joint effort of the physics and electrical engineering departments, was established shortly after the war during Terman's tenure as dean. As provost, he oversaw the construction of the Stanford Linear Accelerator Center, which was the focus of much conflict among Stanford physicists in the early 1960s but the locus of three Nobel Prize–winning experiments during the next decade.

Gillmor is less thorough in discussing Terman's central role in the formation of Silicon Valley, which the author treats in several sections sprinkled throughout the latter chapters of the book. It was a huge role that deserved its own chapter. In the 1930s, Terman convinced his Stanford graduate students William Hewlett and David Packard to remain in the Bay Area and start their own electronics firm, in which he invested $500, rather than take jobs in big, established companies on the East Coast. Terman also played a large part in the formation of the Stanford Industrial Park, where Hewlett–Packard, Varian Associates—another entrepreneurial Stanford spinoff—and other technology-intensive companies set up operations during the 1950s.

Terman deserves much of the credit for the high-technology character of the park and the rest of Silicon Valley, which he saw as a natural, synergistic complement to Stanford's research activities in science and engineering. Except for MIT and Stanford, most universities at the time kept industry at arm's length. Yet Terman recognized that nearby entrepreneurial, high-tech companies could take the products of Stanford research to the commercial marketplace—and that the principals of these successful companies would, later in life, reward the university richly with generous contributions.

My greatest criticism of *Fred Terman at Stanford* is that Gillmor does not step back enough from the many interesting details of Terman's highly productive life to offer readers a broader analysis of his impacts beyond Stanford. We also don't get much feel for the historical context of the cold war amidst which all the steeple building was taking place. We see too many trees and not enough forest.

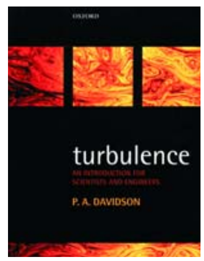
But those are small flaws in an otherwise fine book, and other historians such as Robert Kargon, Stuart Leslie, and Rebecca Lowen have already addressed these issues in depth. Gillmor has gone beyond their work to give us an engaging portrait of the farseeing, hard-working engineer who "proved himself a master builder of a career, a profession, a university, and a regional economy."

Michael Riordan
University of California
Santa Cruz

Turbulence: An Introduction for Scientists and Engineers

P. A. Davidson
Oxford U. Press, New York, 2004. $174.50, $74.50 paper (657 pp.). ISBN 0-19-852948-1, ISBN 0-19-852949-X paper

In *Turbulence: An Introduction for Scientists and Engineers*, Peter Davidson begins the first chapter by writing "The study of turbulence is not easy, requiring a firm grasp of applied mathematics, and considerable physical insight into the dynamics of fluids. Worse still, even after the various theoretical hypotheses have been absorbed, there are relatively few situations in which we can make definite predictions!"



I agree with Davidson's assessment. Historically, there have been two main schools of thought on the theory of turbulence. One emphasizes the study of coherent vortical structures in a turbulent flow; the other emphasizes a statistical approach. Until recently, researchers who followed one of the two methods were reluctant to acknowledge the importance of the other. My own approach is definitely statistical and looks for analogies of turbulence with other problems in statistical physics. Davidson does a nice job in presenting both points of view and in explaining how those views can come together. He keeps the discussion lively with an elegant writing style, frequently quoting a range of experts from Winnie the Pooh to Richard Feynman to Keith Moffatt.

The first three chapters of *Turbulence* give a clear introduction to the classical picture of turbulence. Chapter 4 concerns turbulent shear flows and simple closure models. In chapters 5 through 8, the author develops the physics of homogeneous isotropic turbulence in further detail. For example, chapter 6 covers isotropic turbulence in real, physical space and gives a good description of the conflict between statistical phenomenology and deterministic cartoons. Davidson gives considerable thought to the conflict and explains the problem clearly. In chapter 7, which covers the role of numerical simulation, Davidson summarizes research that was current a few years ago; however, the field is moving very fast, so it is hard for a textbook on the topic to remain current. In chapter 8, on isotropic turbulence in spectral space, Davidson conveniently collects many of the important results.

Chapters 9 and 10 are unusual and welcome additions to a textbook on turbulence. In chapter 9, Davidson focuses on the influence of rotation, stratification, and magnetic fields on turbulence. In chapter 10, he covers two-dimensional turbulence.

I do have a fundamental disagreement with Davidson: He largely ignores the Lagrangian description of turbulence, in which one follows a fluid particle, in favor of the Eulerian description at a fixed spatial point. Considerable evidence exists that a valid statistical theory of the turbulent cascade requires a Lagrangian description. The idea that the smaller eddies are swept by the larger ones without dynamical distortion is fundamental to turbulence dynamics and can be expressed only in Lagrangian terms. A more radical position to which I subscribe is that a turbulent cascade does not exist dynamically but is instead a descriptive property of a statistical steady state.

Davidson's book can be compared with another text on turbulence, *Turbulent Flows* (Cambridge U. Press, 2000) by Stephen B. Pope, a book intended primarily for graduate engineering students. The first half of Pope's book largely overlaps with the first eight chapters of Davidson's. The second half of Pope's book is devoted to the engineering modeling of turbulence. As one might expect, Pope's presentation of the fundamentals is straightforward, and he spends less time on the subtleties and basic difficulties of the subject. Another difference between the two books is in the layout: The layout of Pope's book is easy to read, and the type size and fonts are clear. By contrast, Davidson's book is visually unsatisfactory, and just two-thirds of the width of each page is used for text. The remaining third contains captions and occasional figures. In addition, the book's type is unpleasantly small and the font too light for easy reading. The color plates in the middle of the book, however, are nice.

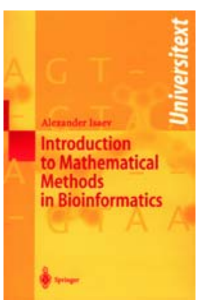
In brief, Davidson presents a thoughtful and detailed discussion of the basic physics of incompressible fluid turbulence. He is careful, if somewhat repetitive, in emphasizing the many places where our knowledge about the field is far from certain. For someone who wants to understand the fundamentals of turbulence, this book is a good start. But for those who want to learn the accepted wisdom on turbulence and then use it, Pope's book is the better choice.

Mark Nelkin
New York University
New York City

Introduction to Mathematical Methods in Bioinformatics

Alexander Isaev
Springer-Verlag, New York, 2004. $59.95 paper (294 pp.).
ISBN 3-540-21973-0

How are biological-sequence data organized? What is the probability that two sequences in a database—such as GenBank, the NIH genetic-sequence database—are related? And if they are related, how long ago did they diverge? How can the evolutionary history of a family of related proteins be reconstructed from observations today? What is the protein-folding problem, and how can it be solved?



In *Introduction to Mathematical Methods in Bioinformatics*, Alexander Isaev describes the mathematical foundations of bioinformatics—the field that addresses these questions. The science started as a practical subfield of molecular biology, grew as a discipline in computer science, and now benefits from contributions from mathematics, statistics, engineering, and physics. At the same time, interest in bioinformatics among undergraduate and graduate students majoring in all of those fields is growing.

Going beyond algorithms and their implementation in software, Isaev discusses broadly the fundamental mathematical, statistical, and physical theories that are used today in bioinformatics and computational biology. As a mathematician, he is well positioned to detail the mathematical principles on which the analyses of DNA, RNA, and protein-sequence data are based.

The book succeeds in describing the fundamental mathematics behind computational sequence analysis, and in giving a taste of typical applied bioinformatics. For example, Isaev presents exact methods of dynamic programming for sequence alignment to motivate the description of heuristic alignment algorithms used in practice. The statistical significance of the resulting alignment is related to extreme-value statistics of random walks. The author details the theory of Markov models and hidden Markov models used to find genes; he then discusses the practical aspect of training such models. His discussion of the theory of continuous-time Markov processes and the convergence of a Markov chain to a unique probability distribution complements his treatment of the molecular-clock hypothesis, phylogenetic trees, evolutionary models, and construction of substitution matrices.

The historical trend of bioinformatics to focus mostly on computational sequence analysis and less on protein structure and function is apparent in the book, although Isaev does devote a chapter to protein folding. The discussion of protein folding, and computational biology in general, is less complete than the rather thorough discussions of sequence analysis in the other eight chapters of the book. The author's relatively light discussion of protein structure and function limits, to some extent, the apparent connection of bioinformatics with physics.

Isaev's book may be difficult to use as a standalone text for an advanced undergraduate course in biological physics. The motivated instructor might reduce the emphasis on sequence analysis and increase the coverage of more general aspects of computational biology. For example, I would establish the connection between statistical physics and the calculation of protein structure and function, and then calculate some examples of partition functions. Much of the material in the second half of the text is, on the one hand, too formal for typical advanced undergraduate and graduate physics students and, on the other, too restrictive in assumptions. For instance, the book excludes Dirac delta functions from probability distributions and ignores the problem of slow convergence of distribution tails to the Gaussian central limit.

The number of examples presented in the book is excellent, and instructors may use a selected set of them to rebalance the rather formal discussions in the second half of the text. In addition, tools from mathematical physics