document, and indeed a large quantity of data are presented, in some cases for the first time. In this respect, the book is valuable and well worth owning for the student of social progress in the United States (though many of the tables might have been made more easily comprehensible).

The dismal history of discrimination against blacks in this country is familiar, including for example laws passed throughout the South in the early 1800s making it a crime to instruct any slave or free black. Not so familiar is the thesis Bechtel puts forward here that, following the Civil War, blacks were denied education because educating them "would have meant extending a privilege that had historically been restricted to the upper classes in the South; it would elevate the former slave to a status higher than that of most former slave owners" (p. 3). At the end of the Civil War, according to Bechtel, "95 percent of the black population in America was illiterate." In well-documented detail, he describes the emergence of separate but unequal schools for blacks. The recounting of the adversity and bigotry encountered by the early black scientists is both disconcerting and fascinating, convincing the reader that it is no wonder that "the black scientist is both rare and relatively unknown" (p. 19).

Subsequent chapters concern black students' instruction in mathematics and science (or lack thereof) in high school and college. Substantial evidence is provided that black students, even when enrolled in the academic curriculum, do not take as much advanced mathematics and science as white students. Relevant recent results from the College Board, the National Assessment of Educational Progress, and a national longitudinal study known as High School and Beyond are described in detail. But throughout the book, especially in Anderson's insightful chapter, the need for further research is emphasized.

Clewell describes three intervention programs in enough detail to persuade the reader of the major premise of her chapter, namely, that what interventions are most appropriate depends primarily on the educational level of the participants.

Fechter's chapter is distinguished by the clarity of the presentation of important and highly relevant data, mainly from the files of the National Research Council, concerning graduate school enrollments and postgraduate school appointment. As in the case of the NAEP data, Fechter has organized the NRC survey results so as to give them new significance. In the case of Ph.D. attainment, for example, he demonstrates that the median time from the receipt of the baccalaureate to receipt of the Ph.D. was two years longer for blacks than for whites (10.3 versus 8.2) in 1985, in part because blacks spend almost twice as much time in nonregistered status. This in turn may be attributable to a dramatic shift in sources of funding for graduate training, away from federal grants and fellowships toward loans, personal (or family) financing, and "other" sources.

In an erudite sociologically oriented chapter on the benefits of black participation in science, Gaston makes the simple but cogent point that if newly recruited black scientists are more talented than the least talented white male scientists then the average level of talent in science will be increased provided, of course, that the less talented white scientists are not also hired. He also argues that increasing the black presence in science would maximize the probability that potentially significant research problems would not be neglected.

In the final chapter Pearson summarizes, integrates, and skillfully enlarges upon the contributions of the authors and ends with the thought that societal opportunities must be created to help black people to help themselves.

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Recombination

Gene Transfer in the Environment. STUART B. LEVY and ROBERT V. MILLER. McGraw-Hill, New York, 1989. x, 434 pp., illus. $54.95. Environmental Biotechnology.

Among the higher eukaryotes, gene transfer in the environment prevents pandas from going extinct. For the prokaryotes, it's a different matter. We know some exquisite details about their mechanisms of gene exchange in captivity, but do they really do these things in nature? They do, and the fascinating story is just beginning to unfold.

Prokaryotic gene transfer is a fairly open system: DNA may be passed between cells in close contact (conjugation), delivered by phages (transduction), or broadcast by living cells for subsequent pickup (natural transformation). Here the inanimate environment is not shut out: it often participates. The regular delivery of specific genes to plants is yet another story.

From these goings on, and their results in the context of powerful selective forces, we recognize a wild card in evolution that permits organisms occasionally to acquire genetic properties from phyletically distant sources. There are four essentials for an enduring long-distance gene transfer: (i) the origin or assembly of an unusual genotype (at least unusual to the recipient); (ii) its transmission to an extraspecific cell; (iii) a resulting advantage to the recipient; and (iv) the multiplication of the recombinant to numbers that render it safe from random loss. Each of these components is improbable. The necessary combination is extremely improbable in the short run, but there is now abundant evidence of its repeated occurrence somewhere among the vast numbers of organisms over vast periods of time. Now genetic engineering has, depending on the case, raised the probability of one or more of these component events. This makes gene transfer far more likely. The nature of the genotype often makes it dangerous as well, adding a new reason to learn about this unfamiliar subject.

This book, by turns informative and exasperating, appears to be the first serious effort to cover the subject, and on balance it is well worth reading, at least for the experienced scientist, to whom it is directed. It begins by describing a variety of genes and plasmids involved in the dramatically widespread acquisition and transfer of antibiotic resistance, continuing with other kinds of resistance and then metabolic functions. All this seems unnecessarily hard to follow, but it leaves no doubt as to what's happening.

The next section contains three excellent chapters on transfer mechanisms: conjugation (both chromosomal and plasmid transmission), transduction, and natural transformation, which is not the same as the experimentally induced type. Also, transposable elements, which can diversify the potential effects of gene transfer, are described superbly by Douglas Berg.

The major section of the book, on model environments, is mixed: in some chapters one finds many intriguing tidbits but little rigor. The chapter on soil does begin in a most enlightening way by illustrating its subject's infrastructure. The chapter on conjugal transfer in plants by Stephen Farrand should be started with the description of the *Agrobacterium* system, an excellent introduction to the otherwise confusing earlier half, which is laden with undefined terms. Other chapters cover the aquatic environment, *Streptomyces*, the (human) urogenital and respiratory tracts, and epidemiology, this last with some interesting case studies.

The obvious motivation of this volume is to lay the groundwork for the responsible release of genetically engineered microorganisms, and it is clear that this must begin with an understanding of the major avenue of risk: gene transfer. The introduced genetic material may find its way into an uncontrollable organism, or the engineered organism may acquire the means of escaping control. Thus the mechanisms of gene transfer are laid out, and the complicity of environmental factors is addressed.

The need to determine the frequency of various types of exchange in nature, and the likelihood of others, is suggested. One important step toward this difficult goal, missing here, is an outline of the pertinent elementary population genetics. For example, a recombinant's chance of survival with a small fitness advantage, say 10^{-4}, is roughly 10^{-4}. That is the probability of its reaching a "safe" frequency, from which its further rise is virtually certain. But a recombinant that can enter a new niche may be safe almost at the outset. This is critical to risk assessment. Another step is to develop general experimental protocols; efforts in this direction in the wrap-up chapter surprisingly lose sight of non–vector-mediated transfer.

This book is not well edited. Writing errors, silly and serious, abound, as do typos, logical errors, and unpublished data; diagrams are often poorly executed. Summaries occasionally introduce new material and references. But this collective venture contains valuable information of four types: well-developed descriptions of the general mechanism of gene transfer in nature; lists of and citations concerning participating organisms; a mixed bag of analyses and retrospective anecdotes; and a number of experiments, many of which (as the authors often recognize) need to be repeated the right way. It calls for a second edition, tightened and amplified, right now.

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Flow Paths

Percolation. GEOFFREY GRIMMETT. Springer-Verlag, New York, 1989. xii, 296 pp., illus. $49.80.

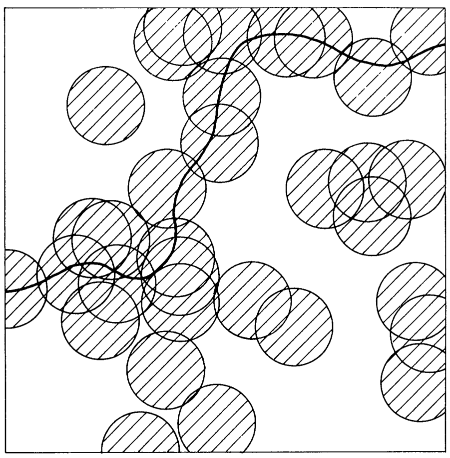
Percolation theory was introduced to model the flow of a fluid or gas through a random medium. The medium is represented by an infinite-lattice graph, in which the edges or vertices are randomly "open" with probability p, where $0 < p < 1$, and "closed" otherwise. The possible movement of the fluid is completely determined by this random medium: fluid may pass through only the open edges or vertices.

Percolation models are relevant to various physical phenomena that involve clustering in a disordered medium. Characteristics of clusters may determine the difference between liquid and solid phases, the presence or absence of spontaneous magnetization in a ferromagnet, or the spread or containment of an epidemic in a population.

The principal object of study in percolation theory is the "open cluster" containing a particular vertex. The open cluster consists of all vertices that can be reached from that vertex by paths of open edges or vertices. Physical scientists are interested in percolation because of the existence of a "critical probability" above which an infinite open cluster exists and below which all open clusters are finite. In the terminology of statistical mechanics, the critical probability is a phase transition point.

Percolation models are popular in the study of disordered media for several reasons. Their predictions are realistic for a variety of applications involving phase transitions and critical phenomena. Their simplicity and ease of description aid in developing intuition and insight. The stochastic independence of the edges or vertices provides more mathematical tractability than alternative models containing interactions, making percolation a proving ground for the development of tools and techniques for dealing with these more complicated interacting particle systems. For mathematicians, the subject is rich in intriguing, and extremely challenging, conjectures. Topics of independent interest, such as subadditive stochastic processes and correlation inequalities, were discovered through the study of percolation models.

Grimmett's *Percolation* concentrates on mathematical percolation theory, a very active research topic in probability theory.



Quandary for a mollusk. "Young lilies inhabit a beautiful large square pond. They grow at a uniform rate. How long need a snail wait beside the pond before it becomes possible for him to traverse the pond without getting his feet [sic] wet? This question may be rephrased in terms of the following classical problem of stochastic geometry: ascertain the minimal density of unit discs in the plane which guarantees the existence of an infinite cluster. It leads to a percolation-type process which has been dubbed the 'Poisson blob model' by the less poetically minded." The thick line indicates a possible route for the snail. [From *Percolation*]

Substantial recent progress, extending the theory to all dimensions, makes the book very timely. Grimmett combines the essential new methods in the disorganized journal literature to provide a coherent development of the subject. The book proceeds from introductory material to recent advances, allowing the uninitiated reader to bypass the previous literature. Yet the material is accessible to nonspecialists: the prerequisites include only a solid probability course at the undergraduate level, with some acquaintance with analysis and graph theory being helpful.

The book may be divided into three principal parts. Chapters 1 through 4 describe the model, applications, problems, and tools, culminating in a readable account of two proofs of the uniqueness of the critical point. The middle third (chapters 5 through 8) deals with the finer behavior of the model in different regimes—below the critical point, above the critical point, and near the critical point—and introduces scaling theory and renormalization near the critical point. The final chapters recast older results for two-dimensional percolation models in light of new methods developed to extend the theory to higher dimensions and survey a variety of modifications and related models, suggesting the diversity of phenomena that it may be possible to explain through the use of percolation theory.

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Antigen-Presenting Cells. Jonathan M. Austyn. IRL (Oxford University Press), New York, 1989. x, 79 pp., illus. Paper, $12.95. In Focus.

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The Birth of the Family. An Empirical Inquiry. Jerry M. Lewis. Brunner/Mazel, New York, 1989. xvi, 201 pp. $26.95.