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.

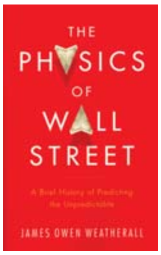
Henry Stroke
New York University
New York City

The Physics of Wall Street

A Brief History of Predicting the Unpredictable

James Owen Weatherall
Houghton Mifflin Harcourt, Boston, 2013. \$27.00 (286 pp.).
ISBN 978-0-547-31727-4

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.

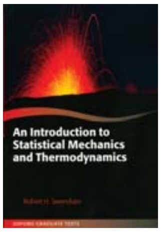
In the 1950s a dissertation by the NRL's Osborne was rejected by the University of Maryland physics department (where I work) because "it wasn't physics." But attitudes are changing. Now, physics departments are beginning to embrace econophysics and other broader applications of physics methods—and rightfully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

Victor Yakovenko
University of Maryland
College Park

An Introduction to Statistical Mechanics and Thermodynamics

Robert H. Swendsen
Oxford U. Press, New York, 2012. \$81.00 (416 pp.).
ISBN 978-0-19-964694-4

The development of statistical mechanics—understanding a macroscopic system through a statistical analysis of its microscopic properties—is one of science's great intellectual achievements. That approach has had a wide-ranging impact on our understanding of many-body systems in the physical and biological sciences and in such fields as economics and information theory. The need is growing for an introduction to statistical and thermal physics, which also includes modern computational methods.



In his innovative new text, *An Introduction to Statistical Mechanics and Thermodynamics*, Carnegie Mellon University physics professor Robert Swendsen presents the foundations of statistical mechanics with, as he puts it, a detour through thermodynamics. That's a desirable strategy because the statistical approach is more fundamental than the classical thermodynamics approach and has many applications to current research problems. The book's focus is on the development of the main theoretical concepts important to understanding equilibrium systems (although much of the current research in statistical physics is on nonequilibrium systems). The organization of the material is different from most texts on thermal physics—another term for the combined study of thermodynamics and statistical mechanics.

The book, which grew out of Swendsen's two-semester course at Carnegie Mellon, is divided into four parts. The first introduces Boltzmann's entropy definition as the logarithm of the probability of a macroscopic state, develops the related mathematical background, and calculates the entropy of a classical ideal gas. With his interpretation of Boltzmann's definition, Swendsen avoids paradoxes associated with distinguishable and indistinguishable particles. It also allows him to avoid the apparent violation of the second law of thermodynamics in closed systems, in which the entropy is defined as the logarithm of the volume of accessible phase space.

The second part begins with the formal postulates and laws of thermodynamics. In delaying the introduction of the general thermodynamic postulates, Swendsen is able to build on his earlier discussion of entropy, the example of the ideal gas, and the thermodynamic limit. In part three, the discussion focuses on the various ensembles of statistical mechanics and on computer simulations of classical systems, and in part four, it centers on quantum statistical mechanics and properties of materials. Applications to semiconductors and the Ising model are discussed toward the end of the book.

Theoretically inclined students will find *An Introduction to Statistical Mechanics and Thermodynamics* highly rewarding because it develops the more general concepts first, makes few assumptions, and develops its consequences as theoretical physicists like to do. Students who have had no previous exposure to thermal physics and those who are motivated more by observations and experiments are likely to find the material too abstract.

An Introduction to Statistical Mechanics and Thermodynamics has few illustrative examples to illuminate the abstract concepts discussed or to inspire students to tackle the material. It contains few figures; for instance, it does not include the usual flow charts for various engine cycles. For those reasons, additional exercises would be useful, especially for undergraduate students who have seldom encountered probability in a previous science course and who are grappling with multidimensional calculus.

Swendsen has made many important contributions to developing Monte Carlo algorithms, and it is not surprising that he emphasizes computational applications. A brief appendix on computer calculations and the programming language VPython can be found at the end of the book, and many of the problems at the end of chapters are computational. The author assumes students will have a reasonable proficiency in computational physics; those who are not already proficient will be challenged to learn the necessary techniques while simultaneously tackling the physics and mathematical concepts newly encountered in statistical physics. Surprisingly, random walks are not mentioned, even though they are important for gaining an intuitive understanding of random processes. Kinetic theory is also not discussed.

Although I do not envision that *An Introduction to Statistical Mechanics and Thermodynamics* will be used as a primary text for the more typical one-semester undergraduate course on thermodynamics and statistical physics, the book would be a helpful companion textbook. The mathematical notation is carefully introduced and useful; the selected mathematical techniques are clearly explained in a conversational style that both graduate and advanced undergraduate students will find easy to follow. The author's subject organization and conceptual viewpoint address some of the shortcomings of conventional developments of thermal physics and will be helpful to students and researchers seeking a deep appreciation of statistical physics.

Arshad Kudrolli
Clark University
Worcester, Massachusetts

new books

history and philosophy

The Neutron's Children: Nuclear Engineers and the Shaping of Identity. S. F. Johnston. Oxford U. Press, New York, 2012. $62.99 (313 pp.). ISBN 978-0-19-969211-8

Something Incredibly Wonderful Happens: Frank Oppenheimer and His Astonishing Exploratorium. K. C. Cole. U. Chicago Press, Chicago, 2012 [2009, reissued]. $19.00 *paper* (396 pp.). ISBN 978-0-226-11347-0

instrumentation and techniques

LACAME 2010: Proceedings of the 12th Latin American Conference on the Applications of the Mössbauer Effect. V. A. Peña Rodríguez et al., eds. Proc. conf., Lima, Peru, Nov. 2010. Springer, New York, 2012. $199.00 (311 pp.). ISBN 978-94-007-4300-7

Raman Imaging: Techniques and Applications. A. Zoubir, ed. *Springer Series in Optical Sciences 168*. Springer, Berlin, 2012. $179.00 (383 pp.). ISBN 978-3-642-28251-5

Recent Advances in Broadband Dielectric Spectroscopy. Y. P. Kalmykov, ed. *NATO Science for Peace and Security Series B: Physics and Biophysics*. Proc. wksp., Perpignan, France, Sept. 2011. Springer, Dordrecht, the Netherlands, 2013. $189.00, $89.95 *paper* (196 pp.). ISBN 978-94-007-5011-1, ISBN 978-94-007-5014-2 *paper*

Scanning Probe Microscopy in Nanoscience and Nanotechnology. Vol. 3. B. Bhushan, ed. *Nanoscience and Technology*. Springer, Berlin, 2013. $199.00 (630 pp.). ISBN 978-3-642-25413-0

materials science

Chalcogenides: Metastability and Phase Change Phenomena. A. V. Kolobov, J. Tominaga. *Springer Series in Materials Science 164*. Springer, Berlin, 2012. $129.00 (284 pp.). ISBN 978-3-642-28704-6

Electromagnetic Behaviour of Metallic Wire Structures. S. T. Chui, L. Zhou. Springer, London, 2013. $129.00 (141 pp.). ISBN 978-1-4471-4158-7

Encyclopedia of Nanotechnology. Vols. 1–4. B. Bhushan, ed. Springer, New York, 2012. $1,600.00 *set* (2868 pp. *set*). ISBN 978-90-481-9750-7

Liquid Crystal Elastomers: Materials and Applications. W. H. de Jeu, ed. *Advances in Polymer Science 250*. Springer, Berlin, 2012. $259.00 (239 pp.). ISBN 978-3-642-31581-7

Nanoalloys: Synthesis, Structure and Properties. D. Alloyeau, C. Mottet, C. Ricolleau, eds. *Engineering Materials*. Springer, London, 2012. $179.00 (412 pp.). ISBN 978-1-4471-4013-9

Nanoparticles from the Gas Phase: Formation, Structure, Properties. A. Lorke, M. Winterer, R. Schmechel, C. Schulz, eds. *NanoScience and Technology*. Springer, Berlin, 2012. $179.00 (418 pp.). ISBN 978-3-642-28545-5

Quantum Simulations of Materials and Biological Systems. J. Zeng, R.-Q. Zhang, H. R. Treutlein, eds. Springer, Dordrecht, the Netherlands, 2012. $129.00 (197 pp.). ISBN 978-94-007-4947-4

nonlinear science and chaos

Applications of Chaos and Nonlinear Dynamics in Science and Engineering. Vol. 2. S. Banerjee, L. Rondoni, M. Mitra, eds. *Understanding Complex Systems*. Springer, Berlin, 2012. $179.00 (270 pp.). ISBN 978-3-642-29328-3

Complex Networks. R. Menezes, A. Evsukoff, M. C. González, eds. *Studies in Computational Intelligence 424*. Springer, Berlin, 2013. $129.00 (266 pp.). ISBN 978-3-642-30286-2

Econophysics of Systemic Risk and Network Dynamics. F. Abergel, B. K. Chakrabarti, A. Chakraborti, A. Ghosh, eds. *New Economic Windows*. Springer, Milan, Italy, 2013. $129.00 (298 pp.). ISBN 978-88-470-2552-3

Geography of Order and Chaos in Mechanics: Investigations of Quasi-Integrable Systems with Analytical, Numerical, and Graphical Tools. B. Cordani. *Progress in Mathematical Physics 64*. Birkhäuser, Boston, 2013. $129.00 (332 pp.). ISBN 978-0-8176-8369-6

Networks in Social Policy Problems. B. Vedres, M. Scotti, eds. Cambridge U. Press, New York, 2012. $99.00 (299 pp.). ISBN 978-1-107-00983-7

Time Reversibility, Computer Simulation, Algorithms, Chaos. 2nd ed. W. G. Hoover, C. G. Hoover. *Advanced Series in Nonlinear Dynamics 13*. World Scientific, Hackensack, NJ, 2012 [2001]. $88.00 (401 pp.). ISBN 978-981-4383-16-5

optics and photonics

Progress in Ultrafast Intense Laser Science VIII. K. Yamanouchi, M. Nisoli, W. T. Hill III, eds. *Springer Series in Chemical Physics 103*. Springer, Berlin, 2012. $129.00 (201 pp.). ISBN 978-3-642-28725-1

Schlieren and Shadowgraph Methods in Heat and Mass Transfer. P. K. Panigrahi, K. Muralidhar. *Springer Briefs in Applied Sciences and Technology: Thermal Engineering and Applied Science*. Springer, New York, 2012. $49.95 *paper* (128 pp.). ISBN 978-1-4614-4534-0

particle physics

Classical Solutions in Quantum Field Theory: Solitons and Instantons in High Energy Physics. E. J. Weinberg. *Cambridge Monographs on Mathematical Physics*. Cambridge U. Press, New York, 2012. $100.00 (326 pp.). ISBN 978-0-521-11463-9

Gravity, Special Relativity, and the Strong Force: A Bohr-Einstein-de Broglie Model for the Formation of Hadrons. C. G. Vayenas, S. N.-A. Souentie. Springer, New York, 2012. $129.00 (144 pp.). ISBN 978-1-4614-3935-6

An Introduction to Non-Abelian Discrete Symmetries for Particle Physicists. H. Ishimori et al. *Lecture Notes in Physics 858*. Springer, Berlin, 2012. $59.95 *paper* (286 pp.). ISBN 978-3-642-30804-8

Quantum Chromodynamics at High Energy. Y. V. Kovchegov, E. Levin. *Cambridge Monographs on Particle Physics, Nuclear Physics and Cosmology 33*. Cambridge U. Press, New York, 2012. $125.00 (339 pp.). ISBN 978-0-521-11257-4