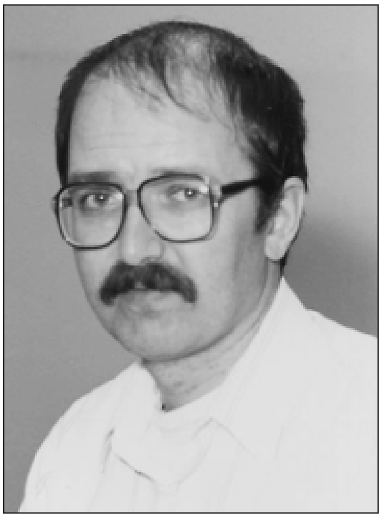
2006 Cole Prize in Algebra



János Kollár

The 2006 Frank Nelson Cole Prize in Algebra was awarded at the 112th Annual Meeting of the AMS in San Antonio in January 2006.

The Cole Prize in Algebra is awarded every three years for a notable research memoir in algebra that has appeared during the previous five years (until 2000, the prize was usually awarded every five years). The awarding of this prize alternates with the awarding of the Cole Prize in Number Theory, 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 US$5,000.

The Cole Prize in Algebra is awarded by the AMS Council acting on the recommendation of a selection committee. For the 2006 prize, the members of the selection committee were: Georgia Benkart (chair), Eric M. Friedlander, and Craig L. Huneke.

Previous recipients of the Cole Prize in Algebra are: L. E. Dickson (1928), A. Adrian Albert (1939), Oscar Zariski (1944), Richard Brauer (1949), Harish-Chandra (1954), Serge Lang (1960), Maxwell A. Rosenlicht (1960), Walter Feit and John G. Thompson (1965), John R. Stallings (1970), Richard G. Swan (1970), Hyman Bass (1975), Daniel G. Quillen (1975), Michael Aschbacher (1980), Melvin Hochster (1980), George Lusztig (1985), Shigefumi Mori (1990), Michel Raynaud and David Harbater (1995), Andrei Suslin (2000), Aise Johan de Jong (2000), and Hiraku Nakajima (2003).

The 2006 Cole Prize in Algebra was awarded to János Kollár. The text that follows presents the selection committee's citation, a brief biographical sketch, and the awardee's response upon receiving the prize.

Citation

The 2006 Cole Prize in Algebra is awarded to János Kollár of Princeton University for his outstanding achievements in the theory of rationally connected varieties and for his illuminating work on a conjecture of Nash.

The notion of a rational variety has long played an important role in algebraic geometry. An algebraic variety X is rationally connected if there are enough rational curves to connect points in X. A pioneer of the notion of rationally connected varieties, Kollár extended the theory from the complex numbers to local fields. His papers (*Annals of Math.* **150** (1999), 357–367, and *Michigan Math. J.* **48** (2000), 359–368) and his joint work with Endre Szabó (*Duke Math. J.* **120** (2003), 251–267) are recognized as significant advancements in the theory of rationally connected varieties.

In 1952, after proving that a compact differentiable manifold M is diffeomorphic to the zero set of real polynomials, John Nash conjectured that there exists a smooth real algebraic variety, birational to projective space, whose real points are diffeomorphic to M. Although known to be false in dimension two, evidence suggested a positive solution in higher dimensions until Kollár provided counterexamples by classifying the diffeomorphism types of smooth threefolds birational to projective space whose real points are orientable. This work is explained in a series of remarkable papers, notably his paper in *J. Amer. Math. Soc.* **12** (1999), 33–83.

Biographical Sketch

János Kollár was born in Budapest, Hungary, in 1956. He did his undergraduate studies at Eötvös University in Budapest and his graduate studies at Brandeis University with Teruhisa Matsusaka. After receiving his doctorate in 1984 he was a Junior Fellow at Harvard University (1984–87) and then a faculty member at the University of Utah (1987–99). Since 1999 he has been a professor at Princeton University.

Kollár was elected to the Hungarian Academy of Sciences in 1995 and to the National Academy of

Sciences in 2005. He gave the AMS Colloquium Lectures at the New Orleans Annual Meeting in 2001. Kollár's main research area is the birational geometry of higher dimensional algebraic varieties, and he also likes to explore the various applications of algebraic geometry to algebra, combinatorics, complex analysis, differential geometry, and number theory.

Response

The most basic algebraic variety is affine n-space C^n, and it has been a long-standing problem to understand which varieties behave like C^n. For surfaces the problem was settled by Castelnuovo in the 1890s: these are the surfaces which are birational to C^2. It took nearly a century to understand that the correct higher dimensional concept is not so global. Instead, we should focus on rational curves on varieties. There are plenty of rational curves in C^n: lines, conics, etc. Roughly speaking, a variety is rationally connected if it contains rational curves in similar abundance.

It took some time to establish that rationally connected varieties are indeed the right class, but by now it is firmly settled that, at least in characteristic zero, we have the right definition.

I am very glad that the committee recognized the significance of this field and I feel deeply honored that they chose me to represent a whole area. This was truly a joint effort over the past fifteen years. Much of the foundational work was done with Campana, Miyaoka, and Mori, and the last piece of the basic theory was completed by Graber, Harris, de Jong, and Starr. Arithmetic questions over finite and p-adic fields were explored with Colliot-Thélène, Esnault, Kim, and Szabó, but the theory over global fields consists mostly of questions. Joint work with Bien, Borel, Corti, Schreyer, and Smith touched other aspects of rational connectedness.

The Nash conjecture on the topology of rationally connected varieties over R turned out to be beautiful algebraic geometry in dimension three, and the higher dimensional versions by Eliashberg and Viterbo use techniques from symplectic geometry.

The theory of rationally connected varieties is rapidly growing, with recent major results by Hacon, Hassett, McKernan, Tschinkel, and Zhang. I hope that the recognition by the Cole Prize will spur further activity.

Finally, I would like to thank three mathematicians who had a great influence on my work: my thesis advisor Teruhisa Matsusaka, who taught me to look for the big picture; my collaborator Shigefumi Mori, with whom many of these ideas were developed; and my former colleague Herb Clemens and the University of Utah for providing a wonderful environment to accomplish most of this research.