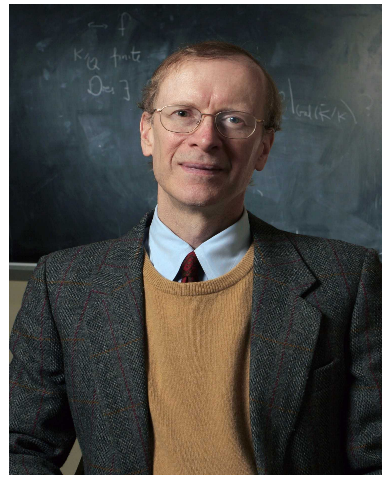
Andrew John Wiles

In 1995, **Andrew John Wiles** (April 11, 1953 -) succeeded in proving the 350 year-old Fermat's Last Theorem (FLT), and suddenly the unassuming English mathematician became a celebrity. After Fermat's death, the following marginal note was found in his copy of Bachet's edition of the complete works of Diophantus: "To divide a cube into two cubes, a fourth power, or in general any power whatever above the second, into two powers of the same denomination, is impossible, and I have assuredly found an admirable proof of this, but the margin is too narrow to contain it." With these words Fermat set the mathematical world on a long uncharted voyage to discover a proof of his claim. In modern notation, FLT asserts that there do not exist positive integers x, y, z and n such that



$$x^n + y^n = z^n \text{ when } n > 2.$$

For centuries mathematicians were unable either to prove or disprove Fermat's statement. Many talented mathematicians struggled with the problem. In the 18th century, Leonhard Euler reviewed Fermat's work on number theory and proved most of the latter's assertions. Euler noted that Fermat had provided a proof of his theorem in the case when $n = 4$, and Euler showed how to prove the assertion for $n = 3$. Some thought they had solved the general case but were mistaken, while mathematicians like Gauss and Hilbert claimed they had better things to do with their time than waste it on such a triviality, likely to result in failure anyway. Many mathematicians owed their reputation, at least in part, to the advances they made while working on the problem.

Wiles, born at Cambridge, became aware of FLT when at ten years of age he found a discussion of it and its history in a library book. He decided then and there that one day he would solve the problem. Wiles earned a B.A. at Merton College, Oxford in 1974 and a doctorate from Clare College, Cambridge in 1980. His thesis, supervised by John Coates, was not concerned with FLT, but was a work on the theory of elliptic curves, which would later prove to have a connection with his avowed goal. While completing his doctorate, Wiles was a Junior Research fellow at Clare College and also a Benjamin Peirce Assistant Professor at Harvard. In 1981, he moved to the Institute for Advanced Study and the next year was appointed a professor at Princeton University. In 1994, he became Eugene Higgins Professor of Mathematics at Princeton.

The final chapter in the long history of FLT began in 1955 when 28-year-old Yutaka Taniyama posed a problem at an international conference on algebraic number theory held in Tokyo. Three years later Taniyama committed suicide and his work was taken up by his close friend Goro Shimura. The result, known as the Taniyama-Shimura conjecture, establishes an important connection between elliptic curves, studied in algebraic geometry, and modular forms, which are certain functions investigated in number theory. Elliptic curves are not ellipses but Diophantine equations of the form

$$y = Ax^3 + Bx^2 + Cx + D$$

Such equations were found among Fermat's work. The Taniyama-Shimura conjecture effectively claims that every rational elliptic curve is a modular form in disguise.

In 1984, Gerhard Frey of Germany suggested that if the Taniyama-Shimura conjecture were true, then so would FLT. The next year Kenneth Ribet of the University of California at Berkeley proved the connection. When Wiles proved a special case of the Taniyama-Shimura conjecture, it was strong enough to remove Fermat's Last Theorem from the ranks of unsolved mathematical problems.

In 1993, Wiles gave a series of lectures, whose subject was not announced, at the Isaac Newton Institute at Cambridge. In his final lecture, before an overflowing crowd of spectators who could tell where Wiles was going, he announced his proof. At the end of his talk, Wiles wrote on the board: "I think I'll stop here." This was the culmination of seven years work for Wiles, in which he concentrated solely on finding a proof. But the announcement was premature and was not followed by a publication of the details of his proof. When his results were written up for publication, a subtle error was discovered. While this was a terrible blow, he went back to his research with his former student Richard Taylor for another 18 months, before – well, let Wiles speak for himself:

> "… suddenly, totally unexpectedly, I had this incredible revelation. It was the most important in my working life. Nothing I ever do again … it was so indescribably beautiful, it was so simple and so elegant, and I just stared in disbelief for twenty minutes, then during the day I walked round the department. I'd keep coming back to my desk to see if it was still there - it was still there."

This time the proof stood, but it took the mathematical world two additional years to verify it, after his original manuscript, *Modular elliptic curves and Fermat's Last Theorem*, and the Wiles-Taylor correction was published in the *Annals of Mathematics* in May 1995. In 1999 Christophe Breuil, Brian Conrad, Fred Diamond and Taylor gave a proof of the full Taniyama-Shimura conjecture.
With Wiles' triumph came many honors. He was awarded the Schock Prize in Mathematics from the Royal Swedish Academy of Sciences and the Prix Fermat from the Université Paul Sabatier. In 1996, he received the Wolf Prize and was elected as a foreign member to the National Academy of Sciences of the United States, receiving its mathematics prize. On June 27, 1997, Wiles collected the Wolfskehl Prize, worth roughly $50,000, which because of inflation was much less than what Wolfskehl had intended when he provided money in his will to establish the prize a hundred years earlier. On May 10, 1999, Wiles received the first Clay Mathematics Institute Award.

Though Wiles is unlikely ever to find another problem of such great significance, he is still a relatively young man who may make great strides in other areas. At any rate he serves as an admirable mathematical model of dedication to a childhood dream. Some may have been disappointed that Wiles solved the famous problem and that his proof would not fit into the margin of a book or be as simple as Fermat seemed to think it was. It seems unlikely that Fermat actually had a proof of the general case of his last theorem. Andre Weil wrote:

> "Only on one ill-fated occasion did Fermat ever mention a curve of higher genus $x^n + y^n = z^n$, and there hardly remains any doubt that this was due to some misapprehension on his part […] for a brief moment perhaps […] he must have deluded himself into thinking he had the principle of a general proof."

Wiles isn't the first and probably won't be the last person to decide to solve a major problem while still a child. After a successful business career, Heinrich Schliemann realized his lifelong ambition of finding the site of the Homeric poems. He led the excavation of the tell (a mound covering the successive remains of ancient communities) at Hisarlik in Asia Minor, where he discovered nine superimposed city sites of Troy. As a child, French scholar Jean François Champollion declared that one day he would decipher the "silent" symbols of the Egyptian hieroglyphs. He succeeded by discovering the Rosetta Stone in July 1799 in the small Egyptian village of Rosette (Raschid). It contains three inscriptions that represent a single text, a decree of the priests of Memphis in honor of Ptolemaios (196 BCE), in three different variants of script. The text appears in the form of hieroglyphs (the script of the official and religious texts), of Demotic (the everyday Egyptian script) and in Greek. Then there was Dutch paleontologist Eugènie Dubois whose interest in the "missing link" between the apes and man took him to Java in 1887. In the 1890s he found the humanoid remains named as *Pithecanthropus erectus* or "Java Man," which he claimed to be the missing link. Although his view was contested and ridicules, in the 1920s, it became widely accepted in the scientific world. Finally, while still a lad in Texas, Sam Rayburn decided that being the Speaker of the U.S. House of Representatives was the best job imaginable and announced that one day he would hold the position –

and hold it he did, at various times from 1940 to 1961.

Quotation of the Day: “Pure mathematicians just love a challenge. They love unsolved problems. When doing maths there’s this great feeling. You start with a problem that just mystifies you. You can’t understand it, it’s so complicated, you just can’t make head nor tail of it. But then when you finally resolve it, you have this incredible feeling of how beautiful it is, now it all fits together so elegantly. Most deceptive are the problems which look easy, and yet they turn out to be incredibly intricate. Fermat is the most beautiful example of this. It just looked as though it had to have a solution and, of course, it’s very special because Fermat said that he had a solution.” – Andrew Wiles