

Scientific Truth and Objectivity: Analytic Philosophy of Science after Kuhn.
Or
Whose side are we on?

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I. Introduction - Science Wars

If one believes the spate of recent books on the field of Science Studies, we are at war - the "Science Wars". According to some of the more conservative and polemical partisans on the science side, the Sciences are fighting for their intellectual lives against the Humanities who have been subverted by radical relativists and anti-rationalists in the form of feminists, Marxists and other social constructionists. The equally polemical partisans of the Science Studies side think this call to arms amounts to just the paranoid ranting of people who stopped reading outside their discipline in graduate school and for whom the recent cultural re-evaluation of the proper role of science in our society has led to serious self-esteem problems.

Which side are the Philosophers of Science on? Most of the people on the science side are deeply suspicious of philosophy. After all, Derrida and Foucault were philosophers. Moreover, many philosophers of science teach the work of people like Kuhn, Feyerabend, and Latour in their courses, and engage openly in critical analysis of scientific practice. In fact, most modern philosophers of science have rejected the traditional, "Logical Positivist" model of science with its emphasis on empirically derived truth and objectivity.

At the same time, many of the people on the Science Studies side are equally suspicious. Philosophy of Science has always fit more comfortably into the Analytic school of philosophy than it has in the Continental. While Continental philosophy with its roots in German phenomenology gained strength in other philosophical sub-disciplines, Philosophy of Science continued to rely (too) heavily on logic and empiricism.

I will argue that contemporary Philosophy of Science, while deeply critical of the traditional model of science as "factual" and objective, is no enemy to science. I will show that it is possible to deny that scientific theories can be justified with certainty and to deny that science, by virtue of its reliance on empirical data, has any special claim on objectivity, and still NOT be reduced to relativism and anti-rationalism. In the end, I hope that my argument also demonstrates that critical studies of science are far more complicated and important than many scientists credit them with being.

II. Truth

Traditionalists about science base their conviction that science gives us a true account of the universe on the empirical nature of the "scientific method". Scientists deal in "facts". Many a scientist has come to regret this simple-minded understanding of scientific methodology. It's this way of thinking about science that leads some benighted individuals to argue that we shouldn't teach Evolution in school because it's, "just a theory and not a fact". The reality is that science never produces facts; at its best, science produces good theories.

The traditional model of science tied the grounds for asserting the truth of an hypothesis to our observational experience. The truth-value of particular scientific claim can be determined with certainty by testing hypotheses against observational evidence. A scientist develops an hypothesis by inductive inference from a number of discrete observations or from inferences based on other "true" theories. Good scientific hypotheses entail particular observational consequences. Scientists confirm the truth or falsity of their theories by testing - looking for the occurrence of the predicted observational consequences.

There are two basic reasons why the traditional position that science gives us facts must be rejected. First, for the traditionalist, observation served as the independent foundational justification for our theoretical claims. It turns out that observation is not independent of theory at all. All observations are dependent on some theory at some level. Humans have no direct access to perceptual data. All experience must be filtered through a set of theories or concepts (Kant called them "Categories"). At one level, these concepts determine what counts as valid observation and what counts as tainted observation. Concepts tell us what to observe. That is, they tell us what to define as object and what to define as background. We are always observing the world through a conceptual/theoretical network. Any given hypothesis is confirmed by an observation only to the extent that the concepts that make that observation possible are justified.

The second reason why the traditionalist account of scientific methodology must be rejected has its own particular name: "Underdetermination". The basic problem of Underdetermination comes in a variety of subtypes: Humean, Quinean, Duhemian; but the basic point is the same in all of them: Theories entail observational consequences, but observations do not entail particular theories.

The same observational data can be consistent with a great many theories or hypotheses. The observation that the rock falls to the ground when I release it from atop the tower would seem to confirm Newton's theory of gravity, but also Einstein's and Aristotle's. This is called Humean Underdetermination. Quine and Duhem each pointed out that testing an hypothesis always involves testing a set of auxiliary hypotheses. Testing the hypothesis that a particular disease is caused by a particular bacterium by using a microscope to look at a victim's blood involves both a theory about the causes of disease and theories about how microscopes work.

Most Philosophers of Science deny that the theory dependence of observational evidence leads necessarily to anti-realism or to relativism. Observations count as good evidence in favor of a particular theoretical claim. But, observation alone is never enough and no matter how strong the evidence, science can never prove a theory true with certainty. Fortunately, there are other sources of evidence beyond the strictly observational that indicate truth.

These additional sources of evidence do not rely on asserting a "match" between the claims made by the theory and the world itself. Instead, this evidence come from an evaluation of the internal coherence of the theory itself. Evaluating an hypothesis becomes a two-step process: We want to know whether the hypothesis is "empirically adequate"—is it consistent with our observations. Second, we want to know whether the hypothesis has certain "virtues" we think correlate with its being likely to be true. These virtues include: Simplicity, Generality, Fecundity, Entrenchment, and Testability.

If one accepts that these virtues do, in fact, correspond with truth in such a way that hypotheses that bear these virtues are more likely to be true, then one does not have to be a relativist - there is probably only one theory available at a time that is optimally acceptable.

III. Objectivity

The image of science as objective has a lot to do with our society's general high regard for science as an institution and for scientific method as a way of knowing. Traditionally, science is thought to provide us with a view of the world that is objective in at least two different senses of the term. In one sense, objectivity is bound up in questions about the truth and referential character of scientific theories. In this sense, to claim that science is objective is to claim that the account provided by science is an accurate description of the objects in the world and the relations among them as they really are. In the second sense, objectivity has to do with modes of inquiry. To claim that science is objective in this sense is to claim that the account of the world provided by science was arrived at by methods that rely on nonarbitrary and nonsubjective criteria for developing, accepting, and rejecting the hypotheses and theories that make up the view.

The traditional account of science rests the objectivity of the scientific institution on the objectivity of the scientific method. Objectivity is granted based on the theory-neutral nature of the observational data and the necessary nature on the logical relationship between hypotheses and their observational consequences. The traditional account attributes objectivity to the individual practitioner of science to the extent that he/she follows the scientific method.

The claim that the statement, "there are electrons" is objectively true because there are really electrons in the world independent of any individual scientist's beliefs about electrons is a non-starter. We do not have access to that world in order to verify whether such an object exists except through theories and concepts. In light of the theory-dependent nature of observation discussed above, this kind of objectivity must be qualified. For example, we can be certain that there is a covariance in the measurements as obtained by certain instruments of what we call the temperature and pressure of a gas. We can not be certain that pressure and temperature are real properties of real entities or that their measurement provides us with an unmediated view of the natural world. Nothing about the real world follows necessarily from the covariance of these two measurements. In a sense, what we have here is intra-theoretic objectivity—objectivity within a particular body of theory or paradigm. Thus, the status of science with respect to the first sense of objectivity is greatly altered.

Let us accept for the moment that science cannot be objective in the strong sense of the term offered in sense one above. Is it still possible for science to be objective in the second sense? One obvious alternative to appeal to an external world as a grounding for objectivity is an appeal to intersubjectivity. We do not know electrons through the agreement of any individual scientist's theory with the world as it really is, but through the intersubjective agreement of the scientists who study them. Claims about electrons are objective to the degree that the relevantly trained and interested scientists agree about them.

Unfortunately, intersubjectivity does not provide objectivity in the second sense. Science was thought to be objective in this sense to the degree that its methods for accepting and rejecting hypothesis were nonarbitrary and nonsubjective. Intersubjectivity does filter out individual bias and personal oversight. It does remove the arbitrary motivations and prejudices of individual scientist. However, intersubjectivity does not block institutional biases. It does not block, for example, the arbitrariness introduced into the system by the homogeneous training of the scientific community or of the institutional control of the publication of new ideas.

Is there no way to save scientific objectivity? Science certainly cannot be objective in the traditional sense outlined above. Philosophers of Science argue that objectivity can be saved if we alter the way we conceive of science. Under both the traditional account, science is seen as the applications of a particular set of rules to data. Both accounts of science see this as an individual activity. Adequately functioning sense organs and the capacity to reason are all that are required to science on the traditional model. The model is of individual scientist sitting in individual labs working to solve individual problems. Of course, these individuals will have to interact at some level. Principle Investigators have to interact with post-docs and grad students. Colleagues may even collaborate on particular problems. Nevertheless, the products of the scientific enterprise are seen as the products of individual people. It is Darwin's Theory of Evolution, Einstein's Theory of Relativity, and Hinesburg's Uncertainty Principal.

In order to save scientific objectivity we have to do away with both the idea that science is the applications of a set of rules to data and the idea that scientific knowledge is produced by individuals (either individual scientists or individual scientific communities). The first step is to accept that science is a "practice". Science is not just a set of methodological rules and abstractions. Science is an activity in which people engage. And science is not an activity practiced primarily by individuals, but rather by social groups within a larger social context. In other words, we need to re-conceive of science as a "Social Process".

The social nature of scientific practice has long been recognized. Three aspects of the social character of science have been traditionally recognized: One, the individual members of the scientific enterprise are dependent upon one another for the conditions under which they practice (ideas, instruments, facilities, labor, etc.) Two, initiation into the practice of science requires education and certification. One does not simply declare oneself a scientist. And third, the practitioners of science all together constitute a network of communities embedded with a larger social context. The survival and flourishing of these scientific networks depends on the larger society's valuing what they do.

Scientific knowledge is thus produced by a community and transcends the contributions of any individual or even of any sub-community within the larger community of scientific practitioners as a whole. Once hypotheses are developed, what will ultimately become scientific knowledge is produced collectively through the interaction of a variety of points of view. This interaction takes the form of public criticism of proposed hypotheses (peer-review and publication).

Such public criticism is of two types: evidential - based on experimental or observational concerns; and conceptual - proceeding on the basis of theoretical or metatheoretical concerns. Evidential criticism is perhaps the type we are most familiar with. Such criticisms question the degree to which a given hypothesis is supported by the evidence adduced for it, questions the accuracy, generality, and conditions of performance of the experiments and observations serving as evidence, and questions their analysis and reporting.

While the conceptual sorts of criticisms are less familiar to us, it is these criticisms that I would argue give science its objective nature. Conceptual criticisms come in three types: (1) criticisms of the soundness of a hypothesis - these are not questions about the justifiedness of the hypothetical claim, but about the soundness of status of the hypothesis as a scientific claim, and a claim worth

testing. (2) criticism of the consistency of a given hypothesis with previously accepted theory or well entrenched theories in related fields. (3) questions about the background assumptions in light of which evidence is taken as being relevant to a given hypothesis or is taken as being evidence at all. It is this ability to question the very foundational assumptions of the scientific community itself that is crucial to solving the problem of objectivity. As long as the background beliefs can be articulated and subjected to criticism from the community, they can be defended, modified, or abandoned in response to such criticism. As long as this kind of response is possible, the incorporation of hypotheses into the canon of scientific knowledge can be independent of any individual's subjective preferences. Objectivity is preserved.

Conclusion

When I began this essay I set out two goals: First, to show that contemporary philosophy of science, while deeply critical of the view of science as factual and objective in the traditional sense, has not abandoned reason or science as the appropriate practices for gaining knowledge about the world in which we live. Second, to provide an argument that might motivate scientists to take seriously some of the criticism leveled against them by those in the critical sciences studies business. I have argued that the only sense in which science can be seen as objective is in the sense that science is a public practice in which communities engage and which involves open criticism of the very conceptual foundations of that practice. This conception of objectivity does not require that the scientific community alter its basic assumptions and background beliefs just because the larger society raises questions about those assumptions and beliefs. In fact, understanding is enhanced and science is strengthened if the community can defend itself against criticism. What is required is that the scientific community listen to and engage in the critical discussion taking place between knowledgeable members of the society in which it is embedded and that the assumptions that govern their group activity remain logically sensitive to that discussion.