Edge Question 2008

WHAT HAVE YOU CHANGED YOUR MIND ABOUT?

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Clear and simple is not the same as provable and well defined

I used to think that if something is clear and simple, it must also be provable or at least well defined, and if something is well defined, it might be relatively simple. It isn't so.

If you hear about sightings of a weird glow approaching us in the night sky, it might be explained as a meteorite or as little green men arriving in a spaceship from another galaxy. In most specific cases, both hypotheses can be neither proved nor disproved, rigorously. Nothing is well defined here. Yet, it is clear that the meteorite hypothesis is scientifically much more likely.

When you hear about a new perpetual motion machine or about yet another claim of cold fusion, you raise an eyebrow, you are willing to bet against it and, in your guts, you know it is wrong, but it is not always easy to disprove it rigorously.

The reliability of forecasts regarding weather, stock markets and astrology is descending in that order. All of them are based on guesses, with or without historical data. Most of them are rarely revisited by the media, after the fact, thus avoiding being exposed as unreliable. In most cases, predicting that the immediate future will be the same as the immediate past, has a higher probability of being correct, than the predictions of the gurus. Yet, we, as scientists, have considerable faith in weather predictions; much less faith in predicting peaks and dips of the stock market and no faith at all is astrology. We can explain why, and we are certainly right, but we cannot prove why. Proving it by historical success data, is as convincing (for the future) as the predictions themselves.

Richard Feynman in his famous Lectures on Physics provided the ultimate physics definition of Energy: It is that quantity which is conserved. Any Lawyer, Mathematician or Accountant would have laughed at this statement. Energy is perhaps the most useful, clear and common concept in all of science, and Feynman is

telling us, correctly and shamelessly, that it has no proper rigorous and logical definition.

How much is five thousand plus two? Not so simple. Sometimes it is five thousands and two (as in your bank statement) and sometimes it is actually five thousand (as in the case of the Cairo tour guide who said "this pyramid is 5002 years old; when I started working here two years ago, I was told it was 5000 years old").

The public thinks, incorrectly, that science is a very accurate discipline where everything is well defined. Not so. But the beauty of it is that all of the above statements are scientific, obvious and useful, without being precisely defined. That is as much part of the scientific method as verifying a theory by an experiment (which is always accurate only to a point).

To speak and to understand the language of science is, among other things, to understand this "clear vagueness". It exists, of course, in other areas of life. Every normal language possesses numerous such examples, and so do all fields of social science.

Judaism is a religion and I am an atheist. Nevertheless, it is clear that I am Jewish. It would take a volume to explain why, and the explanation will remain rather obscure and ill defined. But the fact is simple, clear, well understood and undeniable.

Somehow, it is acceptable to face such situations in nonscientific matters, but most people think, incorrectly, that the quantitative natural sciences must be different. They are different, in many ways, but not in this way.

Common sense has as much place as logic, in scientific research. Intuition often leads to more insight than algorithmic thinking. Familiarity with previous failed attempts to solve a problem may be detrimental, rather than helpful. This may explain why almost all important physics breakthroughs are made by people under forty. This also explains why, in science, asking the right question is at least as important as being able to solve a well posed problem.

You might say that the above kind of thinking is prejudiced and inaccurate, and that it might hinder new discoveries and new scientific ideas. Not so. Good scientists know very well how to treat and use all of these "fuzzy" statements. They also know how to reconsider them, when there is a good reason to do so, based on new solid facts or on a new original line of thinking. This is one of the beautiful features of science.