"The Golem: what everyone should know about science"
by Harry Collins and Trevor Pinch
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Most of us probably think we know pretty well what to expect from a book subtitled "what everyone should know about science"; in this case, we would be dead wrong. Of course, since that expectation has little to do with golems, perhaps we should not be too surprised. Collins and Pinch are among the leading practitioners of the field generally known as "sociology of scientific knowledge," or SSK. This discipline examines science from the point of view that truths are accepted, controversies resolved, and knowledge created, not by any logically rigorous "scientific method," but rather by social factors.

To support their viewpoint, Collins and Pinch present seven case studies of controversy in science, varying widely by topic as well as outcome. An excellent illustration is provided by one that might not occur to many contemporary scientists as particularly controversial: the roles of the Michelson-Morley experiment and the Eddington observations of stellar displacement during an eclipse in "proving" the theory of relativity. In the first, complications by various factors that could have caused the observed negative result — no dependence on direction of the speed of light — could not be rigorously excluded. Furthermore, another scientist subsequently obtained a positive result (for which he received a prize from the AAAS in 1925)! Similarly, in the eclipse studies, some of the results gave deflections compatible with Einstein's prediction, while others were more consistent with classical Newtonian physics. The experiment was announced as confirming Einstein, though; the latter set of results was assumed to be of poorer quality and ignored.

From this and other studies — including episodes such as Pasteur's rejection of spontaneous generation of life, chemical transfer of memory, gravity waves, and cold fusion — Collins and Pinch conclude that there are no rigorous

criteria available by which to judge the validity of an experiment and the resulting implications. Instead, such judgment is inextricably bound up with what one already believes: "relativity....is a truth which came into being as a result of decisions about how we should live our scientific lives....a truth brought about by agreement to agree about new things. It was not a truth forced on us by the inexorable logic of a set of crucial experiments."

The chapter on gravity waves introduces the key concept of the "experimenter's regress," A novel experiment gives a certain result, but is it a good experiment? A good experiment would give the correct result — but until we've carried out such an experiment, we don't know the correct result! Hence, the authors argue, it is impossible to resolve a disagreement by any rigorous experimental criteria. Thus in their view of the cold fusion controversy, choosing to favor Pons and Fleischmann's positive results or Nate Lewis' negative ones can only be based, ultimately, on whether or not we believe in cold fusion; a dispassionate assessment of the experiments cannot be reached.

Collins and Pinch do challenge us to think about scientific research in ways that are probably rather new to most of us. Nonetheless, it is hard to see that they have even come close to justifying such sweeping conclusions, summed up as: "we have shown that scientists at the research front cannot settle their disagreements through better experimentation, more knowledge, more advanced theories, or clearer thinking." The support for the theory of relativity described above may not have been completely unambiguous, but additional results that Collins and Pinch call "mutually reinforcing" have left no doubt even in their minds about its truth. Isn't that a good example of settling a disagreement through better experimentation and all the rest?

As for the experimenter's regress, again they go too far. It <u>is</u> in fact often possible to assess the validity of an experiment free from any straitjacket of belief. To take an extreme case, in evaluating the failure to observe a signal one might discover that the apparatus had not been plugged in. Some of the mistakes made by cold fusion researchers were not much less egregious! I would imagine that most readers familiar with the cold fusion story to any degree of detail will disagree strongly with the statement "In cold fusion we find science as normal."

Should scientists read this book? It's not obvious that Collins and Pinch think so: "this view of science....should make very little difference to the way scientists act when they are doing their work at, metaphorically speaking, the laboratory bench." It seems to me that better sensitivity to when and where social factors enter into scientific practice could well have a positive effect on scientific progress. Collins and Pinch, on the other hand, believe that these factors are ubiquitous and inescapable, and that understanding the social view of science might even be detrimental to scientists — perhaps like the centipede who can't walk when he thinks about how he does it? It seems paradoxical but almost inevitable that, having disagreed with so many of their conclusions, I would also contest the low value for scientists that they seem to have placed on their work. In any case, the book amply satisfies one key criterion for recommendation: it's fun to read.

What about the use of "golem" as title and central metaphor for science? The golem, a creature of early Jewish legend, was a clumsy monster, superhuman in physical strength but subhuman in intelligence. The implication is that science bumbles about its business, settling on answers more or less at random, and never learning from its experience how to do things better. In fact, Collins and Pinch have chosen the wrong legendary figure. What they do show clearly is that science is not Superman — it doesn't leap tall problems with a single bound, but follows an often tortuous and iterative path, affected (but not determined) by the social factors upon which they lay so much stress. For those who needed it, Collins and Pinch convincingly knock down the straw man (straw Superman?) representing a perfectly rational and straightforward scientific method. The clay man of Golem science that they set in its place is far less convincing.