

## On Ramanujan's bust\*

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Ramanujan was elected a Fellow of the Society in 1918 and he died in 1920, slightly more than a year after his return to India in 1919. The story of how a bust of one who had died in 1920 came to be made 60 years later is of some interest; and I hope that it is proper to tell that story on this occasion.

In his biographical note for Ramanujan (*Proceedings of the Royal Society*, A99, xiii–xxix), G. H. Hardy wrote:

'It was his insight into algebraical formulae, transformation of infinite series, and so forth, that was most amazing. On this side most certainly I have never met his equal, and I can compare him only with Euler or Jacobi. He worked, far more than the majority of modern mathematicians, by induction from numerical examples: all his congruence properties of partitions, for example, were discovered in this way. But with his memory, his patience, and his power of calculation he combined a power of generalisation, a feeling for form, and a capacity for rapid modification of his hypotheses, that were often really startling, and made him, in his own peculiar field, without a rival in his day.'

In his lectures on 'Ramanujan' at the Harvard Tercentenary Conference of Arts and Sciences in 1936, Hardy reassessed what he had written in 1921 as follows:

'I do not think now that this extremely strong language is extravagant. It is possible that the great days of formulae are finished, and that Ramanujan ought to have been born 100 years ago; but he was by far the greatest formalist of his time. There have been a good many more important, and I suppose one must say greater, mathematicians than Ramanujan during the last fifty years, but no one who could stand up to him

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\*Remarks made by the author on the occasion of presenting the bust of Ramanujan to the Royal Society on 11 May 1994

<sup>§</sup> Since deceased

on his own ground. Playing the game of which he knew the rules, he could give any mathematician in the world fifteen.'

In more recent times Ramanujan's reputation has been enhanced considerably. For example, the slight overtone of criticism implied in Hardy's remark 'the great days of formulae are finished' has been countered by 'the days of great formulae are not finished'. With respect to the fall and rise of Ramanujan's reputation, Bruce Berndt (the author of five volumes of 'Ramanujan's Notebooks') has compared him to Johann Sebastian Bach, who remained largely unknown for years after his death in 1750. For Bach, the big turnaround came on 11 March 1829 with Felix Mendelssohn's performance of the *St Matthew Passion*. For Ramanujan, the roughly analogous event was George Andrew's discovery of the 'Lost Notebook' in 1976.

And what is this 'Lost Notebook'?

G. N. Watson had worked on Ramanujan's papers for many years before World War II. When Watson died in 1965, The Royal Society asked J. M. Whittaker (the son of E. T. Whittaker) to write Watson's Biographical Memoir. For that purpose, Whittaker had asked Mrs Watson whether he could examine the papers that Watson might have left in his study. There, in Watson's study, as Whittaker recalled

'... papers covered the floor of a fair sized room to a depth of about a foot, all jumbled together, and were to be incinerated in a few days. One could only make lucky dips [into the rubble] and, as Watson never threw away anything, the result might be a sheet of mathematics but more probably a receipted bill or a draft of his income tax return for 1923. By an extraordinary stroke of luck one of my dips brought up the Ramanujan material.'

This 'material', of some 87 loose sheets, was part of a batch of papers Dewsbury (the Registrar at the University of Madras during the years 1909–1924) had sent to Hardy in 1923 and that had, somehow, wound up with Watson. After his 'lucky dip', Whittaker

passed them on to Robert Rankin (Watson's successor in Birmingham), who in 1968 handed the 87 loose sheets mentioned, together with other unpublished material, to Trinity College, Cambridge.

And there it lay in the Trinity archives without anyone's knowledge till George Andrews rescued it. George Andrews, who had worked on problems related to 'mock theta functions' the subject of Ramanujan's last letter to Hardy a few months before he died, came to Cambridge to explore if any related material was available in the Trinity archives. He was thrilled and excited by what he discovered in the 87 loose sheets deposited in the Archives by Rankin.

Andrews told me, at a later time, that when he presented a paper on the "Lost Notebook" at a meeting of the American Mathematical Society, Dr Olga Taussky-Todd, who was chairing the session, said 'The discovery of the "Lost Notebook" is as sensational a discovery for the mathematicians as a complete draft of a tenth symphony of Beethoven would have been to the musicians'.

Let me continue with what Richard Askey has written in this connection:

'These pages [of the Lost Notebook] are not dated, but from internal evidence they were written late in Ramanujan's life, much of it in his last year. Two thirds of the pages deal with basic hypergeometric series and most of this work is significantly deeper than Ramanujan's earlier work on the same subject. Try to imagine the quality of Ramanujan's mind, one which drove him to work unceasingly while deathly ill, and one great enough to grow deeper while his body became weaker. I stand in awe of his accomplishments, understanding is beyond me. We would admire any mathematician whose life's work was half of what Ramanujan found in the last year of his life while he was dying.'

'Some of Ramanujan's work has one quality which is shared by very little other work. Most mathematics, including some very good work, is predictable. Much of the rest seems inevitable after it is understood, and it would

eventually be discovered by someone else. Little of Ramanujan's work seems predictable at first glance and after we understand it there is still a fairly large body of work about which it would be safe to predict that it would not be rediscovered by anyone who has lived in this century. Then there are some of the formulas Ramanujan found that no one understands or can prove. We will probably never understand how Ramanujan found them.'

Let me conclude this part of my story with a quotation from Freeman Dyson:

'The wonderful thing about Ramanujan is that he discovered so much, and yet he left so much more in his garden for other people to discover. For forty-four years I have intermittently come back to Ramanujan's garden; and every time when I come back, I find fresh flowers blooming.'

I now turn to the other strand of the story: how the bust came to be made. It begins with a letter of Hardy's to me.

Hardy was to give a series of 12 lectures on subjects suggested by Ramanujan's life and work at the Harvard Tercentenary Conference of Arts and Sciences in the autumn of 1936. In the spring of that year, Hardy told me that the only photograph of Ramanujan available at that time was the one of him in cap and gown, 'which makes him look ridiculous'. And he asked me whether I would try to secure, on my next visit to India, a better photograph which he might include with the published version of his lectures. It happened that I was in India that same year from July to October. I knew that Mrs Ramanujan was living somewhere in South India, and I tried to find where, at first without success. On the day before my departure for England in October 1936, I traced Mrs Ramanujan to a house in Triplicane, Madras. I went to her house and found her living under extremely modest circumstances. I asked her if she had any photograph of Ramanujan which I might give to Hardy. She told me that the only one she had was the one in the passport which he had secured in London early

in 1919. I asked her for the passport and found that the photograph was sufficiently good (even after 17 years) for one to make a good negative and copies. It is this photograph that appears in Hardy's book, *Ramanujan, Twelve Lectures on Subjects Suggested by His Life and Work* (Cambridge University Press, 1940). It is of interest to recall Hardy's reaction to the photograph: 'He looks rather ill (and no doubt, he was very ill): but he looks all over the genius that he was.'

The rest of the story as told by Richard Askey:

'The story of the thread from the "Lost Notebook" to the bust is simple. Andrews has done a lot of very deep work trying to understand what Ramanujan discovered. Eventually the *New York Times* heard about it and interviewed him. *The Hindu* followed with a more extensive interview, and also published an interview with Ramanujan's widow, Janaki Ammal. She lamented the fact that a statue of Ramanujan had never been made, although one had been promised. Andrews sent me copies of these interviews, and after a couple of months my subconscious finally got through to my conscious mind and it was clear that a bust should be made. Since Janaki Ammal was 80, time was important\*, so it was up to individuals rather than governments or societies, since institutions move slowly. My first reason for wanting a bust was simple: if Ramanujan's widow wanted one, she should have it. That was the least we could do to show our appreciation of Ramanujan to someone who had been a great help to him.'

'Later I realized there was a second reason, which Janaki Ammal must have realized all along. She knew Ramanujan, and while she did not understand his mathematics, she knew that he was one of the few whose work will last. As long as people do mathematics, some of Ramanujan's work will be appreciated. In Ramanujan's case a more permanent memorial is appropriate; one which can be appreciated by those who do not understand his mathematics should be added to the memorial Ramanujan made for himself with his work.'

From the desire to the accomplishment is a long way.

1. A likeness of Ramanujan had to be found. It was provided by the original of

the photograph that is the frontispiece in Hardy's book on Ramanujan.

2. A sculptor who would accept the challenge of making a three-dimensional bust from a two-dimensional photograph. Askey found such a sculptor of distinction in Paul T. Granlund of Gustavus College, Saint Peter, Minnesota, USA.

3. A minimum of four busts had to be commissioned. Askey obtained enough funds by donations from the international community of mathematicians for one bust to be presented to Mrs Ramanujan (which it was in the autumn of 1983). Askey acquired one; and my wife and I two†.

That was how the bust that you see came to be made. And as Askey has said.

'While Granlund does not appreciate Ramanujan's mathematics as those of us who have studied it do, he studied Ramanujan's passport photo deeply, and the results show in the bust. He probably understands some things about Ramanujan that we do not.'

May I now present the bust of Srinivasa Ramanujan to President Sir Michael Atiyah for his gracious acceptance on behalf of the Royal Society.



\*Mrs Ramanujan died on 13 April 1994. She was 94.

†Since the original four and additional five have been acquired by other institutions, including the one in the Cambridge Mathematical Faculty Library.