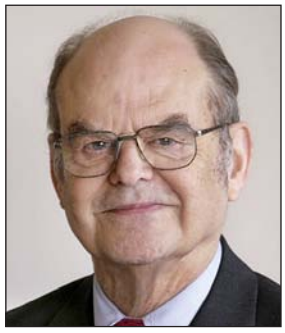
Thompson and Tits Receive 2008 Abel Prize

On March 27, 2008, the Norwegian Academy of Science and Letters announced it would award the Abel Prize for 2008 to JOHN GRIGGS THOMPSON, University of Florida, and JACQUES TITS, Collège de France. Thompson and Tits receive the Abel Prize "for their profound achievements in algebra and in particular for shaping modern group theory".



John Thompson

Jacques Tits

Citation of the Abel Prize Committee

Modern algebra grew out of two ancient traditions in mathematics, the art of solving equations, and the use of symmetry as for example in the patterns of the tiles of the Alhambra. The two came together in late eighteenth century, when it was first conceived that the key to understanding even the simplest equations lies in the symmetries of their solutions. This vision was brilliantly realized by two young mathematicians, Niels Henrik Abel and Evariste Galois, in the early nineteenth century. Eventually it led to the notion of a group, the most powerful way to capture the idea of symmetry. In the twentieth century, the group theoretical approach was a crucial ingredient in the development of modern physics, from the understanding of crystalline symmetries to the formulation of models for fundamental particles and forces.

In mathematics, the idea of a group proved enormously fertile. Groups have striking properties that unite many phenomena in different areas. The most important groups are finite groups, arising for example in the study of permutations, and linear groups, which are made up of symmetries that preserve an underlying geometry. The work of the two laureates has been complementary: John Thompson concentrated on finite groups, while Jacques Tits worked predominantly with linear groups.

Thompson revolutionized the theory of finite groups by proving extraordinarily deep theorems that laid the foundation for the complete classification of finite simple groups, one of the greatest achievements of twentieth century mathematics. Simple groups are atoms from which all finite groups are built. In a major breakthrough, Feit and Thompson proved that every non-elementary simple group has an even number of elements. Later Thompson extended this result to establish a classification of an important kind of finite simple group called an N-group. At this point, the classification project came within reach and was carried to completion by others. Its almost incredible conclusion is that all finite simple groups belong to certain standard families, except for 26 sporadic groups. Thompson and his students played a major role in understanding the fascinating properties of these sporadic groups, including the largest, the so-called Monster.

Tits created a new and highly influential vision of groups as geometric objects. He introduced what is now known as a Tits building, which encodes in geometric terms the algebraic structure of linear groups. The theory of buildings is a central unifying principle with an amazing range of applications, for example to the classification of algebraic and Lie groups as well as finite simple groups, to Kac-Moody groups (used by theoretical physicists), to combinatorial geometry (used in computer science), and to the study of rigidity phenomena in negatively curved spaces. Tits's geometric approach was essential in the study and realization of the sporadic groups, including the Monster. He also established the celebrated "Tits alternative": every finitely generated linear group is either virtually solvable or contains a copy of the free group on two generators. This result has inspired numerous variations and applications.

The achievements of John Thompson and of Jacques Tits are of extraordinary depth and influence. They complement each other and together form the backbone of modern group theory.

Biographical Sketch: John G. Thompson

John Griggs Thompson was born in Ottawa, Kansas, on October 13, 1932, and now holds a position as Graduate Research Professor at the Department of Mathematics, University of Florida in Gainesville.

Thompson received his bachelor's degree from Yale University in 1955 and his Ph.D. from the University of Chicago in 1959. His thesis advisor was

More on Buildings and the Monster

Two installments of the *Notices* "What is…?" column relate to the work of this year's Abel Prizewinners: "What is the Monster?" by Richard Borcherds (October 2002), and "What is a Building?" by Kenneth S. Brown (November 2002). Find these articles online at `http://www.ams.org/notices`.

Saunders Mac Lane, one of the founding fathers of category theory.

Thompson was an assistant professor at Harvard University until he was appointed as a professor at the University of Chicago in 1962. In 1970 he moved to Britain to take up the Rouse Ball Professorship of Mathematics at the University of Cambridge. After 23 years in Cambridge he moved back to the United States to his present position at the University of Florida. He is currently Professor Emeritus of Mathematics at the University of Cambridge.

John Griggs Thompson has been awarded honorary doctorates at the Universities of Illinois, Yale, Oxford, and Ohio State. He was elected a member of the U.S. National Academy of Sciences in 1967 and became a Fellow of the American Academy of Arts and Sciences in 1998. He is a foreign member of the Royal Society of London and of the Accademia Nazionale dei Lincei. Thompson has received many international awards for his outstanding contribution to mathematics. Among them are the Fields Medal, the Senior Berwick Prize, the Sylvester Medal, the Wolf Prize, and the Poincaré Medal. In 1965 he and Walter Feit received the AMS Cole Prize in Algebra for their paper "Solvability of groups of odd order", *Pacific Journal of Mathematics*, volume 13 (1963), pp. 775–1029. In 2000 he was awarded the National Medal of Science by U.S. President Bill Clinton.

The late Walter Feit, with whom Thompson proved one of the key theorems of group theory, said of him: "He is a mathematician who studies important problems and does not let difficulties discourage him. He frequently overcomes such difficulties by introducing new ideas which then have an enormous impact on future developments." This impact is all the greater for the generosity with which he shares the ideas with his many research students and other mathematicians.

Biographical Sketch: Jacques Tits

Jacques Tits was born in Uccle, in the southern outskirts of Brussels, Belgium, on August 12, 1930. He retired from his professorship at the Collège de France in Paris in 2000 and has since then been professor emeritus.

His father a mathematician, Jacques had mathematical talent that showed early. At the age of three he was able to do all the operations of arithmetic. He skipped several years at school. His father died when Jacques was only thirteen years old. Since the family had very little to live on, Jacques started tutoring students four years older to contribute to the household expenses. He passed the entrance exam at the Free University of Brussels at the age of fourteen and received his doctorate in 1950 at twenty years of age.

Tits was promoted to professor at the Free University of Brussels in 1962 and remained in this position for two years before accepting a professorship at the University of Bonn in 1964. In 1973 he moved to Paris, taking up a position as Chair of Group Theory in the Collège de France. Shortly after, in 1974, he became a naturalized French citizen. Tits held this chair until he retired in 2000.

Jacques Tits has been a member of the French Académie des Sciences since 1974. In 1992 he was elected a foreign member of the U.S. National Academy of Sciences and the American Academy of Arts and Sciences. In addition he holds memberships in science academies in Holland and Belgium. He has been awarded honorary doctorates from the Universities of Utrecht, Ghent, Bonn, and Leuven.

Tits has received many awards, such as the Wolf Prize, the Cantor Medal, the Grand Prix des Sciences Mathématiques et Physiques, and the Wettrems Prize. He was appointed Chevalier de la Légion d'Honneur in 1995 and Officier de l'Ordre National du Mérite in 2001.

In addition to his mathematical research Tits has played a major role in international mathematical life. He was editor-in-chief for mathematical publications at the Institut des Hautes Études Scientifiques from 1980 to 1999. He served on the committee awarding the Fields Medal in 1978 and again in 1994. He has also served since 1985 on the committee awarding the Balzan Prize.

The publications of Jacques Tits contain a remarkable number of fundamental and pathbreaking mathematical ideas, making him one of the most influential and original mathematicians of our time.

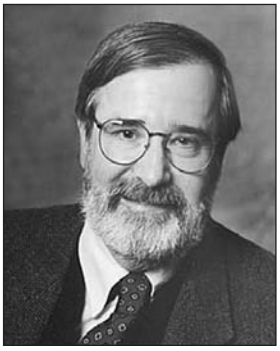
About the Abel Prize

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 amount is 6 million NOK (approximately US$1.2 million), and it was awarded for the first time in 2003. The prize is awarded by the Norwegian Academy of Science and Letters, and its choice of Abel Laureate is based on a recommendation by the Abel Prize Committee consisting of five internationally recognized mathematicians. The 2008 prize will be presented by His Majesty King Harald at the Abel Prize Award Ceremony in Oslo, May 20, 2008.

Previous recipients of the Abel Prize are Jean-Pierre Serre (2003), Michael Atiyah and I. M. Singer (2004), Peter Lax (2005), Lennart Carleson (2006), and S. R. S. Varadhan (2007).

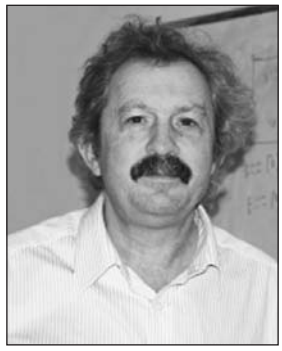
—From Norwegian Academy of Science and Letters news releases

Clarke, Emerson, and Sifakis Receive 2007 ACM Turing Award



Edmund M. Clarke

E. Allen Emerson



Joseph Sifakis

The Association for Computing Machinery (ACM) has named EDMUND M. CLARKE, E. ALLEN EMERSON, and JOSEPH SIFAKIS the winners of the 2007 A.M. Turing Award, widely considered the most prestigious award in computing, for their original and continuing research in a quality assurance process known as model checking. Their innovations transformed this approach from a theoretical technique to a highly effective verification technology that enables computer hardware and software engineers to find errors efficiently in complex system designs. This transformation has resulted in increased assurance that the systems perform as intended by the designers. Clarke and Emerson, working together, and Sifakis, working independently, developed this fully automated approach that is now the most widely used verification method in the hardware and software industries.

The Turing Award carries a US$250,000 prize, with financial support provided by Intel Corporation and Google Inc.

Description of the Prizewinners' Work

Model checking as a standard procedure for quality assurance has enabled designers and manufacturers to address verification problems that span both hardware and software. It has also helped them to gain mathematical confidence that complex computer systems meet their specifications, and it has provided added security for a range of both common and critical computing applications.

Logical errors in digital circuit designs, software, and communication protocols are an important problem for system designers. They often result in delays in getting new products to market, failures of critical systems already in use, and expensive replacement of faulty hardware and patching of flawed software.

Model checking started as an academic research idea. The continuing research of Clarke, Emerson, and Sifakis, as well as others in the international research community over the last 27 years, led to the creation of new logics, as well as new algorithms and surprising theoretical results. This in turn has stimulated the creation of many model checking tools by both academic and industrial teams, resulting in the widespread industrial use of model checking.

Many major hardware and software companies now rely heavily on model checking. Common examples include verification of the designs for integrated circuits such as microprocessors, as well as communication protocols, software device drivers, real-time embedded systems, and security algorithms.

Among the beneficiaries of model checking are personal computer users, medical device makers, and nuclear power plant operators. As computerized systems pervade daily life, consumers rely on digital controllers to supervise critical functions of cars, airplanes, and industrial plants. Digital switching technology has replaced analogue

About the Cover

The grave of Carl Friedrich Gauss

All seems serene in the cemetery and park of St. Albani in Göttingen where Carl Friedrich Gauss and some of his family are interred.

But beneath the superficial serenity, ah! the soul of Gauss writhes in contemplation of how Danel Kehlmann has distorted his life in his recent novel whose English title is *Measuring the World*.

Frans Oort's review of Kehlmann's book in this issue is quite negative, as are some, but not all, of the other reviews of the original German edition by European mathematicians. These include an extremely critical one by Winfried Scharlau in the *Mitteilungen* of the German Mathematical Society, and one by Ivo Schneider in the *Mitteilungen* of the Gauss Gesellschaft of Göttingen. In view of the book's many faults, the intriguing question is, why has its original German edition been so popular? This is what Norbert Schappacher has tried to answer, with a somewhat more generous look at the book, in his review in the April 2006 issue of the *Mathematische Semesterberichte*.

Göttingen treats one of its most famous and respected inhabitants rather well. Much care was taken in erecting the original monument a few years after Gauss' death, and it has been well cared for since. The Gauss Gesellschaft was founded in 1962, and holds an annual meeting every fall to commemorate some aspect of his work, in addition to publishing its journal.

Our thanks to Benno Artmann for acting as guide in Göttingen, and to Axel Wittmann, president of the Gauss Gesellschaft, for information about Gauss' grave.

—Bill Casselman, Graphics Editor
(notices-covers@ams.org)

components in the telecommunications industry, and security protocols enable e-commerce applications and privacy. Wherever significant investments or human lives are at risk, quality assurance for the underlying hardware and software components becomes paramount.

Biographical Sketches

Edmund M. Clarke is the FORE Systems Professor of Computer Science and Professor of Electrical and Computer Engineering at Carnegie Mellon University. Clarke received a Technical Excellence Award from the Semiconductor Research Corporation in 1995 and the Harry M. Goode Memorial Award from the Institute of Electrical and Electronics Engineers (IEEE) in 2004. A Fellow of the ACM and the IEEE Computer Society, he was elected to the National Academy of Engineering in 2005. Clarke received a bachelor's degree in mathematics from the University of Virginia and a master's degree in mathematics from Duke University. He earned a Ph.D. in computer science from Cornell University and has taught at Duke University and Harvard University.

E. Allen Emerson is an Endowed Professor in Computer Sciences at the University of Texas at Austin. He was a co-recipient of the 2006 Test-of-Time Award from the IEEE Symposium on Logic in Computer Science for his research on efficient model checking in the propositional mu-calculus, a highly expressive temporal logic, with Chin-Laung Lei. Emerson received a bachelor's degree in mathematics from the University of Texas at Austin and a Ph.D. in applied mathematics from Harvard University.

Joseph Sifakis is the founder of Verimag Laboratory, a leading research center for embedded systems in Grenoble, France, where he was director from 1993 until 2006. He is *directeur de recherche* at the Centre National de la Recherche Scientifique and director of the CARNOT Institute on Intelligent Software and Systems in Grenoble. Sifakis earned a degree in electrical engineering from the Technical University of Athens and a Ph.D. in computer science from the University of Grenoble.

About the Turing Award

The A.M. Turing Award was named for Alan M. Turing, the British mathematician who articulated the mathematical foundation and limits of computing and who was a key contributor to the Allied cryptanalysis of the German Enigma cipher during World War II. Since its inception in 1966, the Turing Award has honored the computer scientists and engineers who created the systems and underlying theoretical foundations that have propelled the information technology industry.

—From an ACM news release