CHAPTER 2

What Makes Sciences "Scientific"?

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The first serious difficulty raised in the titular question of this chapter is that there does not seem to be a unified "science," in the singular. At least, "unity" ought to be operationalized as a variable, not fixed, in advance and a priori, as a constant property of the "nature" of science. Empirical research on the sciences suggests a manifest cultural, structural, and organizational disunity (Galison, 1997). There also are considerable differences between the frontiers of a science and its more routine or normal areas. Sciences change over time as well, and some of them, such as the locations where rapid discoveries are being made, change very quickly, with little respect or eye toward philosophical definitions, criteria, or rules of method.

The evidence supports the suspicion that the unity of science is a myth and exaggeration. Significantly, the mythical properties of logic and rationality also are a core theme in neo-institutionalist theories of organizations (Meyer & Rowan, 1977). They find widespread loose coupling between formal and informal systems. Similar loose coupling exists between logic and practice of a science. There are many sciences now, and new sciences or specialties emerge all the time. Worse for unity, within a science there are specialties, clusters, and research fronts that behave in ways not necessarily consonant with unity. The sciences look more like a patchwork quilt than a logically unified pyramid.

To say the sciences are historical, social, and cultural is true, but only the beginning of a problem, not its solution. Logic is a poor predictor for what an actual science does, in the here and now of its occurring and happening. What a science does is the result of its own previous operations, not its philosophy. Most active scientists are too busy to pay much attention to philosophical puzzles and enigmata. They might become more involved in philosophy once their active careers are over, or when an outside observer, such as postmodernism, appears to be saying there are no truth and objectivity in science. Major upheavals in a culture, including revolutions, also tend to generate so much uncertainty and novelty that it is hard to separate "science" from "metaphysics." A major metaphysical controversy during the Scientific Revolution opposed natural philosophers to scholastics and humanists on the question of whether *any* "contrived" experiments, that is, "the experiment as such," could ever be true to the essence of nature.

The sciences do have philosophical dimensions, but once they become "normal," they no

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longer reflect on them. To be sure, normalization and establishment need not happen and are rather unlikely, since most organizational upstarts fail due to a widespread "liability of newness" (Hannan & Freeman, 1989). However, if a science does take off toward maturity and institutionalization, it begins to forget the origins and transcendental foundations of science itself. As a science becomes more normal and mature, with a well-established and -defined niche in the world, it gradually sediments its core operations and building blocks. These become routines, hardwired into the blueprints and black boxes of a particular culture (Berger & Luckman, 1967).

Whether experiments "as such" are "true to nature" is not a problem a mature science could understand let alone turn into a viable research puzzle. Who would fund such research and how could research prove that research as such captures the essence of nature? Once doing research becomes the prevalent intellectual mode of relating to the world, metaphysics becomes obsolete and eventually disappears into academic and professional philosophy. The "truth" is now the outcome of scientific research, not metaphysics. After a while, systematic philosophy turns into naturalism, that is, global advocacy and endorsement of science.

A mature science solves the problems it has posed for itself. It does so on the basis of its previous problems and solutions. It can change these, of course, but mature and professionalized sciences do not wonder about the metaphysical or ontological foundations. They might remain skeptical, but not about themselves. The truths of a science also change, together with advances and discoveries, but as its maturity increases, so does a science's inability or unwillingness to engage in metaphysics. It no longer has a protocol for handling metaphysical mysteries, or it operationalizes these into empirically decidable propositions.

With Medawar (1963/1990), a science becomes more scientific when it has mastered the "art of the soluble." A metaphysics, in contrast, does not "solve" anything but wonders whether "solving" some problem or puzzle might not be just one way among others to practice the intellectual craft. Unlike science, a religion becomes weaker and more secular when the great mysteries disappear.

FROM PHILOSOPHICAL TO LOCAL UNITY

Call the epistemological sort of unity "strong." More in tune with recent evidence from science studies is the much weaker assumption that unity is local and temporary, the result of actual mergers or hybrids between various sciences (Shapin, 1995). This unity lasts as long as it does and extends as far as it does until further notice, that is, until the configurations of sciences and specialties change yet again. Unity is not global or transcendental, and it can be lost and found. Unity also is a matter of degree. Rarely is a unity "complete." This weaker empirical or contingent, as opposed to conceptual, unity is not the realization of philosophical analysis or reduction. Rather, it follows from the observable movements, alignments, and coalitions among the sets of networks within which science actually occurs or happens.

There is, then, no agreeable and robust philosophical criterion or set of criteria that made a science "scientific" (Laudan, 1996). Even within philosophy, the suspicion grows that the very search for such criteria might be in vain (Rorty, 1991). It turns out that such criteria change over time; they are not the same for different sciences, and what follows from them for the way an actual science assembles and reassembles itself is uncertain. No doubt there are rules of method, but they rarely lead to concise and clear proscriptions for rationality.

Troubles with rationality surface not just in science, though it is here that rationality has traditionally been placed with privilege. Rationality is not a good empirical metaphor for

action generally (Collins, 1993), and this includes the decisions scientists might make in advancing a certain project, program, or line of research.

The unity of science is an exaggeration, observed within a segment of analytical epistemology. This particular observer is placed at a large distance from where science actually gets done. Philosophy observes science from far away and from within its own networks and traditions. The farther away an observer is from a referent, the more unity that observer tends to attribute to what is being observed (Collins, 1988; Fleck, 1935/1979). Observers at a far distance depend on their observing strongly on the more or less official front stage self-presentations of that which they observe. Such presentations summarize and condense select features and data into rational versions or formats, maybe for the benefit of instruction or popularization. Move closer to an actual science, into the laboratory, and that unity dissolves into multiple clusters and networks. What happens in these networks is, at best, loosely coupled to epistemological rules and regulations, much as the informal systems in organizations separate, to a variable degree, from the official manuals, charts, and handbooks.

The closer an observer gets to the local assembly of a science, the less "consensus" is being measured. A widespread criterion for making a science scientific has been that the "harder" and more "mature" a science becomes, the more consensus it displays. This is not false, but needs modification. More consensus is being claimed than exists or can be cashed in when needed, and science is no exception (Gilbert & Mulkay, 1984). You think other reasonable people do, will, or would agree with the reasonable opinions you hold yourself. Probe deeper into consensus, however, and it tends to become brittle, fall apart, or become vague and empty, as in "universal values." Actual consensus—that is, not the quasi-transcendental fictions of Habermas and not the ideological appeals to "the people"—shrinks and expands over time and according to how concretely it specifies what is to be said and done. An empirical consensus cannot extend both its range or width and depth simultaneously. At the frontiers of a culture, where breakthroughs occur, conflict and controversy undermine consensus.

What the sciences do not have, however, is dissensus on whether it is a good thing to do science or whether it might be better to do something else instead, maybe criticism, moralizing, or the latest fad in social and cultural theory—writing about yourself. Nonsciences keep arguing and dissenting on what they are, really, and what they should do. Sciences also do not have multiple fragmentation along political or ideological cleavages, including sex and race.

A science becomes more scientific as it externalizes its outcomes to "reality," instead of attributing them to "standpoints" or "perspectives." This is the difference between science and ideology (more on this later). The more scientific a science, the more it will generate its own foci of attention and reputational structures, and the less attention it will pay to what it observes as nonscience, prescience, or pseudo-science. In turn, those non-, pre-, and pseudo-sciences either imitate or challenge and debunk science.

Some constructivists conclude from the empirical record of science studies that method, progress, cumulation, and rational reconstructions are "fictions," but this is premature and triggers misleading connotations and "science wars" (Fuchs, 1996). Confronted with critical debunkings of their core possessions, the scientists feel provoked and outraged, since their sacred symbols are being desecrated. This reaction is not particularly surprising, since any profession will respond to attacks on its front stage myths with emotionally charged vehemence. Constructivists also would rightly be upset if the integrity of their motives were being challenged. As far as they are still doing science or doing work commensurate with science, constructivists will insist that their contributions to scholarship are based on methodical and objective research, not perspectival or political biases.

To call something a "fiction" suggests unreality, maybe deception. But method and rationality are very real and they are not deceptions. Instead, they surface in certain places, at certain times, to do certain kinds of cultural work. In some areas of a science, where more routine puzzles are being solved, "method" is indeed more of an empirical presence. Method appears prominently in low-level science instruction, as well as in grant proposals or written reports of findings. Likewise, rationality appears regularly when a science is asked or invited to tell its history, which then appears as cumulative progress or, in more dramatic cases, as victory over superstition and the forces of unreason. No science "follows" rational rules of method, especially not when it is making breakthroughs, but no science can do without method and rationality on certain occasions and in certain areas of its work.

BOUNDARIES AND DEMARCATIONS

"What makes a science scientific" as opposed to different ways of knowing? This is the problem of demarcation (Ward, 1996). In philosophy, demarcation is essentialist; that is, demarcation of science from nonscience by means of separating the "nature" of scientific knowing from other ways or other cultures. Various candidates for demarcation have been suggested and dropped. These include distinctions between facts and values, subjective and objective, internal and external, and logical versus contingent. By its very nature science is objective, rational, empirical, disinterested, cumulative, and truthful. Nonscientific ways of knowing, such as religion, metaphysics, or art, are valuable forms of culture but they do not correspond to anything real, outside of themselves. Outside of science there are superstition, faith, tastes, money, or power.

Not one of these "demarcation criteria" has proven operational or successful for separating science from the rest of culture in all possible worlds. Start with the distinction of science–metaphysics. A science does have some metaphysical or paradigmatic structures in the cores of its networks, where the black boxes and routine equipment are being housed (Latour, 1987). These are metaphysical, in the sense that they are not themselves the themes, topics, and puzzles of research, at least not within the science whose "presuppositions" are in question. "Materialism" belongs to the "metaphysics" of any modern science, but no modern science could turn the truth of materialism itself into a soluble experimental puzzle. A science also could not establish by means of an experiment that experiments as such are "true to Nature."

To say science is "objective," as opposed to art, for example, is misleading as well, since there is very little objective consensus on objectivity (Fuchs, 1997). At its frontiers, where a science produces rapid breakthroughs and innovations, there is less "objectivity" than in its settled and established parts. Virtuoso performance in science and art appear phenomenally similar, colored by ecstacy, charisma, and genius (Schneider, 1993; Heinich, 1996). A science is not without "faith"; it has faith in itself and the overall soundness of its accomplishments. It trusts that more progress will be made in the very near future, as soon as the new equipment can be funded and delivered. During major upheavals and ruptures, "prophets" might appear in the history of science as well. In fact, this happens under much the same structural conditions as in the history of a religion (Spengler, 1923/1993). A science that were utterly "disinterested" would be a very poor science indeed, since an active science is very keenly interested in itself and in its continuation and expansion.

We find, then, actual sciences and cultures in unruly disregard for proper philosophical conduct and procedure. Some allegedly "subjective" arts look surprisingly objective; think of

socialist realism, with its centralized rules and regulations for politically correct art. A revolutionary science has much in common, at least in its beginning and emergence, with avant-gardes in music (Mullins, 1973). To say science is based on "observation" raises a host of difficulties as well, even within the analytical movement (Lakatos, 1970). Aristotle did a good bit of observing; there are theoretical entities and unobservables in any science; how observation relates to theory also is controversial.

AFTER PHILOSOPHY

Sociologically, demarcation criteria are not logical or analytical but empirical and temporal. They are the various empirical and therefore revisable boundary markers a culture employs to distinguish itself from that which it is not, not anymore, or not yet. All cultures perform some boundary work, and the robustness of boundaries varies together with the strength and confidence of a culture. Establishing a boundary also varies with the environment against which a specialty, network, or culture distinguishes itself. Distinctions lead to "identity" (White, 1992). This identity is not essential, constant, or written in stone. Rather, an identity is the current summary or definition of a previously accomplished identity.

A specialty with high-velocity changes its boundaries and demarcations very rapidly, without pause for philosophical reflection and solidification. When the environment of related specialties changes rapidly as well, turbulence breaks out. Weak boundaries surround specialties-in-formation; stronger boundaries signal a consolidated culture with a known and celebrated history of recognized achievements and successes. However, weak and strong are matters of degree, not principle, and the weaker might become stronger over time, or the other way around. As boundaries grow very strong and as a culture or specialty consolidates into the smooth and confident continuity of a normal tradition, its demarcations from rivals or other cultures tend to grow firmer as well, approaching analytical, definitional, and possibly tautological status (Quine, 1964). Tautologies can be found in the redundant and fortified cores of cultures and their institutions (Fuchs, 2000).

Demarcation criteria are variable distinctions an observer draws to distinguish its—not his or hers—identity from the identity of other observers. Distinctions drawn by observers run both ways; there are self-observations and observations by other observers (Baecker, 1999). When the latter happen to be rivals or competitors over a certain niche or territory, the conflicts over demarcations may heat up into intellectual property struggles. Occasionally, a specialty invades another one and conquers it without indigenous rest. Now, a local unity and new identity emerge, distinguishing itself in new ways from past identities and from the related specialties in the larger networks among specialties.

A "reduction" of one specialty or even discipline to another one occurs not as a result of some philosopher claiming to have demonstrated that one entity is really another entity, the latter being more fundamental, basic, or original than the reduced entities (Spear, 1999). Sociologically, reduction is an improbable and contingent event in the competitive relations between specialties and cultures. Reduction is an event that either happens or not. If it happens, it happens locally, not globally; that is, interdisciplinarity tends to involve a fairly small number of specialties. In some cases, "interdisciplinarity" may just be a ritualistic and fashionable buzzword the administrators, funders, and planners of science like to use, but rarely does interdisciplinarity involve more than, say, three or four disciplines, and even then, it tends to become its own discipline, complete with special institutes specializing in interdisciplinarity.

SOCIOLOGICAL PHILOSOPHY

The evidence from science studies does not resonate well with analytical philosophical criteria for what makes a theory and science truly or essentially scientific. But there might be sociological ways for distinguishing science from other cultures, ways of knowing, and nonsciences. Sociological demarcation refers to variable cultural boundaries, not essential or logical criteria. To make the step from philosophy to sociology, we need to switch to a second-order mode of observation (Luhmann, 1992). In this observational mode, the observer sociology observes how actual sciences, not philosophy of science, distinguish themselves from that which they are not, not yet, or not anymore. Sociology theorizes such distinctions as the variable cultural markers and boundaries that professions employ to lay claim to intellectual property and turf.

Avoid, again, the mistake to conclude there are no truth, objectivity, or rationality in science. Far from it. But as a second-order observer, sociology cannot simply confirm or repeat, en bloc, scientific claims to truth and objectivity. Neither, of course, can it deny them (Bloor, 1976). What is left, then, is to explore when and how truth and objectivity and progress are made to "happen" and how this is accomplished. This observational Gestalt–switch marks the transition from philosophy to sociology of science. Sociology cannot really say: That which makes a science scientific are its truth and rationality. For it has no independent way to decide anything about a science's claims to truth *other than* its own claims to truth.

Science is indeed "objective," but in a sociological, not philosophical, sense. Sociologically, objectivity is an internal accomplishment of cultures committed to objectivity. It does not fall out of the sky, but must be accomplished or not. Objectivity is contingent; it either is made to happen or not. Therefore, it has a history and semantic career (Daston, 1992). Sociologically, objectivity is not adequate representation, lack of bias, or simply the opposite of "subjective." To say objectivity is "intersubjective" comes a bit closer, but conversations and traffic signs are intersubjective as well.

Think of objectivity as a semantic currency running through certain intellectual networks. By means of this currency, the network explains to itself or an audience how it behaves, and why. In this mode of formal or official self-observation, the outcomes and results of a network are, by and large and in the long run, "objective," because they reflect actual states in the world. If they are "subjective," someone has made a mistake, and that mistake ought to be corrected, since objective is better than subjective. The subjective is "merely" so, indicating that something is lacking and amiss. The same applies to "perspectives." If a fact is objective only within a perspective, then it is not really objective, so that the idea is to overcome perspectives, not celebrate them, as happens in networks that are fragmenting into ideological politics.

Objectivity deserves trust. At first, this was trust in the honor of gentlemen (Shapin, 1994). Since these have long since departed, trust in honor has transformed into trust in reputation and procedure. This trust trusts that the scientific mistakes are generally honest, not deceptive. Deceptions are misconduct, to be investigated and sanctioned harshly, usually by ostracism from the tribe, since a sacred object has been violated (Fuchs & Westervelt, 1996).

Objectivity is the "code" that structures how the communications in the network should be handled and rewarded (Luhmann, 1992). According to the code, the contributions are generally based on solid evidence, sound research, and plausible explanations, not on sexual bias or racial prejudice. The outcomes offered are the results of research, not intuition, charismatic vision, or prophetic revelation. Or, how the insights communicated were gathered is irrelevant; what counts is whether they survived the usual tests. No reputation goes to those

offering the merely subjective or perspectival. This does not mean that the culture the network sustains were in close contact with the way the world really is; only that "objective" is the way in which recursively networked communications that cherish and institutionalize objectivity are coupled within a network. When this happens, when networks with objectivity emerge, we may get "science": "For the scientific truth is but that which *aspires* to be true only to those who want the scientific truth" (Weber, 1904/1982, p. 184).

SOCIOLOGICAL DEMARCATION

What makes a science scientific? What makes a religion religious? Search now for sociological, not philosophical, distinctions. Max Scheler (1924) leads the way. He compares the modern sciences, metaphysics, and religion as social structures and historical cultures. The modern *sciences* are organized as reputational and professional networks. Doing science is the career path for credentialed and specialist workers trained by teachers and drills or exercises. The sciences do "research," that is, they solve the puzzles they pose to themselves with their own means and devices. Research is done on soluble problems for which exists a protocol of decidability. Research is administered in projects and programs; it is organized into small and competitive specialties. The organizational nucleus of science is the laboratory or, more correctly, a network among laboratories. Laboratories are sites of controlled experiments. To do those, much equipment is needed.

A *metaphysics* surrounds a virtuoso "master." The metaphysician still belongs to generations of metaphysicians and often gathers admirers, but metaphysics is not organized as a professional work organization. When this happens nevertheless, when metaphysics becomes part of a specialist academic curriculum, metaphysics comes to an end. It dies with the likes of Nietzsche, Heidegger, Adorno, and Sartre. As Max Weber (1919/1982), who had his own metaphysical moments, predicted, there are no longer any genuine metaphysical virtuosos and masters. The remaining prophets have become "false," that is, prophethood becomes visible as being constructed and accomplished.

The closest we currently have to metaphysics is "theory," but theory is also located in institutions of specialties, so that one can specialize in it and become a "theorist." Another successor to the metaphysician is the "scholar," particularly of the humanist variety; but scholars are experts also, which means they are not experts, but amateurs, outside their particular area of expertise. The "popular intellectual" belongs in this set of heirs to metaphysics as well, although the last thing on a genuine metaphysician's mind is to become popular and commercial. The irony about popular intellectuals is that they deride those very forces that created a niche for them in the first place. There is still something metaphysical about a Habermas or Luhmann, but both praise "postmetaphysical" thinking.

As opposed to the professional philosopher, who hurries from conference to conference, the metaphysician is not comfortably at home in the contemporary university and its networks. Metaphysicians prefer solitude; Heidegger had his cabin in the Black Forest around Todtnauberg and Nietzsche fled to the mountains of Sils Maria. This does not mean the metaphysician wants to be left alone or that he or she does not like other people, only that they dislike being part of a *Betrieb*. Metaphysics is often snobbish about academic politics and elitist about popular culture or common sense. Plato preferred ideas to experiences.

Metaphysics must be "lived," not taught. In this, it behaves much like a cult. Admission to the cult resembles an initiation rite more than admission by examination or credential. The new recruits are being transformed, not educated. They participate in a Truth unavailable to non-

members. Membership does have its privileges. Metaphysics, at least in its self-understanding, is not a set of propositions or assertions that could be "tested" in some way against "the evidence." Neither does it advertise itself as one "worldview" among others. Metaphysics has no "method," or declares method to be secondary and subordinate to "substance." The substance of metaphysics are the perennial and foundational mysteries: the essence of Being, the nature of reality, or how to live the good life.

What makes a science scientific, in contrast, is its relationalism and antiessentialism (Cassirer, 1969). In a science, things are what they are because the relations and forces working on them have made them what they are. Change these relations and forces and a different thing emerges. A number, for example, is a position in a set of operations and relations among numbers. The number is defined by those relations, not by any "intrinsic meaning." In antiessentialism, a thing is nothing but a temporary balance of forces impinging on it. A thing has no intrinsic properties. There is no "thing-in-itself." All that which exists exists empirically; that is, until further notice, or until new evidence suggests something different might be the case. The sciences are against essentialism.

The metaphysician does not do "research." Work is not done in company with others, as happens in a "laboratory." Metaphysics might be part of a university and curriculum, complete with courses and exams and grades, but then metaphysics turns into a philosophy and philosophical specialty, next to other such specialties. A metaphysician has maybe followers but not really "students," in the sense of the cohorts in bureaucratic mass education. The extreme case, Nietzsche, derided those seeking followers as those seeking Zeros and Nullities. Sometimes, as in the ancient world, the sage metaphysician and his devotees share certain communal living arrangements, maybe around a patrimonial household or "academy." The master and his disciples see themselves as the long arm of a destiny or transcendence, not as intellectual workers or even "intellectuals."

Metaphysics does not aim or claim to make any "progress." To the contrary, it suspects or resents progress as the departure from a true origin, authentic life, or essential Being. In Heidegger, this is *Seyn*, as opposed to mere *Sein* and the even lesser *das Seiende*. In Nietzsche, this ultimate Truth is the *Uebermensch*, Zarathustra, and in Hegel and Marx, it is absence of alienation. Unlike any modern science, but much like a religion, metaphysics looks backward, not forward. A metaphysics may have utopian themes to it, but such utopias are often returns also.

Different metaphysics envision the Origin in different ways. It might have the form of a dialectical completion of history, as in Marx, or it might be pre-Socratic Greekhood (Heidegger), the transcendental Ego (Kant, Husserl), or the absolute Idea or Spirit (Plato, Hegel). But that which calls metaphysics into thinking are not solvable problems that disappear once they are solved, to be replaced by future problems (Heidegger, 1938/1977, 1969). Rather, the "problems" of metaphysics are mysteries. Unlike problems, mysteries are perennial and essential. They return forever, as in Nietzsche, though maybe in different guises. Metaphysical mysteries cannot be researched or experimented upon. They are holistic, not analytical, and require not methods but *Wesensschau*.

A metaphysics remains centered and focused on the identity of sages. Their metaphysics is very much *theirs* and difficult to repeat or replicate elsewhere. Even coauthorship does not resonate well with the "spirit" or thrust of metaphysics. Therefore, the death of the sage often means the death of his metaphysics as well. In contrast, a science has no such deep attachments and investments in "personality." It has its prophets and geniuses, but is never *merely* cultish, or for very long. After the metaphysical master's demise, there might be epigones and pupils carrying on the torch, but their work tends to remain derivative and focused the original. A rather late example might be Garfinkel's (1967) *Studies in Ethnomethodology*, which is close

to the metaphysics of Husserl and even Heidegger. The epigone's work tends to be confined to commentary, exegesis, or elaboration, without any novel metaphysics emerging in the process. Alternatively, the students of a metaphysical master might enter the universities and transform metaphysics into professional philosophy or research there.

As opposed to science, both metaphysics and *religion* keep remembering their foundations and origins. They do not and do not want or plan to "overcome" their foundations and origins. For, the Truth, with a capital T, is in the beginnings and origins, back when a religion and its First Prophet appeared. The life of metaphysics or religion comes from its source, and that source must be recovered, worshipped, and kept alive. The past is not just studied, as in "historical research," but brought into the present by means of hermeneutics. The passing of time represents a possible danger and threat, not a promise to unlimited progress. The danger comes from forgetting and straying away from the origin.

Both metaphysics and religion believe in essences and universals. They are nothing without "transcendence," although just what is transcendent differs from case to case. No metaphysics or religion could understand itself as just another worldview, system of thought, or ideology. They are not just empirical occurrences, but the origin of all occurrence.

Religions offer and deliver salvation, not knowledge or expertise. Religions do not do "research," although the intellectuals of a church might respond to research in various ways or even do a bit of research themselves, say on sacred texts. Even then, however, research is a subordinate and secondary part of religious and sacred practice, done not to find out something "new" but to affirm and celebrate that which is already True. The truth of a religion lies at its beginnings and ends, in an original state of bliss, and in the eventual recovery of that bliss in the Afterworld. The Truth, again with a capital T, is already known; it may have been forgotten in sin but can be regained by traveling a path to salvation. Religious officials of a church might assist in this quest, due to their special calling and closeness to the sacred.

In sharp contrast, the truth of a science is in its future, not past. Part of that which makes a science scientific is, then, the discarding and overcoming of its past. The past appears as an incomplete version and prehistory of the present. The past is something less than the present and even less than the future. Less was known then than is now or will be known; there was less reason, truth, success, and objectivity in the past. Only the past knowledge that still measures up to what is known now deserves to be preserved and only until it, too, finally becomes obsolete. A science has no developed historical sense, or turns its history into yet another science, such as history of science. A science that goes back to its origins is a dying science, running out of new discoveries to make. When it makes no further progress, a science loses its claim to more support and funds and will rather quickly succumb to the intense competition.

A science is not "foundationalist" in the way religion and metaphysics are. It does research *within* these foundations but not *on* them. This is why Heidegger (1969) suspected that science does not "think"—it does not allow thinking to turn to that which remains unthought as a science goes about its business.

Therefore, science is more "restless" and "homeless" than religion and metaphysics. A science only has the resting points and periods it makes or allows for itself, until it is ready to move on, or is pushed to move on by the competition. The periods of rest are short and idle. A science at rest for a long time is in danger of backwardness and obsolescence. Religions are calmer because salvation can surely be attained, or already has been attained. Whether or not salvation is certain cannot be decided by "research."

In modern times, the sheer tempo of scientific research accelerates spectacularly, up to a level unknown outside of the modern sciences (Price, 1986). Acceleration happens both at the rapidly moving frontiers of a science, as well as through increasing specialization and

differentiation. This makes the experts in a science amateurs in most specialties other than their own. The increased speed makes it more and more difficult to "synthesize" scientific knowledge into a comprehensive "worldview." There are still calls for cosilience and unification, but they remain at a very abstract level and are opposed by appeals to emergence and irreducibility. The scientific advances come at a much faster pace than changes in religion or metaphysics. To be sure, changes occur here as well, but no religion or metaphysics is structured so as to make discoveries and advances its regular business.

Solutions to a research puzzle in science become pieces in subsequent puzzles. A science does not come to its natural end, when all the truths converge into the Truth. Grandiose reductions to, say, particle physics are sometimes being envisioned, and this is when a science sounds most "metaphysical," but so far, reduction amounts to little more than promise (Wilson, 1998). There is no end to science, unless it is being destroyed, and there is no "final" theory, as in metaphysics, since a "final" science would put itself out of business—the business of making more progress in the future.

SOME ANTIESSENTIALIST CAUTIONS

Keep in mind that distinctions between science, religion, and metaphysics are empirical and revisable. They do not remain constant and do not refer to any "essences" or natural kinds. Rather, demarcations and distinctions change together with the actual configurations of cultural fields and networks. As the relationships between such cultures change, so do their mutual distinctions and possible insults. Expect that, sometimes, a science will resemble a metaphysics more than at other times. Since not all the sciences are alike, some might be structurally and culturally closer to metaphysics or religion than others. Likewise, some more secular and humanist religions may resonate more strongly with the sciences than more orthodox and traditionalist religions.

For example, a science undergoing major ruptures or revolutions has its own share of prophets, virtuosos, and charismatics. But that science cannot stop there, restricting itself to worship, admiration, or commentary on foundational texts. Rather, a science renormalizes a prophetic vision into a workable and operational research program. As a result, history and systematics become separate.

The densely clustered groups at the frontiers of a science sometimes behave in ways similar to emerging charismatic movements, especially when a novel science comes into being (Mullins, 1972). However, in the course of its institutionalization, charisma becomes routinized and decomposed into procedure. A science worships its heroes and geniuses, but not for their own sake and not because genius represents a link to the transcendental. Rather, "genius" is the way in which a science explains to itself how it makes its most astonishing breakthroughs.

Allow for variation and observe when and why a metaphysics becomes more scientific, or a science more artistic. Demarcations and distinctions are in flux. An ossified religion and a normal science possibly share a degree of bureaucratic routineness in their everyday operations, especially when teaching or instructing large numbers of novices and students in the established truths. There also are some metaphysics closer to science than others, such as Husserl's phenomenology or the antimetaphysics of positivism. As a metaphysics turns into an academic philosophy, it becomes part of an organization and administered in departments. This process gradually renormalizes and assimilates metaphysics into expert philosophical "research."

So the caution is to not treat empirical distinctions as logical criteria and to allow for as much variation as possible, both across social and cultural space and over time.

HOW MUCH OF SCIENCE IS TECHNOLOGY?

Some European philosophers hold that what makes a science scientific is its level of technical control and success, allowing for the manipulation of predictable effects (Mitcham, 1994). When technology is being criticized, this philosophy is called the "critique of instrumental reason." This critique comes in various more or less conservative and romantic versions, but the common theme is that technology means mastery of the world. Mastery becomes possible as the result of mathematical, experimental, and then applied science. Since the origin of science is in metaphysics, it is ultimately this modern metaphysics that allows for mastery and domination of the world.

Modernist metaphysics sees the world and Nature as the object to the Subject's will to power and representation. Correct representations lead to working technologies. How technologies are to be used depends on will and decision. Science and technology provide the will with the power and means of domesticating and disciplining Nature and reified society. Planning and control become the dominant relation to the world, at the expense of other relations, such as poetry or metaphysics.

While science does not "make" or "construct" nature, it does establish such a relation to it that nature appears as raw material, to be decomposed and recombined. In this relation, the world and nature emerge as a lawfully ordered cosmos of observable events. The truth of science is its own truth, and that truth is not the only possible one. In fact, the truths of science are rather shallow and superficial, as opposed to, say, the Truth in a metaphysics or religion, which is deeper, more profound, and longer lasting than mere facts of the matter.

In science, the world appears as such that it can be arranged or rearranged at will and by decision, guided by facts and true theories. Science builds a home for itself in the world by means of technology and the instrumental-*cum*-mathematical reification of the world into things, facts, and their objective relations. This first happens during the Scientific Revolution, with metaphysical assistance and assurance from Descartes, Kant, and the empiricists. After some time, this essentially "modern" way of scientific knowing deems itself the only valid and reliable one. Weber's "unbrotherly aristocracy of rational research" begins its long reign. Whatever knowledge fails to measure up to scientific standards is, from now on, not really knowledge at all.

Since science is cumulative, control and mastery of the world improve over time, with better scientific and social technologies. Progress is possible precisely because science forgets its own metaphysical origins and dimensions. Science cannot even ask the sorts of questions metaphysics or religion ask, let alone transform and renormalize them into soluble puzzles analyzed by the current methods and tools. For science, there is no metaphysics beyond or at the foundation of physics, or else such a metaphysics is sheer nonsense and charlatanry.

This latter insult and assault on metaphysics marks a watershed: Philosophy becomes "scientific philosophy" with Logical Positivism and its analytical heirs. The more thorough and complete this transformation, the more philosophy becomes science's handmaiden, appendix, or popular mouthpiece. Much of this analytical philosophy is philosophy of science, which provides science with cultural rationalizations and myths.

The remaining metaphysics becomes academic philosophy. In the university, philosophy

becomes part of the *Betrieb*, which is when metaphysics dissolves. Its organizational form is the cult or charismatic movement, not specialized intellectual administration. From then on, philosophy lives a spooky shadow existence between the humanities and sciences. It loses its identity and becomes uncertain about what philosophy still can do once the sciences move into its territory.

In this European view, science and technology are essentially identical, united by the driving force of instrumental Reason. In this view, what makes a science scientific ultimately is its technical success in bringing about predictable and observable effects. Science works because it is true, and we know it to be true since it works. With this circle, the fact that science is the only way to find out the truth becomes obvious and self-evident.

SOME TROUBLES IN EUROPE

Metaphysics is essentialism and wants to be. In essentialism, there are things-in-themselves, natural kinds, and Being, in addition to empirical and observable Beings. In essentialism, what a science does follows from what it "is," and it is, by its very nature or essence, that which metaphysics believes this essence to be.

Against essentialism, allow for variation and introduce the second-order observer. Sociologically, an essence is not really an essence but an outcome of holding something constant and doing this for a long time, until it becomes habit or institution. An essence emerges as a web of forces and temporarily freezes into a stable and steady *eigenstate*. This is how the observer "philosophy" observes science—at a large distance from where science is actually made, exaggerating its unity, rationality, and logic. Recall that, once an observer moves closer to the sites of science-in-the-making, this essence dissolves into higher complexity.

Empirically, there is little unity or logic to science. Science and technology are related, but loosely so. Citation data suggest that much of the science that gets done leads nowhere and makes little difference to other science or future science (Price, 1986). It has proven terribly difficult to "finalize" research according to preset plans and goals. A technical device that works "follows" more from other devices, those that work already, not from a theory or true representation. There is no direct logical path leading straight from a scientific finding or discovery to a working technical device.

Likewise, metaphysics exaggerates and overestimates technological mastery and effective scientific control. Frequently, control is fragile and prone to breakdowns and failures. This fragility increases with closer coupling and complex interactions (Perrow, 1984). Some sciences, such as those associated with "complex systems," warn against the revenge effects and unplanned consequences of interventions and manipulations. Planning and prediction happen but so do surprises, and surprises often generate still more surprises. The surprises also come at a much faster rate than do the firm and solid solutions. Science and technology are not really that impersonal, cold, or instrumental. There are areas and periods of intense conflict, passion, and drama.

EXPERIMENTAL CONTROLS

The European critics and romantics exaggerate the unity of science and technology, but they do point at a feature that distinguishes science from other ways of relating to reality. This feature is the laboratory, where experiments are being arranged and performed. There

might be laboratories and experiments outside of science, but those in science are distinctive in that they try to "entrap" nature by putting it to the test outside of where that nature usually occurs. The displacement of nature inside the laboratory and then again from the laboratory into the world, strengthens control, but this is control over the experimental settings and conditions, not, or at least not yet, control in the sense of technical mastery.

Inside the laboratory, nature is being decomposed and rearranged. This is the sciences' "analytical" approach as opposed to more "holism" in metaphysics and religion. Parts of nature are being subjected to unusual trials and tribulations. Experiments speed up or slow down reactions to "unnatural" levels; they dissect, bombard, and mix up their materials. Laboratories are arranged so that the experiments done can hold constant that which makes a difference to an outcome or effect, but is not currently under investigation.

Experiments focus the attention space on very selective and restricted forces and variables. They separate signals from noise by eliminating backgrounds. It is this analytical zooming-in on isolated signals that makes "cumulation" in a science possible. Progress or cumulation occur when most of the world is taken for granted, including any "presuppositions" research might rely on (Fuchs & Spear, 1999). Cumulation loses its progressive and linear directionality when there is no narrow focus of attention on well-defined puzzles and parameters. Cumulation can occur because experiments "make everything else equal."

Unlike metaphysics, a science does not start anew each day, with the great mysteries of Being. Instead, it operationalizes its problems into soluble puzzles that can be worked on in specialist settings of expertise. In this, one picks up where one left yesterday. In no way does this imply that all the problems a science poses to itself are actually solved in some way. However, the problems that are currently unresolvable will become tractable in the future, when more is known and better instruments are available. A science knows of no "essential" mysteries.

Religion and metaphysics do not "cumulate" or make "advances." They remain textual modes of mental production, restricted to reading and writing. This also restricts their ability to tinker with their materials and equipment. Nonexperimental sciences may have substitutes for experimentation, such as regression analysis and historical comparisons, but these are poor substitutes indeed and remain dependent on verbal and discursive operations.

What makes a science scientific then also is its high instrumental and experimental capacity for progress. Metaphysics does not make and does not want to make any progress. A "progressive" religion turns into a more secular worldview, moving away from the sacred, until the Gods begin to escape altogether or become privatized and personal. In many humanities and the humanistic social sciences the very idea of "progress" has become ideologically suspect.

WHAT WOULD MAKE SOCIOLOGY SCIENTIFIC?

The prospects for cumulative advances become dimmer still as an intellectual network becomes fragmented into competing ideological positions and movements. Structural fragmentation also fragments the common attention space. A science turns into rival ideological camps when the suspicion hardens that observation is not "disinterested" but driven by unacknowledged standpoints, perspectives, or political biases. Then, a central intellectual strategy is to "reveal" these underlying biases and interests. Science turns into mutual ideological critique and exposure. Theories lose their innocence and are not to be taken at face

value. Science becomes ideological politics, driven by the institutional entrenchment of diverse status groups. In the end, science itself becomes ideologically suspect, as an ally of capitalism, imperialism, ethnocentrism, sexism, and so on.

What kinds of work are being done once science fragments into ideological politics? Prominent specimens include textual or "discourse analysis," social theory and philosophy, critical theory, exegesis and commentary, or foundational and epistemological "critique." History gains precedent over systematics. Moral and political advocacy of some "cause" or other becomes acceptable. Debates on the "identity" of a field or discipline run rampant. Very little gets actually solved or resolved, so that old problems and puzzles do not go away but appear and reappear all the time. There is little consensus on even basic matters, such as whether a field "is" a science or even whether it "should" be. The very idea of "progress" comes under attack.

Fields or disciplines where these sorts of work prevail are, in a sense, "metaphysical," not "scientific." A sign of metaphysics is not being able or not wanting to forget the sacred origins and authentic foundations. But this very forgetting is a crucial condition for research and cumulation. These take place when the attention space is very narrowly focused on solvable puzzles for which a protocol of decidability is available. Such protocols do not effectively make sure that a problem or puzzle will, in fact, be resolved, but they do limit which sorts of questions and answers count as a possible solution or step toward solution. No cumulative advances can be made in the presence of manifest uncertainty and controversy over foundational enigmata and mysteries. What makes a science unscientific is its inability to forget its past.

SOME HYPOTHESES

In lieu of a conclusion, here is a hypothetical list of empirical features that distinguish science from metaphysics and religion:

1. A science looks forward and expects to make further progress in the future.
2. A science forgets its origins and brackets its foundations or presuppositions.
3. A science is organized into specialized research professions making continuous advances in highly restricted areas of expertise.
4. Research is done in more or less circumscribed programs or projects for which funding can be obtained.
5. The previous results of a science are the conditions for the current work which generates future results.
6. A science goes to work on relations, not essences.
7. At the uncertain and intensely competitive frontiers of a science, rapid discoveries and innovations are being made. These form the backbone of the reputational structure. High reputations go to discoverers, not sages, priests, or guardians of traditions.
8. Laboratories and equipment allow a science to perform experiments on a select arrangement of variables under controlled conditions.
9. A science institutionalizes nonideological modes of observing, or "objectivity."

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