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## Andrew Wiles

Andrew Wiles is one of the very few mathematicians – if not the only – whose proof of a theorem has been international headline news. In 1994 he cracked Fermat's Last Theorem, which at the time was the most famous, and long-running, unsolved problem in the subject's history.

Wiles' proof was not only the high point of his career – and an epochal moment for mathematics – but also the culmination of a remarkable personal journey that began three decades before. In 1963, when he was a ten-year-old boy growing up in Cambridge, England, Wiles found a copy of a book on Fermat's Last Theorem in his local library. He became captivated by the problem – that there are no whole number solutions to the equation  $x^n + y^n = z^n$  when  $n$  is greater than 2 – which was easy to understand but which had remained unsolved for three hundred years. "I knew from that moment that I would never let it go," he said. "I had to solve it."

Wiles studied mathematics at Merton College, Oxford, and returned to Cambridge, at Clare College, for postgraduate studies. His research area was number theory, the mathematical field that investigates the properties of numbers. Under the guidance of his advisor John Coates, Wiles studied elliptic curves, a type of equation that was first studied in connection with measuring the lengths of planetary orbits. Together they made the first progress on one of the field's fundamental

conjectures, the Birch and Swinnerton-Dyer conjecture, proving it for certain special cases. Wiles was awarded his PhD in 1980 for the thesis *Reciprocity laws and the conjecture of Birch and Swinnerton-Dyer*.

Between 1977 and 1980 Wiles was an Assistant Professor at Harvard University, where he started to study modular forms, a separate field from elliptic curves. There he began a collaboration with Barry Mazur, which resulted in their 1984 proof of the main conjecture of Iwasawa theory, a field within number theory. In 1982 he was made a professor at Princeton University.

During the early years of Wiles' academic career he was not actively trying to solve Fermat's Last Theorem – nor was anyone else, since the problem was generally regarded as too difficult, and possibly unsolvable. A turning point came in 1986 when it was shown that the three-century-old problem could be rephrased using the mathematics of elliptic curves and modular forms. It was an amazing twist of fate that two subjects that Wiles had specialized in turned out to be exactly the areas that were needed to tackle Fermat's Last Theorem with modern tools. He decided that he would return to the problem that so excited him as a child. "The challenge proved irresistible," he said.

Wiles made the unusual choice to work on Fermat alone, rather than collaborating with colleagues. Since



the problem was so famous, he was worried that news he was working on it would attract too much attention and he would lose focus. The only person he confided in was his wife, Nada, who he married shortly after embarking on the proof.

After seven years of intense and secret study, Wiles believed he had a proof. He decided to go public during a lecture series at a seminar in Cambridge, England. He did not announce it beforehand. The title of his talk, *Modular Forms, Elliptic Curves and Galois Representations*, gave nothing away, although rumour had spread around the mathematical community and two hundred people were packed in the lecture theatre to hear him. When he wrote the theorem up as the conclusion to the talk, the room erupted in applause.

Later that year, however, a referee checking the details of his proof found an error in it. It was devastating for Wiles to contemplate the idea that he had not, in fact, solved Fermat's Last Theorem. He set to work trying to fix the issue, enlisting one of his former students, Richard Taylor, to help him with the task. After a year's work, Wiles found a way to correct the error. "I had this incredible revelation," a tearful Wiles told a BBC documentary. "It was the most important moment of my working life."

Not only is it rare to announce the proof of a famous theorem, but it is also extremely unusual to go back and

fix an error like this, because of the mental exhaustion from trying it the first time around. No gaps were found in the revised proof and it was published in *Annals of Mathematics* in 1995, with the title *Modular elliptic curves and Fermat's Last Theorem*.

As well as the attention of the global media, Wiles received many awards. They include the Rolf Schock Prize, the Ostrowski Prize, the Wolf Prize, the Royal Medal of the Royal Society, the U.S. National Academy of Science's Award in Mathematics, and the Shaw Prize. The International Mathematical Union presented him with a silver plaque, the only time they have ever done so. He was awarded the inaugural Clay Research Award. In 2000 he was given a knighthood.

Wiles was at Princeton between 1982 and 2010, except for short periods of leave. In 2010 he returned to Oxford as a Royal Society Research Professor. His address at the Mathematical Institute is the Andrew Wiles Building, which opened in 2013 and was named in his honour.

Sources:

Fermat's Last Theorem by Simon Singh.

Wikipedia

Notices of the AMS

Shawprize.org

BBC Horizon.

