COMMENTARY

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Special to the Law Weekly

ENVIRONMENTAL LAW

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Communicating Basic Science in Environmental Cases

Environmental lawyers are regularly called upon to translate science into language that judges, other lawyers, bureaucrats, businesspeople, journalists and all other sorts can understand. This may be the most important thing we do for clients.

Last year, our Supreme Court amended Comment 8 to Rule of Professional Conduct 1.1 expressly to require lawyers to become knowledgeable about "technology." But the court probably had information technology used in practice in mind, not the issue that faces environmental lawyers.

In any event, my experience is that environmental lawyers do not have a problem communicating the cutting edge; expert scientists and engineers explain that fairly well, and we can channel them. The problem lies in reminding decision-makers of basic precepts we learned in middle school and high school, then forgot. They are so basic that the experts do not think of them without prompting, but people get them wrong with regularity.

If practitioners work hard to explain these basics correctly (and avoid cynically exploiting confused judges, jurors or government agencies), perhaps we can do our little part to advance outcomes in environmental matters. Below are a few of the many apparently hard-to-communicate issues that have appeared in my practice more than once.

SCIENTIFIC INDUCTION REQUIRES HYPOTHESIS TESTING

Remember the scientific method? It requires a hypothesis and an experiment that could disprove the hypothesis. If the experiment does not disprove the hypothesis, then confidence increases that the hypothesis is true. But that increase in confidence only occurs to the extent that the experiment could have come out the other way if the hypothesis were not true. If you can explain away an unfortunate outcome in the experiment, then the experiment does not increase or decrease confidence.

For example, suppose the issue is whether the chlorinated solvent found in the groundwater came from the leak in a tank on the neighbor's property or from spills on your client's property. Lots of data on the concentrations of solvent in the groundwater are just that: lots of data. In order to help resolve the issue of the source of the solvent, you have to have an experiment that excludes a hypothesis. If the tank were the source, one would expect to find undissolved solvent in the soil under or near the tank and the plume of dissolved solvent in the groundwater to be at the surface of the groundwater table under or near that undissolved soil source. If 10 feet of clean groundwater lies over top of the dissolved solvent under the neighbor's property, it is fairly unlikely that the neighbor is the source. That is true even if the concentrations in the groundwater are very high under the neighbor's property. The material cannot have gotten from the tank into the deeper groundwater without having passed through the shallower groundwater. In order to test the hypothesis, then, one has to have data on the three-dimensional distribution of the contamination; you have to be able to look at how deep within the groundwater the solvent can be found.

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Environmental lawyers can often help clarify thinking by asking an expert what hypothesis he or she is testing and how the experiment would disconfirm the hypothesis. Often, the expert has designed data collection that he or she intends to explain as being consistent with his or her opinion no matter how it comes out. That is not really science. It should not be persuasive to anyone. It is more like a statement of faith.

By asking the middle school scientific method questions, one can hone the analysis of one's own experts, one can help advise one's own client, and one can sharpen disputes with others' experts. A lawyer can also help his or her client save a lot of money and time by avoiding data collection that does not usefully test a hypothesis.

MASS VERSUS CONCENTRATION

Even educated people who do not do this work find the distinction between mass and concentration difficult. Most environmental issues arise from unacceptable concentrations of some substance in the environment. Air quality standards, water quality standards, permit limits of all sorts, Act 2 standards and so forth are mostly expressed in parts per million or billion, not kilograms or pounds. Many people have difficulty thinking about the two distinctly. For example, more contaminant means more mass, but it does not necessarily mean more concentration. If contaminants wash into a stream in storms, more mass enters the stream, but the concentration of a water pollutant in the water column (or on the suspended solids) may or may not be higher because there is more water and there are more solids in the stream as the result of the storm. Similarly, when two things mix, their concentrations average, they do not add. Light blue and medium blue can never mix to make dark blue. These facts are confusing.

Sometimes the reservoir into which a pollutant goes—the atmosphere, for example—is fixed in size, so mass and concentration are proportional and functionally the same. Other times, what matters is whether the hot spots are too hot. A spill violates Act 2 soil standards in specific locations, not in all the soil everywhere in Pennsylvania all at once. Water quality standards are violated in the concentrated area right downstream of an outfall (or a mixing zone), not everywhere in the stream. In those situations, more pollutant is not the same as more concentration, and that is hard to communicate.

SCALE MATTERS

Regulators and courts often focus on data points. They look at the concentration of pollution in the air or water, contamination in the soil or groundwater from a single sample and treat that as if it is a measure of a single point in space and time. They then often disdain averaging sample results across multiple sampling locations or over time. But whether the averaging across space or time is appropriate turns on the appropriate scale. If a contaminant only poses a risk when you are exposed to it for a long time at a particular concentration, then it only matters if the contaminant exceeds that concentration on average across all the places and times that you will be exposed. The analytical result reported on a data sheet is the average concentration in the sampling tool (a little shovel or bucket or air monitor) over the time of the sample collection. If that scale is not relevant, then multiple data points have to be averaged or assessed to determine the condition of the environment to which you will be exposed. Remember that molecules either are or are not a pollutant; they have concentrations of either 0 percent or 100 percent TCE or PCB or methane. The reported result is the average concentration in the sample, which is a pretty arbitrary scale. Lawyers often have to remind people of that, and of the scale that matters.

'ONE MOLECULE' IS A SILLY STANDARD

All of us have been in a case where someone has demanded that "not even one molecule" of an environmental contaminant be found in the wrong place. That is, of course, silly. You may recall from high school chemistry that Avogadro's number is the number of molecules in a mole of something. A mole is as many grams of a substance as its molecular weight. Avogadro's number is huge—a little more than 600 billion trillion. That many molecules spilled anywhere find themselves everywhere by random processes of diffusion, dispersion and just sticking to things. That many molecules spread evenly across the surface of the Earth would put about three-quarters of a million molecules in each square inch, including the oceans.

And a mole is not very much. A mole of water is 18 grams, just more than a tablespoon. A mole of TCE—a common solvent—is 133 grams, or 100 cubic centimeters, less than half-a-cup. What matters is not "one molecule." It is a concentration of pollution that could cause harm to something, a concentration that we can measure and address, but judges and even regulators often speak of "one molecule" as if that were meaningful.

This list could go on. We all need to develop simple ways to explain these issues. The better we do with this, the better the system will work. •

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