REFERENCE FRAME

What's Wrong with this Sustaining Myth?

N. David Mermin

I have a colleague who goes around declaring that the laws of physics require consciousness to cease with the death of the body. What he really means is that although he has no idea what underlies the phenomenon of consciousness, he can't imagine it's more than an extremely subtle manifestation of physiological processes that come to a halt when the body does. I'd be inclined to agree if he'd put it that way, but he doesn't. He insists on saying "Science has shown it," which I take to be shorthand for "Stop thinking and believe me." He invokes "science" as a blessing to sanctify what he says, or as a club to beat into submission those he disagrees with.

The public should be warned about such abuses of the name of science, and two sociologists, Harry Collins and Trevor Pinch, have set out to do that. "What everyone should know about science" is the subtitle of *The Golem,* their award winning book of essays (Cambridge U. P., 1993). Written "for the general reader who wants to know how science really works and to know how much authority to grant to experts," it is a central text in a growing controversy between scientists and those who study science. Collins and Pinch take as their image for science the mythical golem, a "lumbering fool who knows neither his own strength nor the extent of his clumsiness and ignorance . . . not an evil creature, but a little daft." Their aim is to explain "what actually happens" in science. Prepare, they enjoin the reader, "to learn to love the bumbling giant for what it is."

This is a fine goal. Scientists who set themselves up as sorcerers are a menace to the public and to science itself. People ought to have a better idea of what science can and cannot do. Unfortunately, however, though there are many fascinating tales about science in *The Golem*, Collins and Pinch infer from these studies a seriously deficient picture of the scientific enterprise. Here are some typical conclusions:

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1. "Scientists at the research front cannot settle their disagreements through better experimentation, more knowledge, more advanced theories, or clearer thinking."
2. "The truth about the natural world [is] what the powerful believe to be the truth about the natural world."
3. Scientists "have, of course, their special area of expertise, the physical world, but their knowledge is no more immaculate than that of economists, health policy makers, police officers, legal advocates, weather forecasters, travel agents, car mechanics, or plumbers."

One could, of course, interpret these conclusions as virtually self-evident. The first merely characterizes the research front, that boundary between known and unknown, where disagreement among scientists is the order of the day. When disagreements are settled we are no longer at the research front. The second is valid because if the powerful in science persisted in believing what was false about the natural world, they would soon cease to be powerful. The third is a warning about people who wave the wand of Science to waft away opinions they do not share, and it is an injunction to respect the knowledge of all experts within their spheres of competence. On the whole, however, Collins and Pinch have something different in mind: "Science works the way it does not because of any absolute constraint from Nature, but because we make our science the way that we do."

The Golem is full of such declarations. Their collective import is this: It is naive to think that the aim of our enterprise is to discover things about nature or to frame concepts that capture important features of the world. What we are actually doing is constructing a consensus among our fellow investigators. Ours is one of the most effective processes of consensus building ever achieved, and one of the aims of sociology is to learn why it works so well. You and I may think it works because, by a long and arduous process, scientists have become better and better at formulating questions that extract useful information from the natural world while avoiding questions that lead nowhere. This view is an expression of our naive realism, but it is important that we believe it. The conviction that we are trying to learn an objective truth is a powerful sustaining myth that drives us onward in our efforts at consensus building.

If this sounds absurd to you, consider: Scientists do, in fact, build consensus out of disagreement by a social process. How could it be otherwise? Consensus is a social phenomenon. The notion that this is the whole story—that all we are doing is exercising our exceptional skills at coming to agreement—is a sustaining myth for sociologists. It leads them to reject facile explanations of how scientific controversies come to an end, and to examine more thoroughly the actual process by which we come to agree that "the truth of the matter" has been established.

The pertinent issue in assessing the claims of *The Golem* is not whether scientific truth is determined by constraints from nature or by social construction, but whether Collins and Pinch strike a satisfactory balance between these two aspects of the process. I believe their book furnishes an instructive demonstration of what can go wrong if you focus too strongly on the social perspective. By paying insufficient attention to how nature does constrain us, Collins and Pinch draw lessons about the building of scientific consensus that leave out an essential part of that process.

The authors of *The Golem* know, as do you and I, that much of what one reads about "scientific method" bears little relation to what actually happens. We rarely proceed by framing a hypothesis and devising an experiment to test it, rejecting the hypothesis if the test is not passed. This is a cartoon version of what we do. Our under-

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standing may be too uncertain to frame a clear-cut test, our interpretation of experiments depends strongly on the conceptual context in which they were designed, and our data are often ambiguous and susceptible to a wide range of explanations, many of which have little or nothing to do with what the experiment was intended to probe.

Collins and Pinch illustrate this with case studies from a variety of disciplines. But although they provide many demonstrations that cartoon science is a fiction, they leap directly from there to strong statements about the social construction of scientific truth, without inquiring further into what features of naive realism the cartoon might have left out. In their case studies, they typically follow a chain of difficult experiments intended to address a certain constellation of questions, noting the successes, the failures, the ambiguities, the disputes, going on for months, years, even decades. They find that even while the struggle rages, while doubts are still unresolved, a broad consensus can emerge about the issues that originally gave rise to those experiments. "It is always thus," they conclude, "science works by producing agreement among experts. . . . Experiments in real science hardly ever produce a clear-cut conclusion—that is what we have shown. . . . The mess [is] not allowed to be the message. At the end triumphalism rule[s]." This triumph of triumphalism is not confined to textbook oversimplifications, Nobel prize citations or newspaper interviews. The claim of *The Golem* is that it lies at the very heart of the scientific enterprise.

Every case study in *The Golem* supports this picture of experimental studies plagued by conflict and ambiguity, and I'm sure most of us could write comparable case studies based on our own experience. Why indeed does the scientific community nevertheless often reach firm agreement on a question, long before a difficult experiment designed to explore it has come close to a definitive conclusion? Are we really just experts at negotiating myths? Or could something else be going on?

Read these essays. I think you will find the answer to be obvious (though I doubt it will be to the lay reader). Agreement is reached not just because scientists are so very good at agreeing to agree. It is reached because many other things have been going on that Collins and Pinch have said nothing about—things outside the scope of their study. Even first-class studies of episodes in the history of science can't cover all parallel activities at the same level of scholarly detail. Furthermore, if attention were redirected toward a different set of related questions and experiments, those too might well provide another case study supporting the same view of how science operates. To a first approximation, it is "always thus" because even though many clues in a complex network of evidence will always be far from definitive, the probability of a conclusion supported by a multitude of interlocking mutually reinforcing clues can still be close to certainty.

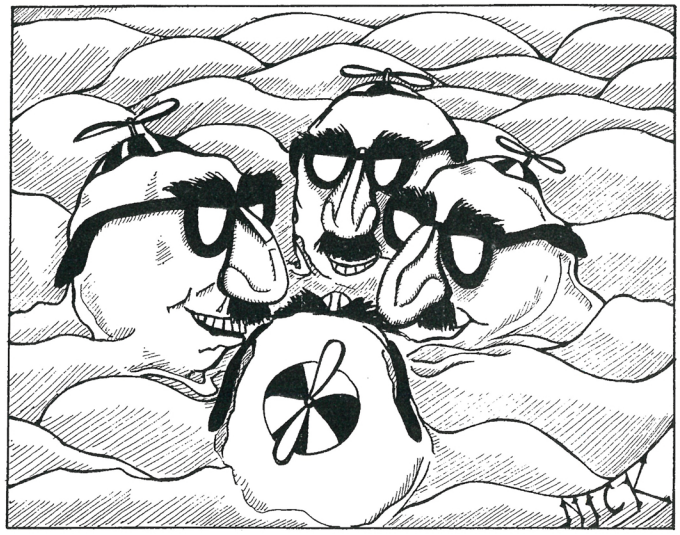
I don't have to elaborate on this for readers of PHYSICS TODAY, but the point ought to be made more extensively to "the general reader who wants to know how science really works." The method of Collins and Pinch is to follow one strand of an enormous tapestry of fact and analysis. They note that the strand is quite thin in places. Often they can demonstrate that the contribution of that particular thread to the whole picture has been greatly exaggerated. But they pay only perfunctory attention to everything else that holds the tapestry together. They never acknowledge that an enormous multiplicity of strands of evidence, many of them weak and ambiguous, can make a coherent logical bond whose strength is enormous. On the few occasions when they hint at this, the resulting consensus is nevertheless attributed not to reason, but to internal politics.

Collins and Pinch are smart people and they have some fascinating stories that they tell very well. They say they love science, they know a lot about it and they may be starting to have a serious effect on how people think about it. But their own sustaining myth of the social construction of scientific truth has lulled them into finishing their case studies with an incomplete story of how science acquires knowledge about the world. By focusing exclusively on individual threads, they have produced a picture of "what actually happens in science" that overlooks the crucial role played by the intricate structure of the whole interconnected tapestry.

The view of science that emerges from this oversight is succinctly expressed in the fable with which Collins and Pinch conclude *The Golem*. A class of children—"a microcosm of frontier science"—all try to measure the boiling point of water. In the last ten minutes of the lesson, the teacher collects their disparate results and, without performing the experiment herself, persuades the children that "their experiment has proved that water boils at exactly 100 C." And, Collins and Pinch explain to their general reader, "that ten minutes illustrates better the tricks of professional frontier science than any university or commercial laboratory. . . . Eddington, Michelson . . . are [the schoolchildren] with clean white coats and 'PhD' after their names. . . . There are theorists hovering around, like the schoolteacher, to explain and try to reconcile. In the end, however, it is the scientific community (the head teacher?) who brings order to this chaos, transmuting the clumsy antics of the collective Golem Science into a neat and tidy scientific myth."

That, the general reader is told at the end of *The Golem*, is "most of what there is to know about the sociology of science."

In next month's "Reference Frame," I'll examine how *The Golem* treats a subject we all know something about, the theory of relativity, to illustrate how Collins and Pinch go about constructing such a case. ■



At a resolution of 10^{-24} meters, isolated clumps of strange matter pop briefly out of the quantum foam to debate the possible existence of particle physicists.