2002 Cole Prize in Number Theory

The 2002 Frank Nelson Cole Prize in Number Theory was awarded at the 108th Annual Meeting of the AMS in San Diego in January 2002.

The Cole Prize in Number Theory is awarded every three years for a notable research memoir in number theory that has appeared during the previous five years (until 2001, the prize was usually awarded every five years). The awarding of this prize alternates with the awarding of the Cole Prize in Algebra, also given every three years. These prizes were established in 1928 to honor Frank Nelson Cole on the occasion of his retirement as secretary of the AMS after twenty-five years of service. He also served as editor-in-chief of the *Bulletin* for twenty-one years. The Cole Prize carries a cash award of \$5,000.

The Cole Prize in Number Theory is awarded by the AMS Council acting on the recommendation of a selection committee. For the 2002 prize, the members of the selection committee were: Benedict Gross, Carl Pomerance, and Paul Vojta (chair).

Previous recipients of the Cole Prize in Number Theory are: H. S. Vandiver (1931), Claude Chevalley (1941), H. B. Mann (1946), Paul Erdős (1951), John T. Tate (1956), Kenkichi Iwasawa (1962), Bernard M. Dwork (1962), James B. Ax and Simon B. Kochen (1967), Wolfgang M. Schmidt (1972), Goro Shimura (1977), Robert P. Langlands (1982), Barry Mazur (1982), Dorian M. Goldfeld (1987), Benedict H. Gross and Don B. Zagier (1987), Karl Rubin (1992), Paul Vojta (1992), and Andrew J. Wiles (1997).

The 2002 Cole Prize in Number Theory was awarded to Henryk Iwaniec and Richard Taylor. The text that follows presents, for each awardee, the

selection committee's citation, a brief biographical sketch, and the awardee's response upon receiving the prize.

Henryk Iwaniec

Citation

The Frank Nelson Cole Prize in Number Theory is awarded to Henryk Iwaniec of Rutgers University for his fundamental contributions to analytic number theory. In particular, the prize is awarded for his paper (with J. Friedlander) "The polynomial $X^2 + Y^4$ captures its primes", in Ann. Math., which is the first paper ever to show that an integer polynomial with "sparse" range takes on infinitely many prime values. The method is robust, and already D. R. Heath-Brown has extended the method to certain cubic polynomials. In addition, the prize is awarded for the series of papers (with W. Duke and J. Friedlander) "Bounds for automorphic *L*-functions, I, II, III", in *Invent. Math.*, and the paper (with B. Conrey) "The cubic moment of central values of automorphic *L*-functions", in *Ann. Math.* In these papers, critical-line bounds for *L*-functions associated to certain modular forms were greatly improved by novel methods, including an amplification technique that provided the starting point for J. W. Cogdell, I. Piatetskii-Shapiro, and P. Sarnak to finally resolve Hilbert's eleventh problem (on representation by quadratic forms in a number field). And, the prize is awarded for the paper (with P. Sarnak) "The nonvanishing of central values of automorphic L-functions and Landau-Siegel zeros", Israel J. Math., for the introduction of far-reaching averaging and mollification techniques for families of automorphic *L*-functions.

Biographical Sketch

Henryk Iwaniec was born in Elblag, Poland, on October 9, 1947. He graduated from Warsaw University in 1971, and he received his Ph.D. there in 1972. From 1971 until 1983 he held various positions in the Institute of Mathematics of the Polish Academy of Sciences. In 1976 he defended his habilitation thesis. In the year 1976-77 he enjoyed a fellowship of the Accademia Nazionale dei Lincei at the Scuola Normale Superiore di Pisa. In 1979-80 he visited the University of Bordeaux. In 1983 he was promoted to professor. The same year he became member correspondent of the Polish Academy of Sciences.

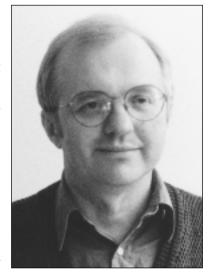
Iwaniec left Poland in 1983 to take visiting positions in the USA at the Institute for Advanced Study in Princeton (1983-84 and 1985-86) and the University of Michigan at Ann Arbor (summer 1984), and he was the Ulam Distinguished Visiting Professor at Boulder (fall 1984). In January 1987 he assumed his present position as New Jersey State Professor of Mathematics at Rutgers University. He was elected to the American Academy of Arts and Sciences in 1995. He spent the year 1999-2000 as a distinguished visiting professor at IAS. Recently he became a citizen of the USA.

Iwaniec received first prizes in the Marcinkiewicz contests for student works in the academic years 1968-69 and 1969-70. In 1978 he received the State Prize from the Polish Government, in 1991 he received the Jurzykowski Award from the Alfred Jurzykowski Foundation in New York, and in 1996 he received the Sierpinski Medal. Iwaniec was an invited speaker at the International Congress of Mathematicians in Helsinki (1978) and in Berkeley (1986).

Response from Professor Iwaniec

I thank from my heart the American Mathematical Society and the committee of the Cole Prize for selecting me for this award. My joy is even greater when I think that this is a significant award for professional accomplishments from beyond my native country, and in particular that this is coming from my new homeland in the USA. Less emotional, nevertheless important for me, is also the feeling of larger recognition of analytic number theory which the Cole Prize manifests in this case. Indeed, all the works cited for the prize are joint with many of my colleagues. Without their collaboration I cannot imagine how could I get that far. Yes, working together offers an immediate satisfaction from sharing ideas, but above all it is the only way we can cultivate in depth the modern analytic number theory.

Analytic number theory pursues hard classical problems of an arithmetical nature by means of best available technologies from any branch of mathematics, and that is its beauty and strength. Analytic number theory is not driven by one concept; consequently it has no unique identity. Fourier analysis was always present, but in the last two decades it has been expanded to nonabelian harmonic analysis by employing the spectral theory of automorphic forms. For example, applying this analysis implicitly we have established the asymptotic distribution of primes in residue classes in the range beyond the capability of the Grand Riemann Hypothesis. Moreover, along these lines, we were able to produce primes in polynomial sequences. To this end one needs to enhance the **Henryk Iwaniec** Dirichlet characters by more powerful cusp forms on congruence groups. In a different direction we performed amplified spectral averaging from which to deduce important estimates for individual values of L-functions and to apply the latter to questions of equidistribution of many arithmetical objects. Other fruitful resources for solving problems in analytic number theory were uncovered by exploiting the Riemann hypothesis for varieties. Connections of these problems with the profound theory of Deligne are by no means straightforward. Perhaps these brief words may give some idea of what the





Richard Taylor

trends are in the subject today, or at least what we are doing there.

There are many colleagues to whom I owe my gratitude for inspiration and joint research over the last years; among them I would like to mention Enrico Bombieri, Brian Conrey, Jean-Marc Deshouillers, William Duke, John Friedlander, Etienne Fouvry, Philippe Michel, and Peter Sarnak.

Richard Taylor

Citation

The Frank Nelson Cole Prize in Number Theory is awarded to Richard Taylor of Harvard University for several outstanding advances in algebraic number theory. He led an effort to extend his earlier work with Wiles, to show that all elliptic curves over Q are modular, i.e., are factors of the Jacobians of modular curves. In his book with M. Harris, he established the local Langlands conjecture, giving a complete parametrization of the *n*-dimensional representations of a

Galois group of a local field. He has also made important progress on 2-dimensional Galois representations, establishing the Artin conjecture for an infinite class of nonsolvable cases, and increasing our understanding of the conjectures of Fontaine-Mazur and Serre.

Biographical Sketch

Richard Taylor was born on May 19, 1962, in Cambridge, England. At the age of two he moved to Oxford, where he grew up. In 1980 he went back to Cambridge for his undergraduate studies. In 1984 he moved to Princeton University for his graduate studies, receiving his Ph.D. in 1988 for a thesis on congruences between modular forms. His advisor was Andrew Wiles, who had a very great influence on Taylor's mathematical development.

After graduating Richard Taylor spent a post-doctoral year at the Institut des Hautes Études Scientifiques outside Paris. Encouraged and supported by John Coates, he then moved back to Cambridge University for six years. Following his marriage in 1995, he left Cambridge first for the Savilian chair of geometry at Oxford University, and a year later moved to Harvard University, where he is still employed. In 1990 he was awarded a junior Whitehead Prize by the London Mathematical Society, in 1992 he was awarded the Prix Franco-Brittanique by the French Académie des Sciences, and in 1995 he was elected a fellow of the Royal Society.

Richard Taylor is an algebraic number theorist working on the interconnections between automorphic forms and representations of Galois groups. In 1994 he collaborated with Andrew Wiles to repair the gap in Wiles' proof of Fermat's last theorem.

Response from Professor Taylor

It is a great honour and pleasure for me to receive the Frank Nelson Cole Prize. It is also an honour to share the prize with a mathematician I admire as much as Henryk Iwaniec. The citation mentions three papers and one book, on which I have worked with a total of seven collaborators. I would like to thank them all, above all for the enjoyment I have had working on these various projects.