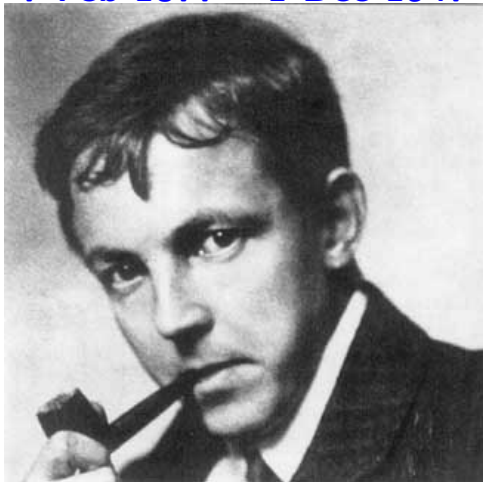


# Godfrey Harold Hardy

7 Feb 1877 – 1 Dec 1947



The History and Context of Mathematics  
Spring 2009

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## Young age

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### Parents:

Sophia Hardy – a teacher at Lincoln Teacher's Training School

Isaac Hardy – a bursar and an art master at Cranleigh school

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*"At the age of two, he was writing down numbers up to millions (a common sign of mathematical ability). When he was taken to church he amused himself by factorizing the number of the hymns..."*

(C.P. Snow, Foreword in: G.H. Hardy, A Mathematician's apology)

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*"I do not remember having felt, as a boy, any passion for mathematics... I thought of mathematics in terms of examinations and scholarships: I wanted to beat other boys, and this seemed to be the way in which I could do so most decisively."*

(G.H. Hardy, A mathematician's apology)

## Young age

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- Cranleigh School, Surrey  
He came top of his class in all subjects
- Won a scholarship to Winchester College in 1889 (aged 12).
- Won an open scholarship to Trinity College, Cambridge.  
Entered 1896
- First advisor: Professor R.R. Webb  
Wanted to change to history
- Second advisor: Professor A.E.H. Love  
*"My eyes were first opened by Professor Love, who first taught me a few terms and gave me my first serious conception of analysis. But the great debt which I owe to him was his advice to read Jordan's "Cours d'analyse"; and I shall never forget the astonishment with which I read that remarkable work, the first inspiration for so many mathematicians of my generation, and learnt for the first time as I read it what mathematics really meant."*

## Career

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- 1900 Hardy was elected a fellow of Trinity College, Cambridge
- 1901 Smith's prize
- 1906–1916 Lecturer in mathematics at Trinity College, Cambridge
- Before 1911:  
*"I wrote a great deal... but very little of any importance; there are not more than four or five papers which I can still remember with some satisfaction."*  
(G.H. Hardy, A mathematician's apology)
- 1911 Began his collaboration with J E Littlewood which was to last 35 years.
- 1913 Hardy received Ramanujan's first letter from India which was to start his second major collaboration.

Their collaboration ended due to the early death of Ramanujan. Hardy wrote:

*"I owe more to him than to any one else in the world with no exception, and my association with him is the one romantic incident in my life."*

## Career

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- 1919 Elected to the Savilian Chair of Geometry at Oxford and migrated to New College.

In Snow's words:

*"He was offered a chair at Oxford in 1919 and immediately walked into the happiest time of his life... now the collaboration with Littlewood rose to its full power."*

- 1928–1929 Visiting Professor at Princeton and at the California Institute of Technology.
- 1931 Return to Cambridge, Sadleirian Chair of Pure Mathematics
- 1942 Retired from the Sadleirian Chair
- 1947 He died suddenly on 1st December 1947

## Hardy's Personality

Very shy, self-conscious:

Snow wrote:

*At school "He came top of his class in all subjects. But, as a result of coming top of his class, he had to go in front of the school to receive prizes: and that he could not bear."*

*Later: "He could not endure his photograph taken: so far as I know, there are only five snapshots in existence. He would not have any looking glass in his rooms, not even a shaving mirror. When he went to a hotel, his first action was to cover all the looking glasses with towels."*

## Hardy's Personality

Sports: He liked to play squash, tennis, but his great passion was for cricket.

At the end of his foreword in "A Mathematical Apology" Snow wrote:

*"he told his sister: "If I knew that I was going to die today, I think I should still want to hear the cricket scores."*

He even explained the content of one of his results in one of his papers using the language of cricket.

## Hardy's Work and Legacy

- Hardy's major contributions were in the fields of **Number Theory** and **Mathematical Analysis**.
- He published more than **300** original papers and **11** books, some being a joint work with his collaborators.

*"Hardy was the author, or part author, of more than 300 original papers, covering almost every kind of analysis, which by their originality and quantity marked him as one of the leading mathematician of the time."*

(E.C. Titchmarsh, "G.H. Hardy", in Journal of the London Mathematical Society, 1950)

## Hardy's Work and Legacy

- He had 25 students and 1357 descendants.

Source: Mathematics Genealogy Project

- He was instrumental in launching the *Quarterly Journal of Mathematics* and the *Journal of the London Mathematical Society*.
- Hardy served on the Council of the LMS (short for London Mathematical Society) and was elected to the posts of Secretary and President of the LMS.
- Hardy had honorary degrees from many universities (such as Harvard, Athens and Birmingham).
- He was an honorary member of many of the leading foreign scientific academies.

## Hardy's Work and Legacy

Hardy was awarded, among many others,

- Royal Society Royal Medal (1920)
- De Morgan Medal of the Royal Society (1929)
- Royal Society Sylvester Medal (1940)
- Elected “associé étranger” of the Paris Academy of Sciences (1947)
- Royal Society Copley Medal (1947)  
Hardy learnt of the award only a few weeks before his death.

## Role of Hardy in British pure mathematics in the first half of the 20<sup>th</sup> century

Rice-Wilson highlights the following four points:

- He vigorously promoted research into various areas of analysis, particularly integrals and Fourier, as well as topics in analytic number theory.
- He helped to found new publication outlets for pure mathematicians working in Britain and elsewhere.
- He consistently advocated an internationalist approach to mathematical research activity.
- He urged academic institutions to increase financial support for the emergent profession of research level mathematics.

## Hardy's views

### On **religion**:

- *“Hardy always referred to God as his personal enemy”*  
(E.C. Titchmarsh, “G.H. Hardy”, in Journal of the London Mathematical Society, 1950)
- During a trip to Denmark he sent back a postcard claiming that he had proved the Riemann hypothesis. He reasoned that God would not allow the boat to sink on the return journey and give him the same fame that Fermat had achieved with his “last theorem”.
- When he went to cricket matches he would take what he called his “anti-God battery”. This consisted of thick sweaters, an umbrella, mathematical papers to referee, student examination scripts etc. His theory was that God would think that he expected rain to come so that he could then get on with his work. Hardy thought that God would then have the sun shine all day to spite him.

## Hardy's views

### **On real mathematics:**

In "A Mathematician's Apology", Hardy wrote

*"It is true that there are branches of applied mathematics, such as ballistics and aerodynamics, which have been developed deliberately for war... but none of them has any claim to rank as 'real'. They are indeed repulsively ugly and intolerably dull... So a real mathematician has his conscience clear; there is nothing to be set against any value his work may have; mathematics is, as I said at Oxford, a 'harmless and innocent' occupation."*

*"I have never done anything 'useful'. No discovery of mine has made, or is likely to make, directly or indirectly, for good or ill, the least difference to the amenity of the world."*

*"Judged by all practical standards, the value of my mathematical life is nil; and outside mathematics it is trivial anyhow."*

Hardy's views

**On the permanence of mathematical achievement:**

*“What we do may be small, but it has a certain character of permanence; and to have produced anything of the slightest permanent interest, whether it be a copy of verses or a geometrical theorem, is to have done something utterly beyond the powers of the vast majority of men.”*

*“‘Immortality’ may be a silly word, but probably a mathematician has the best chance of whatever it may mean.”*

## Hardy's views

### **On war:**

In "A Mathematician's Apology", Snow wrote:

*"Hardy, like Russel and many of the high Cambridge intelligentsia, did not believe that the war should have been fought."*

Hardy wrote:

*"The first and the most obvious is that the effect of science on war is merely to magnify its horror..."*

*"...there is one purpose at any rate which the real mathematics may serve in war. When the world is mad, a mathematician may find in mathematics an incomparable anodyne. For mathematics is, of all the arts and sciences, the most austere and the most remote..."*

## End of life

Hardy had remained remarkably youthful in both mind and body until 1939 when, at the age of 62, he had a heart attack.

His remarkable mental powers began to leave him and sports which he had loved to participate in up till then became impossible.

By the time the war ended in 1945 Hardy health was failing fast.

He became very depressed. By 1946 he could only get around by taking taxi rides, a few steps would make him short of breath.

In early summer of 1947 he tried to take his own life by taking a large dose of barbiturates. He took so many, however, that he was sick and survived.

In “A Mathematician’s Apology”, Hardy wrote:

*“The mathematician’s patterns, like those of the painter’s or the poet’s, must be beautiful, the ideas, like the colours or the words, must fit together in a harmonious way. There is no permanent place in the world for ugly mathematics.”*