Chair Comment

Bugs, Marbles, and More Than You Bargained For

It's the basic questions that bug us: What determines the pattern of masses in the universe? Why must time's arrow point forward? Why is there more matter than anti-matter in the Universe? Where did matter come from? (Hint: *the big bang singularity* is not a satisfying answer!)

The pursuit of these questions leads to others of a more general nature, such as: What is science? Can science explain human behavior? How will we know when the work of science is finished?

These questions derive from and lead us to the history and philosophy of science. But is it appropriate to discuss the history and philosophy of science within the AAPT? The purpose of the AAPT is to promote better physics teaching; why get distracted? Let me share two examples that demonstrate the importance of history and philosophy of science to physics teaching.

Every summer, we offer a three-week summer institute at the University of Wisconsin Oshkosh on content and pedagogy for physics teachers. During the past two years, I've become increasingly aware of an interesting, and fairly reproducible, phenomenon. It all starts so innocently. During a heated debate among physics teachers over the solution to a physics problem, a teacher makes a statement like, "The energy is stored here, not there, and then goes over here!" or "As you move around, you can kind of feel the force, um, I mean acceleration" or "That just a model—what's really happening here?" What follows is very lively discussion on the relation between theory making, concept formation, and fact gathering; the tacit ontological and epistemology commitments of the teachers spill out on the table like a lose bag of marbles. For me (the instructor) it's very exciting! However, the fun usually ends quickly when one of teachers, as if waken from a trance, exclaims, "Wait! What are we doing? Let's get back on track!" Not long after, the whole group has left the trail of something truly significant.

New students to physics, with fresh eyes for science, do not so easily dismiss the rich under-layer of scientific inquiry. Indeed, questions of the most basic kind, such as "How do we know?" and "Why should we care?" are foremost on their minds. They will often ask questions like, "If we can't see atoms directly, why do we have pictures of them in the textbook?" Rarely do such questions receive the careful and thorough response they deserve. Soon, such questioning ceases altogether, not because they have become unimportant, but because they have been forgotten—swept aside by a wave of traditional instruction. "It is probably for the best," the instructor says, "I teach physics, not a philosophy or theology class. Hey, I just want them to know F=ma." Still, the questions concerning the goals of science, the reality of physical constructs, etc. will eventually surface again, to nag students and teachers alike, for the content of science demands it. In the mean time, the inability to properly relate facts, concepts, and theory will continue to hamper their understanding of physics at every turn.

Teachers should present something of the richness of science, and engage students in some of the big questions that consume scientists—questions, I argue, that students sensed were important from the beginning. With the guidance of the teacher, students must follow these questions into the history and philosophy of science. There, students will find fascinating examples of sustain inquiry, clever experimentation, and insightful hypothesis; the "thrill of victory and the agony of defeat"; heated philosophical and theological debates; economic and political upheaval—all of which shape our current understanding of the physical world. This exposure will leave a lasting impression on the student. In the end, the teacher will get more than they bargained for: not only a better student understanding of the science content and epistemology, but also a better student appreciation of science as a human endeavor.

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