3-1-1995

Is Fundamentals of Physics Too Violent?: Reply

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Is *Fundamentals of Physics* Too Violent?

While teaching a freshman physics course at Princeton University, I noted a disturbing trend toward the use of violent examples and images in the course's textbook, *Fundamentals of Physics*, by David Halliday, Robert Resnick and Jearl Walker (fourth edition, Wiley, 1993). Previous editions, such as the third, published in 1988, have long been standard at colleges and universities around the world, including at Princeton.

In the preface to the fourth edition, the authors explain how they "have devoted considerable attention to illustrating real-world applications of physics topics." To this end, they state, "the features of each chapter were carefully planned to motivate students." Among the new features is the use of full color for diagrams and most of the photographs, as well as a "puzzler" at the beginning of each chapter "describing a curious phenomenon that is intended to entice a student." The puzzlers, the authors claim, "are carefully linked to the physics of the associated chapters, and the memorable photographs of the puzzlers have been chosen in order that the relevant physics also be memorable."

Many of the new, glossy, full-color photographs and associated text in the fourth edition of *Fundamentals of Physics* are indeed memorable, but are they in fact how I want my students to remember their first college-level physics course?

The first sentence in the chapter on electromagnetic oscillations reads, "On June 30, 1956, a United Airlines DC-4 and a TWA Constellation collided over the Grand Canyon; everyone aboard both airplanes was killed." In the third edition, the same chapter begins with the sentence "The radar beams that make modern air travel possible are generated in the electromagnetic oscillator of a ground-based radar transmitter."

The chapter on current and resistance in the fourth edition opens with a photograph of the fiery, catastrophic explosion of the zeppelin Hindenburg. In the third edition, a photo of the levitation of a magnet above a disk of superconducting material is presented.

In the fourth edition, the capacitance chapter opens with a glossy color photograph of a half-naked, unconscious young man lying on the pavement with tubes in his mouth and electrodes taped to his chest and shoulders. The capacitance chapter in the third edition begins with a photograph of a laser used in fusion research.

In the fourth edition, the opening of the chapter on Maxwell's equations shows war-ravaged England after it was bombed by Nazis in World War II. In the third edition, the chapter starts with a photo of a smiling woman wearing a Maxwell's equations sweatshirt.

The chapter on mechanical oscillations in the new edition begins with a sentence about how the 1989 earthquake in Oakland "cause[d] extensive damage and kill[ed] 67 people," accompanied by a photograph of a devastated freeway and chaos caused by a major car and truck accident. In the third edition, the collapse of the Tacoma Narrows bridge in 1940 is described, an event that led to no injuries or fatalities.

The chapter on collisions in the fourth edition begins with a photograph of a man breaking concrete slabs with his hand, with the caption "Ronald McNair, a physicist and one of the astronauts killed in the explosion of the Challenger space shuttle, was a black belt in karate." A picture of a tennis ball hitting a racket opens the collisions chapter in the third edition.

The fourth edition's chapter on waves opens with a close-up photograph of a scorpion and a description of how it "turns toward the beetle and dashes to its location to kill and eat it." The third edition's waves chapter opens with a picture of a surfer and the caption "Hanging ten off the California coast!"

One of the most gruesome inclusions in the fourth edition, absent in the third, is in the chapter on fluids. There the story of the asphyxiation of 1700 people from a rush of carbon dioxide from Lake Nyos in Cameroon in 1986 is told, accompanied by a photograph of some five dozen asphyxiated hogs. This is meant to illustrate Ar-

chimedes' principle. Also new to the fourth edition, in the questions section of the fluids chapter, is one problem that discusses a 1985 plane crash that "killed 136 of the 167 people on board." The question is accompanied by an otherwise useless color photograph of wreckage.

There are many other examples in the fourth edition in which a photograph or description of some physical phenomenon in the third edition has been deemed too uninteresting for freshman physics students and has been replaced by a more "memorable" image of some sort of act of violence involving injury or death. A quick browse through all the chapters reveals a new trend in the presentation of the fourth edition: The words "danger," "injury," "lethal," "die," "death" and various forms of "kill" appear some 20 times in the short puzzlers at the start of the chapters.

The authors and publisher of *Fundamentals of Physics* clearly made a decisive change of philosophy in presenting the material in the fourth edition. There is no doubt they were aware of what they were doing, having "carefully planned" the "features of each chapter." But why have they made this change? The authors state that in illustrating their view of the "real world," they intend to "provide long-term reinforcement of the associated physics."

I cannot help but question the judgment behind their decisions. It is certainly true that today's freshmen, by the time they reach college, have been inundated with countless images of horrific violence from newspapers, television and film, and may even associate such images with "entertainment." But is this really the direction in which the teaching of physics should be moving in the 1990s? What does it say about our society if physics professors assume the best way to present physics to students is not to use the inherent, natural interest of the subject matter itself, material replete with elegant equations, beautiful concepts and surprising, counterintuitive effects like magnetic levitation, but rather to show photographs of destruction and death?

Another point worth making regards a separate but no less important issue. Physicists at universities have puzzled for years over why there are so few female physics majors. It may well be the case that the more violent images shown in the fourth edition of *Fundamentals of Physics* would serve to repel young women (as well as sensitive young men) from the subject matter.

If professors planning introductory courses at universities either do not notice this trend or are not made aware of it, sales of the fourth edition will remain steady, and rival publishers may follow suit. This would be a genuine shame; centuries of devoted intellectual scientific effort would be presented to the next generation of scientists in the same way that daily tabloid news is presented to the mass population, catering to the basest of human emotions. I believe physics, being a fundamental science and rich intellectual pursuit, especially as presented at an institution of higher learning, deserves better.

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WALKER REPLIES: For the fourth edition of *Fundamentals of Physics*, I looked for examples that are interesting and instructive. As many of us have seen as teachers, it is impossible for a student to learn from a physics textbook if the student does not even bother to read the textbook. From what teachers and the publisher tell me, students *are* reading the fourth edition of *Fundamentals*.

I agree with Victoria Kaspi that violence in itself is incompatible with teaching physics. However, I do not think anything is wrong with historical accounts in which physics played a role and which incidentally involved danger or harm. After all, if physics is supposed to be about the real world, then putting a few examples of reality among thousands of problems about things like frictionless planes and massless pulleys seems acceptable, even useful.

When I wrote the examples cited by Kaspi, I took care to write in the factual, journalistic style of *Science News* and the editorial pages of *Nature*. In fact, half of the cited examples came from those two journals. (The other half came from other science journals or from historical records.)

Here, I shall comment on just one cited example: As reported in *Nature* and *Science News*, when Lake Nyos suddenly spilled carbon dioxide down a mountainside, killing many people, the gas erupted from the water because it was lighter than water, and then it descended the mountainside because it was heavier than air. The event was most tragic and horrible, but it was also interesting and instructive. In fact, Lake Nyos is again being discussed in *Nature*, because another eruption of carbon dioxide could happen at any time. That the same physics might lead to the same tragedy is important.

Finally, I hope that the apparent gender stereotyping in Kaspi's letter is due to an accidental choice of words. So do the women at Wiley (my publisher) who helped develop, edit and produce the book, and so does my wife (a former science major), who helped select the examples cited by Kaspi.

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