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Asura

The world makes the assumption that the exposure of an error is identical to the discovery of truth—that truth and error are simply opposites. They are nothing of the sort. What the world turns to when it has been cured of one erorr, is usually simply another error, and maybe one worse than the first.

H.L. Mencken

Measurements are imprecise. Our ability to determine the size, shape, location, concentration, or any other characteristic of an object is less than exact. Errors in measurement may be due to a lack of reproducibility of the condition or object under investigation, some features of the measuring device, or its application. When a group of MIT students measured the length of the bridge over the Charles River at Massachusetts Avenue, for example, they used a fraternity brother as both the device and unit of measurement, arriving at a length of 364.4 Smoots plus one ear.

Even the word *measure,* though derived from the latin root mensura, can be parsed into other less reassuring elements. Playing the elementary school game of "see how many other words can be made from *measure*" several concepts emerge. *mea-* the latin for self, and *sure-* well, that is clear. Another concept embedded in measure is Asura. Asura, an ancient spirit from the Rg-Veda, whose very breath drove the sun across the sky. In time, this representative of the immeasurable forces of nature became associated with demonic forces of reversal. It seems the ancients knew of the duality of measuring reality. Measurement—the blessing and the curse of science.

Repetition of the measurement is frequently necessary to obtain a better estimate of the value. While this concept may give rise to the mistaken impression that quantity can beget quality, repetition helps identify both the utility and limits of a measurement. The cloud of uncertainty surrounding the measurement, its standard deviation, is accepted—and the distinction between a measured difference and a real difference is appreciated.

Progress brings new measurements. We compare the new with the old to determine that we are, indeed, looking at aspects of the same reality. Frequently the outcome of the comparison is a graph, plotting the results from the two methods against one another. This relationship looks like a circle, if the measurements are unrelated, and like an ellipsoid, if the correlation is good. The standard error of the estimate indicates the cloud of uncertainty between the two measurements. When the comparison relates three parameters to each other in a three-dimensional graph, the cloud of uncertainty takes on the shape of a sphere—an area where observed differences may be due to chance.

Spheres of uncertainty can create Chaplinesque complications in science and in life. What should we do when the weatherman forecasts a 20% chance of rain? Ignore it? Take an umbrella? The best solution may be not to carry an umbrella at all, but rather to have several available, one at each of the places we are likely to be when it starts to rain.

H. William Strauss
Editor, The Journal of Nuclear Medicine