1987 Steele Prizes Awarded at Summer Meeting in Salt Lake City

Three Leroy P. Steele Prizes were awarded at the Society's ninetieth Summer Meeting in Salt Lake City, Utah.

The Steele Prizes are made possible by a bequest to the Society by Mr. Steele, a graduate of Harvard College, Class of 1923, in memory of George David Birkhoff, William Fogg Osgood, and William Caspar Graustein.

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

The recipients of the Steele Prizes for 1987 are MARTIN GARDNER for the expository award; HERBERT FEDERER and WENDELL H. FLEMING for research work of fundamental importance; and SAMUEL EILENBERG for the career award.

The Steele Prizes are awarded by the Council of the Society, acting through a selection committee whose members at the time of these selections were Frederick J. Almgren, Richard W. Beals (Chairman), Jerry L. Bona, Hermann Flaschka, John P. Hempel, William S. Massey, Lawrence E. Payne, Frank A. Raymond, Louis Solomon, and Richard P. Stanley.

The text that follows contains the Committee's citations for each award, the recipients' responses at the prize session in Salt Lake City, and a brief biographical sketch of each of the recipients. Professor Federer and Dr. Gardner were unable to attend the Summer Meeting to receive the prize in person. They did, however, send written responses to the award. Professor Eilenberg is out of the country at this time and could not be reached prior to the awarding of this prize.

Expository Writing

Martin Gardner

Citation

The 1987 Steele Prize for expository writing is awarded to MARTIN GARDNER for his many books and articles on mathematics, and particularly for his column "Mathematical Games" in *Scientific American*. Martin Gardner has introduced generations of readers to the intellectual excitement, the wonder, the variety, and the sheer fun of mathematics and mathematical ways of thought. With Dr. Matrix and his other friends, he has exposed spurious thinking and the misuse of mathematics in areas from numerology to economics. Martin Gardner has captured the attention of his readers, obtained their active involvement, and stretched their minds to an extent which is the envy of all of us who teach.

Martin Gardner

Response

Had I not developed a strong interest in philosophy when I was an undergraduate at the University of Chicago, I might have majored in mathematics, become a professional, and perhaps made some contributions to the field. As it happened, I had no formal training in math, only an amateur's passion for its marvels, and admiration and awe for its leaders. I think of myself as like a person who loves classical music, but whose talents never advanced beyond playing simple tunes on a musical saw.

There is no better way to teach oneself mathematics than to write about it. Every column I completed for *Scientific American* was a learning experience that gave me intense pleasure. If I have been able to convey to others something of the fascination of mathematics, it is because I did not know enough to write about it on a

technical level. Fortunately, my blunders were promptly called to my attention by readers, and I am able to bury most of them when I revise my columns for book collections.

At the risk of offending a few good friends, let me say I am a hopeless, unashamed Platonic realist. I think mathematicians discover theorems that in some sense are "out there," independent of human minds. I believe that when two trilobites crawled onto a rock to join two other trilobites, it made four trilobites on the rock even though no humans observed it and the trilobites were unaware of it. I believe that if humanity is ever exterminated by a nuclear holocaust, the orbits of planets will still approximate ellipses, and that the Pythagorean theorem will still hold for Euclidean geometry in all possible (noncontradictory) worlds.

To be given a Steele Prize, is the greatest honor I can imagine myself receiving. I rate it many cuts above obtaining, as I expect to next year, an Erdős number of 2.

Biographical Sketch

Martin Gardner was born in Tulsa, Oklahoma, October 21, 1914. After receiving a BA degree at the University of Chicago in 1936, he worked at various jobs including newspaper reporter, social worker, and publicity writer, until he enlisted in the Navy in 1941. Following World War II, he returned briefly to the University of Chicago, where he did graduate work in philosophy under Rudolf Carnap, later collaborating with Carnap on an *Introduction to the Philosophy of Science* (1966).

His first Mathematical Games column in *Scientific American* was an article on hexaflexagons in 1956. The column appeared monthly for 25 years, until Gardner retired in 1981 to the mountains of western North Carolina. Eleven book collections of his columns have been published. The twelfth, *Time Travel and Other Mathematical Bewilderments*, is scheduled for this fall. A third collection of his puzzle columns in *Asimov's Science Fiction Magazine* will be published this winter by the Mathematical Association of America.

Gardner's other books on recreational math include *Mathematics, Magic, and Mystery* (1956), *Aha! Insight* (1978), *Aha Gotcha!* (1982), and several puzzle books for children. He is also the author of *Logic Machines and Diagrams* (1958) and numerous books about philosophy, science, and literature, of which the best known is his *Annotated Alice* (1960).

Gardner received an honorary doctorate in 1978 from Bucknell University, and in 1983 was given the American Institute of Physics/U.S. Steel Foundation Award for science writer of the year.

Fundamental Paper

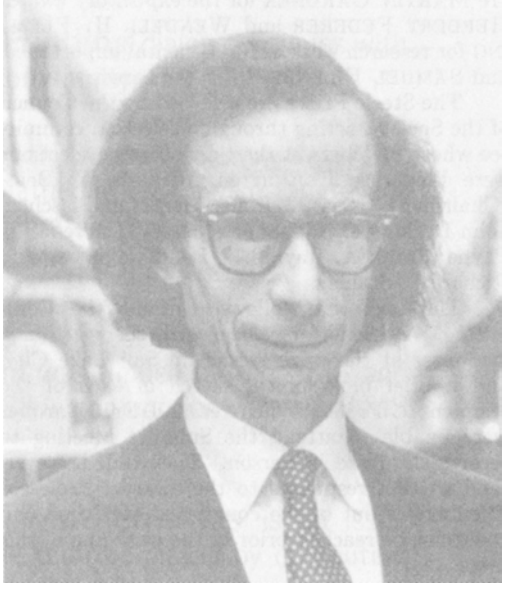
Herbert Federer and Wendell Fleming

Citation

The 1987 Steele Prize for a paper which has proved to be of fundamental or lasting importance in its field is awarded to HERBERT FEDERER and WENDELL FLEMING for their pioneering paper

Normal and integral currents, Annals of Mathematics **72** (1960), pages 458-520.

This paper gave birth to geometric measure theory, introducing and studying the "integral currents" which now appear to be the natural setting for the geometric calculus of variations in higher dimensions. Among the paper's striking achievements are the *Compactness Theorem*, giving the existence of minimizing integral currents representing integral homology classes, and the *Deformation Theorem*, which yielded the first isoperimetric inequality in general dimensions and codimensions. The methods and ideas introduced here revolutionized the study of geometric variational problems and provided the foundation for developments still in vigorous flower.



Herbert Federer

Response from Federer

With regrets that a prior commitment prevents me from attending this meeting, I am writing to express my sincere gratitude for the award of a Steele Prize.

Work on *Normal and Integral Currents* was a special pleasure because it accomplished the merger of measure theory with homology theory. Now general isoperimetric inequalities illustrate this connection. Intersection chains can be constructed through differentiation of measures. The

compactness of certain classes of chains is related both to density and projection properties of Hausdorff measures, and to deformations patterned after simplicial topology. Those limiting currents, which solve elliptic minimum problems of the multidimensional calculus of variations, are partially smooth in the sense of classical differential geometry, but often have essential singularities whose structure still presents extremely challenging questions.

I hope very much that this first award of a prize for work in geometric measure theory will encourage future research in the subject.

Biographical Sketch

Herbert Federer was born on July 23, 1920, in Vienna, Austria. He immigrated to the United States in 1938 and became a naturalized citizen in 1944. During 1944 and 1945 he served in the U.S. Army. He was educated at the University of California in Berkeley, receiving the degrees B.A. in Mathematics and Physics in 1942, and Ph.D. in Mathematics in 1944.

Since 1945 Herbert Federer has been a member of the Mathematics Department of Brown University. He became a full professor in 1951, Florence Pirce Grant University Professor in 1966, and Professor Emeritus in 1985.

Professor Federer has been a member of the American Mathematical Society since 1943. He served on the Invitations Committee for the 1958 Summer Institute, as an Associate Secretary during 1967 and 1968, and as Representative on the National Research Council from 1966 to 1969. He delivered an Invited Address (New York City, April 1951) and was a Colloquium Lecturer (Seattle, August 1977).

Professor Federer was an Alfred P. Sloan Research Fellow (1957-1960), a National Science Foundation Senior Postdoctoral Fellow (1964-1965), and a John Simon Guggenheim Memorial Fellow (1975-1976). He has been a Fellow of the American Academy of Arts and Sciences since 1962, and a Member of the National Academy of Sciences since 1975.

The major part of Professor Federer's scientific effort has been directed to the development of the subject of Geometric Measure Theory, with its roots and applications in classical geometry and analysis, yet in the functorial spirit of modern topology and algebra. This work includes more than thirty research papers published between 1943 and 1986, as well as a book published in 1969.

Response from Fleming

I would like to express my profound thanks for the award of the Steele Prize.

The paper by Federer and myself cited was a step in the development of what has since been called geometric measure theory. In the research during 1959 which led to this paper, we sought a theory dealing with objects which from the standpoint of algebraic topology behaved like chains with integer or real coefficients. The theory needed to be broad enough to allow for integration of differential forms over objects which differ in small measure from pieces of oriented manifolds of class C^1. Moreover, the class of objects admitted was required to have compactness properties needed to obtain existence theorems for geometric problems of the calculus of variations, including the problem of least area in arbitrary dimension.

Wendell Fleming

De Rham's theory of currents provided the setting in which to define these objects, which we called integral or normal currents in the respective cases of integer or real coefficients. We were significantly influenced by earlier results of a number of people, including works of De Giorgi and Federer on measure-theoretic extensions of the Gauss-Green theorem and L.C. Young's theory of generalized surfaces.

Within a few years after this paper was written I left geometric measure theory to work on different topics. Other mathematicians have carried on the tasks of developing geometric measure theory and of identifying its connections with other areas of mathematics. It is not an easy field. Such problems as to characterize the singularities of area minimizing integral currents have proved to be especially challenging. Even at the early stages connections were apparent between geometric measure theory and such areas as calculus of variations, nonlinear elliptic partial differential equations and complex varieties. It is pleasing that more recently applications, perhaps unexpected, to such topics as structural mechanics and liquid crystal theory have also been found.

Biographical Sketch

Wendell H. Fleming was born March 7, 1928, in Guthrie, Oklahoma. He received his Ph.D. in 1951 from the University of Wisconsin.

Professor Fleming worked as a mathematician at Rand Corporation beginning in 1951 before becoming an assistant professor at Purdue University (1955–1958). Professor Fleming has been at Brown University ever since, advancing from assistant professor (1958–1960) to associate professor (1960–1963) to professor (1963–present). He has served as chairman of the Mathematics Department and of the Division of Applied Mathematics at Brown.

Professor Fleming has served on a number of Society committees including the Committee on Employment and Educational Policy, 1975–1977, the Committee on Employment and Educational Policy's Data Subcommittee (1977–1981), and the Nominating Committee (1978–1979).

Professor Fleming has given Invited Addresses at the Summer Meeting (Missoula, August 1973), the Symposium on Stochastic Differential Equations (New York City, March 1972), the Special Session on Approximate Solutions of Random Equations (Atlanta, January 1978), the Short Course on Introduction to Systems and Control Theory for Mathematicians (Providence, August 1978), and a Special Session on Stochastic Analysis (Ann Arbor, August 1980).

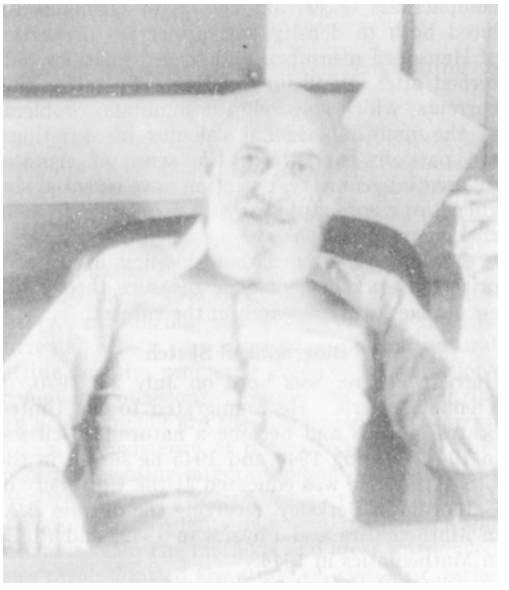
Professor Fleming was a National Science Foundation Postdoctoral Fellow (1968–1969) and a Guggenheim Fellow (1976–1977).

Career Award

Samuel Eilenberg

Citation

The 1987 Steele Prize for cumulative influence is awarded to SAMUEL EILENBERG for his fundamental contributions to topology and algebra. Eilenberg's classic papers on singular homology and his work with Steenrod on axiomatic homology theory had a profound influence on the development of algebraic topology. The Eilenberg-Zilber theorem is basic in singular homology theory, and the Eilenberg-Moore spectral sequences are a powerful tool for fiber spaces. With Mac Lane, Eilenberg founded category theory and advanced the study of group homology and cohomology; with Cartan, he founded cohomological algebra. By his example, his energy, his enthusiasm, and his encouragement of others, Eilenberg has left his mark on topology, on algebra, and on mathematics in America.



Samuel Eilenberg

Biographical Sketch

Samuel Eilenberg was born September 30, 1913, in Warsaw, Poland. He earned his M.A. in 1934 and his Ph.D. in 1936 from the University of Warsaw.

Professor Eilenberg advanced from instructor to associate professor of mathematics at the University of Michigan (1940-1946). He was a professor at Indiana University from 1946-1947. Since 1947, he has been a professor at Columbia University, and since 1981 he has been an emeritus professor there.

Professor Eilenberg served as a Member-at-Large of the Council (1947-1949) and as Vice President of the American Mathematical Society (1966-1967). He has served on a number of Society committees including the Transactions Editorial Committee (1948-1953), the Committee on Translations of Russian and Other Foreign Languages (1948-1951), the Committee on Visiting Lectureships (1956-1959), the Committee on Graduate Programs in Mathematics (1963), and the Colloquium Editorial Committee (1973-1978).

Professor Eilenberg gave Invited Addresses at the Summer Meeting (New Brunswick, September 1945) and at the Annual Meeting (Pittsburgh, December 1954). He gave an hour address at the International Congress of Mathematicians in 1958. He was a Colloquium Lecturer (Toronto, Summer 1967), and he spoke at the Symposium on Applications of Categorical Algebra (New York, April 1968).

Professor Eilenberg was a Guggenheim Fellow and a Fulbright Scholar (1950-1951). He is a member of the National Academy of Sciences.