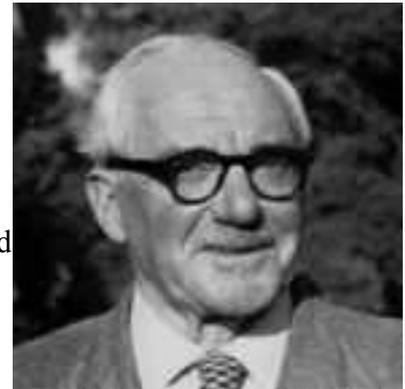# John Littlewood

British mathematician **John Edensor Littlewood** (June 8, 1885 –
September 6, 1977) was a close friend and collaborator of G.H. Hardy.
For 35 years the two men shared a number of common mathematical
interests, among which were the Riemann zeta function, inequalities, and
the theory of functions. Hardy and Littlewood used series to produce
several major breakthroughs in number theory and extended their
usefulness to a variety of other mathematical areas. Littlewood was the lesser known and less colorful
of the two very fine mathematicians. Once when Littlewood attended an international conference in
France, a French mathematician greeted him: "So there really is a Littlewood, and it is not just a
pseudonym which G.H. Hardy uses to publish his poorer papers!" Littlewood, who had a marvelous
sense of humor, probably had a good laugh at this, but there was nothing poor about Littlewood's
mathematical work. Hardy knew Littlewood's worth, once writing of his colleague, "no one else who
could command such a combination of insight, technique, and power." Littlewood's mathematical
reputation does not depend on his relation to Hardy alone. He outlived Hardy by thirty years and
remained active in mathematics even to an advanced age. One of his most complicated pieces of work,
100 pages of hard analysis, which he dubbed "The Monster," was completed when he was over
seventy. His last paper that broke new ground appeared when he was 84 and his last published paper
was in 1972, when he was 87.

Hardy and Littlewood established four axioms for collaboration. The first was that when one wrote to
the other it was not to matter whether what was said was right or wrong, otherwise they could not write
as openly as they pleased. The second was that the one who received a message from the other was
under no obligation to read it or respond to it, as the recipient might not be interested in the particular

problem. The third was that it did not matter if they both thought about the same detail; in fact it was preferable if they did not. Finally the fourth and most important axiom was that it didn't matter if one of them had not contributed anything to the contents of a paper under their joint names, otherwise arguments might arise, and one or the other would not wish to be named co-author. J.C. Burkill describes their partnership: "Normally Littlewood would make the penultimate version of a paper, with a skeleton of all the essential mathematics, simplifying and abbreviating in notation clear to Hardy. Hardy would add what they called the 'gas' and write the paper in the elegant prose of which he was a master. Littlewood's own style, in its clarity and brevity, was equally magisterial."

Littlewood was born in Rochester, Kent, England, the eldest son of Edward Thornton Littlewood and Sylvia Maud Ackland. Edward Littlewood attended Peterhouse College, Cambridge, where he was the ninth wrangler in the Mathematical Tripos of 1882. He later became the headmaster at a newly founded school at Wynberg near Cape Town, remaining there until his retirement. John E. Littlewood attended St. Paul's from 1900 to 1903, where he came under the influence of F.S. Macaulay, a creative mathematician who encouraged his students to work independently. This university approach served Littlewood well, as he gained self-reliance and good judgment. He was awarded an Entrance Scholarship at Trinity College, Cambridge, in 1903. Two years later, Littlewood was Senior Wrangler and in the following year he was placed in Class I, division 1 in Part II of the Mathematical Tripos. From 1907 to 1910, Littlewood was Richardson lecturer at the University of Manchester. In 1908 he won a Smith's Prize and returned to Trinity as a Fellow in 1910, becoming Rouse Ball professor of mathematics there in 1928.

The Hardy-Littlewood collaboration was interrupted by World War I. Littlewood joined the Royal Artillery. From 1914 to 1918, he served as a 2nd Lieutenant in the Royal Garrison Artillery, performing hand calculations needed for ballistic work in the pre-electronic era. Just before Littlewood left for the

war, a letter arrived from the self-taught Indian mathematical genius Srinivasa Ramanujan. The two Cambridge Dons poured over his list of unproven theorems and found that the author had discovered or rediscovered important mathematical results. From then on until his untimely death, Ramanujan became a special partner of Hardy and Littlewood. When Ramanujan arrived in Cambridge, Littlewood taught him rigorous mathematical methods. In the first proof sheets of an article Hardy composed about Ramanujan, he wrote, "As someone said, each of the positive integers was one of his personal friends." Littlewood remarked to Hardy, "I wonder who said that; I wish I had." In the printed article, the particular passage read, "It was Littlewood who said, each of the positive integers was one of his personal friends."

Littlewood shared Hardy's passion for pure mathematics, but unlike his friend, he saw the importance of teaching, saying in his usual wry way: "In passing, I firmly believe that research should be offset by a certain amount of teaching, if only as change from the agony of research. The trouble, however, I freely admit, is that in practice you get either no teaching, or else far too much." Littlewood's fine sense of humor is revealed in his book *A Mathematician's Miscellany* (1953), which demonstrated and celebrated the intellectual joy he found in life and in doing creative mathematics. It is still one of the most accessible popular books written by a mathematician, consisting of a collection of random and fascinating mathematical curiosities, anecdotes and opinions. After Littlewood's death, his friend and colleague Béla Bollobás reedited the book as *Littlewood's Miscellany.* The new version contains some amusing "gossip" about Littlewood and his contemporaries. The following are selections from the two works:

 "A good mathematical joke is better, and better mathematics, than a dozen mediocre papers."

 "I recall once saying that when I had given the same lecture several times I couldn't help feeling that they really ought to know it by now."

 "The surprising thing about this paper is that a man who could write it would."

"This paper is very heavy going and I should have never read it had I not written it myself."

Littlewood shared an amusing typing story: "A [memo] I wrote (about 1917) for the Ballistic Office ended with the sentence, 'Thus σ should be made as small as possible.' This did not appear in the printed [memo] But P.J. Grigg said, 'What is that?' A speck in a blank space at the end proved to be the tiniest σ I have ever seen (the printers scoured London for it)."

Littlewood was elected a Fellow of the Royal Society in 1915. He received the Royal Medal of the Society in 1929, the Sylvester Medal of the Society in 1943, and in 1958 the Copley Medal of the Society. Except for the years he was in the service, Littlewood lived in Neville's Court, Trinity College for 51 years. He was described as "slightly below average in height, strongly built and agile." He had been a gymnast at school and like Hardy enjoyed attending sporting events, particularly cricket. He took up skiing, rock climbing, and enjoyed walking for many miles at a quick pace. He had a serious interest in music, particularly the works of Bach, Beethoven and Mozart, owned a large collection of gramophone records, and as an adult taught himself to play the piano. In August 1977, Littlewood fell out of his bed and was not discovered until morning. As a result he was transferred to a nursing home, where he died suddenly on September 6, 1977.

Quotation of the Day: "Try a hard problem. You may not solve it, but you will prove something else." – John E. Littlewood