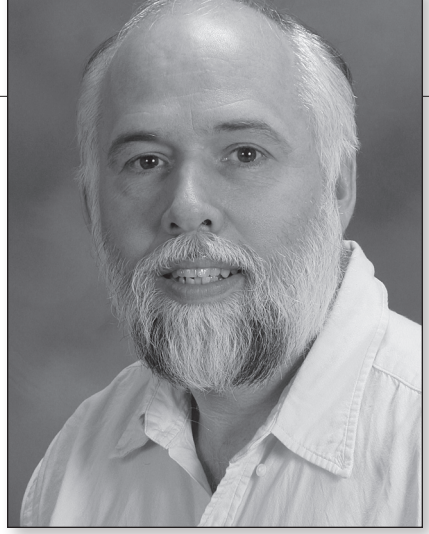

By Craig M. Pease

Strong Evidence for a Small Harm

Every profession has its own tools. Carpenters use saws, hammers, and paper blueprints. Lawyers employ words as terms of art, crafted into legal arguments. Scientific instruments gather data, analyzed with the machinery of statistics. Alas, many environmental problems are interdisciplinary. When there are insufficient tools for collaboration, law and science clash, each reverting to its own specialized toolkit.

In *American Farm Bureau Federation v. EPA*, pending in the D.C. Circuit, a consortium of states and environmental groups challenge the Environmental Protection Agency's 2006 rule setting the annual National Ambient Air Quality Standard for fine particulate matter air pollution ($PM_{2.5}$) at 15 millionths of a gram per cubic meter of air ($\mu g/m^3$). In so doing EPA Administrator Stephen Johnson made a clean sweep of the medical and scientific communities, rejecting the advice of physicians (including the American Medical Association), an external advisory committee (Clean Air Scientific Advisory Committee), and internal agency scientists (quantitative estimates of excess mortality in a risk assessment) to set a lower standard.

This is more than a dispute over how uncertain or clear cut the science is. Like the game of rock, scissors, and paper in which different tools compete for supremacy, this dispute, like much environmental litigation, concerns whether society will solve environmental problems using the tools of law or of science. Consider the two-pronged legal defense of EPA offered by the Department of Justice: The science is uncertain. And the agency's decision should receive deference.

In theory, the law might simply employ the scientists' concept of uncertainty, and there would be no clash. Alas, like a cross-threaded jar lid that only gets tighter the harder you turn, the uncertainty perceived by the court increases when any attorney — on either side — presents confused or incomplete science. And the defense actually has an incentive to obfuscate the science. The scientists' view of uncertainty is largely missing.

Scientists measure uncertainty by comparison. They want to ensure that, relative to the harmful health effects of air pollution they seek to measure, the uncertainty is small, like a carpenter who marks a board to be cut to the closest 1/4 inch, knowing the saw kerf is 1/8th inch.

This dispute, like much environmental litigation, concerns which tools society will use in solving problems

Here there is an extensive human epidemiological literature. For example, Arden Pope and colleagues' elegant 2002 *Journal of the American Medical Association* paper compares the incidence of heart disease and lung cancer in cities with high vs. low levels of air pollution. It concludes, inter alia, that for every 100 lung cancer cases at $10\mu g/m^3$ there will be 104 at $15\mu g/m^3$. This additional risk certainly seems small. Yet the relevant question is not whether it is small, but rather whether it is so small as to be masked by doubt.

Remarkably, a reanalysis of the seminal human epidemiology papers from the 1990s audited the original raw data, finding only entirely trivial data recording and transcription errors. It also reran the statistical analyses using two software packages and recomputed risk estimates, finding altogether negligible differences as compared to the original, thereby suggesting the statistical analysis was performed correctly. Moreover, scientists have compared straight-line vs. threshold dose-response curves, consistently finding the linear models provide a superior fit, suggesting little error from this assumption.

Thus the evidence that there are significant effects below 15 $\mu g/m^3$ is quite strong. Even so, if $PM_{2.5}$ really does not cause lung cancer, it might appear to if other pollutants and tobacco are systematically more prevalent in cities with more air pollution. Yet numerous studies, using diverse methodologies, have adjusted the available human epidemiological data for potential confounders, and in comparing these analyses we still find consistent harmful effects of $PM_{2.5}$.

Scientists can draw inferences only where there are sufficient data. For example, the Pope study involves half a million individuals, with about 40 percent of their cities having levels below $15\mu g/m^3$. Indeed, there are plenty of data down to about $10\mu g/m^3$, as can be seen by inspecting their 95 percent confidence intervals. In essence, these compare the data actually gathered to hypothetical data that might conceivably have been gathered, allowing one to judge how much the results would change with a different sample of individuals. Yet because $PM_{2.5}$ is ubiquitous, we have hardly any data from cities lower than $10\mu g/m^3$. And we do not have a true control group with exposure of zero.

Ironically, by failing to set a more stringent standard in the past, EPA is itself directly responsible for a not insignificant portion of the very uncertainty it now highlights in refusing to set a standard lower than $15\mu g/m^3$, and exploits in its legal defense.

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