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transfer from the collapsing bubble occurs very rapidly and with high efficiency.

References

1. M. M. Chaudhri, L.-A. Almgren, A. Persson, in *Proc. Fifteenth Int. Congress on High-Speed Photography and Photonics*, SPIE Proc. 348, L. L. Endelman, ed., SPIE, Bellingham, Wash. (1983), p. 388.
2. F. P. Bowden, M. M. Chaudhri, Nature **220**, 690 (1968).
3. A. W. Campbell, W. C. Davis, J. R. Travis, Phys. Fluids **4**, 498 (1961).
4. M. M. Chaudhri, in *Proc. Ninth Symp. (Int.) on Detonation*, Office of the Chief of Naval Research, Arlington, Va. (1989), p. 857.

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I Get No Thick from Champagne

The paper by Neil E. Shafer and Richard N. Zare (October 1991, page 48) was a pleasure for somebody like me, who has used for years examples from everyday life such as the formation of bubbles in beer to teach transport phenomena to engineering students. However, my pedagogical form of the problem is slightly different from the issues addressed by Shafer and Zare.

The question I ask my students to consider is the following: Why is the foam formed in a beer glass so stable that one may actually cut it with a knife, while the bubbles that form in a champagne glass result in a quickly subsiding foam? Champagne (one hopes) has a slightly higher alcohol content, but the strongest beers one may buy in Europe are right up there with the lightest champagnes. Thus the difference in alcohol content, though possibly significant for explaining the widespread preference for champagne over beer, cannot be invoked as the basic reason for the different foam behavior. Shafer and Zare's initial argument about the equilibrium between the gaseous CO_2 under the cap and the liquid being upset when a beer bottle is opened also doesn't furnish any clue. Granted, a champagne bottle gets flamboyantly uncorked rather than absent-mindedly opened, but the physical effect is just the same: Pressure is suddenly relieved, as the fizz accompanying the beer bottle opening and the pop accompanying the champagne bottle uncorking reveal. The pop, of course, is much more spectacular than the fizz—but the difference in foam behavior is still left unexplained.

So wherein lies the difference? I use this problem to illustrate the fact that phenomena dominated by interfacial forces are tricky. The difference in foam behavior is related to the stability of the thin films between the bubbles in foam; unstable films collapse, the bubbles coalesce, and the foam subsides. Film stability is influenced by the Marangoni effect:[1] When mass transfer is taking place (in this case, when CO_2 is being desorbed to the gas phase), the thin films are or are not stable depending on the *sign* of the derivative of surface tension with respect to concentration. The thinnest regions of the films between adjacent bubbles are the ones with the lowest CO_2 concentration; hence if the derivative is positive, the surface tension is locally the lowest, resulting in an unstable film, and vice versa.

The sign of the derivative may well be influenced by the presence of trace components (for instance, proteins coming from the malted barley in beer, or even, God forbid, surfactants added to second-rate beers to increase head retention). Such trace components, to the general satisfaction of champagne drinkers and to the partial justification of the ethics of champagne manufacturers in establishing the prices of their wares, may indeed be as important to foam behavior as they are to taste.

Reference

1. C. Marangoni, Nuovo Cimento, Ser. 2 **5/6**, 239 (1872).

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Textbook Authors, Rewrite Old Wrongs

Your special issue on pre-college education (September 1991) discusses many new programs for improving physics teaching but doesn't make much evaluation of the existing programs and how they can be improved within existing frameworks—for example, books distributed by major publishers.

The involvement of professional physicists and astronomers has led to great advances in junior high school science texts in recent years. As an astrophysicist, for example, I became involved a dozen years ago with *Scott, Foresman Physical Science* and *Scott, Foresman Earth Science* (the latter includes much astronomy). Though we professional scientists don't have free rein in determining the content of junior high texts, and overlapping state requirements must be met, we were able to make our books much more accurate, up to date and interesting than previous junior high texts in wide use. It was shocking how inaccurate and how badly explained much of the existing material I looked at was; the content of junior high books just shouldn't be left to junior high and high school teachers and to editors alone, since they apparently don't understand the material well enough to explain it clearly. The junior high books led to the elementary school series *Discover Science*, which is also much more interesting and accurate than previous texts on that level.

One mustn't ignore the mainstream just because some much smaller project may be flashier. I have done what I can to add clear explanations of interesting material to junior high texts, and I hope that many other scientists can join the good fight. Further, if we all pressured local and state school boards to make accuracy (instead of merely readability) a requirement, the next generation of texts would be helped.

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Let *PRL* Readers Review the Referees

Richard Greene (January, page 96) complains that the "uneven, subjective nature of the referee process" makes publication of a paper in *Physical Review Letters* an unreliable indicator of research quality. Since promotions and grants often depend on publication success in *PRL*, many authors feel cheated when their work is rejected by that journal while similar (or possibly inferior) work is accepted. Greene therefore proposes abolishing *PRL*, while the journal's editors respond that it serves its purpose. We believe both he and the editors have missed an obvious solution: Let the readers referee the referees!

A simple reader response page inserted into each issue would encourage feedback to the editors, referees and authors. Readers could rapidly check off "Yes" or "No" to three easy questions on each article: "Did you read this Letter?" "Was it of sufficient importance and quality to warrant rapid dissemination in *PRL*?"