Milnor Receives 2011 Abel Prize

The Norwegian Academy of Science and Letters has awarded the Abel Prize for 2011 to JOHN WILLARD MILNOR, Stony Brook University, “for pioneering discoveries in topology, geometry and algebra.” The Abel Prize recognizes contributions of extraordinary depth and influence to the mathematical sciences and has been awarded annually since 2003. It carries a cash award of 6,000,000 Norwegian kroner (approximately US$1 million). John Milnor received the Abel Prize from His Majesty King Harald at an award ceremony in Oslo, Norway, on May 24, 2011.

Biographical Sketch
John Milnor was born in Orange, New Jersey, in 1931. He spent his undergraduate and graduate student years at Princeton, receiving his Ph.D. in 1954. He has served on the faculties of Princeton University and the Institute for Advanced Study, as well as at the University of California Los Angeles and the Massachusetts Institute of Technology. He joined Stony Brook University and became its first director of the Institute for Mathematical Sciences in 1989; he is now codirector of the institute. His research interests have included such subjects as game theory, differential geometry, algebraic topology, differential topology, quadratic forms, and algebraic K-theory. For the past twenty-five years his main focus has been on dynamical systems, particularly low-dimensional holomorphic dynamical systems. Milnor has received many awards and honors. He received the Fields Medal in 1962 for his work in differential topology. This year he was awarded the 2011 Leroy P. Steele Prize for Lifetime Achievement by the AMS. Milnor had previously won two other Steele Prizes: for Mathematical Exposition (2004) and for Seminal Contribution to Research (1982). In 1989 he received the Wolf Prize in Mathematics. Milnor was elected as a member of the National Academy of Sciences in 1963 and was awarded the National Medal of Science in 1967. Since 1994 he has been a foreign member of the Russian Academy of Sciences, and in 2004 he became a member of the European Academy of Sciences, Arts and Letters.

Citation
All of Milnor’s works display marks of great research: profound insights, vivid imagination, elements of surprise, and supreme beauty. Milnor’s discovery of exotic smooth spheres in seven dimensions was completely unexpected. It signaled the arrival of differential topology and an explosion of work by a generation of brilliant mathematicians; this explosion has lasted for decades and changed the landscape of mathematics. With Michel Kervaire, Milnor went on to give a complete inventory of all the distinct differentiable structures on spheres of all dimensions; in particular they showed that the 7-dimensional sphere carries exactly twenty-eight distinct differentiable structures. They were among the first to identify the special nature of 4-dimensional manifolds, foreshadowing fundamental developments in topology. Milnor’s disproof of the long-standing Hauptvermutung overturned expectations about combinatorial topology dating back to Poincaré. Milnor also discovered homeomorphic smooth manifolds with nonisomorphic tangent bundles, for which he developed the theory of microbundles. In 3-manifold theory, he proved an elegant unique factorization theorem. Outside topology, Milnor made significant contributions to differential geometry, algebra, and dynamical systems. In each area Milnor touched upon, his
insights and approaches have had a profound impact on subsequent developments. His monograph on isolated hypersurface singularities considered the single most influential work in singularity theory; it gave us the Milnor number and the Milnor fibration. Topologists started to actively use Hopf algebras and coalgebras after the definitive work by Milnor and J. C. Moore. Milnor himself came up with new insights into the structure of the Steenrod algebra (of cohomology operations) using the theory of Hopf algebras. In algebraic K-theory, Milnor introduced the degree 2 functor; his celebrated conjecture about the functor—eventually proved by Voevodsky—spurred new directions in the study of motives in algebraic geometry. Milnor’s introduction of the growth invariant of a group linked combinatorial group theory to geometry, prefiguring Gromov’s theory of hyperbolic groups. More recently, John Milnor turned his attention to dynamical systems in low dimensions. With Thurston, he pioneered “kneading theory” for interval maps, laying down the combinatorial foundations of interval dynamics, creating a focus of intense research for three decades. The Milnor-Thurston conjecture on entropy monotonicity prompted efforts to fully understand dynamics in the real quadratic family, bridging real and complex dynamics in a deep way and triggering exciting advances. Milnor is a wonderfully gifted expositor of sophisticated mathematics. He has often tackled difficult, cutting-edge subjects for which no account in book form existed. Adding novel insights, he produced a stream of timely yet lasting works of masterly lucidity. Like an inspired musical composer who is also a charismatic performer, John Milnor is both a discoverer and an expositor.

About the Prize
The Niels Henrik Abel Memorial Fund was established in 2002 to award the Abel Prize for outstanding scientific work in the field of mathematics. The prize is awarded by the Norwegian Academy of Science and Letters, and the choice of Abel Laureate is based on the recommendation of the Abel Committee, which consists of five internationally recognized mathematicians.


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