Shaw Prize 2017

The Shaw Prize in Mathematical Sciences for 2017 was awarded to János Kollár, of Princeton University, and Claire Voisin, of Collège de France, "for their remarkable results in many central areas of algebraic geometry, which have transformed the field and led to the solution of long-standing problems that had appeared out of reach".

The Shaw Prize, now in its 14th year, is an international award to honour those who have made significant advances or greatly contributed to the research in the fields of astronomy, life sciences and medicine, or mathematical sciences. It is widely regarded as the "Nobel Prize of the East", and the monetary reward for each award is US$1.2 million.

Both János Kollár and Claire Voisin have been instrumental in the development of characterising rational varieties. Rational varieties are those that are birationally equivalent to ordinary n-dimensional space, for some n. The past few decades of understanding of birational classification of higher-dimensional varieties have led to many exciting developments in algebraic technology. Amongst those include Shigefumi Mori's Minimal Model Program, for which Mori won the Fields Medal.

János Kollár first studied algebraic geometry at the Eötvos University, where it was still completely unknown in Hungary at the time. This allowed him to learn the fundamentals very well, and several years later he applied for a PhD programme in Moscow. He was failed by the examiner on the required Marxism–Leninism exam, but it turned out to be a great twist for him. Kollár wrote to David Eisenbud, asking to be a student in the USA, which was still illegal at the time. Nevertheless, Eisenbud arranged for a full scholarship for him, and in 1981 he arrived at Brandeis University. After graduating, he started a Junior Fellowship at Harvard in 1984, where he got the opportunity to spend three months in Nagoya, collaborating with Shigefumi Mori. This collaboration was extremely influential for Kollár's future work. In 1987, Kollár accepted an invitation into the University of Utah, in Salt Lake City. There he spent twelve years and three intense Summer seminars working together with dozens of brilliant young algebraic geometers on the minimal model programme, the moduli theory of canonical models and the early stages of the study of rationally connected varieties. Those three topics have been his main areas of research ever since. Kollár is now at Princeton

János Kollár [Photo Credit: William Crow]

Claire Voisin [Photo Credit: P. Imbert/College de France]

University, since moving there in 1999.

János Kollár's most recent work, on the definition and study of modules of higher-dimensional varieties (which can be thought of as sophisticated geometrical structures whose points represent equivalence classes of these varieties), is expected to be greatly influential for algebraic geometry for decades to come. A great many topologists, combinatorialists and physicists study the moduli problem in dimension one, already a very subtle and difficult problem. Kollár's work and ideas in higher-dimensional moduli is field-defining.

Claire Voisin first learnt all sorts of mathematics at Lycée Louis-le-Grand and the Pierre and Marie Curie University, before she did her thesis at University of Paris-Sud. Her thesis, proving the Torelli theorem for cubic fourfolds, involved a large part of Hodge structure theory, and has been a large ingredient of her algebraic geometry research ever since. She then got a permanent research position at CNRS (Centre Nationnal de la Recherche Scientifique) in 1986, and became Professor at Collège de France since 2016. That year, Voisin was awarded the CNRS 2016 gold medal, France's highest scientific distinction. Voisin then met Kollár in 1987 at the University of Utah. For a long period of time after that, she worked at home, balancing research work and taking care of her children. She had an eventful three years from 2002–2005, obtaining results on syzygies of curves (the Green conjecture for generic canonical curves), as well as contributing to the Lüroth problem. The latter, a method to detect irrational varieties has had many recent spectacular advances.

One of Claire Voisin's major achievements is the solution to the Kodaira problem, which asks whether all Kähler manifolds (which roughly speaking, means a geometric set that locally has a structure compatible with the complex numbers) are deformations of complex projective manifolds. Voisin did not just find Kähler manifolds that fail to be deformations of projective manifolds, she found some that were not even topological equivalent to projective manifolds. Another stunning breakthrough was her establishment of a new technique for showing that a variety is not rational, allowing for results that would previously have been unthinkable. She also found a counter example to an extension of the Hodge conjecture, a problem so notoriously difficult, it became one of Clay Mathematical Institute's seven Millenium Problems. That counter example could rule out several approaches to the conjecture. Voisin likes algebraic geometry for its balance of its theory and its objects, allowing everyone to appreciate the general theoretical machinery at our disposal. She wishes to tackle open problems in algebraic geometry like Chow groups, hyper-Kähler manifolds, positivity problems for cycles,variations of Hodge structures, etc.

Sources:
http://www.shawprize.org/en/