted to study, he works like mad on his formulas, but having no proofs, nobody seems to understand him. He has a strong bond with his mother and her way of forcing him to find a job is by arranging a marriage with Janakiammal. She is still a child, being 12 years younger than Ramanujan, so she will stay with her family until puberty.



Ramanujan's house in his birthplace



Kumbakonam

Ramanujan travels all over the country looking for a job and he finally got one because some mathematicians of the starting-up Indian Mathematical Society recognized his mathematical skills. Trying to bring his work to the attention of British mathematicians, Ramanujan writes them letters

¹See the review in this Newsletter issue 72, March 2009 or see nalag.cs.kuleuven.be/papers/ade/n035/.

with excerpts from his notebooks. G.H. Hardy was the first one to react. He asked Neville, then teaching in Madras (now Chennai) to contact Ramanujan and convince him to come to Cambridge. According to his religion, a Brahmin could not cross the ocean. His mother also objected, but was ordered in a dream by the family goddess to let him go. Ramanujan left for England in 1914, leaving his wife with his parents. He stayed for five years in Cambridge working with Hardy and Littlewood. He got eventually a BA degree for his work and was elected for the London Mathematical Society and later became an FRS (Fellow of the Royal Society) and of Trinity College.

However, Ramanujan, was lonely, cooking on his own being a strict vegetarian, and working intensely, not being very sociable. Moreover his way of approaching mathematics was still a problem and he could not always solve the problems as was expected from him. His intuitive approach had flaws or formulas were approximations holding only under certain conditions. He got sick, probably he caught TBC, and spent time in different sanatoriums. He even attempted suicide. Moreover the link with his family in India was broken. One reason was that the letters from and to his wife were intercepted by his mother. His mother used Janakiammal as a servant, which was not unusual because it was considered part of the preparation to become a descent housewife. But the quarrels ran high and Janakiammal, under the pretext of attending the marriage of her brother returned home not to come back.

By now Ramanujan was a star in Southern India and when he returned home in 1919 he was celebrated as a hero. However, he never recovered from his sickness and the next year he died at the age of 32. There was a big dispute among his wife and the rest of his family about the legacy, both scientifically and most of all financially. The notebooks of Ramanujan were a treasure trove for mathematicians and it took Bruce Berndt and coworkers many years to find proofs for the formulas. They were published in 5 volumes (1985-1998). The so called Lost Notebook with Ramanujan's notes from a very productive period at the end of his life in 1919-1920 were again elaborated in 4 more books (2009-2013).

Of course Leavitt's novel and this biography overlap greatly, except that this is much more of a biography with a thick appendix with notes referring to the sources, an extensive index, and a bibliography.

The first 100 pages are about the boyhood of Ramanujan, the background of his family, and an explanation of the caste, the religious, the educational, and the economic system in Southern India. The next 60 pages (and continued in an epilogue) are devoted to Hardy, the second protagonist of this book. Kanigel, like Leavitt, is an American and so he does a good job in explaining the unworldly English traditions at Cambridge, the tripos, the senior wranglers, the wooden spoon, the *Cambridge Apostles*, the boyish male world of the academia semi-detached from the rest of 'the world outside'. A climate in which an unspoken hidden homosexuality lured. Kanigel spends several pages on whether or not Hardy was 'a non-practicing homosexual' as Littlewood formulated it. There is no evidence though.

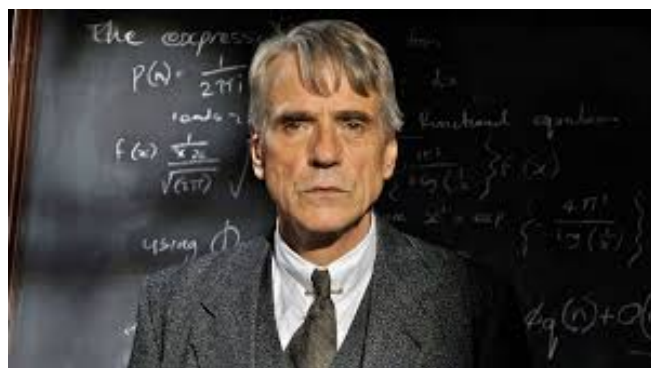
There are also some laudable attempts to explain some of the mathematics to the layman: what the book of Carr looked like, the number systems, including complex numbers, functions, summation sign and infinite series, Bernoulli numbers, integrals, continued fractions, logarithm, number theoretic partitions, prime numbers and the prime number theorem, limits, division by zero, Rogers-Ramanujan identities, the zeta, tau, theta, and mock theta functions, etc. Two of Ramanujan's conjectures about the tau function were proved by Mordell in 1917, the third one $|\tau(p)| \leq 2p^{11/2}$ by Deligne in 1974. Also the difference between the loose British kind of mathematics and the much more rigorous continental kind, which also Hardy adhered since he learned it in Jordan's book *Cours d'analyse de l'École Polytechnique*.

Of course Kanigel continues about the spreading of Ramanujan's fame after his death, which is where Leavitt's novel stops. It also contains two sections with photographs of the main characters in the book and of some of the buildings where Ramanujan lived and some of his scriptures.

The film. The film was made to commemorate the 125th anniversary of Ramanujan's birthday. Clearly the film is much less thorough than the book and starts when Ramanujan (Dev Patel) gets a job as a clerk in Madras and is urged by Narayana Iyer (the secretary of the Indian Mathematical Society) to explain his work and to send it to professors in England. The rest of the film concentrates on the five years that Ramanujan spent in Cambridge. Much attention is paid to his relation with his lovely wife Janaki (Devika Bhise), which has not been so romantic in reality if we can believe Kanigel. Her mother in law intercepting the correspondence hence preventing Janaki to join Ramanujan because she was afraid that her son would never come back, is of course a dramatic element used in the film.



Matt Brown



Jeremy Irons (G.H. Hardy)



Dev Patel (Ramanujan) & Devika Bhise (Janaki)

We see Ramanujan dropped in an academic world completely alien to him. The constant urge of Hardy (Jeremy Irons) giving him a hard time repeatedly pushing him to produce proofs, something that Ramanujan did not understand. His formulas were true, because he dreamed them up inspired by his goddess and because they were written down. Equations had no meaning unless they expressed the thoughts of god. He clearly adheres the Platonic view that mathematics is timeless and that we have to discover it. Hardy, an ardent atheist, is of an opposite idea and believes mathematics is the result of the human intellect. For Ramanujan, proofs are a waste of time, he just wants his results to get published. That is why he came to England.

John Littlewood (Toby Jones) is the antipode of Hardy. He is the Sancho Panza, working in the shadow of Don 'Hardy' Quixote. He is kind to Ramanujan while Hardy, although a believer and admirer of Ramanujan is trying to squeeze the mathematics out of him 'for Ramanujan's own good'. Hardy's friend Bertrand Russell (Jeremy Northam) does not think this is the best approach.

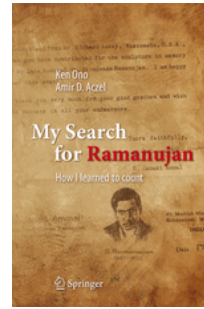
Ramanujan is also the subject of racist physical atrocities by students as well as prejudices by professors. MacMahon (Kevin McNally) in particular, a whirlwind of a calculator himself, is an opponent of Hardy and Ramanujan. When Hardy proposes Ramanujan for a Trinity fellowship, the application is denied. 'He is Indian for god's sake.'

We see Ramanujan getting sick and more and more miserable while a war hospital is being installed in Trinity College. The film is working towards a climax while Ramanujan, more dead than alive is still producing results and Hardy realizes that he has not been as good a friend to Ramanujan as he should have been. He can move Ramanujan to beat MacMahon in producing a formula approximating the number of partitions of an integer. Hardy, trying to make up for his bluntness is proposing Ramanujan as a fellow of the Royal Society. With Littlewood returning from the war front, and MacMahon convinced too, the fellowship is approved. Ramanujan, now an FRS, can not be denied a fellowship from Trinity anymore.

In an obituary speech announcing the death of Ramanujan, Hardy says that he is proud to have worked with Littlewood and Ramanujan 'more or less on an equal basis'.

My Search for Ramanujan, Ken Ono and Amir D. Aczel, Springer Verlag, (2016) ISBN 978-3-319-25566-8 (hbk), xviii+238 p.

Ken Ono is a number theorist and writes a kind of autobiography and a summary of a biography of Ramanujan and draws parallels between both. Ramanujan was picked up by Hardy and brought to Cambridge just before WWI, Ken's father was brought to Princeton by André Weil just after WWII. The Ono family experienced some racist reactions in this post-war climate, but his father became a respected professor and raised his offspring like tiger-children. Performing at their utmost best was not good enough. Ken, the youngest rebelled and left home, like Ramanujan did at some point. He joined his older brother in Canada and was dedicated to cycling.



Ken Ono



Ken Ono and Jeremy Irons



Ken Ono and Dev Patel

He is accepted at the University of Chicago but without parental supervision he enjoys student life as an active member of the Psi Upsilon fraternity and becomes a semi-professional cyclist. Professor Paul Sally picks him up and can convince him to get his BA and pushes him to start doing mathematical research. He however feels stills insecure and when his first public lecture is a disaster, he falls into a depression. Fortunately he is talked out of it by UCLA professor Basil Gordon. He eventually got his PhD in 1993 and accepts a job at the University at Athens (Georgia), working on the legacy of Ramanujan, placing it in the context of work by Deligne and Serre. When Andrew Wiles proved Fermat's last theorem, number theory, his field, became a hype and it boosted his career.

In 2005 he visits Ramanujan's home in India as a kind of pilgrimage and in 2011 he is invited to be the mathematics advisor for the film *The Man Who Knew Infinity* based on Kanigel's bio.

It is clear that Ono is a strong admirer of Ramanujan. The message of his book is that no matter how depressed you are, there is always something or somebody coming to your rescue. If you think your research is hopelessly stuck, there may come a sudden moment when you least expect it, that you see the light and the puzzle falls into place.

Even though Hardy had chosen his mathematics to be the least applicable and therefore the least harmful (thinking of military applications), it turned out that the prime numbers became the key element in modern cryptography that is used by anybody using a digital password, which is almost everybody. Ono also links to the applications of Ramanujan's formulas in string theory which is trying to understand the basic building block of our universe.

Adhemar Bultheel