1997 Steele Prizes

Three Leroy P. Steele Prizes were awarded at the 103rd Annual Meeting of the AMS in January in San Diego. These prizes were established in 1970 in honor of George David Birkhoff, William Fogg Osgood, and William Caspar Graustein and are endowed under the terms of a bequest from Leroy P. Steele.

The Steele Prizes are awarded in three categories: for expository writing, for a research paper of fundamental and lasting importance, and for cumulative influence extending over a career, including the education of doctoral students. The current award is $4,000 in each category.

The recipients of the 1997 Steele Prizes are ANTHONY W. KNAPP for Mathematical Exposition, MIKHAEL GROMOV for a Seminal Contribution to Research, and RALPH S. PHILLIPS for Lifetime Achievement.

The Steele Prizes are awarded by the AMS Council acting through a selection committee whose members at the time of these selections were Richard Askey, Ingrid Daubechies, Eugene Dynkin, Ciprian Foias, H. Blaine Lawson, Andrew J. Majda, Louis Nirenberg, Gary M. Seitz, and John T. Tate.

The text that follows contains, for each award, the committee's citation, a brief biographical sketch of the recipient, and the recipient's response upon receiving the award.

Steele Prize for Mathematical Exposition: Anthony W. Knapp

Citation

For his book *Representation Theory of Semisimple Groups (An overview based on examples)*, Princeton University Press, 1986, a beautifully written book which starts from scratch but takes the reader far into a highly developed subject. The motivation, which is consistently and artfully provided as the general theory unfolds, is a model of exposition. In addition, Anthony Knapp has written other major texts in more recent years, all outstanding expositions of important and difficult material.

Biographical Sketch

Anthony W. Knapp is the author of seven books. His first book, *Denumerable Markov Chains*, was written jointly with John Kemeny and Laurie Snell and appeared in 1966. He has written one book about elliptic curves, and the others are on Lie groups and representation theory, the most recent one being *Lie Groups beyond an Introduction*, published in 1996. His book with David Vogan entitled *Cohomological Induction and Unitary Representations* was designated the best mathematics book in 1995 by the Professional and Scholarly Publishing Division of the Association of American Publishers.

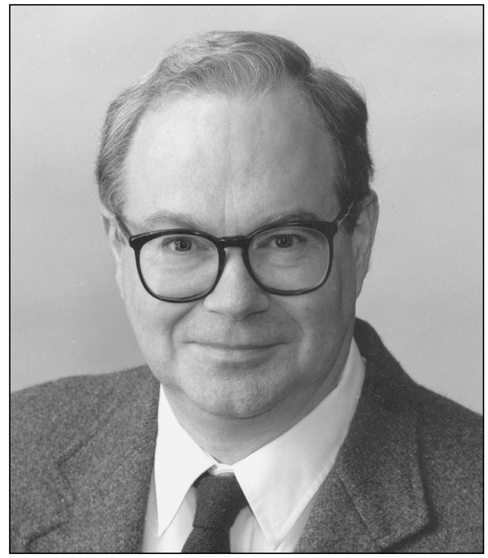
Knapp was born in 1941, was an undergraduate at Dartmouth, and received his Ph.D. from Princeton in 1965, with Salomon Bochner as thesis advisor. He was a C. L. E. Moore Instructor at

MIT for two years and joined the faculty of Cornell University in 1967. Since 1986 he has been professor of mathematics at SUNY at Stony Brook.

He has been a member of the Institute for Advanced Study in Princeton for three one-year terms and has had visiting positions for one year at MIT; for one semester each at Princeton University, Rice University, and Université Paris VII; and for shorter intervals at places in the United States, Canada, France, Italy, Sweden, India, China, and Australia. He was an invited speaker at the International Congress of Mathematicians in Vancouver in 1974 and was a Guggenheim Fellow in 1982–83.

Response

It is a great honor to be awarded the Steele Prize for exposition and to have my book associated with the extraordinary books that have been the subjects of this award in past years. I thank the Committee for its choice, and I thank the AMS for long recognizing that high-quality exposition has an important role to play in the advance of mathematics. Writing a book of this level and length takes large blocks of time and requires active support from one's immediate family; I thank my wife and two children for providing that support. As late as 1981, the field of representation theory, particularly the representation theory of semisimple groups, was notoriously difficult to enter. Tackling two thousand pages of Harish-Chandra was not for the faint-hearted. One needed to learn from mentors in order to see what was beautiful about the subject, to get through the background, and to find out where the subject might be headed. About that time, after having given several short series of lectures on aspects of representation theory to nonexperts, I began to look for a way for more mathematicians to gain some appreciation for the field without help from a specialist. That way was in fact already what I was doing in my lecture series—explaining things often in the context of examples—and what I was sometimes witnessing in the lectures of others. Many times with theorems about semisimple groups, there is one example where one can see all the important ideas without being distracted by technical details. I remember lectures by G. D. Mostow, for example, where he would cut through technicalities right away by defining a semisimple Lie group to be a connected closed subgroup of real or complex matrices stable under conjugate transpose and having finite center. Mostow's definition does not cover all cases, but it does cover enough cases to make a start at appreciating the subject. It was a question of weaving such descriptions into a coherent book. Despite the use of examples in this way, I felt that it was important to state precise theorems and to provide a guide to further reading so that a person could selectively go more deeply into an aspect of the subject at will.



Anthony W. Knapp

Several things made the writing of such a book possible. One was the readability of Harish-Chandra's papers and the presence of several entry points to their study. Another was the encouragement of editor Robert Langlands. A third was that the literature in the subject was in good order, any mistakes not having spread into paper after paper. The opportunity to do a serious experiment with this writing style came with a semester-length course at Université Paris VII in 1982. The handouts of notes for that course became a preliminary edition of the book, and the writing of the full text was complete two years later.

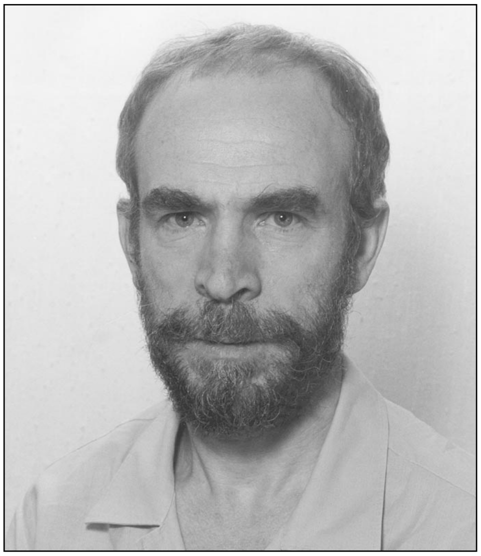
Steele Prize for a Seminal Contribution to Research: Mikhael Gromov

Citation

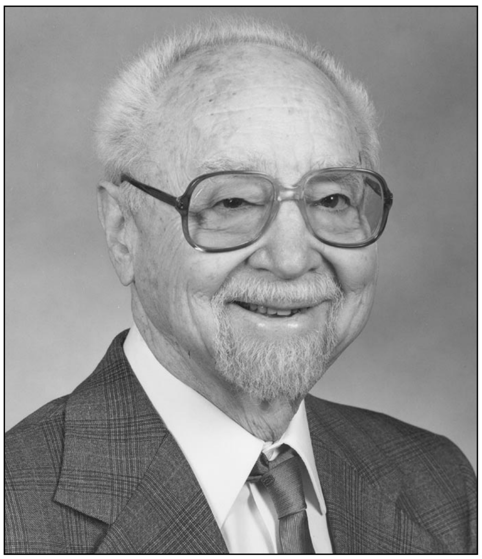
For his paper "Pseudo-holomorphic curves in symplectic manifolds", *Inventiones Math.* **82** (1985), 307–347, which revolutionized the subject of symplectic geometry and topology and is central to much current research activity, including quantum cohomology and mirror symmetry.

Biographical Sketch

Gromov was born in 1943 in Boksitogorsk, Russia. He received his Ph.D. in 1969 and his D.Sc. in 1973 from the University of Leningrad. After holding positions at the University of Leningrad, the State University of New York at Stony Brook, and the Université de Paris, he moved to Institut des Haute Études Scientifiques, where he is a permanent fellow (1982–). For five years he also held the position of professor of mathematics at the University of Maryland, College Park. He is now a professor at the Courant Institute of Mathematical Sciences. Gromov received the Moscow Mathematical Society Prize (1971), the AMS Oswald Veblen Prize in Geometry (1971), the Elie Cartan Prize of the French Academy of Sciences (1984), the Prix UAP (1989), and the Wolf Prize in Mathematics (1993). He also holds an honorary doctorate from the University of Geneva. He is a foreign member of the U.S. National Academy of Sciences, the French Academy



Mikhael Gromov



Ralph S. Phillips

of Sciences, and the American Academy of Arts and Sciences.

Response

I saw the light when struggling with Pogorelov's proof of rigidity of convex surfaces where he appeals to the Bers-Vekua theory of quasianalytic functions. There was nothing seemingly complex-analytic in the linearized system written down by Pogorelov, and then it struck me that *every* first order elliptic linear or quasilinear system of two equations in two variables has the same principal symbol as Cauchy-Riemann and then the solutions appear as (pseudo) holomorphic curves for the almost complex structure defined by the field of the principal symbols. Now the surface rigidity trivially followed from positivity of the intersections of holomorphic curves. What fascinated me even more was the familiar web of algebraic curves in a surface emerging in its full beauty in the softish environment of general (nonintegrable!) almost complex structures. (Integrability had always made me feel claustrophobic.) And my mind was ready for the miracle; Donaldson's ideas were in the air. So I tried to replay Yang-Mills on my holomorphic curves (strings?) and reluctantly abandoned the idea, being convinced by Pierre Deligne that the area of curves cannot be controlled without a symplectic structure. Everything went smoothly with the symplectic structure, and I even came to understand the definition of quasianalytic functions and of the nonlinear Riemann-mapping theorem of Schapiro-Lavrentiev (albeit I am still unable to read a single line of this style of analysis).

I was happy to see my friends using holomorphic curves immediately after birth: Eliashberg, Floer, McDuff. Eliashberg came across them independently in the contact framework but was unable to publish (staying in the USSR). Floer has morsified them by breaking the symmetry, and I still cannot forgive him for this. (Alas, prejudice does not pay in science.) McDuff started the systematic hunt for them which goes on till present day. And what goes on today goes beyond these lines and the pen behind them.

Steele Prize for Lifetime Achievement: Ralph S. Phillips

Citation

Ralph Phillips is one of the outstanding analysts of our time. His early work was in functional analysis: his beautiful theorem on the relation between the spectrum of a semigroup and its infinitesimal generator is striking as well as very useful in the study of PDEs. His extension theory for dissipative linear operators predated the interpolation approach to operator theory and robust control. He made major contributions to acoustical scattering theory in his joint work with Peter Lax, proving remarkable results on local energy decay and the connections between poles of the scattering matrix and the analytic properties of the resolvent. He later extended this work to a spectral theory for the automorphic Laplace operator, relying on the Radon transform on horospheres to avoid Eisenstein series. In the last fifteen years, Ralph Phillips has done brilliant work, in collaboration with others, on spectral theory for the Laplacian on symmetric spaces, on the existence and stability of cusp forms for general noncompact quotients of the hyperbolic plane, on the explicit construction of sparse optimal expander graphs, and on the structure of families of isospectral sets in two dimensions (the collection of drums that sound the same).

Biographical Sketch

Ralph S. Phillips was born on June 23, 1913, in Oakland, California. He received his A.B. degree from the University of California, Los Angeles, in 1935 and his Ph.D. from the University of Michigan in 1939. He was an instructor at the University of Washington (1940–41) and Harvard University (1941–42) before becoming the leader of a research group at the Radiation Laboratory at the Massachusetts Institute of Technology. In 1946 he became an assistant professor at New York University, and the following year he moved to the University of Southern California. He took a position as professor at UCLA in 1958 and in 1960 moved to Stanford University, where he is currently a professor.

Professor Phillips was a Rackham Fellow at the University of Michigan while he was a doctoral student there. He was a member of the Institute for Advanced Study (1939–40 and 1951–52) and was a Guggenheim Fellow (1954 and 1974). He was elected to the American Academy of Arts and Sciences in 1971. In 1977 he was the Robert Grimmett Professor of Mathematics at Stanford.

Response

I am both elated and surprised to have been chosen as a recipient of this prize, and I am very grateful to all those who made it happen. Since this prize is for lifetime achievement, let me briefly sketch my mathematical history. I started out in functional analysis, and traces of this field can be found in all of my work. My pursuit of mathematics was interrupted for five years during World War II while I was at the MIT Radiation Lab. After this I worked my way back into mathematics by mastering Einar Hille's book on functional analysis and semigroups. I wrote several papers on semigroups of linear operators and was invited by Hille to coauthor the revised edition of his book. Starting in 1961 I began a very fruitful twenty-year collaboration with Peter Lax on scattering theory, first on the acoustic equation in Euclidean spaces and later on the wave equation for automorphic functions in hyperbolic spaces. This automorphic function research led to a very productive ten-year collaboration with Peter Sarnak on problems related to number theory and geometry. Finally I would like to take advantage of this opportunity to present a list of what I consider to be the ten most insightful of my papers; they are not necessarily the most influential.

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