# Quantification and the Quest for Medical Certainty

J. Rosser Matthews
*Princeton U. P., Princeton, N. J., 1995. 195 pp. $39.50 hc ISBN 0-691-03794-9*

This is a well-researched and timely account of an important and perdurable topic: the nature and importance of statistics in medicine. The book is written by a historian of science who now studies health-care policy. It provides a new account of medical research and practice as social and cultural activities from the early 19th century on. It demonstrates that, despite the very real differences in outlook between the medical practitioner and the medical researcher, both have often shared an abiding antipathy towards methods of quantitative or statistical inference (a fact that may surprise those unfamiliar with either field). The antipathy arises, in part, because physicians have an insistent ethical constraint to treat the individual patient; to researchers, mathematical probabilities are too often merely the defective but necessary tools of those who know too little (to borrow philosopher Ian Hacking's phrase).

The issues Rosser Matthews addresses are broadly similar to those addressed by several other books on the sociology of science: the 1962 classic *The Structure of Scientific Revolutions* by the physicist Thomas Kuhn (University of Chicago) and the 1935 book that in part inspired it, *Genesis and Development of a Scientific Fact,* by the pathologist Ludwik Fleck (University of Chicago). It is also reminiscent of Hacking's 1990 book *The Taming of Chance* (Cambridge University). These issues, in the long debate over the nature and size of the role of statistics, have been how (and sometimes whether) to make medical practice and research more "scientific." The debate has always been complicated by, as Matthews puts it, "the general dichotomy between the moral imperative to heal the individual and the desire to advance knowledge by making comparisons within a population."

To describe this latter end in the 19th century, Matthews summons Adolphe Quetelet's proposed concept of the "average man" for assisting in diagnosis ("extreme deviations from the mean are bad") and Simeon Poisson's "law of large numbers" for assessing the probability of successful treatment. Both concepts raised the question of whether the "aggregative thinking" of the statistician or the "tacit knowledge" of the medical practitioner and researcher could provide the more "scientific basis" for medicine.

Major early opponents were the British and European bacteriologists and physiologists, especially the acknowledged father of experimental medicine Claude Bernard, who in 1865 proposed "experimental determinism" as the way to make medicine into an "exact science," rather than the statistical methods of clinician Pierre Louis that would, Bernard feared, make it into a "conjectural science."

Although Matthews's book is an exceedingly well-written and richly detailed and documented account of an extremely interesting and important topic, there are a few places where some additional information would have been helpful. For example, a brief epilogue describing in more detail the nature and size of the current roles of quantitative methods (now know as "clinical epidemiology") in medical practice and health policy would have usefully enlarged the reader's perspective. The grave statistical weaknesses that encumber many current clinical studies and trials have required medical researchers to borrow from those in the social sciences the *post hoc* salvage maneuver of "meta-analysis", a new discipline that critically reviews and statistically combines the results of previous trials and studies. And although the clinical trial is widely accepted as the standard against which all treatments are assessed, it is in practice still far from being the major change agent in the diffusion of modern medical technology.

Matthews remarks that "the emergence of the clinical trial can thus be seen as a special case of a more general trend—the growing belief that 'numbers rule the world'," and argues that the acceptance of the clinical trial as the "gold standard" owes more to social pressures for the regulation of medical decisions than to any other single factor. (This prefigured the current external social pressures for statistical measures of the performance—as measured by patient "outcomes"—of the abundant, augmenting and expensive technologies that define Western medical practice and research. The government, insurers and employers are becoming ever more adamant that the health-care providers either monitor their performance—and publish provider-specific findings themselves—or have it done by others.)

Matthews has written an important and timely book that should be of the greatest interest to all medical researchers and practitioners and health policy makers, as well as to those interested in the history of science and mathematics—and especially to any who suspect that they may one day be patients.

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# Ideas and Methods of Supersymmetry and Supergravity, or a Walk Through Superspace

Iosef L. Buchbinder
and Sergei M. Kuzenko
*IOP, Philadelphia, 1995. 640 pp. $300.00 hc ISBN 0-7503-0258-5*

In the two decades since theoretical physicists first proposed supersymmetry, the topic has become a leading prospect—if not the dominant one—in the search for what Einstein called a "unified field theory." This can be seen in the broad spectrum of areas to which such ideas are being applied, from the still-evolving notion of a supersymmetric standard model to the quixotic construction of a "theory of everything."

During this period a list of books too long to mention has appeared in the effort to make the topic more accessible to ever larger audiences. Among the earliest was my own *Superspace* (Benjamin-Cummings, 1983), in collaboration with Marc Grisaru, Martin Roček and Warren Siegel, as well as *Supersymmetry and Supergravity* by Jonathan Bagger and Julius Wess (Princeton, 1983). These two books set the pattern for all that followed. Most of these works simply provide an introductory-to-intermediate-level treatment. (I have found the works by Bagger and Wess and *Introduction to Supersymmetry and Supergravity* by Peter West (World Scientific, 1986) particularly well suited for graduate students and others who are beginning to learn the topic.)

For a more comprehensive treatment, however, there has been only *Superspace*. As an example of the level of its comprehensiveness, topics such as the superfield formulation of Chern–Simons theory, the so-called Konishi anomaly and the "breakdown" of the nonrenormalization theorems appeared in *Superspace* before their appearance in the research literature. Now, however, a worthy successor to *Superspace* has appeared: *Ideas and Methods of Supersymmetry and Supergravity* by Iosef Buchbinder and Sergei Kuzenko succeeds very well, in my view. The intended audience for this book includes the intermediate to advanced

graduate student and the postdoctoral or research investigator (in such areas as theoretical physics and mathematics).

One of its strengths is that it has a large degree of detail in its presentation. The authors start with an extensive discussion of the required mathematical background. For mathematically oriented physicists as well as mathematicians, this should provide real insight into the issues that are confronted in the manifest supersymmetrically formulated field theories as applied to proposed theories of nature.

After devoting a quarter of the book to a thorough discussion of the mathematical setting (number fields, functions, groups, and the like), the authors begin the task of introducing nonquantum superfield theory. This treatment is brisk and comparable to that of other books at the intermediate to advanced level. The authors continue, however, in what becomes the hallmark of this book, by treating in unusual detail such topics as Kähler geometry, infinitesimal gauge superfield variations and K and $\Lambda$ Yang–Mills gauge groups. The book presents many more details than did *Superspace*, but a few topics, such as variant representations and irreducible super P forms, have been ignored. Quantization is carried out via modern methods involving path integrals and functional differentiation, appropriately generalized to superspace.

One nice discussion includes a demonstration of the subtle nature of the superfield nonrenormalization theorem, which has often been misunderstood. The section on supergravity is a real gem, containing derivations and proofs within the context of the Lie algebraic descriptions of supergravity and gravity, which have until now appeared only in the research literature, and the section includes a very clear discussion of more standard topics. Also presented is a nice discussion of higher spin superfields (a topic of great importance in the still-developing field of manifest supersymmetrical string theory).

The book ends on a high note, looking at issues of the effective action in curved superspace. The authors confirm by their presentation that they are among the most knowledgeable in this field—a field that is also of great importance to the manifest supersymmetrical string theory of the future. My only criticism of *Ideas and Methods of Supersymmetry and Supergravity* is that, like *Superspace*, its bibliography could be more detailed. This would have provided a fine capstone to an already excellent work.

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# New Books

## Plasmas and Fusion

**Lectures on Non-linear Plasma Kinetics.** *Springer Series on Atoms and Plasmas 17.* V. N. Tsytovich (translated from the Russian by D. ter Harr). Springer-Verlag, New York, 1995. 376 pp. $117.00 *hc* ISBN 0-387-57844-7

## Theory and Mathematical Methods

**Chaos and Gauge Field Theory.** *World Scientific Lecture Notes in Physics 56.* T. S. Biró, S. G. Matinyan, B. Müller. World Scientific, River Edge, N.J., 1995. 288 pp. $61.00 *hc* ISBN 981-02-2079-0

**Collision Theory (A Short Course).** T. Kopaleishvili. World Scientific, River Edge, N.J., 1995. 200 pp. $44.00 *hc* ISBN 981-02-2098-7