Jack K. Horner
Peter A. Rubba

It makes a pretty and heroic story—the fable of the "Little Theory That Could"—the scientific theory that worked and worked until one day it grew up to become a law. But a fable it is—a misconception of the nature of science that is unwittingly perpetuated by teachers and texts.

According to this fable, there was once in the Kingdom of Reason a lowly Scientific Theory, *T*, which aspired to become a Scientific Law. Its hero was a Very Powerful Law which had risen from the rank of Theory to that of Law by withstanding repeated testing. And, as all good fables must, this one has a happy ending. In time, *T* was recognized for its virtue and knighted a Law, too.

Jack K. Horner teaches physics and mathematics at Fountain Valley School, Colorado Springs, and is an assistant editor of "Auslegung," a journal of philosophy. He holds MAs in philosophy, philosophy of science, and mathematics, and is currently completing a secondary physics text. (Address: Fountain Valley School, Colorado Springs, CO 80911.)

Peter A. Rubba is an assistant professor in the Department of Curriculum, Instruction, and Media at Southern Illinois University at Carbondale. A former high school physics and chemistry teacher, he holds an EdD in science education from Indiana University, Bloomington. (Address: Southern Illinois University at Carbondale, Carbondale, IL 62901.)

At the heart of this fable is a fatal assumption about the relationship between laws and related theories: namely, that theories *mature* into laws by constant testing and confirmation. If one looks closely at actual cases from the history of science, however, one finds this is not true.

Consider, for example, the ideal gas laws as formulated by Boyle and Charles. These laws *describe* regularly observed relationships among the observable properties *pressure, temperature,* and *volume.* In particular, Boyle noted that the product of pressure and volume is a constant at constant temperature; and Charles discovered that volume is proportional to Kelvin temperature at constant pressure. Though they described the relations among the three gas properties, Boyle's and Charles' laws did nothing to explain *why* such relationships are reasonable. (One can, in fact, test the gas laws until helium freezes over without ever getting closer to an explanation of them.)

To the rescue in this dark corner of the Kingdom of Reason came the kinetic theory of gases, which held that gases are collections of point masses endowed with a distribution of velocities. By assuming that the collision of these masses with the walls of their container is elastic, one could mathematically deduce Boyle's and Charles' laws; hence the kinetic theory of gases explained the ideal gas laws.

This example suggests that the relationship between theories and laws is an *explanatory* one—not, as the fable insists, a *maturational* one. In addition, it illuminates a second, but related, misconception widely held about related laws and theories—namely, that the two must "look" alike, since the one is presumed to be just a more "mature" version of the other. The previous example suggests, however, that a theory need not even faintly resemble the law it explains. Notice, in particular, that the ideal gas laws never mention point masses, velocities, elastic collisions, and all the other hardware of the kinetic theory of gases.

Similarly, in chemistry, the valence laws assert that ions bear integral charges, but do not explain why. That job is reserved for electron orbital theory, which holds that charges arise from the presence or absence of unit charge-bearing microparticles (electrons) in certain orbitals.

This fable arises, we believe, because of another common fallacy—one we described previously in *TST* as *"The Myth of Absolute Truth."* For if one believes that absolute truth can be discovered and described by science, then one tends also to believe in a kind of maturational relationship among laws and related theories—that one "grows" into another by constant testing and refinement.

The philosophy of science—indeed that of all human knowledge—is subtle and complicated. But we do ourselves and our students a disservice by perpetuating naive misconceptions. ■

References

1. Hempel, Carl G. *Philosophy of Natural Science.* Prentice-Hall, Inc., Englewood Cliffs, N.J. 1966.
2. Horner, Jack K. and Peter A. Rubba. "The Myth of Absolute Truth." *The Science Teacher* 45:29–30; January 1978.
3. Martin, Michael. *Concepts of Science Education: A Philosophical Analysis.* Scott, Foresman & Co., Glenview, Ill. 1972.
4. Robinson, James T. "Philosophy of Science: Implication for Teacher Education." *Journal of Research in Science Teaching* 6:99–104; 1969.

Reprinted from *The Science Teacher*, Volume 46, Number 2, February 1979