

The following excerpt from "The End of Philosophy," Chapter Two of John Horgan's 1996 book *The End of Science*, is based on Horgan's interview of Kuhn.

The Structure of Thomas Kuhn

"Look," Thomas Kuhn said. The word was weighted with weariness, as if Kuhn was resigned to the fact that I would misinterpret him, but he was still going to try--no doubt in vain--to make his point. Kuhn uttered the word often. "Look," he said again. He leaned his gangly frame and long face forward, and his big lower lip, which ordinarily curled up amiably at the corners, sagged. "For Christ's sake, if I had my choice of having written the book or not having written it, I would choose to have written it. But there have certainly been aspects involving considerable upset about the response to it."

"The book" was *The Structure of Scientific Revolutions*, which may be the most influential treatise ever written on how science does (or does not) proceed. It is notable for having spawned the trendy term "paradigm." It also fomented the now trite idea that personalities and politics play a large role in science. The book's most profound argument was less obvious: scientists can never truly understand the "real world" or even each other.

Given this theme, one might think that Kuhn would have expected his own message to be at least partially misunderstood. But when I interviewed Kuhn in his office at the Massachusetts Institute of Technology (of all places) some three decades after the publication of *Structure*, he seemed to be deeply pained by the breadth of misunderstanding of his book. He was particularly upset by claims that he described science as irrational. "If they had said 'arational' I wouldn't have minded at all," he said with no trace of a smile.

Kuhn's fear of compounding the confusion over his work had made him a bit press shy. In fact, when I first telephoned him to ask for an interview, he turned me down. "Look. I think not," he said. He revealed that *Scientific American*, my employer, gave *Structure* "the worst review I can remember." (The squib was indeed dismissive; it called Kuhn's argument "much ado about very little." But what did Kuhn expect from a magazine that celebrates science?) Pointing out that I had not been at the magazine then--the review ran in 1964--I begged him to reconsider. Kuhn finally, reluctantly, agreed.

When we finally sat down together in his office, Kuhn expressed nominal discomfort at the notion of delving into the roots of his thought. "One is not one's own historian, let alone one's own psychoanalyst," he warned me. He nonetheless traced his view of science to an epiphany he experienced in 1947, when he was working toward a doctorate in physics at Harvard. While reading Aristotle's *Physics*, Kuhn had become astonished at how "wrong" it was. How could someone who wrote so brilliantly on so many topics be so misguided when it came to physics?

Kuhn was pondering this mystery, staring out his dormitory window ("I can still see the vines and the shade two thirds of the way down"), when suddenly Aristotle "made sense." Kuhn realized that Aristotle invested basic concepts with different meanings than modern physicists did. Aristotle used the term "motion," for example, to refer not just to change in

position but to change in general--the reddening of the sun as well as its descent toward the horizon. Aristotle's physics, understood on its own terms, was simply different from rather than inferior to Newtonian physics.

Kuhn left physics for philosophy, and he struggled for 15 years to transform his epiphany into the theory set forth in *The Structure of Scientific Revolutions*. The keystone of his model was the concept of a paradigm. Paradigm, pre-Kuhn, referred merely to an example that serves an educational purpose; amo, amas, amat, for instance, is a paradigm for teaching conjugations in Latin. Kuhn used the term to refer to a collection of procedures or ideas that instruct scientists, implicitly, what to believe and how to work. Most scientists never question the paradigm. They solve "puzzles," problems whose solutions reinforce and extend the scope of the paradigm rather than challenging it. Kuhn called this "mopping up," or "normal science." There are always anomalies, phenomena that the paradigm cannot account for or that even contradict it. Anomalies are often ignored, but if they accumulate they may trigger a revolution (also called a paradigm shift, although not originally by Kuhn), in which scientists abandon the old paradigm for a new one.

Denying the view of science as a continual building process, Kuhn held that a revolution is a destructive as well as a creative act. The proposer of a new paradigm stands on the shoulders of giants (to borrow Newton's phrase) and then bashes them over the head. He or she is often young or new to the field, that is, not fully indoctrinated. Most scientists yield to a new paradigm reluctantly. They often do not understand it, and they have no objective rules by which to judge it. Different paradigms have no common standard for comparison; they are "incommensurable," to use Kuhn's term. Proponents of different paradigms can argue forever without resolving their basic differences because they invest basic terms--motion, particle, space, time--with different meanings. The conversion of scientists is thus both a subjective and political process. It may involve sudden, intuitive understanding--like that finally achieved by Kuhn as he pondered Aristotle. Yet scientists often adopt a paradigm simply because it is backed by others with strong reputations or by a majority of the community.

Kuhn's view diverged from Popper's in several important respects. Kuhn (like other critics of Popper) argued that falsification is no more possible than verification; each process implies the existence of absolute standards of evidence, which transcend any individual paradigm. A new paradigm may solve puzzles better than the old one does, and it may yield more practical applications. "But you cannot simply describe the other science as false," Kuhn said. Just because modern physics has spawned computers, nuclear power and CD players does not mean it is truer, in an absolute sense, than Aristotle's physics. Similarly, Kuhn denied that science is constantly approaching the truth. At the end of *Structure* he asserted that science, like life on earth, does not evolve toward anything but only away from something.

Kuhn described himself to me as a "post-Darwinian Kantian." Kant, too, believed that without some sort of a priori paradigm the mind cannot impose order on sensory experience. But whereas Kant and Darwin each thought that we are all born with more or less the same, innate paradigm, Kuhn argued that our paradigms keep changing as our culture changes. "Different groups, and the same group at different times," Kuhn told me,

"can have different experiences and therefore in some sense live in different worlds." Obviously all humans share some responses to experience, simply because of their shared biological heritage, Kuhn added. But whatever is universal in human experience, whatever transcends culture and history, is also "ineffable," beyond the reach of language. Language, Kuhn said, "is not a universal tool. It's not the case that you can say anything in one language that you can say in another."

But isn't mathematics a kind of universal language? I asked. Not really, Kuhn replied, since it has no meaning; it consists of syntactical rules without any semantic content. "There are perfectly good reasons why mathematics can be considered a language, but there is a very good reason why it isn't." I objected that while Kuhn's view of the limits of language might apply to certain fields with a metaphysical cast, such as quantum mechanics, it did not hold in all cases; for example, the hypothesis that AIDS is not caused by the so-called AIDS virus is either right or wrong; language is not the crucial issue. Kuhn shook his head. "Whenever you get two people interpreting the same data in different ways," he said, "that's metaphysics."

So were his own ideas true or not? "Look," Kuhn responded with even more weariness than usual; obviously he had heard this question many times before. "I think this way of talking and thinking that I am engaged in opens up a range of possibilities that can be investigated. But it, like any scientific construct, has to be evaluated simply for its utility--for what you can do with it."

But then Kuhn, having set forth his bleak view of the limits of science and indeed of all human discourse, proceeded to complain about the many ways in which his book had been misinterpreted and misused, especially by admirers. "I've often said I'm much fonder of my critics than my fans." He recalled students approaching him to say, "Oh, thank you Mr. Kuhn for telling us about paradigms. Now that we know about them we can get rid of them." He insisted that he did not believe science is entirely political, a reflection of the prevailing power structure. "In retrospect, I begin to see why this book fed into that, but boy, was it not meant to, and boy, does it not mean to."

His protests were to no avail. He had a painful memory of sitting in on a seminar and trying to explain that the concepts of truth and falsity are perfectly valid, and even necessary--within a paradigm. "The professor finally looked at me and said, 'Look, you don't know how radical this book is.'" Kuhn was also upset to find that he had become the patron saint of all would-be scientific revolutionaries. "I get a lot of letters saying, 'I've just read your book, and it's transformed my life. I'm trying to start a revolution. Please help me,' and accompanied by a book-length manuscript."

Kuhn declared that, although his book was not intended to be pro-science, he is pro-science. It is the rigidity and discipline of science, Kuhn said, that makes it so effective at problem-solving. Moreover, science produces "the greatest and most original bursts of creativity" of any human enterprise. Kuhn conceded that he was partly to blame for some of the anti-science interpretations of his model. After all, in *Structure* he did call scientists committed to a paradigm "addicts"; he also compared them to the brainwashed characters in Orwell's 1984. Kuhn insisted that he did not mean to be condescending by using terms

such as "mopping up" or "puzzle-solving" to describe what most scientists do. "It was meant to be descriptive." He ruminated a bit. "Maybe I should have said more about the glories that result from puzzle solving, but I thought I was doing that."

As for the word "paradigm," Kuhn conceded that it had become "hopelessly overused" and is "out of control." Like a virus, the word spread beyond the history and philosophy of science and infected the intellectual community at large, where it came to signify virtually any dominant idea. A 1974 *New Yorker* cartoon captured the phenomena. "Dynamite, Mr. Gerston!" gushed a woman to a smug-looking man. "You're the first person I ever heard use 'paradigm' in real life." The low point came during the Bush administration, when White House officials introduced an economic plan called "the New Paradigm" (which was really just warmed-over Reaganomics).

Kuhn admitted, again, that the fault was partly his, since in *Structure* he had not defined paradigm as crisply as he might have. At one point paradigm referred to an archetypal experiment, such as Galileo's legendary (and probably apocryphal) dropping of weights from the Leaning Tower of Pisa. Elsewhere the term referred to "the entire constellation of beliefs" that binds a scientific community together. (Kuhn denied, however, that he had defined paradigm in 21 different ways, as one critic has claimed.) In a postscript to later editions of *Structure*, Kuhn recommended that paradigm be replaced with the term "exemplar," but it never caught on. He eventually gave up all hope of explaining what he really meant. "If you've got a bear by the tail, there comes a point at which you've got to let it go and stand back," he sighed.

One of the sources of *Structure's* power and persistence is its profound ambiguity; it appeals to relativists and to science worshippers alike. Kuhn himself acknowledged that "a lot of the success of the book and some of the criticisms are due to its vagueness." (One wonders whether Kuhn's style is intended or innate; his speech is as profoundly tangled, as suffused with subjunctives and qualifiers, as his prose.) *Structure* is clearly a work of literature, and as such it is subject to many interpretations. According to literary theory, Kuhn himself cannot be trusted to provide a definitive account of his own work. Here is one possible interpretation of Kuhn's text, and of Kuhn. Kuhn focuses on what science is rather than on what it should be; he has a much more realistic, hard-nosed, psychologically accurate view of science than Popper. Kuhn realizes that, given the power of modern science and the tendency of scientists to believe in theories that have withstood many tests, science may well enter a phase of permanent "normalcy," in which no further revolutions, or revelations, are possible.

Kuhn thus accepted, as Popper could not, that science might not continue forever, even in a normal state. "There was a beginning to it," Kuhn said. "There are lots of societies that don't have it. It takes very special conditions to support it. Those social conditions are now getting harder to find. Of course it could end." Science might even end, Kuhn said, because scientists cannot make any further headway.

Kuhn's recognition that science might end—leaving us with what Charles Saunders Peirce had defined as the "truth" about nature—made it even more imperative for Kuhn than for Popper to challenge science's authority, to deny that science can ever arrive at absolute

truth. "The one thing I think you shouldn't say is that now we've found out what the world is really like," Kuhn said. "Because that's not what I think the game is about."

Kuhn has tried, throughout his career, to remain true to that original epiphany he experienced in his dormitory at Harvard. During that moment Kuhn saw--he knew!--that reality is ultimately unknowable; any attempt to describe it obscures as much as it illuminates. But Kuhn's insight forced him to take the untenable position that because all scientific theories fall short of absolute, mystical truth, they are all equally untrue. Because we cannot discover The Answer, we cannot find any answers. His mysticism leads him toward a position as absurd as that of the literary sophists who argue that all texts--from *The Tempest* to an ad for a new brand of vodka--are equally meaningless, or meaningful.

At the end of *Structure*, Kuhn briefly raised the question of why some fields of science converge on a paradigm while others, art-like, remain in a state of constant flux. The answer, he implied, was a matter of choice; scientists within certain fields were simply unwilling to commit themselves to a single paradigm. I suspect Kuhn avoided pursuing this issue further because he could not abide the answer. Some fields, such as economics and other social sciences, never adhere to a paradigm because they address questions for which no paradigm will suffice. Fields that achieve consensus, or normalcy, to borrow Kuhn's term, do so because their paradigms correspond to something real in nature, something true.