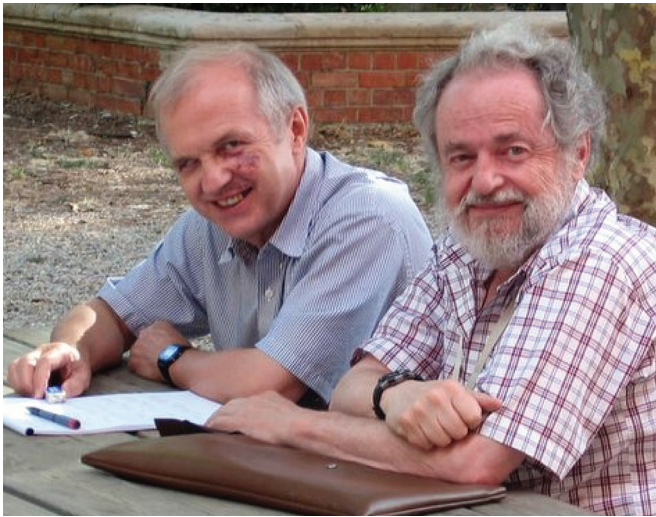


2017 Joseph L. Doob Prize



John Friedlander and Henryk Iwaniec

JOHN FRIEDLANDER and HENRYK IWANIEC were awarded the Joseph L. Doob Prize at the 123rd Annual Meeting of the AMS in Atlanta, Georgia, in January 2017 for their book *Opera de Cribro*, published in 2010 as volume 57 of the American Mathematical Society Colloquium Publications.

Citation

This monograph by two top masters of the subject is dedicated to the study of sieves in number theory and to their applications. Its Latin title could be translated literally as “A Laborious Work Around the Sieve,” but the Latin has a conciseness easily missed in any translation.

The Eratosthenes sieve, going back to the 3rd century BCE, was a simple but efficient method to produce a table of prime numbers, and for a long time it was the only way to study the mysterious sequence of primes, at least experimentally. It was only in 1919 that the Norwegian mathematician Viggo Brun obtained the first quantitative results of the correct order of magnitude for the density of sifted sequences by combining the sieve with ideas from combinatorics. From another direction, the introduction of complex variable methods by Hardy, Ramanujan, and Littlewood and of techniques of harmonic analysis by Vinogradov helped to obtain the correct conjectures about the distribution of prime numbers of special type and of their fine distribution, such as the study of the sequence of gaps between prime numbers.

For a long time Brun’s method and its refinements by Buchstab and many others were the only tools at the mathematician’s disposal for obtaining unconditional results on the arithmetical structure of sequences of integers

until, in 1950, Selberg put forward a new, simple, elegant method to study such questions. Selberg’s method and Brun’s combinatorial method were independent of each other and gave rise to new deep results on the arithmetic structure of special sequences. In the 1950s and early 1960s the new ideas of Linnik and Rényi gave origin to the so-called Large Sieve, particularly apt to the study of the distribution of sequences of integers in arithmetic progressions.

In the next thirty years many very deep results on classical questions previously considered to be inaccessible were obtained. Suffice it here to mention the asymptotic formula for the number of primes representable as the sum of a square and of a fourth power, obtained by Friedlander and Iwaniec in 1998, and a similar result by Heath-Brown in 2001 for the number of primes which are the sum of a cube and of twice a cube. So it was time for a new book dealing not only with the sieves per se but, in fact, with the very deep new techniques needed for the applications. The first nine chapters of this monograph deal with the sieves, followed by three chapters dedicated to the optimization of parameters. The next ten chapters are dedicated to specific problems, including several milestone results. The last three chapters, which are a most original contribution to this monograph, deal with the future by raising new questions, giving partial answers, and indicating new ways of approaching the problems.

Two long appendices deal with technical results of general application. The bibliography, with 161 entries, is a major complement to this work. Everything is well written, the motivations of the arguments are well explained, and the numerous examples help the student to understand the subject in depth. These features distinguish this unique monograph from anything that had been written before on the subject and lift it to the level of a true masterpiece.

The selection committee thanks Professor E. Bombieri for writing the citation.

Biographical Sketch: John Friedlander

John Friedlander was born in Toronto, less than a mile from his current office. Following a BSc in Toronto and an MA in Waterloo, he received his PhD at Penn State in 1972 working under the supervision of S. Chowla. His first position was that of assistant to A. Selberg at the Institute for Advanced Study. After further positions at IAS, MIT, Scuola Normale Superiore (Pisa), and the University of Illinois (Urbana), he returned to the University of Toronto in 1980, where he was mathematics department chair from 1987 to 1991 and, since 2002, has been University Professor of Mathematics. He was awarded

FROM THE AMS SECRETARY

the Jeffery-Williams Prize of the Canadian Mathematical Society (1999) and the CRM-Fields (currently CRM-Fields-PIMS) Prize, given by the Canadian Mathematical Institutes (2002). He has given an invited lecture at the ICM in Zurich in 1994, been a Research Professor at MSRI Berkeley in 2001–2002, and was a Killam Research Fellow during the period 2003–2005. He is a Fellow of the Royal Society of Canada, a Founding Fellow of the Fields Institute, and a Fellow of the American Mathematical Society. His best friend, Cherry, has been sharing her life with him and, amongst many other things, has been largely responsible for creating the space-time during which he has found a chance to think about mathematics.

Biographical Sketch: Henryk Iwaniec

Henryk Iwaniec was born on October 9, 1947, in Elblag, Poland. He graduated from Warsaw University in 1971, and he received his PhD in 1972. In 1976 he defended his habilitation thesis at the Institute of Mathematics of the Polish Academy of Sciences, where he held various positions from 1971 until 1983. In 1983 he was promoted to extraordinary professor (which is one step below the ordinary professor) and was elected to member correspondent of the Polish Academy of Sciences. Henryk Iwaniec spent the year 1976–1977 at the Scuola Normale Superiore di Pisa and the year 1979–1980 at the University of Bordeaux I. He left Poland in 1983 to take visiting positions in the United States: at the Institute for Advanced Study in Princeton (1983–1984), at the University of Michigan in Ann Arbor (summer 1984), as Ulam Distinguished Visiting Professor at Boulder University (fall 1984), and again at IAS in Princeton (January 1985–December 1986). Iwaniec was appointed as New Jersey State Professor of Mathematics at Rutgers University, where he has held this position from January 1987 until the present. Iwaniec was elected to the American Academy of Arts and Sciences in 1995, to the National Academy in 2006, and to the Polska Akademia Umiejetnosci in 2006 (foreign member). He received the Docteur Honoris Causa of Bordeaux University in 2006. Iwaniec twice received first prizes in the Marcinkiewicz contest for student works in the academic years 1968–1969 and 1969–1970. Among several other prizes he received are the Alfred Jurzykowski Award (New York, 1991); the Waclaw Sierpiński Medal (Warsaw, 1996); the Ostrowski Prize (Basel, 2001, shared with Richard Taylor and Peter Sarnak); the Frank Nelson Cole Prize in Number Theory (AMS, 2002, shared with Richard Taylor); the Leroy P. Steele Prize for Mathematical Exposition (AMS, 2011); the Stefan Banach Medal (Polish Academy of Sciences, 2015); and the Shaw Prize in Mathematical Sciences (Hong Kong, 2015, shared with Gerd Faltings). Henryk Iwaniec was an invited speaker at the International Congresses of Mathematicians in Helsinki (1978), Berkeley (1986), and Madrid (2006).

Response from John Friedlander and Henryk Iwaniec

We are grateful to the American Mathematical Society and to the Joseph L. Doob Prize Selection Committee for having chosen our book *Opera de Cribro* for this award.

We are, in particular, gratified by the recognition that this prize brings to the (beloved by us) subject of our book. The study of sieve methods in number theory began its modern history with the works of Viggo Brun just about one hundred years ago. Brun's works were of an elementary (though not at all easy) combinatorial nature, yet led to theorems about prime numbers that still today have found no other source of proof. The first few following decades saw further development of the sieve mechanisms themselves given by many people, most notably Atle Selberg. Beginning in the 1970s, the subject entered into a new period during which it has become possible to incorporate into the sieve structure deep results coming from several of the main sources which power modern analytic number theory more generally. These include, most frequently, harmonic analysis, both classical and automorphic; algebraic tools of various types; and arithmetic geometry. But anything is fair game. Basically, the modern sieve takes from mathematics anything it can use, and the more surprising the source, the more intensely the beauty shines through.

We also greatly appreciate the timing of the Joseph L. Doob Prize. Although we spent five years working intensively on our *Opera*, it of course actually incorporates works of the authors dating back over a considerably longer period of time. This prize represents to us a milestone of our collaboration almost precisely forty years after it began in Pisa reading the preprint of *The Asymptotic Sieve*, written by Enrico Bombieri.

About the Prize

The Doob Prize was established by the AMS in 2003 and endowed in 2005 by Paul and Virginia Halmos in honor of Joseph L. Doob (1910–2004). Paul Halmos (1916–2006) was Doob's first PhD student. Doob received his PhD from Harvard in 1932 and three years later joined the faculty at the University of Illinois, where he remained until his retirement in 1978. He worked in probability theory and measure theory, served as AMS president in 1963–1964, and received the AMS Steele Prize in 1984 “for his fundamental work in establishing probability as a branch of mathematics and for his continuing profound influence on its development.” The Doob Prize recognizes a single, relatively recent, outstanding research book that makes a seminal contribution to the research literature, reflects the highest standards of research exposition, and promises to have a deep and long-term impact in its area. The book must have been published within the six calendar years preceding the year in which it is nominated. Books may be nominated by members of the Society, by members of the selection committee, by members of AMS editorial committees, or by publishers. The prize of US\$5,000 is given every three years.

FROM THE AMS SECRETARY

The Doob Prize is awarded by the AMS Council acting on the recommendation of a selection committee. For the 2017 prize, the members of the selection committee were the following:

- Lawrence Craig Evans (Chair)
- William Fulton
- Mark Goresky
- Fan Chung Graham
- Philip J. Holmes

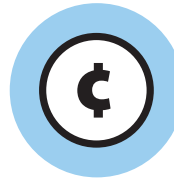
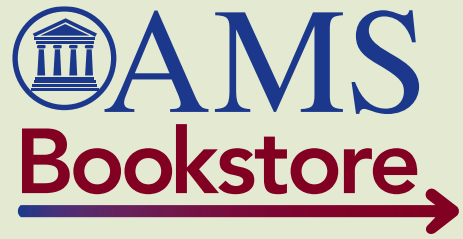
The complete list of recipients of the Doob Prize follows.

2005 William P. Thurston
 2008 Enrico Bombieri and Walter Gubler
 2011 Peter Kronheimer and Tomasz Mrowka
 2014 Cédric Villani
 2017 John Friedlander and Henryk Iwaniec

Photo Credits

Photo of John Friedlander is courtesy of John Friedlander. Photo of Henryk Iwaniec is courtesy of Olivier Ramaré.

AMERICAN MATHEMATICAL SOCIETY



Spend smart.

As an AMS member, enjoy up to 20% off any of our titles. Visit the

Bookstore regularly for special monthly sales and discounts.

Search better.



Our full listing of books is conveniently organized by multiple criteria and searchable by various advanced options to help you find exactly what you need.



Stay informed.

The monthly AMS Bookstore New Releases email offers many benefits to subscribers.

Stay up-to-date on all AMS publications and sales. Sign up today at:

ams.org/bookstore/keepinformed

bookstore.ams.org



facebook.com/amermathsoc
 @amermathsoc
plus.google.com/+AmsOrg