Truth and Science

A (1842-word) Consideration

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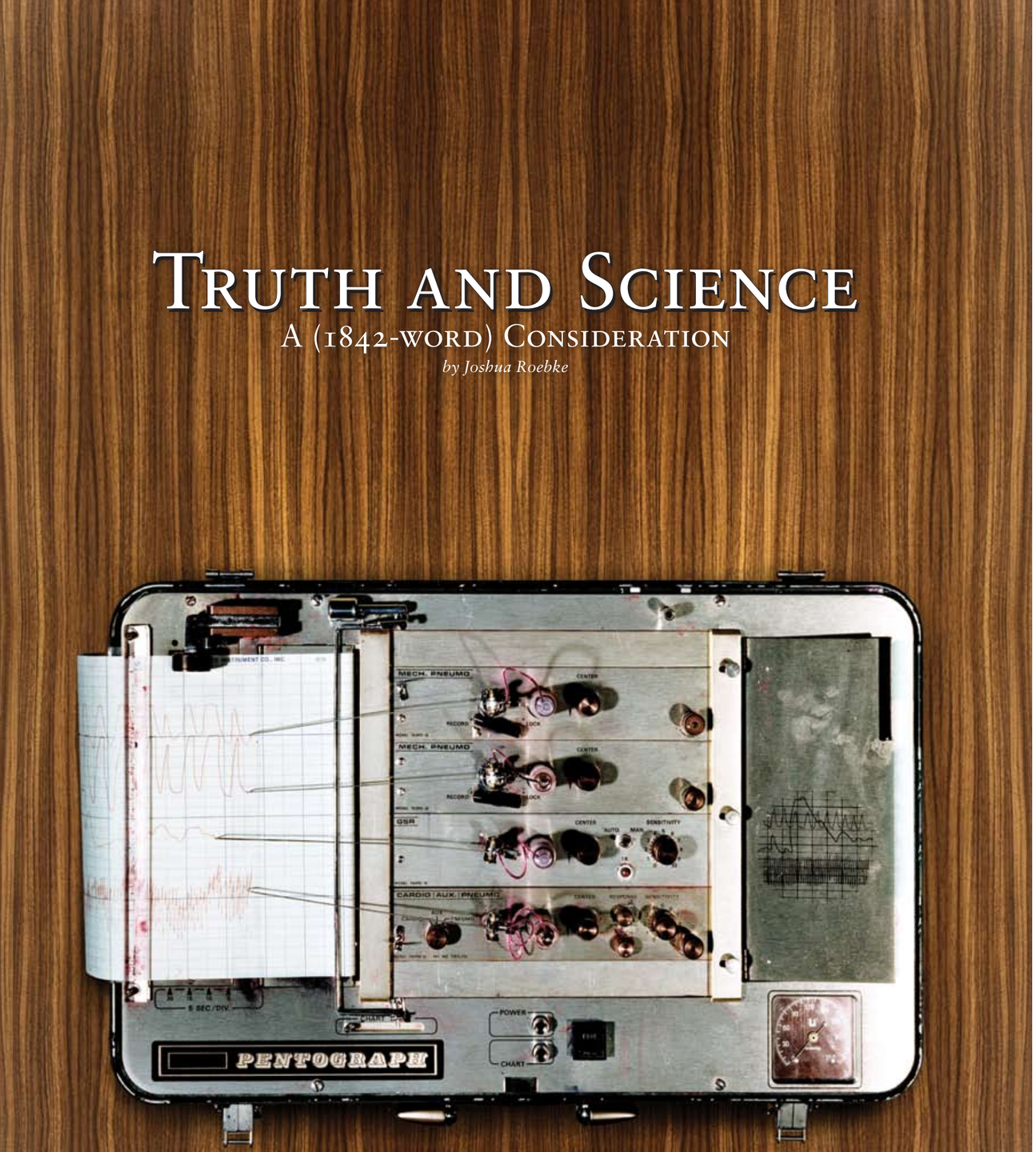

What is truth? How do we recognize it? Truth is a concept with which we are all pretty familiar. It is an undercurrent in every conversation and interaction we have with one another. Yet few of us ever give it much conscious thought except when we believe it is absent or in doubt. It's one of those intangibles that, when it does come up, we typically speak of only in absolutes. A statement can be either true or false, and that is all.

Even when we do think about truth and admit to blends of gray between the black and white, we frequently have a sense that a true answer merely exists beyond our immediate grasp. Given sufficient information and time, we could all eventually figure out the veracity of any claim or idea. In the meantime, most of us are satisfied with our hunches. We have a gut feeling for what is correct and proceed with our lives content in our beliefs.

Part of the reason for our satisfaction probably stems from the difference between what we say is "true" and what we consider to be "truth." The distinction isn't just semantic nitpicking. "True" is what we say of a statement we agree with or believe in. "Truth" is a far more nebulous and fundamental concept. We understand it as more of an ideal toward which we strive, rather than one we hold any dominion over.

Some of us are never entirely content with what is true in our lives and so are compelled to pursue the more elusive notion of truth. It is among this fervent group of people that scientists often count themselves (with poets, artists, authors, and others). Truth is an idyllic absolute to which they rigorously aspire, but the forms that it takes vary even for these different groups that seek it out.

The gamut of truths ranges from frowsy to elegant. We recognize some through experience, some we know by experiment, and others we accept without questioning. To simplify this diversity, we can split truths into two categories. There are those that reside within us, which will be gone when we humans are, and those that lie outside us. The first is a gestalt; emotional, ephemeral, and social. It lies within the purview of art and literature and most of us feel it at some level when we encounter it. The second is mathematical, permanent, and somehow not of this world. This exterior truth is often more difficult to attain and to understand.

The truth that science lusts after straddles this boundary between the mathematical and the artistic. It is creative, elusive, and yet ingrained within the very fabric of our universe. It would exist even if we were not here to discover it or to make use of it.

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Yet there are some people who doubt that science has any privileged vista onto the truth—that the spectrum of truths is open to all, and that what science achieves is in no way more rigorous than what any of us perceive. If this is correct, and those who purportedly look deepest and hardest at the fundamental questions of the universe are simply deluding themselves, what does that mean for the rest of us? Are the pursuits of artists and poets then also in vain? Science claims, through the rigor of its methods, to have some foothold on reality so perhaps the question then becomes, does truth even reside in reality? And can we prove this.

There is an elementary difference between the truth that science seeks and mathematical truth. Mathematics is not empirical. No one has ever observed Fermat's last theorem in nature. We can all imagine a ball falling upward, which would immediately contradict what we know of Newtonian physics, but it is absurd to believe someday one of us will discover that 2+3 does not equal 5.

Science is built up from facts that are observed firsthand, or indirectly through deduction from other facts. With a telescope and patience, one can discern the movements of the planets through the heavens, and with the knowledge gained from these observations, can also reproduce their entire orbits. Using intuition and observation (which is based on facts built upon the foundation of other facts verified for millennia) scientists make representations of our universe. These models of the natural world are what scientists call theories, a term whose colloquial twin has unfortunately been misconstrued to mean "opinion." In science, opinion does not get you very far.

Facts must conform to *reality*, and a theory must adequately explain those facts as well as predict new ones. This is what science is all about. It is certain that, as Karl Popper philosophized, no scientific theory can ever be proven true in the same sense that a mathematical theorem can. Theories are only ever demonstrably false through observation, and nature is always the final arbiter. Counterintuitively, it is in this idea where the power of the scientific method may be found. As false theories are abandoned, and new theories are discovered to take their place, science converges on something deeper than all of the basic facts it explains. This is how consensus slowly builds in science, and this convergence is what leads science asymptotically to truth. Science is nothing but an unending courtship, flirting ever closer with the absolute truth it desires though may never attain.

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Mathematical truth, because it doesn't appear to derive from the world around us, is a more objective absolute. It can be *proven*. But how can we discover these truths that exist independent of us?

Mathematicians rely on intuition to build up the entirety of their discipline from first principles. Mathematics is founded on inherent fundamental truths, called axioms, to use the vernacular. For example, one of the basic truths of Euclidian geometry holds that "parallel lines do not cross." By the very definition of the word "parallel," we can all consent to this. When we see railroad tracks converging at the horizon, no one believes that the rails ever meet as they appear to.

From these first instinctive truths, mathematicians apply simple rules for deducing theorems, which are nothing but new truths constructed from the old. This process is what mathematicians call proof and in this way, mathematicians can even definitively derive that 2+2=4. Proof always uncovers truths.

At the turn of the 20th century, it was the stated goal of mathematics to discern every mathematical truth imaginable through this bottom-up approach. In 1931 a young logician named Kurt Gödel powerfully demonstrated that this ambition was impossible to realize. Gödel disproved the idea that what is true is provable. Truth still existed, but no matter how hard one tried there would always exist propositions whose truth was indeterminable. Some theorems could be true or false, but one could never prove them either way beginning from the axioms, no matter how many we began with.

Mathematics, though built up from basic intuition, is constructed through a system of increasing abstraction divorced from immediate reality. In that way, Gödel's theorem may be nothing more than a proof of the limits of math's own abstraction. But mathematicians did not quit their jobs because of Gödel, nor do scientists stop chasing after truth though they may never completely attain it.

Where do these apparent deficiencies leave the pursuit of truth? Is humanity's endeavor to know truth in vain? Could it be we are just too human to ever know something as majestic as absolute truth?

Fortunately, there are other ways to the truth. Mathematicians and physicists (along with artist and poets) maintain another oft-stated, instinctive faculty for sensing where truth may lie. Consider string theory, for example. String theory is physicists' vogue attempt to explain the entirety of the universe at its most basic level, to reach the fundamental truth. But critics have derided the theory's proponents for doing little more than beautiful, difficult mathematics with no input from experimentation. As theory has outrun its connection with the real world intuition has stepped in and physicists now rely on a more subjective guide—that of beauty (or elegance, or symmetry). Often evoked as an illuminative principle when a way forward is not readily apparent or when the truth is indeterminable, beauty may now be the sole guide for string theorists. String theorists certainly claim to be following the scientific method, but only when observation catches up with their instincts will it be completely accepted as hard science. That doesn't mean that physicists give up in the meantime—they simply look for other cues.

Indeed, the human brain is an incredibly malleable organ when it comes to recognizing truth. Some philosophers have argued that this is because pursuing truth is an adaptation. We have been naturally selected to be curious about the world and gather knowledge from our experiences in it. Through millennia of trial and error, we have obtained the capacity to reason in ways that would not only help us survive, but would also help us to prosper. Though it is difficult to fathom that any of us has the innate ability to, for example, understand quantum mechanics because of our experiences or those of our forebears, the fact is that we are probably hardwired to do exactly that. Just as we likely have some inbred endowment for language, so do we have several natural instincts for knowing truth—of which beauty is just one. A sense of truth, it seems, is inherent in our very make-up.

Scientists may not have access to ultimate truth, but no one may lay claim to this absolute. Scientists know their own limitations and those of their discipline, and that is what allows science to move forward.

The scientific method—rational thinking based in observation and prediction—is certainly the best tool humans have for discerning facts of the world in its rigor, even if it doesn't necessarily grant us access to truth, the universal. If anything, that only makes the scientific method more trustworthy. Its utility, *despite* its limitations, earns it our trust. For those of us who believe in an independent reality, few can profess to come so near to truth, in any form, as thoroughly and consistently as science. Unfortunately, it is because of many people's elementary misunderstanding of scientific truth, these very claims are still being made. Climate change has reached the U.S. Supreme Court, and detractors decry science's methods and the consensus that has coalesced around the issue. Likewise, proponents of intelligent design have tried to hide their religious convictions under the guise of science to gain inclusion in the nation's school curricula.

The pursuit of truth is human, and scientists are simply one group who heed this evolutionary call in their chosen profession. Scientists may not have access to ultimate truth, but no one may lay claim to have this absolute. Scientists know their own limitations and those of their discipline, and that is what allows science to move forward. The scientific method stands as an illuminating model for how to proceed with honesty and rationality. Science will always have this to offer us. We demand truth from our public figures and loved ones, and it is this that gives our shared humanity strength. With science and rationality behind us, we can only be stronger. ∞