

fable includes, as it must, a great deal of straightforward exposition. Whether one is a Richard Feynman, George W. Bush, or royal chamberlain, he will eventually end up using sentences like “the upper cone that you see there is bounded by all the possible paths that light may take as it moves from you into the future. . . . Along the [present light] cone lie all those events where someone or something might look back and see you as you are now. . . . Within this [past light] cone will lie all the events of your actual past, which must be separated by movements slower than light. . . .” Thus I cannot see why Gilmore thought that bringing Hendrik Lorentz briefly into the picture would make much of a difference in how readers would absorb the scientifically significant parts of his book. A fair number of general readers might find the author’s approach condescending and unhelpful. I salute Gilmore for his desire to connect with the public, but I believe he has little chance of doing so with cosmic fairy tales.

But all is not lost. A segment of the market does exist that might find deep pleasure in such cosmic quests. I can well imagine that someone who has mastered the material, at least in part, could take delight in revisiting topics recast into a fairy-tale format. Small jokes, such as “The Prince and p,” could resonate in a mind primed to understand scientific matters written in a style that might leave others with a diffident, suspicious, or even hostile attitude.

As its inside cover states, *Once Upon a Universe* demonstrates more than one way to shed light on the strange profundities of modern physics and cosmology. The problem is that Gilmore’s way probably won’t fly with those who fear the worst about physical science, and even those with a positive attitude are likely to find his approach of little merit. But give the book to your scientist friends. They will thank you for it—and mean it.

Donald Goldsmith
Berkeley, California

Capillarity and Wetting Phenomena: Drops, Bubbles, Pearls, Waves

Pierre-Gilles de Gennes, Françoise Brochard-Wyart, and David Quéré (translated from French by Axel Reisinger)
Springer-Verlag, New York, 2004, \$69.95 (291 pp.).
ISBN 0-387-00592-7

Capillarity and Wetting Phenomena: Drops, Bubbles, Pearls, Waves is a

translation of the earlier French *Gouttes, Bulles, Perles et Ondes* by the same authors, which was published in 2002 by Éditions Belin-Hersch (Paris) as part of the series Collection Échelles. It has been wonderfully translated by Axel Reisinger. The English is fully fluent and idiomatic, with a style and wit that are undoubtedly faithful to the original.

What we now call capillarity and wetting manifest themselves constantly in everyday life. Their origin had long been the object of much philosophical speculation. As one may read in chapter 2 of this book, or in John S. Rowlinson’s *Cohesion: A Scientific History of Intermolecular Forces* (Cambridge U. Press, 2002; reviewed in *PHYSICS TODAY*, November 2003, page 68), the subject became quantitative science in the early 18th century with the experiments on capillarity by Francis Hauksbee. He showed that the rise of liquid between parallel glass plates is inversely proportional to their separation. (Shortly afterward, James Jurin showed that the rise in a glass capillary is inversely proportional to the capillary’s radius.) Hauksbee also showed that the rise in a capillary is independent of the thickness of the tube’s walls and that it occurs as well in vacuum as in air. That the rise between parallel plates is inversely proportional to their spacing means that when the plates are joined at a vertical edge, forming a wedge, the shape of the resulting meniscus, as viewed from the side through either of the plates, is a hyperbola. The hyperbolic shape of the meniscus was soon confirmed.

The authors are great admirers of Henri Bouasse, the French scientist and author of *Capillarité et Phénomènes Superficiels* (Delagrave, 1924). They state that their intention was to write a book “in the Bouasse tradition, that is to say, by aiming at an audience of students. What we offer here is not a comprehensive account of the latest research but rather a compendium of principles.” In this, they have been eminently successful.

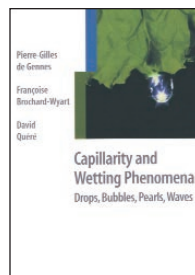
With its many homely examples, references to everyday observation, and invitations to readers to check the principles with “kitchen” experiments, which the authors carefully describe and illustrate, *Capillarity and Wetting Phenomena* is also like another great classic of the subject—Charles Vernon Boys’s *Soap-Bubbles, Their Colours and the Forces Which Mould Them* (Society for Promoting Christian

Knowledge, 1912; Dover, 1959). Indeed, on page 2 of *Capillarity and Wetting Phenomena*, we find a charming sketch of a luxuriant head of hair becoming compact and drooping when wet and exposed to the air, which illustrates an effect of the surface tension of water. One may then instantly recall the same idea in Boys’s book illustrated by an artist’s paint brush, first dry and then fully immersed in water—in both cases the bristles are free from one another and the brush is full—and then removed from the water and exposed to the air, as a result of which the brush becomes compact and pointed. That is not because the brush is now wet—it could not have been wetter than when immersed in the water—but because of water’s surface tension against air.

The captivating drawing in *Capillarity and Wetting Phenomena* of the head of hair above a pert, curvilinear-triangular face is signed with a discreet “PG.” It is the only such sketch in the book, which is a pity: Pierre-Gilles de Gennes is an accomplished amateur artist, as well as a renowned scientist. Still, the book has many (177, by the publisher’s count) illuminating diagrams and photographs. One example among many is a striking photograph of liquid drops hanging under a horizontal panel (as one might observe with wet paint on a ceiling), which illustrates the Rayleigh–Taylor instability.

Although the mathematics and technicalities have been confined to the minimum necessary, they are nevertheless here and are often quite sophisticated. The book can be read with pleasure and profit by the uninitiated, but it is also a valuable—and even an indispensable—reference work for the expert. Still, the mathematics is always motivated and explained in physical terms, never without numerical estimates, and with profuse reference to commonly observable effects. Ever since reading chapter 7 on dewetting, I have been unable to view the hydraulic jump at the edge of the outward-flowing film of water at the bottom of the kitchen sink below the stream from the faucet as anything other than a shock front. In that same

flow from the faucet, we learn (in chapter 5 on the hydrodynamics of interfaces), you can feel with your hands the Rayleigh instability in the discrete drops near the bottom of the stream, which are in contrast to the laminar flow near the top. Are you curious to know what weight of water covers you when, as the



authors put it, “you scramble out of your bath, perhaps to answer an untimely phone call”? Answer: about 250 g “on an average adult human body,” as calculated in chapter 5. Again in chapter 7, we learn that the first studies of dewetting were on the instability of the lachrymal film (dry-eye syndrome). In chapter 10 on transport phenomena, we see a sketch and description of a droplet moving *up* an inclined plane, the droplet being propelled by a surface wettability gradient.

The book is filled with wisdom, as can be found, for example, in “The Myth of the Line Tension” in chapter 3. The authors explain why some measurements of line tension (the tension of the line in which three phases meet) have values too high by factors of thousands. They also remark that the energy to distort the line is predominantly that needed to distort the interfaces that meet at the line rather than the energy needed to stretch the line against its (meager!) tension. (It is because of the concomitant distortions of the interfaces that line tension, unlike surface tension, can be negative—which was already known to J. Willard Gibbs—and the line yet be stable.)

In its fewer than 300 pages, *Capillarity and Wetting Phenomena* con-

tains a whole bookshelf of information—all of it useful and much of it fascinating. To the distinguished authors, we owe thanks for this gift.

Benjamin Widom
Cornell University
Ithaca, New York

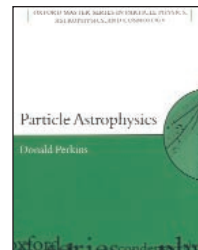
Particle Astrophysics

Donald Perkins
Oxford U. Press, New York, 2003.
\$99.50, \$44.50 paper (256 pp.).
ISBN 0-19-850951-0,
ISBN 0-19-850952-9 paper

Some of the most perplexing cosmic and astrophysical phenomena are inextricably intertwined with the quantum world of elementary particles. Cosmologists have developed a “concordance model” that accounts for the observed global properties of the universe and the cosmic structures that were probably seeded by primordial quantum fluctuations. The standard model of particle physics accommodates all experimentally observed properties of elementary particles. But it completely fails to account for key elements of the concordance model—the dark matter that dominates the dynamics of galaxies and

the dark energy that accelerates the expansion of the universe. Nor can it explain the cosmic preponderance of ordinary matter over antimatter, an asymmetry necessary for our very existence. Well-motivated extensions of the standard model suggest novel particles as dark-matter candidates. Such particles may well show up at new particle accelerators, in one of the many dedicated dark-matter searches, or as an annihilation signature in cosmic-ray observatories.

Cosmic rays may help identify dark matter; independent of that possibility, the field of cosmic-ray physics is rapidly advancing. The largest-ever observatories for cosmic rays, high-energy photons, neutrinos, and gravitational waves are now coming on line. Neutrinos in particular provide a showcase example for the synergy between astro- and particle-physics ideas and methods. Flavor oscillations, which imply that neutrinos have mass, have now been established by detailed observations of solar, atmospheric, and laboratory neutrino



see more.

See the
70% of
Physics Today
content
available only
to registered
readers.



Registration is free to print subscribers at
www.physicstoday.org/jreg.html

PHYSICS TODAY

Mathematical Word Processing • L^AT_EX Typetting • Computer Algebra

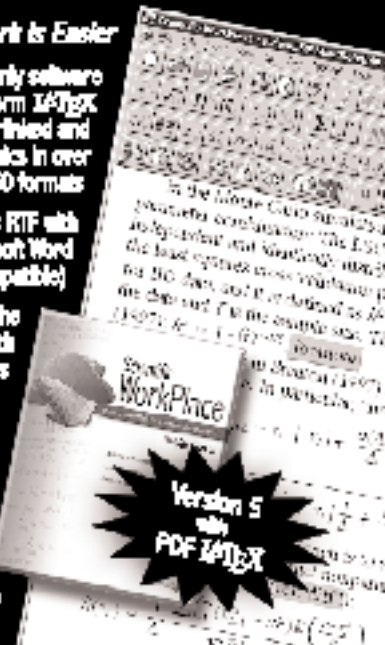
ScientificWorkPlace 5

Sharing Your Work Is Easier

- Typeset PDF in the only software that allows you to transform L^AT_EX files to PDF fully hyperlinked and with embedded graphics in over 50 formats
- Export documents as RTF with editable math (Microsoft Word and MathType compatible)
- Share documents on the web as HTML with math as MathML or graphics

The Gold Standard for Mathematical Publishing

- Increase productivity
- Produce sharing documents quickly & easily
- Typeset documents with L^AT_EX
- Work with the easiest-to-use computer algebra system



Version 5 with PDF L^AT_EX

MacKichan
PUBLISHED BY

Phone: 360-394-6993 • Email: info@mackichan.com
www.mackichan.com/pt
Visit our website for free trial version of all our products.