IN THE BALLPARK: THE PHYSICS OF CORKED BATS AND SCUFFED BALLS

The Physics of Baseball

Robert K. Adair
Harper and Row, New York, 1990. 110 pp. $7.95 pb
ISBN 0-06-096461-8

Reviewed by Geoffrey F. Chew

Although physicists tend to see their discipline as fundamental and all encompassing, the usefulness of physics stems in fact from approximations tailored to some very special and limited range of phenomena. No physical laws are exact: The areas of their application derive legitimacy from large (or small) ratios whose origin is accepted without explanation. The mysterious values of the fine-structure constant and the electron–proton mass ratio, for example, provide legitimacy for separate consideration of particle physics, nuclear physics, atomic physics and molecular physics. Smallness (or largeness) of special parameters allows books with titles such as "Plasma Physics" or "Optics" to focus usefully on some restricted aspect of the universe.

Following this hallowed tradition Bob Adair, a distinguished high-energy experimenter and Sterling Professor of physics at Yale University, has identified an extremely restricted but entertaining domain associated with the American game invented in the mid-19th Century that is called "baseball." Adair's charming monograph, based on approximations tailored to the mass, spatial dimensions and elasticity of baseballs and bats compared to properties of the atmosphere-enveloped earth, will be a delight to any baseball fan who is curious about laws of nature and to any physicist who has an affection for this remarkable pastime. Adair overflows with a contagious affection for the sport.

When I was a college freshman, my physics instructor illustrated the Bernoulli effect by presenting the "curveball" thrown by baseball pitchers. The instructor however had never played baseball and so did not know the direction in which baseball spin induces deviation from a straight-line trajectory. The dominant physical mechanism behind the curveball as discussed by Adair is in fact simpler than the Bernoulli effect, which my 1940 instructor unhappily and unwittingly applied so as to yield curvature of a sign *opposite* to that observed by batters. The curving baseball trajectory turns out to be understandable from momentum transfer in elastic collisions between the baseball and air molecules. My relief after 50 years of puzzlement may be imagined.

Adair emphasizes how the qualitative nature of the game of baseball derives from the similar order of magnitude of atmospheric and gravitational forces acting on the ball. Also important is the operative range of ball speed, which spans a transition between smooth and turbulent motion of adjacent air. With humor and affection Adair relates such notions to a sweep of baseball lore that is wider than has ever been approached as physical phenomena. Readers will gain an appreciation not only of curveballs, but knuckleballs, sliders, screwballs and hopping fastballs, and will learn what pitchers accomplish by (illegally) scuffing a baseball's surface.

Bats and batting—the complement to pitching—get meticulous attention, with geometrical illumination of the difference in bat trajectories employed by "sluggers," who attempt to hit home runs, and "line-drive" hitters, who seek to maximize the probability of reaching first base. The flight path of batted balls is discussed in intriguing detail. Bat elasticity and bat vibration, as factors in the game, are lovingly considered.

For the needs of a baseball addict, nothing yet in print approaches Adair's monograph in its power to satisfy. Adair's gem combines a mastery of physics with love and a deep understanding of this unique piece of Americana.

Geoffrey F. Chew is Dean of Physical Sciences at the University of California, Berkeley.

Femtophysics: A Short Course on Particle Physics

M. G. Bowler
Pergamon, New York, 1990. 207 pp. $35.00 pb
ISBN 0-08-036942

Most textbooks on modern physics arise from lectures or courses in physics given by the authors. A notable exception is the 1964 *PCT, Spin and Statistics, and All That* by Raymond F. Streater and Arthur S. Wightman. In their preface the authors of that classic text state "the idea of this book arose in a conversation with H. A. Bethe, who remarked that a little book about modern field theory which contained only Memorable Results would be a Good Thing." The spectacular success of that approach in historical research—as compared with Walter C. Sellars and Robert J. Yeatman's, *1066 and All That*—possibly suggested to Michael G. Bowler of Oxford University that such a technique would work in the rapidly changing world of particle physics. He might also have followed the late Jun John Sakurai, who began the preface to his 1967 book *Advanced Quantum Mechanics* with the words, "the purpose of this book is to present the major advances in the fundamentals of quantum physics from 1927 to the present in a manner that cannot be made any simpler."

Even though Bowler's book did arise from a short course in nuclear and particle physics for advanced undergraduates offered between 1986 and 1989 at Oxford University, he has apparently followed the scheme of Streater and Wightman, albeit on a