# A biography of Robert P Langlands

## By Alex Bellos

In January 1967, Robert Langlands, a 30-year-old associate professor at Princeton, wrote a letter to the great French mathematician André Weil, aged 60, outlining some of his new mathematical insights.

"If you are willing to read it as pure speculation I would appreciate that," he wrote. "If not – I am sure you have a waste basket handy."

Langlands' modesty now reads like an almost comic piece of understatement. His 17-page letter introduced a theory that created a whole new way of thinking about mathematics: it suggested deep links between two areas, number theory and harmonic analysis, that had previously been considered unrelated.

In fact, so radical were his insights, and so rich the mechanisms he suggested to bridge these mathematical fields, that his letter began a project, the Langlands programme, that has enlisted hundreds of the world's best mathematicians over the last fifty years. No other project in modern mathematics has as wide a scope, has produced so many deep results, and has so many people working on it. As its depth and breadth have grown, the Langlands programme is frequently described as a grand unified theory of mathematics.

Robert Phelan Langlands was born in New Westminster, Greater Vancouver, Canada, in 1936. When he was nine, he moved to a small tourist town near the US border where his parents had a shop selling building supply materials. He had no intention of going to university until a teacher told him, in front of his classmates, that it would be a betrayal of his God-given talents.

Langlands enrolled at the University of British Columbia aged 16. He completed his bachelor's degree in mathematics in 1957, and his master's degree a year later. He moved to Yale University for his doctorate, completing his PhD thesis, *Semi-groups and representations of Lie groups*, in his first year there. In his second year he began to study the work of the Norwegian Atle Selberg, which later became central to his own research.

In 1960, Langlands joined Princeton University as an instructor, where he rubbed shoulders with Selberg, as well as André Weil and Harish-Chandra, all of whom were at the nearby Institute for Advanced Study. He was especially influenced by the work of Harish-Chandra on automorphic forms. Langlands was also learning other areas of mathematics, such as class field theory, an area he was nudged into by his colleague Salomon Bochner, who encouraged him to give a course in it. In 1962,

Langlands was appointed a member in the Institute's School of Mathematics.

During the Christmas break of 1966, Langlands came up with the basic idea of "functoriality", a mechanism for linking ideas in number theory to those in automorphic forms. He bumped into Weil in a corridor in the beginning of January 1967 and began to explain his discovery. Weil suggested he write up his thoughts in a letter.

Langlands swiftly wrote the letter in longhand. Weil had the letter typed up and it was widely circulated among mathematicians. Over the next few years, the letter provided many of them with a number of new, deep and interesting problems and as more people joined the project to prove his conjectures the enterprise became known as the Langlands programme. "There were some fine points that were right that rather surprise me to this day," Langlands later said about the letter. "There was evidence that these L-functions were good but that they would have these consequences for algebraic number theory was by no means certain."

Langlands spent the year 1967-68 at the Middle East Technical University in Ankara. He speaks fluent Turkish. An enthusiastic learner of languages, he also speaks German and Russian.

Langlands returned to Yale where he developed his twin ideas of functoriality and reciprocity and published them in *Problems in the Theory of Automorphic Forms* (1970). In 1972 he returned to Princeton as a professor at the Institute for Advanced Study, where he has been ever since.

Throughout the 1970s, Langlands continued to work on ideas within his programme. In the mid-1980s, he turned his attention to percolation and conformal invariance, problems from theoretical physics. In recent years he has been looking back at ideas that he pioneered, such as one called "endoscopy".

Langlands has won many awards, including the first US National Academy of Sciences Award in Mathematics in 1988 "for his extraordinary vision". He shared the

1996 Wolf Prize with Andrew Wiles for his "path blazing work". Other awards include the 2005 American Mathematical Society Steele Prize, the 2006 Nemmers Prize in Mathematics and the 2007 Shaw Prize in Mathematical Sciences (with Richard Taylor).

While at UBC, aged 19, he married Charlotte Lorraine Cheverie. He has four children with Charlotte, and several grandchildren.

At the age of 81, he continues to work at the Institute for Advanced Study, where he is now Emeritus Professor, and where he occupies the office once used by Albert Einstein.

## Sources

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