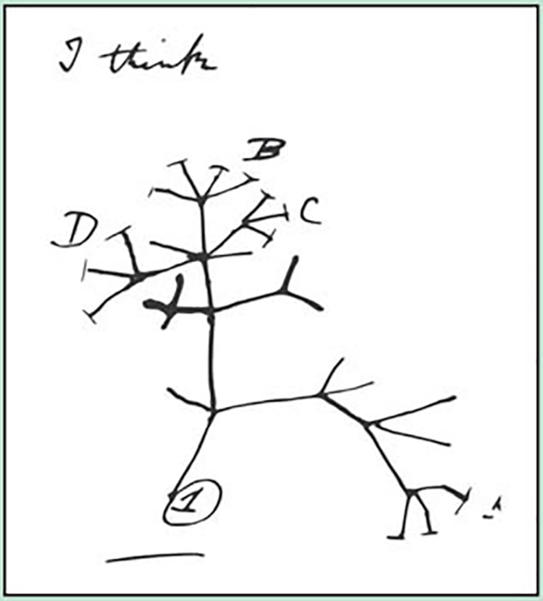
HOW KNOWLEDGE GROWS

The Evolutionary Development of Scientific Practice



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for Philip Kitcher, veteran

Contents

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Introduction

Is it possible to say anything general about the nature of scientific inquiry? Thomas S. Kuhn thought so. Sixty years ago, he argued in *The Structure of Scientific Revolutions* that there were three properties exhibited by intellectual communities that achieve consensus. The first is that these communities coalesce around their members' embrace of an intellectual achievement of unprecedented magnitude, one that members subsequently use as a framework for guiding the smaller-scale research questions and methods with which they concern themselves. The second feature of such communities is that their use of this framework takes on a normative character, in that it encourages them to discriminate against ideas—ideas, say, about nature, or about how to investigate it—that differ significantly from those that are widely accepted by community members. The third is that these communities tend to isolate themselves intellectually from other fields of inquiry and from broader social concerns. The possession of these properties, he argued, tends to produce a characteristic historical pattern displayed by the development of scientific knowledge.

How general are these properties across the different branches of modern science? Kuhn believed that they were in some sense (probably for historical reasons) idiosyncratic to the natural sciences, but that one can find these properties instantiated by premodern intellectual communities—"schools" of philosophy, theology, and so on (Kuhn 1962b, 166). Commentators have alleged that his general image of science was essentially extracted from the tradition of physics in which he was trained (Hacking 2012); or maybe even just the period of physics leading up to World War II (Galison 2016). When we look at the many other fields of inquiry that clearly qualify as science, they often seem to bear little resemblance to the image of science by which Kuhn came to be possessed.

Even though the style of scientific inquiry that he described might have been peculiar to prewar physics, I still think there is an important generality lurking here, one that Kuhn understood clearly but that I do not think has been given sufficient attention. What Kuhn seems to have grasped was that the development of intellectual communities often exhibits a certain historical pattern, and that a community's propensity to exhibit that pattern is a function of the degree to which it possesses the three properties mentioned above. Intellectual communities like prewar physics and classical theology—communities that exemplify what it is like for a group to possess those properties to a high degree—fit that historical pattern very well indeed. Many scientific communities do not possess these properties in abundance. Consequently, their development tends not to proceed in quite the manner Kuhn describes. The relevant generalization, then, is one that holds between the degree to which an intellectual community possesses these properties and its propensity to develop in a certain way.

The interesting thing about this suite of properties is that it is precisely the one that determines a biological population's degree of susceptibility to modification by natural selection. Populations that possess in high degrees biological versions of the properties identified by Kuhn tend to be strongly influenced by adaptive modification through natural selection; those that do not tend to be subject to a variety of influences that do not necessarily improve a population's fit with its environment. Equally interesting is the fact that populations under the influence of natural selection tend to exhibit a characteristic pattern of development—a pattern that, surprisingly, closely mirrors the specific course of scientific development that interested Kuhn. Just as there are obviously significant differences across the various sciences along the dimensions he describes, different populations display differences in the kinds of variation they produce, in their exposure to forces of change that do not depend on how well designed they are for their environment, and in the degree to which offspring resemble their parents. And each of these differences contributes to differences in natural selection's influence over them.

I believe that this correspondence is not accidental. Furthermore, I believe that it helps to explain something we take to be epistemically special about scientific knowledge: its tendency to grow both in depth and in breadth. The sciences, along with other cultural endeavors, differ markedly with respect to their propensity to refine existing elements of practice, as well is in their propensity to generate new specializations, which themselves are then subject to a sustained process of refinement. These disparate propensities can be explained in terms of differences in various communities' susceptibility to modification through natural selection—differences that can, in fact, be understood as a function of the differing degrees to which those communities possess the properties that Kuhn regarded as of particular importance to a certain historical pattern of scientific development. There is something epistemically special about this pattern. Our perception that some branches of science are epistemically special is, I believe, partly informed by their instantiation of it.

This correspondence can also contribute to our understanding of why it is that some varieties of human cultural expression are sometimes able to have epistemically distinctive effects despite being the result of the efforts of epistemically compromised agents. Because social phenomena play such a pivotal role in the formation, stability, and trajectory of scientific disciplines, the disciplinary growth of knowledge has frequently been analyzed using the same principles to which we appeal in our attempts to explain other species of human social activity. To this we can add a number of general considerations that make a sociocultural approach the obvious choice for how to proceed in our efforts to understand the historical development of scientific knowledge. These include (1) that science is carried out by self-interested, fallible human beings; (2) that it is a social enterprise; and (3) that the enterprise of science is itself socially embedded in a broader cultural milieu. In addition, science is, especially in our time, powerfully positioned in society in a way that gives it a potent and widely distributed influence over our lives, significantly raising the stakes on the trajectory of scientific activity. Given that scientific investigation must necessarily be afflicted by our cognitive and moral failings, and given that it must be conducted amid all the variegated factors impinging on human life, one might naturally reject as hopelessly misguided any attempt to understand the growth of knowledge that fails to give due credit to the many cognitive impurities that have contributed to its growth. For science is, in Steven Shapin's words, "never pure" (Shapin 2010).

What is the presumed epistemic significance of the fact that science is "never pure"? More specifically, what is the fact that scientific inquiry is a product of "real people"—agents motivated by many sources, many of them nonepistemic, living in a specific place and time, and thus, subject to the modes of thought dominant in that place and time—supposed to tell us about the status and quality of scientific knowledge? The assumption behind this enormously popular approach seems to be that scientific knowledge cannot be epistemically special if its composition is sensitive to noncognitive, individualistic, and cultural influences; those are the wrong kinds of influences for a species of knowledge to have if it is claiming some kind of privileged epistemic status. And given that scientists are just as susceptible to those sorts of influences as the rest of us, scientific knowledge cannot avoid being tainted by the same epistemic impurities as other nonscientific species of knowledge, none of which we regard as epistemically distinguished in any way. There is no refuge from the contaminating effects of time, place, and human weakness. As long as scientific knowledge is "produced by people with bodies, situated in time, space, culture, and society, and struggling for credibility and authority," there can be nothing epistemically special about scientific knowledge.[1]

This critical approach to the epistemic status of scientific knowledge is an instantiation of an important epistemological principle that holds that the epistemic warrant for a belief is undermined when that belief is causally influenced by factors that we all agree should be irrelevant. A nice, albeit terrifying, illustration of this is the current trend of studies that examine affects of various irrelevancies on judges' decision-making behavior. One recent example purports to show that judges impose longer sentences on juvenile defendants after the Louisiana State University (LSU) football team loses a game that they were expected to win, and that the impact is stronger when judges have a bachelor's degree from LSU or when LSU had been ranked in the top 10 (Eren and Mocan 2018). Yikes. However strongly one might feel about LSU football, I'm sure we can all agree that the team's fortunes on any given Saturday ought not to make a difference in how long a child spends in juvenile detention (excluding the unlikely case that the child's act of delinquency caused LSU's loss). If LSU's performance does affect how judges weigh the evidence, then there is something wrong with how that evidence gets evaluated; sentencing would be better, we think, if football was not part of the equation.

When beliefs are affected by factors that are irrelevant to the well-foundedness of inferences, we tend to view those beliefs as epistemically tainted in some way—"impure," in Shapin's terms. That perception of impurity seems to increase with the influential factor's degree of irrelevance.

Football is highly irrelevant to juvenile sentencing; where one grows up is highly irrelevant to whether one's religious commitments are epistemically well founded. And herein lies the epistemic significance of the assertion that science is never pure. What if we were to discover that physicists' interpretation of climate data was just as sensitive to the LSU football team's losses as juvenile sentencing seems to be? What if we were to discover that the propensity for climatologists to agree with each other was as strongly influenced by country of origin as religious belief apparently is? Would this not cast a pall over the epistemic status of scientific knowledge, just as it does over these other phenomena? But this is just how people are. They are influenced by factors that are irrelevant to epistemic well-foundedness. The practitioners of natural science are not immune to such factors. How likely is it that R. A. Fisher would have been a devout Anglican were he to have been born and raised in Mexico? Not bloody likely!

And yet, scientific knowledge grows ever deeper and ever broader, particularly over the past 400 years. As undeniable as the fact that science is done by fallible, selfish, suggestible human beings, the historical development of scientific knowledge has trended unperturbedly toward an increasingly accurate picture of an increasingly large number of phenomena. This trend has persisted not only across many different "people with bodies," not only across differences in "time, space, culture, and society," but even across radically different conceptions of what nature is like and how it ought to be studied. The stability of the growth of scientific knowledge across so much time and so many different cultural hosts has fueled the nagging sense that there is something about modern scientific inquiry itself that makes epistemic growth inevitable. If scientific knowledge has grown despite vast differences among the scientists who contribute to it, perhaps that is because the ability of modern scientific inquiry to deepen and expand our knowledge is often just plain insensitive to variation at the level of individual scientists. Science may never be pure, but the implications of this insight are far from obvious. Often, science seems to be pure enough.

This book is one long argument for the thesis that scientific knowledge persistently grows, even across generations of highly variable groups of scientists, because the development of scientific knowledge is governed by the Darwinian process of descent with modification. Notwithstanding their many differences and failings, scientists—solely by virtue of their efforts to participate in the growth of knowledge—often form groups whose characteristics are modified in response to certain pressures and as a result of certain demographic properties. Their individual attempts to accommodate those pressures result in the unmitigated increases in breadth and depth that we have come to expect from the development of scientific knowledge.

The book's secondary ambition is to support the philosophical claim that this susceptibility to modification through natural selection is one of the things that explains the distinctive epistemic power of certain branches of modern science. If, as Kuhn averred, the peculiar historical pattern of growth displayed by some branches of science is one of the reasons that pattern should be central to our understanding of knowledge itself (Kuhn 1962b, 9), and if that pattern of growth is generated by certain branches' high degree of susceptibility to selection, then the foundation for our views about the epistemic power of science is partly grounded in the fact that its historical development is governed by the process of selection. Had those branches of modern science not been susceptible to Darwinian modification, they would not show that characteristic growth pattern, and consequently, we would not have held them in such esteem. Or so I argue in this book.

We know that scientific knowledge often develops in this way, not because individual scientists are specially endowed with unique truth-finding abilities, but because the properties that expose a group to Darwinian forces are in fact defining features of certain scientific communities. Moreover, the relevant features of these communities are precisely what historians and sociologists of science have been pleading with philosophers of science to recognize for decades as the sine qua non of knowledge production. Scientific communities possess certain cultural norms to which they hold their members. These communities exert a strong influence over the training and professionalization of future initiates. They engage in boundary policing. They reward members for contributing to scientific knowledge in community-validated ways and very rarely otherwise, and they encourage members to use these rewards as motivators. These community-level properties, idiosyncratic though they may be, turn out to be exactly the sort of properties that result in the community's cross-generational stability and in the propagation and adaptive modification of practices within the community from one generation to the next.[2]

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