

and presented in stimulating ways. I believe Morin did a careful job in taking the edges off some of the rougher passages. Some years ago, one of my daughters took an Electricity and Magnetism course at Harvard that used the second edition of Purcell's book. The text was a challenge for her, and despite Morin's smoothing, the book remains a challenge.

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The Physics of Wall Street

A Brief History of Predicting the Unpredictable

James Owen Weatherall
Houghton Mifflin Harcourt, Boston,
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If you're looking for stories of physicists and mathematicians who made important contributions to understanding and modeling financial markets, you'll find several in *The Physics of Wall Street: A Brief History of Predicting the Unpredictable*. Its author is James Weatherall, a PhD physicist and assistant professor of logic and philosophy of science at the University of California, Irvine. He presents interesting personal details and broad context on how certain econophysicists got involved in rather unconventional studies, seemingly distant from their disciplines' traditional domains. Most of his subjects appear in the book as brilliant, maverick minds, determined to study what they find interesting no matter where they find it.

Having been in econophysics since the late 1990s, when the subject was emerging as an academic field, I knew the main narratives and many of the people personally, but I found many new and interesting details in *The Physics of Wall Street*. I also found the book engaging, well written, and well researched, with detailed notes and references. Avoiding heavy math, it explains the main concepts with clever analogies. I highly recommend it to anyone who is interested in economics and finance. Other books covering similar ground include Jeremy Bernstein's *Physicists on Wall Street and Other Essays on Science and Society* (Springer, 2010)

and Scott Patterson's *The Quants: How a New Breed of Math Whizzes Conquered Wall Street and Nearly Destroyed It* (Crown Business, 2010).

This book's first chapter introduces Louis Bachelier, Henri Poincaré's graduate student, who worked at the stock market in Paris and whose 1900 PhD thesis, "The theory of speculation," was the first to propose a mathematical theory of option pricing based on the random walk—five years before Einstein's theory of Brownian motion was published. Following in successive chapters are introductions to Matthew F. Maury Osborne, a Naval Research Laboratory (NRL) physicist who independently applied random-walk theory to the stock market; Benoit Mandelbrot, whose famous 1963 paper shows that a power-law distribution better describes cotton-price data than the lognormal one proposed by Osborne; and mathematician Edward Thorp, who invented and published a winning strategy for blackjack and teamed up with Claude Shannon to design a wearable, concealed computer that could help them beat a roulette game in Las Vegas.

Other scientists appearing in the book include mathematical physicist James Simons, the poster child for physicists on Wall Street and a benefactor of the mathematical sciences; applied mathematician Fischer Black, of the famous Black–Scholes equation for option pricing; physicists J. Doyne Farmer and Norman Packard, cofounders of a company that uses chaos theory to predict and profit from stock markets; and physicists Didier Sornette and Jean-Philippe Bouchaud, cofounders of what is now the largest hedge fund company in France. In a departure from coverage of financial markets and stock profiting, the eighth and final chapter focuses on an optimal design of the Consumer Price Index for measuring inflation. For that purpose, mathematical physicist Eric Weinstein and economist Pia Malaney have proposed the use of curved-space geometry and gauge theories inspired by Hermann Weyl.

The main sentiment in the book is Weatherall's admiration of how mathematical models that were developed in physics and related disciplines found useful and relevant applications to financial markets—human-based systems that seemingly have nothing to do with conventional physics. I share that admiration. But one cannot escape thinking that the strategists who win when they play the financial markets do so at the expense of the rest of us.

As evidence, my analysis with economist J. Barkley Rosser Jr on the statistical mechanics of money, wealth, and income (*Reviews of Modern Physics* **81**, 1703, 2009) shows that the US has two distinct classes based on income distribution: The lower class, about 97% of the population, has an exponential distribution, reminiscent of the Boltzmann–Gibbs energy distribution; the upper class, about 3% of the population, has a power-law distribution. When financial innovations invented by physicists and mathematicians—called "financial weapons of mass destruction" by Warren Buffett—were rapidly proliferating, the upper-class share of total income doubled, which resulted in a sharp increase in overall income inequality.

Weinstein, the mathematical physicist and now hedge fund manager, has called for a "New Manhattan Project" to reform the world of finance in the wake of the 2008 global financial crisis. Other similar initiatives, including the Institute for New Economic Thinking (INET), established in 2009, are not mentioned in *The Physics of Wall Street*. INET invites grant applications from economists and explicitly from people in the physical sciences. As a recent INET grantee, I was pleasantly surprised to see many fellow econophysicists at the 2013 INET conference. That was a promising sign of budding constructive collaboration between economists and physicists in addressing the urgent problems of the world.

In the 1950s a dissertation by the NRL's Osborne was rejected by the University of Maryland physics department (where I work) because "it wasn't physics." But attitudes are changing. Now, physics departments are beginning to embrace econophysics and other broader applications of physics methods—and rightfully so. The economy is too important to be left to the economists.

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An Introduction to Statistical Mechanics and Thermodynamics

Robert H. Swendsen
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The development of statistical mechanics—understanding a macroscopic system through a statistical analysis of its