

**The Second Law of Economics: Energy, Entropy, and the Origins of Wealth** **FREE**

Marcos G. E. da Luz



*Physics Today* **64** (12), 57–58 (2011);

<https://doi.org/10.1063/PT.3.1366>



View  
Online



Export  
Citation

CrossMark

Your **resume** says  
a lot about you.

Does it  
**stand out?**

Our career resources  
can help.

Find your future at  
[physicstoday.org/jobs](https://physicstoday.org/jobs)

**PHYSICS TODAY**

particles (for example, holes, phonons, and excitons), introduced by Yakov Frenkel and Lev Landau; and the concepts of weak and strong interactions, developed by Enrico Fermi and Hideki Yukawa, respectively.

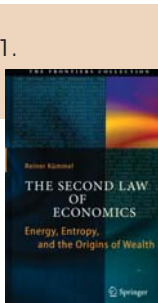
The second narrative's selected focus gives the book an unintended new meaning, since the reader cannot help but notice a striking contrast between its two stories. One reads like a suspense drama, with physicists absorbed in critical dialogs and challenging each other's fundamental beliefs. The other reflects the style of banquet speeches celebrating Nobel Prizes; disagreeing voices are no longer heard and debating the foundations is often dismissed as "metaphysics" and discouraged in favor of constant pushing forward.

The *Quantum Story* characterizes the current situation in quantum field theory as a crisis caused by theoretical speculations running ahead of experimentalists' limited financial resources. But it may also be that theorists have gone far too long without looking back at and critically re-examining their basic assumptions. After all, a hundred years ago authoritative physicists were also expecting sophisticated experiments to prove their latest "theory of everything" and a grand unification under electromagnetism. Instead, the developments took an unexpected turn after an unknown patent clerk in Bern, Switzerland, published a paper that contained some thought experiments and a "mere philosophical" analysis of the concept of simultaneity.

Alexei Kojevnikov  
University of British Columbia  
Vancouver, Canada

## The Second Law of Economics Energy, Entropy, and the Origins of Wealth

Reiner Kümmel  
Springer, New York, 2011.  
\$89.95 (293 pp.).  
ISBN 978-1-4419-9364-9



It is no easy task to write a book that is targeted at a broad audience and merges essential concepts of thermodynamics, statistical physics, and economics. However, theoretical physicist Reiner Kümmel succeeds in doing just that with *The Second Law of Economics: Energy, Entropy, and the Origins of Wealth*. The

book discusses the impact of two fundamental laws of nature—energy conservation and entropy production—on the creation and growth of wealth. For more than 30 years, Kümmel has been at the forefront of the study of economic thermodynamics, which considers the relationship of the natural sciences to economics—thermodynamics and economics are bridged by the constraints that thermodynamic laws place on natural-resources availability and economics-based environmental preservation.

In the first chapter, the author presents Abel, an observer "beyond space

and time." Like the three spirits in Charles Dickens's *A Christmas Carol*, Abel guides the reader through fundamental historical scientific and technological events, beginning with the Big Bang and the evolution of life on Earth and moving to the Industrial Revolution and the rise of the semiconductor industry. He describes the development of agricultural processes, the rise and fall of civilizations, and modern-day challenges of mitigating air pollution and replacing fossil fuels with renewable energy. The chapter is short, and some discussions, such as the one about

CAMBRIDGE

## New and Forthcoming Titles from Cambridge!

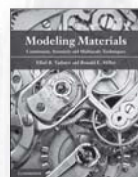
### Foundations of Space and Time Reflections on Quantum Gravity

Edited by Jeff Murugan,  
Amanda Weltman,  
George F. R. Ellis  
\$70.00: Hb: 978-0-521-11440-0:  
488 pp.



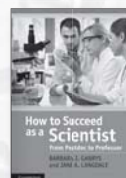
### A Student's Guide to Vectors and Tensors

Daniel Fleisch  
\$75.00: Hb: 978-0-521-19369-6  
\$28.99: Pb: 978-0-521-17190-8:  
208 pp.



### Modeling Materials Continuum, Atomistic and Multiscale Techniques

Ellad B. Tadmor,  
Ronald E. Miller  
\$85.00: Hb: 978-0-521-85698-0:  
792 pp.

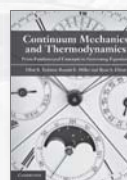


### How to Succeed as a Scientist From Postdoc to Professor

Barbara J. Gabrys,  
Jane A. Langdale  
\$95.00: Hb: 978-0-521-76586-2  
\$36.99: Pb: 978-0-521-18683-4:  
226 pp.

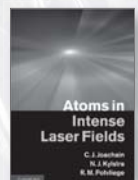
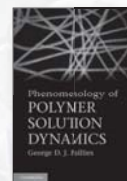
### Continuum Mechanics and Thermodynamics From Fundamental Concepts to Governing Equations

Ellad B. Tadmor,  
Ronald E. Miller,  
Ryan S. Elliott  
\$80.00: Hb: 978-1-107-00826-7:  
384 pp.



### Phenomenology of Polymer Solution Dynamics

George D. J. Phillies  
\$120.00: Hb: 978-0-521-87555-4:  
528 pp.



### Atoms in Intense Laser Fields

C. J. Joachain,  
N. J. Kylstra,  
R. M. Potvlieve  
\$135.00: Hb: 978-0-521-79301-8:  
584 pp.



Second Edition

### Electricity and Magnetism

Edward Purcell  
\$75.00: Hb: 978-1-107-01360-5:  
504 pp.

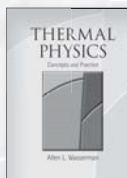
### Semiconductor Quantum Optics

Mackillo Kira,  
Stephan W. Koch  
\$90.00: Hb: 978-0-521-87509-7:  
658 pp.



### Thermal Physics Concepts and Practice

Allen L. Wasserman  
\$65.00: Hb: 978-1-107-00649-2:  
318 pp.



Prices subject to change.

www.cambridge.org/us/physics  
800.872.7423



CAMBRIDGE  
UNIVERSITY PRESS

the conflict between capitalism and communism, are a bit simplistic. In discussing the development of civilizations, Kümmel borrows the approach of the marvelous book by Jared Diamond, *Guns, Germs and Steel: The Fates of Human Societies* (W. W. Norton, 1999). However, a more nuanced perspective would have been appropriate, since a significant number of historians have contested many aspects of Diamond's vision.

In chapters 2 and 3, which are comprehensive and well organized, the author addresses the concepts of energy and entropy. How is energy manifested and conserved and what role does it play in creating wealth? And how can entropy production be used to determine the direction of natural processes, including those involved in generating economic goods? Kümmel describes how the balance between exergy (useful work) and anergy (useless work) sets the cost of producing something efficiently; he argues in a clear and simple way that energy conversion is an essential force in wealth creation and a force to be reckoned with in the crafting of economic policy.

In chapter 4, the main thesis of the book emerges: According to Kümmel, the second law of economics states that "energy conversion and entropy production determine the growth of wealth." That view is in contrast with more traditional ones, including the theory that the importance of energy is proportional to the rather small share of costs in the production process. Kümmel also maintains that production is limited by the availability of energy and that the natural degradation of our environment is driven by increasing entropy. He also acknowledges that such limitations cannot always be compensated by technological progress. He illustrates his thesis by showing how specific models can quantitatively describe real data from different economic indicators, mostly concerning Germany, Japan, and the US. The short epilogue contained in chapter 5 discusses social values and presents philosophical and ethical considerations that could lead to a more sustainable and humane world. It recommends that human societies need to think seriously about the future consequences of their economic practices.

Overall, *The Second Law of Economics* is accessible and quite enjoyable, in part because of the subtle ironic tone Kümmel uses in some places. He points out that, for an interdisciplinary field like economic thermodynamics, even PhD

scientists can make naive observations. He also illustrates the absurdity of real-estate bubbles by describing what value the Japanese emperor's palace would have had in the 1980s. But for an interdisciplinary book, the glossary is too small. Also, in recent years countries outside the North America-Europe-Japan axis have become important players in the global economy. China is the most notable example, but others include Brazil, India, Indonesia, Russia, and South Africa. In a revised version of the book, Kümmel should apply his conclusions to those countries.

Besides physicists and economists, researchers and policymakers concerned with resource conservation and how a society should be economically organized in the future can benefit from *The Second Law of Economics*. After all, understanding that law now can help us guarantee the prosperity of future generations.

Marcos G. E. da Luz  
Federal University of Paraná  
Curitiba, Paraná, Brazil

## Soft Matter The Stuff That Dreams Are Made Of

Roberto Piazza  
Springer, New York, 2011.  
\$24.95 paper  
(293 pp.).  
ISBN 978-94-007-0584-5

A wise man once told me that before soft-matter physics was so named, the science of materials at the meso-scale was appropriately called De Gennes physics. How fitting, then, that Pierre-Gilles De Gennes was responsible for renaming "his" physics simply by titling his 1991 Nobel Prize lecture "Soft Matter." The field has garnered as much attention for the quirkiness of its name as for the subtle complexities of the science it describes. On the 20th anniversary of the name change, we again find that this ever pliable subject is remodeling itself, in particular because of its many applications to biology. Could another name change be in order?

Regardless of what we call it, soft-matter science is familiar to the human experience. From the cream in our coffee to the cement in our buildings and sidewalks, we all experience the impact of soft matter firsthand (and foot). Such a seemingly familiar science may underlie the apparent disincentive for

its experts to popularize it. The many mysteries contained in cosmology, particle physics, and relativity seem to justify their ever-increasing presence on bookstore shelves. However, it appears that the mysteries contained in commonplace materials have been underappreciated.

Satisfying the need of those who seek deep mysteries is *Soft Matter: The Stuff That Dreams Are Made Of* by Roberto Piazza. The book strikes the right balance between historical context and scientific content, and it should appeal to PHYSICS TODAY readers. As a soft-condensed-matter physicist, I find my own soft-matter dreams often turning into nightmares when I realize that I actually have to teach the subject to students. What keeps me up at night is the overwhelming breadth of knowledge needed; to convey the material requires a comprehension of fundamental applications of electrodynamics in continuous media, statistical thermodynamics, and the physical chemistry of everything from colloids to peptides, among other things. Piazza adroitly tackles the hardest parts of soft matter, providing sufficient breadth to explain its ever-increasing canon in a way that will make sense to the undergraduate student.

One of *Soft Matter's* dreamy aspects is the way in which some topics are contextualized. For example, though somewhat curious in its delivery, the prelude, which Piazza calls "Overture: a special day," takes the reader through a day in the life of a working mother by highlighting the indispensable role played by soft materials. The book is full of that type of unconventional storytelling, which perfectly suits the subject.

Early on, Piazza introduces the quintessential soft material—colloidal dispersions, such as coffee, milk, and toothpaste, to name just a few—thus setting the stage for a discussion of the fundamental forces that determine mesoscale interactions. As the book proceeds, colloids give way to polymers with classic treatments of random-walk models and the origins of elasticity. Near the middle, the focus shifts to macromolecular self-assembly and amphiphilic molecules and to a description of packing, structure, and geometry that leads naturally into a discussion of glassy materials and jamming in granular materials. In the latter section, Piazza takes the reader into what he seems to anticipate will be a direction for soft-matter science—biology. As a

