NOTE

Images of the Seattle Space Needle in Raindrops

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It doesn't take long to find an example of a physics principle misunderstanding made by the popular media. For years I've used an old article from the *San Francisco Chronicle* about alpine ski racing. The article claims that at the start of a race, "they [the racers] could go from 0 to 90 [miles per hour] in about 13 seconds. They will accelerate faster than a person jumping out of a plane." Of course, my instinct when I first read the article was to make the quick acceleration calculation and compare it with the acceleration due to gravity. It turns out that the acceleration of the skiers is only 3.1 m/s^2, far less than the free-fall acceleration of a sky diver. Students are satisfied that they can make the calculation and refute the journalist.

Recently, author Bristow brought to class a photo from the front page of the Feb. 17, 1998 *San Francisco Chronicle*. Now we had another local item with which to generate discussion in our physics classes. The photo (see cover) shows the Seattle Space Needle as seen on a rainy day through a pane of glass. There is one large, blurry, upright image, as well as a number of smaller, less-blurry and inverted images visible in the droplets of water on the pane of glass. The photo is very compelling, not only to photographers and those who understand the physics of the images, but also to the lay public (as evidenced by its appearance in the *Chronicle*). The problem is the caption. It states: "Seattle's famous landmark, the Space Needle, reflected in the city's equally famous raindrops."

Clearly, the images are not "reflected in" the raindrops, but rather "refracted through" the raindrops. I'm glad we were able to present the photo and caption to my students. It generated more conversation than I had expected. When I read the caption to them, most agreed that the caption should have read "refracted"; however, a few students responded by saying that it could be a reflection. They noted that glass and water, under the right conditions, are decent reflectors and that if you looked at the raindrops as little convex mirrors, you would expect the images in the raindrops to be smaller than the image on the flat glass. The class as a whole wasn't so sure anymore (it had been five months since we had studied optics and some of the finer points were fuzzy). Then one student reminded the class that all convex mirror images are upright. The fact that these are both inverted and smaller means that the drops are indeed refracting as little convex lenses with the object (the Space Needle) beyond two focal lengths from the water droplet. In a last attempt to salvage the accuracy of the caption, one student suggested that the photograph was taken with the camera on the dry side of the glass and that the surface of the raindrops would then be concave reflectors and thus capable of producing inverted and smaller images. However, it was agreed that if that were the case, then there would also be images produced by the front surface of the glass that would be visible. Since these images are nonexistent, we finally unanimously agreed that the images are due to refraction, not reflection. We were later able to verify that the images were refractions after contacting the photographer, Jimi Lott of the *Seattle Times* (jlot-new@seatimes.com). He was kind enough to e-mail a copy of the original photograph and stated, "The photo was taken through a glass window with a macro lens on a slr (single lens reflex) camera at about a 1-to-1 ratio."

My students now have a strong interest in finding inaccuracies about physics principles in the popular media. A side benefit is that they are seeing a whole lot more physics in the media than they were before. And I now have a standing extra-credit reward for students who find similar photos that I can use to generate class discussions about physics outside the classroom.

Copies of the Space Needle photograph may be obtained by e-mail through author Lapp.

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If lawyers are disbarred and clergymen defrocked, doesn't it follow that electricians can be delighted; musicians denoted; cowboys deranged; models deposed; tree surgeons debarked; and dry cleaners depressed?

—Virginia Ostman

And how about teachers degraded and students detested?

—Kirk Bailey