that Park found wanting in Zangwill's book. The final part is a chapter on crystal growth, with a cursory paragraph on roughening.

Hudson's approach is avowedly experimental. In contrast to the great algebraic detail on beam processes and reaction kinetics, the book has few specifics on surface densities of states (even in conjunction with experiments), band structures, adsorption-energy calculations, collective effects and other properties of interest to the theoretically inclined. While the book offers a broad introduction to the "alphabet soup" of probes that greets the novice, there are notable omissions. The author has laid all the groundwork in sections on x-ray and electron scattering, but he neglects completely fine-structure absorption probes, most notably surface extended x-ray absorption fine structure, which provide arguably the most precise measurement of interatomic spacings. Likewise, I expected some discussion of Bremsstrahlung isochromat spectroscopy or "inverse photoemission," which complements photoemission by probing unfilled states. It is more excusable, though still unfortunate, that the book does not cover new, powerful techniques such as low-energy electron microscopy and photoemission electron microscopy.

Particle physicists who view condensed matter physics as "squalid state" or *Dreckphysik* will not be disabused by this volume. The book provides little sense of the many exciting and aesthetically appealing aspects of surface physics. Also disappointing are the references at the end of the chapters, half of which are quite dated. Numerous fine reviews have appeared over the last decade. While Hudson does alert students to some in the journal *Surface Science Reports*, he does not mention *Progress in Surface Science, Chemistry and Physics of Solid Surfaces* (proceedings of biennial summer schools in Milwaukee, Wisconsin), or several other proceedings and review volumes in Springer-Verlag's series on chemical physics, current physics and modern physics.

This book is particularly valuable for introductory graduate courses in chemistry or chemical physics or for experimenters with little background in solid state theory. For those with stronger theoretical inclinations who opt for Zangwill's text, Hudson's is a useful reference, especially for kinetics. These recessionary times require the comment that paperback editions of Zangwill's book with D. P. Woodruff and T. A. Delcher's *Modern Techniques of Surface Science* (Cambridge U. P., New York, 1986) as an experimental supplement together cost less than Hudson's text alone. Butterworth–Heinemann should follow the laudable lead of Cambridge University Press and produce a paperback soon.

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In the Wake of Galileo

Michael Segre
Rutgers U. P., New Brunswick, N. J., 1991. 192 pp. $27.95 hc
ISBN 0-8135-1700-1

The historical Galileo Galilei is something like the elephant described by the blind men, each of whom has grasped a different part of the pachyderm's anatomy. Was Galileo a neo-Platonist who eschewed experiment, as portrayed by Alexandre Koyré? Or was he the pioneer of the modern experimental method, as described by Stillman Drake and others? Was he the radical innovator of the scientific method? Or did he derive his procedures from the Jesuit teachers at the Collegio Romano? Or was he perhaps merely elaborating on ideas already proposed in the Middle Ages?

In writing *In the Wake of Galileo*, Michael Segre has taken a new tack in exploring Galileo's attitude toward physical reasoning and experimentation. How, he asks, did Galileo's own disciples view these questions? Segre's book is by no means an in-depth study, but rather an ingenious reconnaissance of a curiously neglected approach to the celebrated "mathematician and philosopher" (the title Galileo insisted upon when he moved to the court of Cosimo de' Medici).

Segre's study concentrates on three distinguished scientists in the generation following Galileo, Evangelista Torricelli, Vincenzio Viviani and Giovanni Alfonso Borelli. He shows that the origins of Galileo's image as an empirical scientist date back to the biography written 12 years after Galileo's death by his young protégé Viviani, but at the same time he points out that Viviani's essay can be interpreted in more than one way. One of the most charming parts of Segre's analysis is the demonstration of how strongly Giorgio Vasari's *Vite* of famous Renaissance artists affected Viviani's own style, including an uncanny parallel to Vasari's treatment of the youth of Giotto di Bondone. Included in Viviani's treatment was even an attempt to make Galileo's birth match the date of Michelangelo's death, to the day and hour.

Segre's analysis at last comes to an altered horoscope for Galileo's birth. As an historian of astronomy, I can point out that the planetary positions recorded in the horoscope make clear that the original birthdate was 15 February 1564, as Segre himself concludes from paleographical evidence. Whether Viviani chose 19 February for Galileo's birthday because that was the day of Copernicus's birth is open to speculation. Segre also places the famous Tower of Pisa experiment, first recorded by Viviani, into the same mythologizing context. All of this demonstrates how early the myth-making began, and how difficult it will ever be to find the true Galileo. In any event, we owe Segre a word of thanks for opening another window onto Galileo, a fresh approach in the ongoing task of sorting out Galileo's role in the birth of modern science.

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The Physics of Sports

Edited by
Angelo Armenti Jr
AIP, New York, 1992. 333 pp. $35.00 pb
ISBN 0-88318-946-1

The Physics of Sports is a collection of 57 reprinted articles on a broad array of sports largely taken from the *American Journal of Physics* and *The Physics Teacher*.

Sports physics is not a mature field, and the articles in this collection range from the ridiculous to the sublime. Roughly half of the articles are in areas where I consider myself knowledgeable, and I judge that half of these are irrelevant or have serious errors. But if there is much in it that is wrong or irrelevant, I shall still value my copy of this book for its classic articles by Paul Kirkpatrick on sports measurements and baseball, the fine essay on archery by Paul Klopsteg and Lyman Briggs's discussion of the aerodynamics of baseballs (although Robert Watts has shown that Briggs's parameterization of the Magnus force is probably in error).

For more recent works, Howard Brody's definitive articles on tennis are enlightening and fun. The inclusion of the description of the knuckleball by Watts and Eric Sawyer allowed me to throw away my old Xerox copy of that paper as well as my copy of Richard Garwin's discussion of the superball, which, if not quite sports, is fine classical physics. I found Peter Brancazio's analysis of kicking a foot-

ball interesting, although he still leaves me wondering why modern teams punt rather than place kick on free kicks from the twenty-yard line after a safety. After reading Cliff Frolich's article on the discus, I understand why discus throwers like a head wind.

While I generally found the analyses of running and jumping (where physiology and physics mix) interesting but unconvincing, the article on animal locomotion by the eminent physiologist Knut Schmidt-Nielson, which summarizes much of his great work, is a treasure.

The book also includes articles on sports that I do not know well, such as karate, skiing, fly casting, diving, sailing and others. I read them uncritically but appreciatively. The 20% of the articles that are fundamentally pedagogic did not interest me much, but some readers might find them useful. And with most serious readers of sports physics having access to personal computers that run BASIC, for my taste there are too many analytic calculations that use dubious approximations where simple numerical techniques would do better.

My major criticism of this collection, however, is that it contains too many items that would best have been dropped. Here I would start with a statement by the editor that underhand foul shooting in basketball was "all female" and "virtually unheard of in men's basketball." This statement would have astonished basketball players such as Nat Holman of the original Celtics, Johnny Wooden, an All American at Purdue in 1930, and even Hank Luisetti, an All American at Stanford in the late 1930s. Before 1950 everyone, boy or girl, shot free throws underhanded, while today everyone—man, woman or person—shoots free throws overhanded.

The book would not have suffered in the slightest if the articles on fielding a fly ball in baseball and shooting basketballs had been left out. The note on why the axis of a spiraling football tends to line up with the direction of the ball's motion makes absolutely no sense to me. And the article showing that backspin on a baseball increases the distance it travels is an example of the misleading power of a reasonable answer to a wrong question. In fact, the *many* home runs hit by uppercut sluggers such as Reggie Jackson have less backspin than the *fewer* home runs hit by level swingers such as Wade Boggs. Indeed, one can argue that the ball hit more squarely with less backspin will go farther.

If you know some physics and are interested in sports, by all means get a copy of *The Physics of Sports*, but, *caveat lector*, don't believe everything you read in it.

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