Lafforgue and Voevodsky Receive Fields Medals

Laurent Lafforgue

Vladimir Voevodsky

On August 20, 2002, two Fields Medals were awarded at the opening ceremonies of the International Congress of Mathematicians (ICM) in Beijing, China. The medalists are Laurent Lafforgue and Vladimir Voevodsky.

The Fields Medals are presented in conjunction with the ICM, which is held every four years at different locations around the world. Although there is no formal age limit for recipients, the medals have traditionally been presented to mathematicians not older than 40 years of age, as an encouragement for future achievement. The medal is named after the Canadian mathematician John Charles Fields (1863–1932), who organized the 1924 ICM in Toronto. At a 1931 meeting of the Committee of the International Congress, chaired by Fields, it was decided that the $2,500 left over from the Toronto ICM "should be set apart for two medals to be awarded in connection with successive International Mathematical Congresses." In outlining the rules for awarding the medals, Fields specified that the medals "should be of a character as purely international and impersonal as possible." During the 1960s, in light of the great expansion of mathematics research, the possible number of medals to be awarded was increased from two to four. Today the Fields Medal is recognized as the world's highest honor in mathematics.

Previous recipients are: Lars V. Ahlfors and Jesse Douglas (1936); Laurent Schwartz and Atle Selberg (1950); Kunihiko Kodaira and Jean-Pierre Serre (1954); Klaus F. Roth and René Thom (1958); Lars Hörmander and John W. Milnor (1962); Michael F. Atiyah, Paul J. Cohen, Alexandre Grothendieck, and Stephen Smale (1966); Alan Baker, Heisuke Hironaka, Sergei P. Novikov, and John G. Thompson (1970); Enrico Bombieri and David B. Mumford (1974); Pierre R. Deligne, Charles L. Fefferman, Grigorii A. Margulis, and Daniel G. Quillen (1978); Alain Connes, William P. Thurston, and Shing-Tung Yau (1982); Simon K. Donaldson, Gerd Faltings, and Michael H. Freedman (1986); Vladimir Drinfeld, Vaughan F. R. Jones, Shigefumi Mori, and Edward Witten (1990); Jean Bourgain, Pierre-Louis Lions, Jean-Christoph Yoccoz, and Efim Zelmanov (1994); Richard Borcherds, William Timothy Gowers, Maxim Kontsevich, and Curtis T. McMullen (1998).

The medals are awarded by the International Mathematical Union, on the advice of a selection committee. The selection committee for the 2002 Fields Medalists consisted of: James Arthur, Spencer Bloch, Jean Bourgain, Helmut Hofer, Yasutaka Ihara,

H. Blaine Lawson, Sergei Novikov, George Papanicolaou, Yakov Sinai (chair), and Efim Zelmanov.

Laurent Lafforgue

Laurent Lafforgue was born on November 6, 1966, in Antony, France. He graduated from the École Normale Supérieure in Paris (1986). He became a *chargé de recherche* of the Centre National de la Recherche Scientifique (CNRS) (1990) and worked on the Arithmetic and Algebraic Geometry team at the Université Paris-Sud, where he received his doctorate (1994). In fall 2000 he was promoted to *directeur de recherche* of the CNRS in the mathematics department of the Université Paris-Sud. Shortly thereafter he became a permanent professor of mathematics at the Institut des Hautes Études Scientifiques in Bures-sur-Yvette, France.

Laurent Lafforgue has made an enormous advance in the Langlands Program by proving the global Langlands correspondence for function fields. The Langlands Program, formulated by Robert Langlands in the 1960s, proposes a web of relationships connecting Galois representations and automorphic forms. The influence of the Langlands Program has grown over the years, with each new advance hailed as an important achievement.

The roots of the Langlands program are found in one of the deepest results in number theory, the Law of Quadratic Reciprocity, which was first proved by Carl Friedrich Gauss in 1801. This law allows one to describe, for any positive integer d, the primes p for which the congruence $x^2 \equiv d \bmod p$ has a solution. Despite many proofs of this law (Gauss himself produced six different proofs), it remains one of the most mysterious facts in number theory. The search for generalizations of the Law of Quadratic Reciprocity stimulated a great deal of research in number theory in the nineteenth century. Landmark work by Emil Artin in the 1920s produced the most general reciprocity law known up to that time. One of the original motivations behind the Langlands Program was to provide a complete understanding of reciprocity laws.

The global Langlands correspondence for GL_n proved by Lafforgue provides a complete understanding of reciprocity laws for function fields. Lafforgue established, for any given function field, a precise link between the representations of its Galois groups and the automorphic forms associated with the field. He built on work of 1990 Fields Medalist Vladimir Drinfeld, who in the 1970s proved the global Langlands correspondence for GL_2.

Vladimir Voevodsky

Vladmir Voevodsky was born on June 4, 1966, in Russia. He received his B.S. in mathematics from Moscow State University (1989) and his Ph.D. in mathematics from Harvard University (1992). He held visiting positions at the Institute for Advanced Study, Harvard University, and the Max-Planck-Institut für Mathematik before joining the faculty of Northwestern University in 1996. In 2002 he was named a permanent professor in the School of Mathematics at the Institute for Advanced Study in Princeton, New Jersey.

Vladimir Voevodsky made one of the most outstanding advances in algebraic geometry in the past few decades by developing new cohomology theories for algebraic varieties. This achievement has its roots in the work of 1966 Fields Medalist Alexandre Grothendieck. Grothendieck suggested that there should be objects, which he called "motives", that are at the root of the unity between number theory and geometry.

One of the most important of the generalized cohomology theories is topological K-theory, developed chiefly by another 1966 Fields Medalist, Michael Atiyah. An important result in topological K-theory is the Atiyah-Hirzebruch spectral sequence, developed by Atiyah and Friedrich Hirzebruch, which relates singular cohomology and topological K-theory.

For about forty years mathematicians worked hard to develop good cohomology theories for algebraic varieties; the best understood of these was the algebraic version of K-theory. A major advance came when Voevodsky, building on a little-understood idea proposed by Andrei Suslin, created a theory of "motivic cohomology". In analogy with the topological setting, there is a relationship between motivic cohomology and algebraic K-theory. In addition, Voevodsky provided a framework for describing many new cohomology theories for algebraic varieties. One consequence of Voevodsky's work, and one of his most celebrated achievements, is the solution of the Milnor Conjecture, which for three decades was the main outstanding problem in algebraic K-theory. This result has striking consequences in several areas, including Galois cohomology, quadratic forms, and the cohomology of complex algebraic varieties.

—Allyn Jackson