physics and engineering aspects of turbulence. From a theoretical physicist's point of view, one of the book's most attractive features is the fact that the authors tried to interpret seemingly artificial mathematical assumptions in physical terms: for example, a particular choice of norms in Sobolev spaces is described as setting bounds on the energy or the enstrophy (the square of vorticity).

The book is written in such a way that the details of the proofs can be easily skipped without losing an understanding of the main reasoning. For example, the fact that solutions of the Navier–Stokes equations in two and three dimensions become more regular than their initial conditions leads to the need to consider so-called Gevrey spaces, and this is clearly explained. One highly original feature of the book is its insistence on statistical aspects of turbulence without getting lost in hairy details. The details are relegated to the more technical appendices of each of the chapters.

Here is a brief overview of the book's contents: Chapter 1 sets the background, with a brief account of the fundamental contributions of Kolmogorov and Kraichnan. Chapter 2 discusses the mathematical theory of the Navier–Stokes equations and the physical interpretation of the various spaces used. Chapter 3 discusses the finite dimensionality of turbulent flows—the fact that, in a harmonic decomposition of the flow, the high-wavenumber components decay so rapidly that the energy is carried by a finite number of components with low wavenumbers. The corresponding Kolmogorov and Kraichnan "guesstimates" lead to finite but very large numbers for these dimensions; as a consequence, low-dimensional truncations, such as Edward Lorenz's three-dimensional model, are only a caricature of the real chaotic character of the flow. The second half of the chapter deals with the fractal dimensions of the "attractors"—the long-term evolution of the flows.

Chapter 4 deals in detail with stationary statistical solutions of the Navier–Stokes equations, time averages, and attractors, focusing especially on the problem of "equality" of time and ensemble averages without appealing to ergodic hypotheses. It is the hardest and most interesting of the chapters: It deals with nonstationary statistical solutions of the Navier–Stokes equations and their relation to the conventional statistical approaches. As far as I know, this chapter is the first account of a mathematical validation, based on the Navier–Stokes equations, of the results obtained by conventional, heuristic approaches to turbulence. This includes a justification of the Kolmogorov spectrum and of intermittency, but is far from solving all fluid dynamics problems.

Physical Hydrodynamics is a rather original introduction to fluid dynamics and emphasizes the molecular and microscopic origins of fluid phenomena. It is well illustrated with pictures resulting from actual experiments and numerical simulations, which are cleverly used to motivate the more mathematical developments. The authors have been involved in experimental and numerical modeling of fluid flows and related subjects, and many illustrations in the book are from their original work.

The book starts with discussions of the solid–liquid transition, plastic flows, and macroscopic transport coefficients. It exploits models and numerical simulation to develop the reader's intuition. The text describes in detail experimental aspects, as well as such "unorthodox" fluids as Bingham fluids, thixotropic fluids, bubbles, smoke rings, and others. Another nice feature is the authors' exploitation of electromagnetic analogies, particularly in explaining vorticity and the motion of vortex filaments. Hydrodynamic instabilities and transition to turbulence are beautifully illustrated. In short, this is a book that can be read with pleasure by college seniors, graduate students, or professors familiar with the subject. It nicely complements *Navier–Stokes Equations and Turbulence*, which could have benefited from an index of notations and a more detailed author index. Although, like the authors, I am not a native English speaker, I noticed some Franco–Romanian syntactic structures and nonstandard punctuation in both books. The copyeditors of both could have done more to make the text-flow more laminar.

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Curve Ball: Baseball, Statistics, and the Role of Chance in the Game

Jim Albert and Jay Bennett
Copernicus/Springer-Verlag, New York, 2001. $29.00 (350 pp.). ISBN 0-387-98816-5

The game of baseball produces a plethora of statistical information relating to both team and individual performance: hitters' batting and slugging averages, pitchers' earned run averages, and the like. To translate these data into evaluations of the true ability of a player or team is a difficult challenge, one that is often handled poorly by baseball journalists and TV commentators.

Jim Albert and Jay Bennett's *Curve Ball* is an attempt to apply the techniques of statistical analysis to the understanding of baseball statistics. The authors are both professional statisticians. Both (like the reviewer) are members of the Society for American Baseball Research. Both, (definitely unlike the reviewer) are lifelong fans of the Philadelphia Phillies.

Among the questions addressed in their book are: When a player or team experiences periods of poor and of good performance during a season, is this necessarily (or probably) due to ups and downs of actual ability, or can it be explained by chance? Are some hitters significantly better than others at hitting in particular situations, such as with runners on base, or in night games, or on artificial turf? What offensive statistics are most useful in evaluating a player's true contribution to the scoring of runs? Can the "clutch" performance of a player be objectively evaluated? Is the winner of the World Series really the year's best team in true ability?

The book seems to be addressed primarily to baseball fans who are not necessarily educated in probability theory. The authors do not use even elementary statistical concepts, such as standard deviation, without explanation, and, using various models, they treat examples of player and team performance by computer simulations of entire seasons rather than by proving theorems about the expected spread of this or that result. Physicists who understand baseball will find the mathematical reasoning quite easy to follow; in fact, they may find themselves skimming over some of the explanatory text.

Some idea of the content of the book may be conveyed by citing a few examples of the specific problems treated:

In the treatment of situational effects, the book uses data from *Player Profiles* (Stats Publishing, 1998) for the 1998 season to reach the following conclusions: (a) There is no evidence that players' batting averages differ appreciably between grass and turf, the observed differences being explainable as chance fluctuations. (b) Differences in batting averages between home and road games can be explained by a bias, assuming that every player *a priori* has a batting average 12 points better at home than on the road; further differences between individuals can be explained by chance. (c) Neither pure chance nor bias is capable of explaining the spread in batting averages with runners in scoring position versus bases empty; the evidence indicates that some players are truly better than others when batting with bases occupied.

In discussing the use of batting statistics to predict run production, the authors apply least squares linear regression to various models in order to arrive at correlations among various measures (batting and slugging average, on-base percentage, and more complex modern measures) and team run production. In the process, they also demonstrate pitfalls that can arise, such as a spurious correlation between sacrifice flies and runs scored. As they explain, teams that often have runners at third base with fewer than two out will have many sacrifice flies and will also have many runs.

These are only some of the topics treated in this book. There are a number of other intriguing analyses of team results and individual batting data. The book makes no claim of being an exhaustive treatise on statistical analysis of baseball—for example there is very little said about pitching statistics, nothing about fielding—but it is a most interesting and useful introduction to the subject. It should make enjoyable reading for physicists who are also baseball fans, and it ought to be required reading for baseball managers, executives, and commentators. Unfortunately, these are probably the least likely to buy and read this book.

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Isostasy and Flexure of the Lithosphere

A. B. Watts
Cambridge U. Press, New York, 2001. $110.00, $44.95 paper (458 pp.). ISBN 0-521-62272-7, ISBN 0-521-00600-7 paper

The basic concepts of lithospheric isostasy and flexure predate the development of plate tectonics in the 1960s and 1970s. Nonetheless, those concepts continue to play a major role in modern Earth sciences.

In its simplest form, lithospheric isostasy is a restatement of Archimedes' principle: The upper parts of the Earth float on its interior. Such isostasy represents the balance of vertical forces