Borcherds, Gowers, Kontsevich, and McMullen Receive Fields Medals

On August 18, 1998, four Fields Medals were presented at the Opening Ceremonies of the International Congress of Mathematicians (ICM) in Berlin. The four medalists are: RICHARD E. BORCHERDS, WILLIAM TIMOTHY GOWERS, MAXIM KONTSEVICH, and CURTIS T. MCMULLEN.

At the 1924 Congress in Toronto a resolution was adopted that at each ICM two gold medals should be awarded to recognize outstanding mathematical achievement. J. D. Fields, a Canadian mathematician who was secretary of the 1924 Congress, later donated funds establishing the medals, which were named in his honor. Consistent with Fields's wish that the awards recognize both existing work and the promise of future achievement, the medals are awarded to young mathematicians, where "young" has traditionally been interpreted to mean no more than forty years of age in the year of the Congress. In 1966 it was agreed that, in light of the great expansion of mathematical research, up to four medals could be awarded at each ICM. Today the Fields Medal is widely 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, Alexander 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 (1983); 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-Christophe Yoccoz, and Efim Zelmanov (1994).

The committee choosing the 1998 Fields Medalists consisted of: John Ball (Oxford University), John Coates (Cambridge University), J. J. Duistermaat (University of Utrecht), Michael H. Freedman (Microsoft Research), Jürg Fröhlich (Eidgenössische Technische Hochschule, Zürich), Robert MacPherson (Institute for Advanced Study, Princeton), Yuri Manin (chair, Max-Planck-Institut für Mathematik, Bonn), Kyoji Saito (University of Kyoto), and Stephen Smale (City University of Hong Kong).

Richard Borcherds

Richard Borcherds was born on November 29, 1959, in Cape Town, South Africa. He received his undergraduate and doctoral degrees from the University of Cambridge. He has held various positions at Cambridge and at the University of California, Berkeley. Currently he is on leave from Berkeley and is a Royal Society Research Professor at Cambridge. In 1992 he received a European Mathematical Society Prize at the First European Congress of Mathematicians in Paris. He was an Invited Speaker at the ICM in Zürich in 1994.

As a student of John H. Conway, Borcherds began his research career in finite group theory. He has distinguished himself not only by utilizing techniques and ideas from outside of finite group theory but also by producing results that have had an impact in other areas. In the classification of fi-

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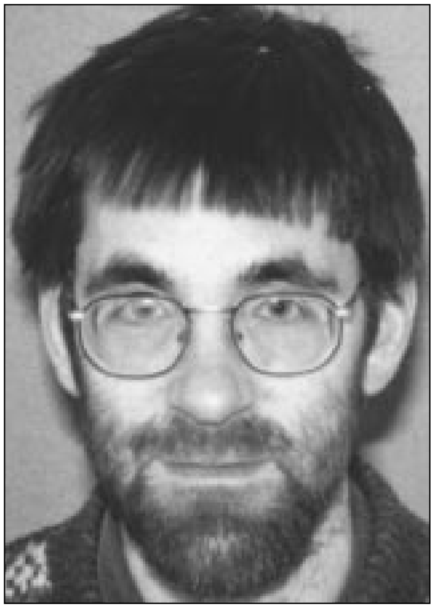


Richard Borcherds

William Timothy Gowers

Maxim Kontsevich

nite simple groups, one of the most mysterious objects found was the monster group. There are various conjectures that attempt to connect the monster to other parts of mathematics. Borcherds invented the notion of a vertex algebra and used it to solve the Conway-Norton conjecture, which concerns the representation theory of the monster group (this theory is sometimes called "monstrous moonshine"). He used these results to generate product formulae for certain modular and automorphic forms. The first such formulae were found in the one-dimensional case by Euler and Jacobi, and the conventional wisdom in algebraic geometry was that such product formulae could not exist in higher dimensions. Borcherds's work is also important in physics, as it lays rigorous groundwork for conformal field theory in two dimensions.

William Timothy Gowers

William Timothy Gowers was born on November 20, 1963, in Marlborough, England. He received his undergraduate and doctoral degrees from the University of Cambridge, where he was a student of Belá Bollobás. Gowers was a Research Fellow at Trinity College, Cambridge, before spending four years at University College, London. He was then appointed as a Lecturer at Cambridge and a Fellow of Trinity College. Currently he holds the Rouse Ball Chair of Mathematics at Cambridge. He was an Invited Speaker at the ICM in Zürich in 1994. In 1996 he received a European Mathematical Society Prize at the Second European Congress of Mathematics in Budapest.

Gowers works in the areas of Banach space theory and combinatorics. His main achievements are his solutions to a number of famous problems first stated in the 1930s by Stefan Banach. Gowers and B. Maurey exhibited in 1991 a Banach space having the property that none of its infinite-dimensional subspaces has an unconditional basis. An unconditional basis provides a useful coordinatization of the space, guaranteeing many "symmetries" (automorphisms).

Gowers also produced an example of a Banach space that is not isomorphic to any of its hyperplanes, thereby solving the famous Banach hyperspace problem. He proved a "dichotomy theorem", which says that every Banach space has either a subspace that has an unconditional basis, and therefore many symmetries, or is such that all of its subspaces have only trivial symmetries. This work solves in the affirmative the homogeneous space problem, one of the central problems in Banach space theory, which asks whether a homogeneous Banach space is a Hilbert space. A hallmark of Gowers's work is the way in which it combines techniques of analysis with combinatorial arguments. His work in combinatorics and combinatorial number theory includes results about Szemérédi's lemma and an improved proof of Szemérédi's theorem on arithmetic progressions.

Curtis T. McMullen

Maxim Kontsevich

Maxim Kontsevich was born on August 25, 1964, in Moscow. He received his doctoral degree from the University of Bonn, under the direction of Don B. Zagier. After holding a professorship at the University of California, Berkeley, he moved to his present position as professor at the Institut des Hautes Études Scientifiques in Bûres-sûr-Yvette, France. In 1992 Kontsevich received a European Mathematical Society Prize at the First European Congress of Mathematics in Paris. He was a Plenary Speaker at the ICM in 1994 in Zürich.

Kontsevich first received international attention for his doctoral thesis, in which he proved a conjecture of Edward Witten. This conjecture says that the generating function for intersection numbers on the moduli spaces of algebraic curves satisfies the Korteweg-de Vries equation. Also drawing on ideas of Witten, Kontsevich produced a vast generalization of the Gauss linking number for knots. He then used this generalization and a new notion of "graph cohomology" to generate Vassiliev knot invariants as well as invariants for three-manifolds. Kontsevich produced the first mathematical definition of the "number" of rational curves on Calabi-Yau manifolds, such as three-dimensional quintics, and gave an explicit formula for this number. This work was crucial for later work in the area of mirror symmetry. Most recently Kontsevich has established that any Poisson manifold admits a formal quantization and has provided an explicit formula for the flat case.

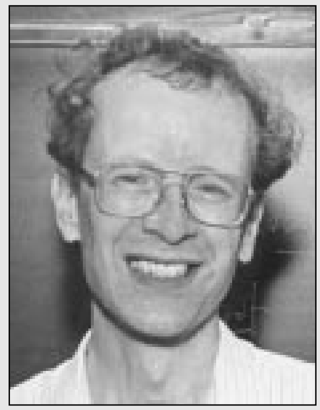
Curtis T. McMullen

Curtis T. McMullen was born on May 21, 1958, in Berkeley, California. He received his undergraduate degree in 1980 from Williams College and his doctoral degree in 1985 from Harvard University. His thesis advisor was Dennis Sullivan. McMullen has held positions at the Massachusetts Institute of Technology, the Mathematical Sciences Research Institute, the Institute for Advanced Study, Princeton University, and the University of California, Berkeley. At present he is a professor of mathematics at Harvard. In 1991 he received the Salem Prize.

McMullen has produced important results in several areas of mathematics, including the theory of computation, dynamical systems, and three-manifolds. In his doctoral thesis he used dynamical systems techniques to solve completely the question of whether there exist generally convergent algorithms for finding the zeros of polynomials of degree three or greater. Newton's method converges for almost all quadratic polynomials and almost all initial points. McMullen exhibited an analogous algorithm for degree three polynomials and proved that no such algorithm exists for degree four and higher. He has also made important strides toward solving one of the central conjectures in one-dimensional dynamics: Are the hyperbolic maps of degree d dense in all maps of degree d? McMullen proved that, given $P_c : \mathbb{C} \to \mathbb{C}$, $P_c = z^2 + c$, if c is in a connected component of the Mandelbrot set that intersects the real axis, then P_c is hyperbolic. He also brought new ideas and insights from dynamical systems to the geometrization program for three-manifolds formulated by 1982 Fields Medalist William Thurston. McMullen has also worked with Sullivan on a "dictionary" between the theory of iterations of rational maps of the Riemann sphere and that of Kleinian groups.

—Allyn Jackson

Wiles Receives Special Award



At the ICM Opening Ceremonies, Andrew J. Wiles of Princeton University received a one-time Special Tribute from the International Mathematical Union in recognition of his work that led to the proof of Fermat's Last Theorem. Because he is over forty years old, Wiles was not considered eligible for a Fields Medal. Instead of a gold medal he received the "IMU Silver Plaque", or, as number theorist Don B. Zagier called it, a "Quantized Fields Medal". Wiles's award also differed from the Fields Medals in that no lecture was presented about his work. Instead, the next day Wiles himself gave a special lecture entitled "Twenty Years of Number Theory".

In 1993 Wiles announced that he had proved Fermat's Last Theorem. The ground-breaking research he did in order to produce the proof seemed likely to secure him a Fields Medal at the ICM in Zürich in 1994 until a gap appeared in the proof. The gap was not repaired until after the Zürich Congress. With the proof complete, the general consensus was that Wiles had done work of Fields Medal quality. This view was reinforced by the 3,000 people assembled for the ICM Opening Ceremonies, who gave Wiles a thundering round of applause longer than that given to any of the other awardees.

—A. J.