

Cathleen Synge Morawetz

On Tuesday, December 8, 1998, Cathleen Synge Morawetz became the first woman to receive the National Medal of Science for Mathematics. The honor was in recognition of her pioneering advances in partial differential equations and wave propagation leading to results in applications to aerodynamics, acoustics and optics. In the 1950s, she published three noteworthy papers in which she used new ingenious estimates for the solution of mixed nonlinear



partial differential equations. Her work influenced engineers' efforts to design airplane wings that minimize the impact of shock waves. Morawetz demonstrated that shock waves are inevitable if a plane moves fast enough, no matter how the wings are designed. Thus engineers now focus on minimizing rather than eliminating shock waves. In the early 1960s, she obtained important results in geometrical optics in connection with sonar and radar, showing that the approximation of acoustic and electromagnetic fields by geometrical optics becomes more accurate as the wavelength approaches zero. Her estimate of the error resulted in geometrical optics being placed on a firmer foundation.

Cathleen Synge's father was the mathematician John Lighton Synge, who in his 98 years of life made significant contributions to classical mechanics, geometrical optics, hydrodynamics, elasticity, electrical networks, differential geometry and the theory of relativity. Her mother Eleanor Mabel Allen Synge also studied mathematics. Morawetz is the grand niece of Irish playwright John Millington Synge, notable for his plays *Riders of the Sea* and *The Playboy of the Western World*. The Synge family traces its ancestry to the fifteenth century. The origin of the family name is described in the introduction to *General Relativity: Papers in Honor of J.L. Synge*. Reportedly it originated with Henry VIII, who commanded a favorite choirboy to "Synge, Millington, sygne."

Her parents were Irish, but Morawetz was born in Canada on May 5, 1923, while her father was an assistant professor at the University of Toronto. She attended schools in Toronto except for the five-year period when the family returned to Ireland, because her father was appointed to the chair of Natural Philosophy at Dublin University. Her parents always encouraged her interest in mathematics and its applications. She won a scholarship and entered the University of Toronto to study mathematics. During 1943-44, she interrupted her college education to do war work as a technical assistant in a government laboratory, thereby experiencing her first taste of scientific discovery. She returned to school and in 1945 received her B.A. degree the same year she married chemist Herbert Morawetz. She faced a major decision, to continue her studies and get a doctorate in mathematics or find a job. She was aware that there were few opportunities for women with Ph.D.s in mathematics.

Morawetz often repeated the story of how her friend and former teacher Cecilia Krieger settled the matter for her. Let her tell it once again:

“I was in my final year at University of Toronto. World War II had almost ended and there had been a call for teachers to go to India. The idea of living in an exotic country appealed to me and since I did not have any other ideas, that is what I was thinking of doing. But I ran into Miss Krieger one day as I crossed campus and she asked me what my plans were. So I told her. She was horrified. ‘Why aren’t you going to graduate school?’ ‘I haven’t the money,’ I said. ‘Easily fixed,’ said Miss Krieger. She assured me that I could receive the Junior Fellowship of the Canadian Association of University Women. So before I knew it I was applying to graduate school and Miss Krieger (who was of course on the Fellowship Committee of the C.A.U.W. – I think even the

Chair) had delivered.”

Cathleen and Herbert Morawetz moved to Massachusetts where in 1946 she earned a Master’s degree from the Massachusetts Institute of Technology. Morawetz received a Ph.D. from New York University in 1951 for a thesis on the stability of a spherical implosion, supervised by Kurt Friedrichs. It was about this time that she became a U.S. citizen. After receiving her doctorate she briefly spent time as a research associate at MIT. In 1952 she joined the Institute of Mathematical Sciences of New York University, where she stayed and flourished throughout her career. In 1984 she became the first woman in the U.S. to head a mathematical institute when she was named director of the Institute, which was named for Richard Courant in 1964. She is currently Professor Emerita at the Courant Institute.

In addition to her research in partial differential equations and wave propagation Morawetz contributed to the mathematical theory of scattering, which describes how waves interact with obstacles. It provides the framework for analyzing many techniques for remote sensing, including ultrasound and radar. In 1980, she received the Lester R. Ford Award of the Mathematical Association of America for her expository writing in mathematics, and in 1990 she was the first woman elected to the Applied Mathematics Section of the National Academy of Sciences. Five years later she became the second woman to serve as president of the American Mathematical Society. In 2003, Morawetz was awarded the Leroy P. Steele Prize for Lifetime Achievement. With all her activities, she found time to raise four children and she has six grandchildren. When she was recognized by the National Organization for Women for combining a successful career and a family, she quipped, “Maybe I became a mathematician because I was so crummy a housewife.”

Morawetz was courageous in deciding to work towards a doctorate in mathematics. Although she had the support of her family, she moved into an area where women seldom went and were generally unwelcome. Making it all the more frustrating for her was addressing questions that would never be put to males. When she was asked if she worried about her children when she was at work, she replied, “No, I’m much more likely to worry about a theorem when I’m with my children.” Commenting on being awarded the National Medal of Science for Mathematics, Morawetz said: “This is an occasion of great moment for me. I am filled with gratitude to all those, and there were a great many, who helped me over the years, and I am proud to be the first woman mathematician to receive the medal. My biggest wish would be that it could help move more women forward in mathematics, be it in grade school or graduate school.”

Quotation of the Day: “Until the women’s movement of the late sixties it really was considered very bad form to be overtly ambitious, very bad form. ... And I think of course that underneath I was always very ambitious.” – Cathleen Synge Morawetz