LETTERS TO THE EDITOR

Letters are selected for their expected interest for our readers. Some letters are sent to reviewers for advice; some are accepted or declined by the editor without review. Letters must be brief and may be edited, subject to the author's approval of significant changes. Although some comments on published articles and notes may be appropriate as letters, most such comments are reviewed according to a special procedure and appear, if accepted, in the Notes and Discussions section. (See the "Statement of Editorial Policy" at http://www.kzoo.edu/ajp/docs/edpolicy.html.) Running controversies among letter writers will not be published.

NEWTON AND NEWTON'S THIRD LAW

Just as students have difficulty with Newton's third law as discussed in the article by Lehavi and Galili,[1] it is of interest to realize that Newton's understanding of the significance of the mutual interaction of bodies in their motion did not occur until very late leading up to his writing of the *Principia*. Cohen[2] published an article on this, which also appeared as an appendix in a revised and updated version of his book.

Newton wrote an essay entitled "De motu" in which he described a calculation of the orbit of a planet in our solar system.[2] He ran into the problem that his calculation did not fit the actual data sufficiently. He realized that assuming a stationary Sun was a potential source of error. He recalculated, but this time he allowed the Sun to move in response to the pull of the planet. The revised calculation yielded numbers within the error of measurements of the orbits of the planet available at the time. Apparently, the notion of the third law of motion was not an explicit and automatic part of Newton's thinking until this point.

According to Cohen this work was completed shortly before Halley's visit with Newton, which led to the writing and publication of the *Principia*. This is in distinct contrast to the impression one often gets from descriptions of Newton's life in physics textbooks that he went home to avoid the plague during college and in two years worked out all of his contributions to physics. We should know better and do better in our textbooks because serious historical scholarship on Newton is now easily accessible.[3]

The final paragraph in the article by Lehavi and Galili illustrates the magnitude of the problem caused in physics education by the emphasis in texts on presenting as much of the canon of physics as possible. At best students develop a kind of technician's view of physics, which is that the goal of learning physics is to remember a list of calculations and facts. In doing so students miss the essence of physics, which is the construction of explanations of physical phenomena.[4] Is it any wonder then that students yearning for such intellectual challenge choose other fields to go into?

[1] Y. Lehavi and I. Galili, "The status of Galileo's law of free-fall and its implications for physics education," Am. J. Phys. **77**, 417–423 (2009).

[2] I. B. Cohen, *The Birth of a New Physics* (Norton, New York, 1985).

[3] R. S. Westfall, *Never at Rest* (Cambridge U. P., New York, 1980).

[4] Compare the typical lecture in a physics course (technician's view of physics) with some of the Feynman lectures, for example, those in R. P. Feynman, *The Very Best of the Feynman Lectures* (Basic Books, New York, 2005), book on CD version. We cannot all be Feynman, but we can all share such things with the students as Feynman did.

Dewey Dykstra
Boise State University

DIET SODA AND LIQUID NITROGEN

In a Letter to the Editor[1] regarding an article by Coffey,[2] Liljehom pointed out that iron filings are an attractive substitute for Mentos in the popular diet soda and Mentos reaction. We would like to share our discovery of an additional method to produce the reaction: the direct immersion of an open plastic soda bottle into liquid nitrogen. In this case, the strong cooling through the thin container wall leads to rapid nucleation.

Because no material is introduced into the liquid, this method has the pedagogical advantage of illustrating that the diet soda and Mentos reaction comes from the rapid release of carbonation alone. This method also has the practical advantage that the nozzle does not need to be designed to allow the introduction of a catalyst into the liquid. The bottle only has to be partially immersed to produce the reaction. Dry ice or another cryogen might work as a substitute for liquid nitrogen.

Liquid nitrogen and other cryogens are frequently used in scientific demonstrations. This discovery raises an additional safety warning about working with cryogens, which is that carbonated liquids can quickly produce dangerous pressures in containers that come into contact with cryogens. This method should not be used with glass bottles or closed containers.

[1] A. Liljeholm, "Diet soda and iron filings," Am. J. Phys. **77** (4), 293 (2009).

[2] T. Coffey, "Diet Coke and Mentos: What is really behind the physical reaction?," Am. J. Phys. **76** (6), 551–557 (2008).

Bart H. McGuyer,
Justin M. Brown, and
Hoan B. Dang
Graduate Students
Department of Physics
Princeton University
Princeton, New Jersey 08544