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Book Review: *Statistical Models for the Fracture of Disordered Media*

Statistical Models for the Fracture of Disordered Media. H. J. Herrmann and S. Roux, eds., North-Holland, Amsterdam, 1990.

The book divides easily into three parts: An introductory one, an experimental part (or, more accurately, a materials science part), and, finally, the detailed description of several theoretical models. Most of the introductory chapters are written by the editors and are a joy to read, especially for showing how engineering concepts are molded into physical thinking or language (such as thermodynamic energy, duals, localization, renormalization, scaling, etc.). The experimental sections focus on the dependences of material properties on parameters such as temperature, composition, morphology, manufacture, treatment, changes in microstructure, and process rates.

When one reaches the theoretical papers one is confronted with the realization that these hardly ever address the real problems and questions that occupy practitioners. (In essence, these questions add up to one: how to produce materials that have improved material properties?) In the ceramic-fish diagram on p. 44 each scale stands for a real-life problem that awaits solution. Needless to say, scaling laws do not provide this. An exception is the article on fragmentation, which is geared to communition processes, though only in a qualitative fashion. However, in another article (on randomness) one experimental figure, about 20 years old, is all that is presented in "support" of 25 pages of results from models.

It is clear that fracture is a difficult subject whose complexities have defied 70 years of research. The approach in this book (and the uniformity of the articles bemuses the reader) breaks away from the traditional, for reasons that (I would hazard) are rooted in the shine and lure of modern statistical methods. Now a new approach deserves a welcome, but when this has so few experimental facts for its support, a more balanced choice of articles would have been justified in a book of this title. Both "statistical models" and "disorder" are also present in the approaches of Atkins,

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Evans, Kachanov, Lawn, Mai, and Rice, where disorder enters in the form of microcracks, voids, and stress distributions either before or after the application of external stresses.

In many of the simulations described in the book there are springs or beams (that oppose fracture or bending on a basic level), and it is not clear how these relate to the primary bonds that characterize the material. The question is not pedantic, since it is these primary bonds that the materials scientist aims at changing (by introduction of new constituents, additives or reinforcements) to meet the desired ends. Similarly, it is not evident how the primary length unit in the simulation is chosen (in cases other than granular solids, in which the grain may, but does not necessarily, define a fundamental length scale). One supposes that an averaging of some material property over some domain in the medium is implied and that the size of this domain defines the basic length scale. But this is not discussed and one wonders, in view of the instability of some cracks, whether the length unit ought not to depend on stress or on some other parameter.

A quotation from p. 150 in the book well summarizes the situation: "The authors have presented their belief of what the Truth is, but the reader should keep in mind that there are other competing Truths around."

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