

The response by Vit Klemeš (PHYSICS TODAY, March 2000, page 100) to a report about the Kansas State Board of Education's decision to exclude evolution theory from its science standards has rekindled some old issues in the perennial science-religion debate in education. In particular, Klemeš poses the question of the proper relationship of science to politics and ideology. This discussion has caused me to reflect on my own role as a teacher and, in particular, to remind me of two of my former students, Doug and Jamal. Both of them had taken my introductory modern physics course during their freshman or sophomore college year.

Doug was an excellent student, and demonstrated a wonderful understanding of what I was teaching. But across the top of his almost perfect final examination paper he wrote, "I still don't believe in relativity!"

Jamal was not the type to be so direct. He came into my office a few years later (just before he was about to graduate) to say goodbye. We chatted awhile, I wished him well, and then, as he was about to leave, he turned to me and said hesitantly in his characteristically shy way: "Do you remember that stuff you taught us about how the universe originated in the Big Bang about 15 billion years ago? Well, I don't really believe all that." I must have looked surprised because he went on. "It kind of conflicts with my religious beliefs." He looked apprehensively at me, perhaps to see if I might be offended or angry or think less of him. But I simply smiled and let it pass.

Why was I not displeased with someone who had rejected a whole semester of my teachings on the physical origins of the universe, and instead possibly believed that the world was created by God about 6000 years ago? Why did I not leap to the defense of science against such irrational beliefs? (For the record, I am perfectly comfortable with the standard scientific models of cosmology and evolution, and am not a closet creationist.)

Every time I teach an introductory modern physics course and look at the students' final exams, a sense of puzzlement comes over me. Not because

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OPINION

Teaching and Propaganda

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some students have taken the elegant theories of relativity and quantum mechanics and made a total hash of them (which happens all too often, unfortunately), but because so many of them seem to actually believe the theories. The difficulties those students have are mostly procedural, in the sense that they find it difficult to apply the theories correctly in the given situations.

I used to ask myself why they believed what I taught them. For one thing, as we now know from research into physics education, everyday phenomena and experience conspire to produce students who think that any motion requires a force. Such a preconception makes even Newtonian mechanics a tough proposition to sell them. (See *Teaching Physics: Figuring Out What Works*, by Edward F. Redish and Richard N. Steinberg, PHYSICS TODAY, January 1999, page 24.) Furthermore, the ideas of relativity and quantum mechanics are so thoroughly contrary to everyday experience that I would expect students, on first hearing these notions, to reject them out of hand.

I used to wonder whether most students were like Jamal, secretly rejecting everything I said, but acting otherwise in order to get good grades. But not many students can successfully maintain that level of dualistic thinking over a long period of time. I finally concluded that most students believe me because they trust me, they feel that I have their best interests at heart and that I would not deliberately deceive them by teaching things that I myself did not believe. They also trust the institution that awarded me a physics PhD, and the university and the physics department that hired me and allow me to teach them.

And I use that trust to effectively brainwash them. We who teach introductory physics have to acknowledge, if we are honest with ourselves, that our teaching methods are primarily those of propaganda. We appeal—

without demonstration—to evidence that supports our position. We only introduce arguments or evidence that support the currently accepted theories, and omit or gloss over any evidence to the contrary. We give short shrift to alternative theories, introducing them only in order to promptly demolish them—again by appealing to undemonstrated

counter-evidence. We drop the names of famous scientists and Nobel prizewinners to show that we are solidly on the side of the scientific establishment. All of this is designed to demonstrate the inevitability of the ideas we currently hold, so that if students reject what we say, they are declaring themselves to be unreasoning and illogical, unworthy of being considered as modern, thinking people.

Of course, we do all this with the best of intentions and complete sincerity. I have good reasons for employing propaganda techniques to achieve belief. I want my students to be accepted as modern people and to know what that entails. The courses are too rushed to allow a thorough airing of all views, of all evidence. In addition, it is impossible for students to personally carry out the necessary experiments, even if they were able to construct the long chains of inferential reasoning required to interpret the experimental results.

So I, like all my colleagues, teach the way I do because I have little choice. But it is brainwashing nonetheless. When the dust settles, what I am asking my students to do is to accept what I say because I, as an accredited representative of my discipline, profession, and academia, say it. All the reason, logic, and evidence that I use simply disguise the fact that the students are not yet in a position to sift and weigh the evidence and arrive at their own conclusions.

Conflicting goals of teaching

But if students believe my views on science because of who I am and what I represent, what makes this better than believing others who also claim to speak in their best interests but give them contrary views, such as those of creationism? Let's suppose I have two students, both of whom take my course and have listened carefully to what I have to say. One believes it and moves on. The other tells me she rejects it because she is unconvinced by me and cannot reconcile my teachings with her other beliefs. Which stu-

dent response should I prefer?

One part of me (the part reflecting my academic training and professional instincts) tells me to prefer the former. Is that not the goal of teaching science: to pass on the hard-earned knowledge gained by our scientific predecessors to the next generation, so that they can build on it? But I am still uneasy because such "good" students have accepted what I say mainly because I said it, and are thus also more likely to unquestioningly accept the words of "experts" in other areas, whether they be in politics, the military, religion, or the media. These so-called experts will (like me) cloak their views in reason, logic, and evidence, but will in actuality be using the same propaganda techniques I use.

The other part of me remembers that I went into teaching science not just to train competent technicians, but also to produce people who will shake up the world and make it a better place. This part prefers the latter student, because her rejection of my teaching requires a willingness to challenge authority (me) and the courage to expose herself to ridicule by taking an unpopular view. Surely it is such people who are also more likely to question authority elsewhere as well, to take the side of the underdog and the powerless against a privileged and powerful establishment?

Students will forget most of the information they get in my classes. The best that I can hope for is to enable my students to think critically, to detect propaganda and reject intellectual coercion, even when I am the one doing it. What troubles me is the assumption by some scientists that it would be quite admirable if people believed what we say and rejected the views of those who disagree with us, even though most people have no real basis for preferring one view over the other. If scientists want the spirit of true inquiry to flourish, then we have to accept—and even encourage—public skepticism about what we say, too. Otherwise, we become nothing but ideologues.

So I salute you Jamal and Doug, wherever you are, and say now what I should have said to you then: "Listen carefully and courteously to what knowledgeable people have to say, and be able to use that information when necessary. Weigh the arguments for and against any issue but, ultimately, stand up for what you believe. Don't ever feel forced to accept something just because some "expert" tells you it is true. Believe things only when they make sense to you and you are good and ready for them."

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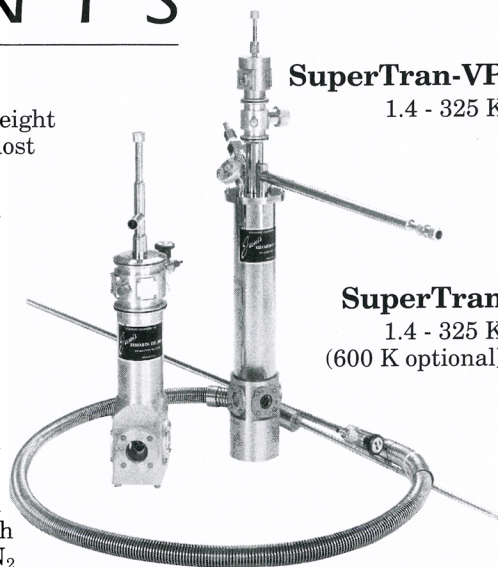
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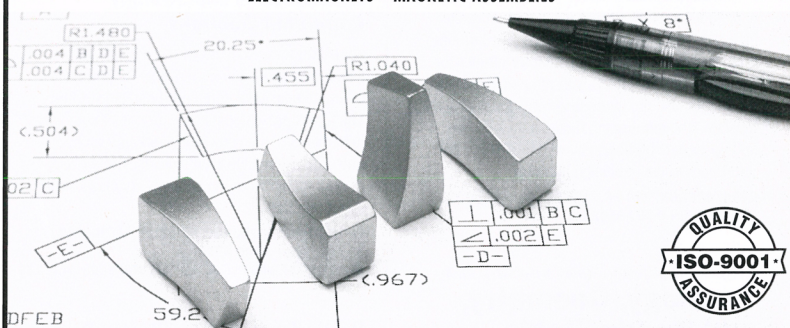
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