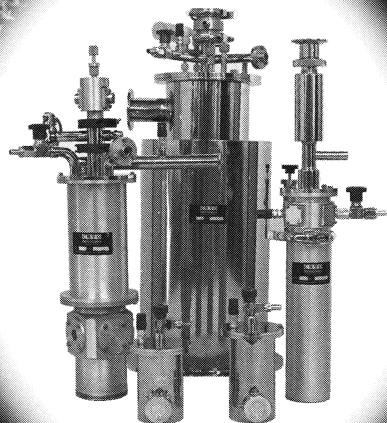


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and historians in sympathy with Kuhn's ideas, even as he largely substantiates Kuhn's highly original concept of pre-paradigm science.

Thus one needs to read Fuller's book with caution. The reader has to have substantial experience with pre-paradigm science to accept that a book with such severe weaknesses could be worth reading.

Why should physicists care about the history of science or a reexamination of the contributions of Thomas Kuhn? Science has grown in the past (after 1760) by about 4.5% a year, as measured by the number of researchers and research articles, according to Derek De Solla Price's *Science since Babylon* (Yale U. Press, 1961). To justify similar increases in the future, scientists must understand this history, including the past societal benefits enabled by the 4.5% growth, and the benefits that ultimately ensued from research fields that went through difficult paradigm shifts or initial pre-paradigm stages first. Because of this need for understanding, all physicists should applaud individual physicists who are now full-time contributors to the history of science and can build on Kuhn's work. They should encourage individual physicists to link their historical research to questions about the future of science and the future of societal support for science.

The Physics of Foams

▶ Denis Weaire and Stefan Hutzler
Clarendon Press/Oxford U. Press,
New York, 1999. \$80.00 (246 pp.).
ISBN 0-19-850551-5

Foams are omnipresent. We separate mineral ores by flotation inside huge tanks of foams. We beat eggs. We drink beer and champagne. We bring pigments and other additives to cloth via foams (better than water because drying is much easier). Our cosmetics are often based on foams, not for technical reasons, but because they are more pleasing to the touch. Many fire extinguishers use foams. (If a tank of burning oil is sprayed with water, the water sinks to the bottom; when the hot front progressively goes deeper, it reaches this water layer and provokes a dramatic explosion. Foam, on the other hand, stays harmlessly on the surface.) One form of oil recovery uses foam injection, which introduces many problems of its own. In some other industrial processes, we must kill a nuisance foam, using cleverly formulated additives.

Thus foam science is very much

alive. Until recently, publications in the field were either scattered or collected in compendia with many authors. Two attempts at a real unification have appeared recently: one on the work of a Bulgarian group (*Foam and Foam Films*, by Dotchi Eksprova and Pyotr Kruglyakov; Elsevier, 1998), and one on that of an Irish group, *The Physics of Foams*, by Denis Weaire and Stefan Hutzler, discussed here.

The Physics of Foams opens with a simple presentation of key features of foam architecture, including the basic Plateau rules for the intersection of three films. The authors spend a long time on foam geometry, including some beautiful theorems (from Leonhard Euler to John von Neumann) and their own recent work in this area. This text is followed by chapters on foam fabrication and foam probing, plus an interesting part on simulation methods. Then we come to the crucial issues: coarsening, rheology, and drainage. The Irish team, to which the authors belong, has produced a beautiful set of experiments, along with a model interpretation, on forced drainage. Drainage is, at this moment, an active field of research: Some surfactant systems with rather rigid surfactant films do not follow the Irish model, and various groups are trying to understand why. The presentation continues with chapters on applications and on ordered foams—an interesting object for metallurgists.

On the whole, the book represents a major advance. It is written in a pleasant style and is accessible to a wide population of physicists. Unfortunately, the beautiful work of Karol Mysels, Kozo Shinoda, and Stan Frankel (40 years ago), on single soap films, is not described. Also, the emphasis is mostly on geometry and hydrodynamics. Physical chemistry is not very much involved, although this sector is important: Why does this surfactant foam while that other one does not? Why the difference between "soft" and "hard" surfactant films? Is foam stability controlled by the intrinsic nucleation of "buttonholes" or by such extrinsic effects as dust?

Together with the Bulgarian book (which contains a more classical view), *The Physics of Foams* is an excellent starting point. Any physicist interested in interfacial phenomena should read it. But a third book may be needed in a few years.

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