

# SCIENCE

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## Science and Trans-Science

Many of the issues that lie at the interface between science and politics involve questions that can be stated in scientific terms but that are in principle beyond the proficiency of science to answer. In a recent paper in *Minerva* [**10**, 209 (April 1972)], I proposed the term “trans-scientific” for such questions. For example, the biological effect on humans of very low level radiation (or of other physical insult, for that matter) will probably never be fully ascertained, simply because of the huge number of animals required to demonstrate an unequivocal effect. Estimates of extremely unlikely events (such as a serious reactor accident) can never be made with anything like the scientific validity that one can apply to estimates of events for which there are abundant statistics.

In the current attempts to weigh the benefits of technology against its risks, the protagonists often ask for the impossible: scientific answers to questions that are trans-scientific. What the scientist can do in clarifying matters of trans-science differs from what he can do in clarifying matters of science. In the latter case, he can bring to bear his scientific expertise to help establish scientific truth; in the former case, he can, at most, help delineate where science ends and trans-science begins. We scientists sometimes refuse to concede that science has limits. The debate on risks versus benefits would be more fruitful if we recognized these limits.

Scientific truth is established by the traditional methods of peer review: only what has value in the intellectual marketplace survives. By contrast, where trans-science is involved, wisdom (rather than truth) must be arrived at by some other mechanism. Our society is experimenting with procedures, either adjudicative or political, for making the delicate judgments of value that underlie the resolution of trans-scientific questions. These procedures are much in vogue now as a consequence of the National Environmental Policy Act. Although these procedures are often marred by their lack of discipline, even unruliness, such untidiness is, I suspect, inevitable in a democratic society.

We scientists value our republic of science with its rigorous peer group review. The uninformed public is excluded from participation in the affairs of the republic of science rather as a matter of course. But when what we do transcends science and impinges on the public, we have no choice but to welcome public participation. Such participation by the uninitiated in matters that have both scientific and trans-scientific elements may pose some threat to the integrity of the republic of science. To my mind, however, this is a lesser threat than is the threat to our democratic processes that would be posed by excluding the public from participation in trans-scientific debate.

We must strive to improve our procedures for conducting this debate in such a way that the issues can be aired fully and yet the procedures themselves cannot be easily abused. That this is easier said than done does not absolve us as scientists from contributing to the development of better institutions for conducting trans-scientific debate.—ALVIN M. WEINBERG, *Director, Oak Ridge National Laboratory, P.O. Box X, Oak Ridge, Tennessee 37830*