

Box Views

Truth and falsehood are delusions. In fact, no statement is either true or false. If you insist that $1 + 1 = 2$, I'll ask you to define "1," "+," and "=". Then, I'll give you endless examples in which $1 + 1$ is clearly not 2.

Once I manage to cast doubt on basics that everyone naively accepts as "true," I'll make statements such as "I ate a peanut butter and jelly sandwich yesterday," whether or not I can even remember what I ate recently. If, to determine the "truth" of this statement, you happened to have a camera aimed at me for 24 straight hours, I'll point out the numerous tricks used in spy movies to subvert video surveillance. Otherwise, I'll force you to define "eat," "yesterday," and "sandwich" with such excruciating relentlessness that you'll never be able to determine what my statement means, much less figure out how it applies to the fact that I was nowhere near either bread, peanut butter, or anything sweet for the last month.

Likewise, we could debate whether evolution or creationism is "true." This is a tougher question since there were no cameras or eyewitnesses, and, even if there were eyewitnesses, they would undoubtedly be divided on every detail. We could debate the evidence ad infinitum, but any notion of "truth" will remain fuzzy at best.

Insisting on the rules of logic doesn't help since logic proceeds deductively from axioms, which, by definition, cannot be determined to be either true or false even if we

accepted these notions. Rather, we can choose the axioms as we see fit and then *define* them to be true, rendering the concept pointless.

If life were as simple as determining what is true and what is false, and then applying the rules of logic, then there would be a lot less disagreement. We wouldn't have numerous courtrooms or prolonged political campaigns, where whatever one might view as "truth" is endlessly qualified and requalified to the point that "facts" are buried under mountains of noise, and the goal is often persuasion and obfuscation. Even in our cozy world of mathematically rigorous engineering, we have persistent debates at conferences, where no one doubts the basic rules of logic or arithmetic, much less the tentative Riemann and continuum hypotheses.

Nothing is either true or false. The whole concept is a myth, and the sooner we accept it the better.

But where does that leave science and technology?

George Box said that all models are false, and therefore none can be true. But he quickly added that what we really need to focus on is what is or is not useful. And how might we gauge usefulness? By the ability to *predict*.

When we think of prediction we think of the future, but that isn't necessary. When a finite element model is used to determine the strain in an airplane wing, I'll call that prediction. Moreover, even if there is no eyewitness to observe it, when an astrodynamics model is used to calculate the effect of a thruster burn on a spacecraft trajectory millions of miles from Earth, I'll call that prediction.

Evolution as a biological phenomenon is useful for prediction. Bacteria evolve when we attack them with antibiotics. The theory is predictive. In contrast, I'm not



(From left) Chaouki Abdallah, Rafael Fierro, Scott Erwin, Dennis Bernstein, and Peter Dorato. Photo taken by Peter's grandson Bryce Dorato.

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aware of any reliable predictions based on creationism. Yet.

The problem with prediction as a practical criterion for replacing truth is that it doesn't apply to historical events. Except for the possibility of new-found data, there is nothing to predict, only noisy and fragmentary data to argue about. Everything is subject to interpretation and subjective weightings. Witnesses pass away, and reality is distorted. If new historical data come to light, explanations can be constructed to accept or discount the information. The possibility of hoaxes and fabrications casts doubt on authenticity. Many doubt the Apollo Moon landings, suggesting vast conspiracies involving members of our own profession. Nothing is "true," and everything is subject to doubt.

Despite its utility, science is not good at predicting lots of things. If I want to know whether I'll be happy



(From left) Vit Babuska, Robbie Roberson, Scott Erwin, Seth Lacy, and Dennis Bernstein.

next month, science has little to say, but horoscopes and fortune cookies are quick to help. Are they useful? I

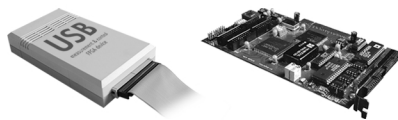
don't know. But I guess I'll need to buy a lottery ticket to find out.

Dennis S. Bernstein 



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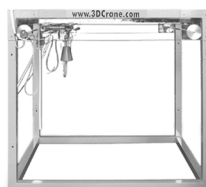
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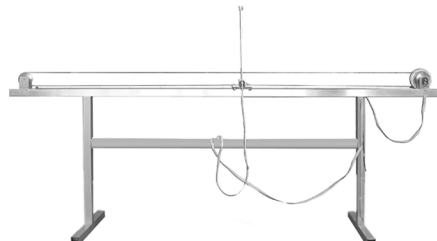
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