2000 AMS-SIAM Wiener Prize

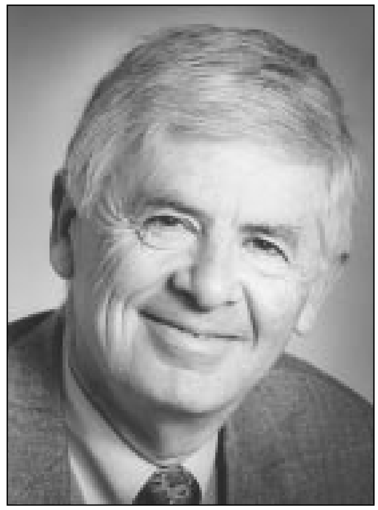
The 2000 AMS-SIAM Norbert Wiener Prize in Applied Mathematics was awarded at the Joint Mathematics Meetings held in January 2000 in Washington, DC.

The Wiener Prize was established in 1967 in honor of Norbert Wiener (1894–1964) and was endowed by a fund from the Department of Mathematics of the Massachusetts Institute of Technology. Since 1970 the prize has normally been awarded every five years jointly by the AMS and the Society for Industrial and Applied Mathematics. The $4,000 prize honors outstanding contributions to applied mathematics in the highest and broadest sense.

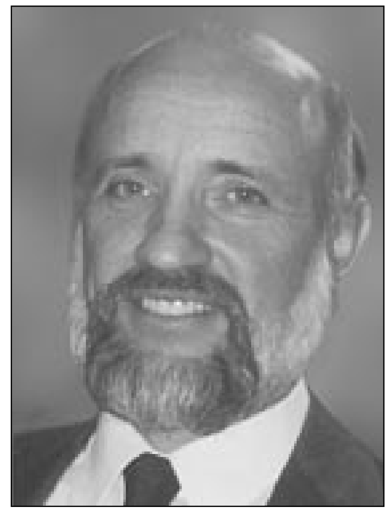
The 2000 Wiener Prize was awarded to ALEXANDRE J. CHORIN and ARTHUR T. WINFREE.

The selection committee for the 2000 prize consisted of Hermann Flaschka, Ciprian I. Foias (chair), and Charles S. Peskin.

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



Alexandre J. Chorin



Arthur T. Winfree

Alexandre J. Chorin

Citation

The 2000 Norbert Wiener Prize is awarded to Alexandre Joel Chorin in recognition of his seminal work in computational fluid dynamics, statistical mechanics, and turbulence. His work has stimulated important developments across the entire spectrum from practical engineering applications to convergence proofs for numerical methods. In computational fluid dynamics he is responsible for the introduction of the Projection Method and the Vortex Method. Convergence of the Projection Method was proved by Chorin himself, and convergence of the Vortex Method was proved by Hald, Beale, and Majda. These methods and their descendants (including the powerful Second-Order Projection Methods) have had a huge impact on numerous applied fields, including biomedical fluid dynamics and combustion, among others. In statistical mechanics, Chorin has introduced novel computational methods for the accurate evaluation of Wiener integrals. In turbulence Chorin has analyzed the blow-up of errors in finite difference calculations involving turbulent flow, and he has created highly original computational methods that overcome these difficulties and thereby enable the first direct simulation of the interaction and self-interaction of vortices leading to small regions in which intense dissipation occurs. He has established the long-sought quantitative link between statistical mechanics and turbulence. His recent work with Barenblatt establishing a correction to the "law of the wall" of turbulent flow yields spectacular agreement with experimental results. Chorin's most recent work goes by the name of "optimal prediction", an entirely new statistical approach to the problem of underresolved computation. From the 1960s to the present day, Chorin has led and inspired applied mathematicians everywhere to tackle the most difficult real-world problems and to make full use of the combined power of advanced computers and sophisticated mathematical analysis. In the process, he has done more than anyone else to create and shape the important discipline of computational applied mathematics.

Biographical Sketch

Alexandre Chorin was born in 1938 in Warsaw, Poland, grew up in Israel and Switzerland, and received a Ph.D. in mathematics from the Courant

Institute, New York University, in 1966. He spent his early career at Courant and has been at the University of California, Berkeley, since 1971. He is a member of the National Academy of Sciences (NAS) and the American Academy of Arts and Sciences, has received the NAS Award in applied mathematics and numerical analysis, and has held visiting positions at the Courant Institute of Mathematical Sciences, Harvard University, Tel-Aviv University, the Institute for Advanced Study at Princeton, and the Collège de France.

Response

I am very honored to be one of the recipients of the Norbert Wiener Prize of the American Mathematical Society and the Society for Industrial and Applied Mathematics. The work for which this prize is awarded has given me great joy; while everyone knows that mathematics can be useful, not everyone knows that the way mathematics functions in mechanics and physics is extraordinarily beautiful—recalcitrant, but unexpected, pithy, and elegant. Specifically, though scientific computing is still in its infancy, its ability to represent nature is already often uncanny; some time in the future it will reveal the structure of turbulence and explain its fascinating superposition of ephemeral coherence with ambient disorder. I am very grateful to my teachers, especially Peter Lax, who led me down this path and to my wonderful students, collaborators, and friends, at Berkeley and elsewhere, who have sustained me along the way.

Arthur T. Winfree

Citation

The 2000 Norbert Wiener Prize is awarded to Arthur T. Winfree in recognition of his profound impact on the important field of biological rhythms, otherwise known as coupled nonlinear oscillators. An experimental mathematician, Winfree has set the agenda in that field. He was the first to determine the conditions under which a large population of coupled nonlinear oscillators would synchronize, thus confirming a conjecture of Norbert Wiener's. Many original ideas that have since borne much mathematical fruit were put forth by Winfree in the course of this research. One was the reduced description of a population of weakly coupled nonlinear oscillators in terms of the phase of each oscillator. Another was the notion that the boundary between synchronization and desynchronization can be viewed as a phase transition, as in statistical mechanics. These ideas were further developed and made rigorous by Guckenheimer, Neu, Kuramoto, Kopell, and Ermentrout, among others. In studying the entrainment of biological clocks by pulses of light, Winfree realized that topological transitions may occur as the amplitude of the stimulus changes. This led to a topological classification that is used today to report the results of virtually every phase-resetting experiment on a biological system. It also led Winfree to the realization that there must be special stimuli that would make a nonlinear oscillator phaseless, i.e., stop the oscillation. Winfree's notion of a phase singularity has proved to be the key to the understanding of spiral waves in two-dimensional and of scroll waves in three-dimensional excitable media, such as cardiac tissue. The impact of these ideas on cardiac electrophysiology has been enormous; indeed, they completely define the field. At every stage of his illustrious career, Winfree has looked deeply into a physical, chemical, or biological phenomenon and managed to extract a mathematical gem. Not content to admire the beauty of his discovery, though, he has put that gem to use in the further pursuit of scientific knowledge.

Biographical Sketch

Arthur Winfree earned a Bachelor of Engineering Physics degree from Cornell University (1965), then a Ph.D. in biology from Princeton University (1970). From 1969 to 1972 he was assistant professor of theoretical biology at the University of Chicago, then professor of biology at Purdue University from 1972 to 1986. He is currently Regents Professor in the Department of Ecology and Evolutionary Biology at the University of Arizona in Tucson. He has been a MacArthur Fellow (1984–89) and recipient of the Einthoven Medal of Cardiology (1988–89). For a month in 2000 he occupies the Aisenstadt Chair of the Center de Recherches Mathématiques at the Université de Montréal.

Response

I give my deepest thanks to SIAM and the AMS for the honor of joining the fellowship of Norbert Wiener Prize awardees. This would not have been possible without continuous support from the National Science Foundation and the moral support of many mathematical collaborators, friends, and students. It is gratifying to know that mathematicians take an interest in the challenging problems that fascinate a biologist. They provide rich inspiration for new concepts. Norbert Wiener was among the first to recognize this, not only with his concept of mutually synchronizing brain waves, but also with his idea of involute spiral waves circulating around holes in heart muscle, which evolved into studies of three-dimensional electrical turbulence during fibrillation. My own perspective on such questions in 1978, freshly updated as the second edition (in press) of *The Geometry of Biological Time*, basically says, "See what these seeds grew into! See what fresh problems abound!" Many talented mathematicians and experimentalists continued the gardening to such fruitfulness that it attracted the Norbert Wiener Prize. I share this honor with all these colleagues.