

New Waves in Philosophy of Science

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Metaphysics between the Sciences and Philosophies of Science

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1. The long birth of the modern sciences

In its conception, one of the motivational goals of this volume was to consider recent developments in the philosophy of science and to offer, with as much audacity as we could muster, some thoughts as to where these debates are going. In the following I will attempt to honor this motivation by tackling an audaciously large issue I see coloring the background of most contemporary work in general philosophy of science. For most of its history there has been a persistent antipathy in this area towards speculative metaphysics, but for several years now, a number of philosophers of science have been embracing it with increasing enthusiasm. These are starkly opposed approaches to the philosophical consideration of scientific knowledge, and something of an impasse exists between them; neither side has grappled very effectively with the other. In this chapter I aim to consider why current work on scientific knowledge has come to exemplify this divergence, and whether it is resolvable. While I cannot pretend to know with any certainty where the philosophy of science will go from here on this issue, it will be my contention that we should expect such a resolution to be unachievable, for reasons of philosophical principle.

Let me begin with an historical allusion. In the seventeenth century, natural philosophy, a human inquiry into the nature of the world along the lines of what we would now regard as several separate dimensions – philosophical, scientific, and theological dimensions, *inter alia* – began the slow process of resolving itself into inquiries that we now take to have separate identities. And so it is that now, both scientists and many philosophers look back to this early modern period as the time during which the modern incarnations of their disciplines began to take

shape, slowly emerging from the fantastic amalgam that was natural philosophy.

Even the historically unschooled can appreciate, I think, the fascinating historiographical puzzles that hang over the seventeenth century. As Christoph Lüthy (2000: 164, 173–174) points out, historians of philosophy and historians of the sciences, in crafting their respective narratives of the modern origins of their disciplines, often point to exactly the same people and texts. Given that we now see these disciplines as engaging in distinct forms of inquiry, how is a historian to make sense of the overlap? While it is true that, in the seventeenth century, natural philosophy began increasingly to embrace empirical and experimental methods, which are often regarded as hallmarks of modern science, this actually led to more confusion than resolution so far as the historical story is concerned. As Lüthy (2000: 165) puts it: ‘The confusing consequence was that everyone who was concerned with some aspect or other of the natural world came to consider himself *ipso facto* a “philosopher”.’ Early modern physicists and chemists called themselves ‘experimental philosophers’. Telescopes and microscopes were philosophical instruments. Galileo’s title was ‘court philosopher’.

There are, of course, reasons to expect the story of how the sciences became inquiries apart from philosophy to be complicated. For one thing, the term ‘natural philosophy’ is often used to cover an enormous amount of ground, including essentially speculative and contemplative investigations focusing on puzzles associated with the Aristotelian tradition, as well as more empirical and experimental investigations associated with medicine, alchemy, metallurgy, optics, and astronomy. Another complicating factor is the ways in which philosophical concerns sometimes insinuate themselves, sneakily, into what we regard as scientific work even when they are supposed to have been exorcised. Margaret Osler (1996) argues, for example, that the common view that the rise of the mechanical philosophy in the seventeenth century banished the scholastic idea of final causes is mistaken. Final causes, she maintains, were simply reinterpreted so as to fit in with the mechanical philosophy. In a similar vein, George MacDonald Ross (1998) documents the persistent appeal to ‘occult’ qualities during this period.

Having raised these historiographical issues, it is not my intention to resolve them. I mention them because I think they foreshadow very effectively the philosophical problem that is my real interest here. However the story of how the modern sciences arose from natural philosophy is told, there is at least one thing that most people agree on, and that is the idea that in the process, the sciences became independent of many of the

philosophical and other preoccupations that had previously informed theorizing about the natural world. For example, where once it made sense to think about issues concerning divine providence and the nature of the soul as relevant to inquiries into the nature of atoms, or space and time, that is no longer the case. Clear examples of what we would now regard as philosophical and theological issues are no longer entertained as relevant to scientific inquiry. That is not to say that there is any precise definition of what the sciences are that might clearly and unproblematically demarcate them from other pursuits. Branches of the sciences differ a great deal from one another with respect to canonical markers, such as how mathematical or experimental they are, whether they make novel predictions as opposed to merely accommodating the data, and so on. But leaving annoying demarcation issues to one side, it is clear that we now have separate domains, and no one doing physics today is expected to worry about whether God could have created the entire contents of the universe just as it is, but ten meters to the left.

To a great extent, then, it is reasonable to say that the sciences today are independent of the major philosophical and other preoccupations that were previously part and parcel of theorizing about the natural world. I say ‘to a great extent’, because for the remainder of this chapter, I will be investigating what I take to be an exception, viz. metaphysics. I will argue that whatever philosophical baggage the sciences have left aside en route to the present, a certain degree of what is reasonably called metaphysics remains and cannot be removed. Given what I mean by ‘metaphysics’, this conclusion may or may not prove especially controversial. I will argue further, however, that there is no correct answer *per se* to the question of what *degree* of metaphysical speculation is properly considered reasonable in interpreting scientific knowledge. In arguing for this further claim, I will suggest that ultimately, we are left with an irresolvable methodological relativism concerning what degree of speculation is appropriate to philosophical analysis in this context. It is this lack of absolute conviction in determining just how metaphysical scientific knowledge is that I take to parallel the historiographical uncertainty surrounding whether early modern natural philosophy is science or philosophy.

2. Metaphysics in science: for and against

As a precursor to arguing for these theses, perhaps it would be useful to say something about what metaphysics *is*. Let us begin with the textbook definition. As one learns on the first page, the term itself originates from

the classification of Aristotle's works three centuries after his death by Andronicus of Rhodes, the works placed after the *Physics* being labeled, naturally, *Metaphysics*. The inquiry itself was identified chiefly with two things: the study of being *qua* being, or the most general nature of existence and the natures of things that exist; and the study of first causes and theology (in Aristotle, the ultimate cause being God, the unmoved mover), which contributes the connotation of providing fundamental or basic explanations. It has a significant a priori dimension, aiming to provide an explanatory account of observable phenomena in terms of underlying realities. This a priori character is manifested in the ways in which its arguments typically proceed, with emphasis on conceptual analysis, intuitions, and explanatory power *inter alia*. Metaphysics as practiced since ancient times through to the present has retained much of the flavor of this original conception. I will leave aside the idea of providing fundamental explanations here, for although many of the great systematic philosophers aspired to do precisely that, metaphysics often includes less ambitious theorizing. The idea of a significantly a priori investigation into something explanatory that underlies the observable phenomena, however, is central.

Some may worry, perhaps, that the emphasis I have just given to the distinction between observable aspects of the world and things underlying them furnishes a misleading characterization of the metaphysical enterprise. The implication here is that 'things underlying' the observable phenomena are not themselves observable, strictly speaking. 'Observable' in this context is used in the philosopher's sense, to refer to those aspects of reality that are in principle detectable using only human sensory faculties. Unobservable entities are thus things that are not in this way detectable. Some may view the explicit invocation of this distinction as tangential to the more general and simply stated aim of metaphysics: that of considering the natures of things in the world. I submit, however, that there is a very short distance between considering natures and speculations regarding the unobservable. In providing accounts of the natures of various aspects of the world, be they observable or unobservable, metaphysicians have traditionally appealed to strictly unobservable elements underlying their surface appearances – universals, substances, bundles, necessities, possibilities, and so on. Given the immediacy of such speculation in carrying out the generic aim of metaphysics, it seems reasonable to take it as constitutive, and I will do so in what follows.

With this first definition of metaphysics in mind, let me now pose the central question of this chapter: do the modern sciences involve or

incorporate metaphysics, in just the way that early modern natural philosophy involved and incorporated other philosophical preoccupations? Some say yes and others no, and my own answer to this question will build on these responses, so let us briefly consider them in turn.

In recent memory, the most strident denunciation of metaphysics in connection with science has come from logical positivism, the founding movement of the philosophy of science as a self-aware, philosophical discipline; it began with a commitment to the positivist premise that, in the sciences, human thought has finally progressed beyond its prior religious and metaphysical modes. The emphasis placed by the positivists and later logical empiricists on sensory experience as the subject matter of the sciences was intended precisely to excise any hint of metaphysics from our understanding of scientific knowledge. More recently, Bas van Fraassen has developed his own version of empiricism in the scientific context, constructive empiricism, in hopes of carrying the empiricist baton forward. In both cases, the idea of an investigation into things underlying sensory experience which might explain aspects of the observable, a priori or otherwise, is an anathema.

Some qualification is necessary here, for clearly these rejections of metaphysics are not so naïve as to miss the fact that much scientific work and discourse makes use of terms whose intended referents appear to be unobservable entities and processes. The empiricist point here is not that these surface features of science are illusory, but rather that they should not be interpreted as leading to knowledge of the unobservable. Thus, it may well be that scientists routinely theorize, experiment, and communicate with one another in a way that suggests speculations about the unobservable, but this, according to various empiricist philosophers of science, should not be taken to reflect the true aims or nature of science. Such suggestive speculation, where it takes place, must be understood in a particular way, as simply serving to further and systematize our claims about the observable. It is a means to an end, where both are conceived in empiricist terms. In this way, the empiricist and the metaphysician may offer precisely the same sorts of descriptions of the surface features of scientific investigation. The difference between them concerns how these surface features are to be interpreted.

How successful, then, are these rejections of metaphysics? Neither has been uncontroversial. Logical positivism and empiricism faced the accusation that the verifiability criterion of meaning, according to which putatively factual propositions amount to meaningless metaphysics unless there are empirical procedures by which they can be verified or confirmed, was itself a piece of metaphysics, or followed from

metaphysical commitments (see Alston, 1954, for instance). In Carnap's later work, the linguistic frameworks within which scientific theories are expressed comprise analytic principles which (partially) constitute the meanings of theoretical terms, and determine what counts as confirming evidence for the framework as a whole. The choice of a linguistic framework cannot be made on the basis of factual evidence, however, for there is simply no framework-transcendent conception of evidence on the basis of which to make such a choice. Recent commentators such as Michael Friedman (1999) have argued that this is nothing less than a neo-Kantian account of the a priori. Constructive empiricism, on the other hand, faced the accusation that its claim that science aims to produce theories that are empirically adequate, where empirical adequacy is to be understood in terms of truth concerning the observable, makes metaphysical commitments in extrapolating beyond the empirical data, and in appealing to the modality inherent in the notion of observability.

These are all important challenges to the rejection of metaphysics in the context of scientific knowledge, but I will not dwell on them here. Let me rather point out another, more general worry attaching to empiricist hostilities to metaphysics, whatever their form. *Prima facie*, the sciences are *plainly* metaphysical, insofar as they appear to take a very strong interest in phenomena underlying the observable. The sciences routinely take an interest, apparently, in particles and fields and genes and enzymes and an endless parade of entities that cannot be detected with the unaided senses. Wherever possible, hypotheses concerning these entities are subjected to empirical tests, but tests never render them *observable*, and some hypotheses are accepted for primarily explanatory reasons. As a consequence, in the attempt to rid scientific practices of the semblance of metaphysics, empiricisms are driven to extraordinary lengths. The logical positivists, for example, were driven to a non-realist semantics, according to which all terms putatively referring to unobservables are meaningless unless reinterpreted in terms of observables – a hopeless semantic theory which led ultimately to the downfall of positivism itself. Constructive empiricism adopts a realist semantics, but in remaining agnostic about the existence of so many entities apparently described by seemingly empirically adequate theories, it too offers an interpretation of scientific claims that is a very long way from what they say on their face. Empiricisms can only make sense of the sciences by radically reinterpreting what they plainly seem to be doing, and that may well make one suspicious.

What, then, of the opposing view, that the sciences incorporate metaphysics as a matter of course? Many post-positivist philosophers of

science have suggested this, but again, not uncontroversially. Edwin Burtt (1959/1925) maintained that not only are metaphysical concepts such as substance, essence, and form pivotal in the work of Copernicus and Kepler, but that in Newton, the concepts of space, time, and mass function in much the same way. R. G. Collingwood (1998/1940) discussed what he took to be metaphysical assumptions underlying physics from Newton's mechanics to Einstein's theories of relativity. Thomas Kuhn (1962) argued that metaphysical commitments, such as commitments to teleological versus mechanistic explanations, are one of the ingredients constituting the disciplinary matrix that governs a period of normal science. Again, there are criticisms one might press in connection with these particular views as they pertain to the modern sciences, but let me mention just one worry that will attach to any such position. It is not always entirely clear how to draw the line, or indeed, whether it is possible to draw a line, between the aspects of theories these commentators identify as metaphysical, and aspects that are properly considered empirical. Given this, the substance of the claim that scientific theorizing incorporates elements of metaphysics may seem inevitably disputable.

Consider an example: in the sociology of scientific knowledge, it is not uncommon to find the suggestion that metaphysical presuppositions (the adoption of which, it is claimed, is best analyzed in terms of social, economic, and political causes) play a role in what ends up as scientific fact. Barnes et al. (1996: chapter 2), for example, examine Millikan's celebrated oil-drop experiments conducted in the early twentieth century, the goal of which was to investigate the hypothesis of a fundamental unit of electric charge. Millikan suspended ionized droplets of oil between two charged plates, and using Stokes equation, measured their charge, ultimately concluding that all of the results were integral multiples of (approximately) 1.602×10^{-19} C – the fundamental unit. Interestingly, a rival physicist, Ehrenhaft, conducted similar experiments at around the same time at the University of Vienna, using tiny metal spheres instead of oil, and his results indicated ever smaller measurements of electric charge, without any suggestion of a fundamental unit as such. The authors suggest that Millikan reached his own conclusion because he was operating with the assumption that electric charge *must be* quantized, an assumption licensed by a physics community excited by the promise of the quantum hypothesis more generally, where previously the idea of a continuous electric field or fluid had been in vogue. Different interpretations of Millikan's data were clearly possible, they argue, citing historian Gerald Holton's analysis of Millikan's notebooks,

indicating the selective use of some data and the laying aside of others. His metaphysical assumption regarding quantization drove these decisions, they claim. But was the quantum hypothesis really a metaphysical assumption influencing Millikan's work, or was it rather an empirical hypothesis established by his experiment, and indeed, other experiments in physics at the turn of the century?

The question of whether scientific hypotheses regarding unobservable entities and processes are metaphysical or empirical is inherently messy. Consider another example. In a recent study of the development of cancer research, J. A. Marcum (2005) argues that two conflicting metaphysical presuppositions – reductionism and organicism – have shaped scientific investigation into the nature of cancer in recent decades, and have themselves been shaped by this research in turn. Reductionism here takes the form of genetic determinism, the idea that certain biological states and processes can be explained in terms of genes, and organicism is the view that emergent phenomena at higher levels of biological organization are crucial to such explanations, such as the explanation of cancer cell production as a consequence of abnormal tissue organization. But again one might ask: are these competing biological 'isms' really metaphysical presuppositions, or are they empirical hypotheses to be tested in the course of cancer research? Given that, as Marcum suggests, they are amenable to reformulation directly informed by scientific research, does this suggest that they are in some sense empirical?

I have just offered considerations on both sides of the same question. On the one hand, among other worries, empiricist critiques of the idea of metaphysics in connection with the sciences may give the impression of rather severe and ideologically driven rational reconstructions; but on the other hand, among other concerns, it is not entirely clear that the sorts of examples found in the literature of metaphysics operating in modern scientific practice are really metaphysical after all. I believe that scientific knowledge is unavoidably metaphysical, but I also believe that the sorts of considerations I have just sketched are incapable of deciding the issue one way or the other. Understanding the relation of metaphysics to the sciences will require a different and more roundabout approach. Let us turn to this now.

3. Stances, rationality, and values

I have mentioned in passing some examples of people who contest the idea that metaphysics is relevant to the sciences, all of whom identify themselves as empiricists. Though one need not be an empiricist to make

such claims, it is not surprising that the most adamant objections to metaphysics in the context of scientific knowledge come from this group. Empiricism is often presented in opposition to forms of metaphysical inquiry. It is too strong simply to say that there is a conflict between empiricism and metaphysics, since the rejection of certain kinds of metaphysical inquiry often proceeds on the basis of what are commonly described as metaphysical arguments. Humean austerity is sometimes referred to as arising from and constituting a Humean metaphysic, for example. But metaphysics as I have described it – an inquiry into the nature of things underlying the observable, having explanatory and a priori dimensions – is no doubt something at odds with most empiricisms. In order to examine the idea of metaphysical inquiry a little more precisely now, I will borrow a tool from some recent work by van Fraassen: the idea of an epistemic stance.¹

An epistemic stance is one concerned with the production of knowledge, and I will use the term 'stance' in this sense henceforth. It is perhaps easiest to understand the concept of a stance in contrast to what we might call propositions, or claims regarding matters of putative fact. Matters of fact would seem to include the claims that grass is green, that chlorophyll facilitates photosynthesis, and that carbon dioxide is used in the process. If endorsed, the appropriate attitude towards such propositions is belief. A stance, on the other hand, is a cluster of attitudes, commitments, and strategies relevant to the production of factual beliefs. Unlike propositions, they do not make claims about the world, but determine how epistemic agents go about making claims about the world. Stances are not believed, but adopted, held, and expressed in human action. They may include beliefs, but unlike propositions, their relation to knowledge seekers is not exhausted by belief in any strictly propositional content.

The stance characteristic of those who do metaphysics, for example, involves taking seriously the idea of explaining observable phenomena in terms of things underlying them, as well as attempts to answer such demands by speculating about the unobservable. It may involve other things, but this much will suffice for present purposes, and I will use 'metaphysics' as a label for this stance, so identified, henceforth. In contrast, a stance characteristic of many empiricists is constituted (again, no doubt among other things) by a rejection of such demands and speculations. As noted earlier, these features of metaphysics annoy empiricists, but to this we can now add the observation that this annoyance is most economically understood at the level of stances. Rather than list the countless factual claims of which empiricists disapprove, whether they

concern the existence and nature of universals or subatomic particles, it is most economical simply to note that metaphysics is a stance of which empiricists disapprove.

Regarding metaphysics and empiricism, the crucial questions for the current discussion are these: on what basis do we choose the stances associated with them; and on what basis do we assess the wisdom of adopting one as opposed to an apparent rival? Van Fraassen (2002) identifies two such grounds, and I am inclined to agree. The first is rationality: one should choose a stance that is rational, where this is defined in a broadly pragmatic way in terms of internal coherence. Accordingly, the 'defining hallmark' of irrationality is 'self-sabotage by one's own lights' (Van Fraassen, 2004: 184). In the absence of such a failing of one's epistemic project as assessed by one's own standards, the stance (or stances) associated with that project is rational. This is a permissive view of rationality, allowing that different and mutually incompatible stances may be rational, and it follows from such a view that there may be cases in which no one stance and resultant set of beliefs is compelled on grounds of rationality alone. The second consideration relevant to choosing stances is the idea of values. Beyond the constraint of rationality, the values of epistemic agents play a decisive role in determining what stances are appropriate for them. Values are agent-relative, and as a consequence, the adoption of stances is generally a relativistic proposition. Those with different values are at liberty, within the bounds of rationality, to choose differently in accordance with their own values.

Thus, an empiricist may reject metaphysics by committing to epistemic policies that are incompatible with it, but so long as metaphysicians themselves adopt rational epistemic stances, this cannot suffice to convince metaphysicians that they are ill-advised in their methods of inquiry. If rationality is the only constraint that applies uniformly to all agents adopting stances, and different, mutually incompatible stances are rational, then the framework for debate concerning one's choice of stances is subject to a form of methodological relativism. The metaphysician and the empiricist appear to be separated here by different intuitions, or values, regarding (at least) two centrally important matters. The first is the question of what sorts of phenomena stand in need of explanation; for what sorts would an explanation be desirable? In this regard, many empiricists are content to rest with the observable, and view the desire to extend belief to explanatory phenomena underlying the observable with evident disdain. On the other side, those adopting the metaphysical stance value such explanations, and thus naturally

take a different view. Closely related to this difference is the question of what sorts of explanations are viewed by epistemic agents as obscure or unilluminating, as opposed to contributing genuine insight. Again, many empiricists view speculations regarding the unobservable negatively in this regard, while those of a metaphysical bent naturally see things differently.

Some will worry here that what I have suggested amounts to an alarming relativism, and that since alarming relativisms are to be resisted at all cost in view of the terrible epistemic consequences they entail, the idea of a stance relativism encompassing metaphysics and empiricism must be resisted too. But there is no cause for alarm here. While certain forms of relativism about knowledge are clearly pernicious, I believe the methodological relativism proposed here to be innocuous. Note, for instance, that it is not a relativism allowing different epistemic agents to adopt contrary beliefs regarding matters of putative fact. Where a metaphysician may be tempted to claim *P*, it is not the prerogative of the empiricist to claim not-*P*. Rather, the empiricist remains agnostic about the truth or falsity of *P*. Where the metaphysician may affirm the existence of quarks or possible worlds, the empiricist does not deny their existence, but remains agnostic. In this way the set of factual beliefs endorsed by the empiricist may be a subset of those endorsed by the metaphysician – they may share beliefs about observables, but the former (and not the latter) will refrain from affirming and denying metaphysical claims regarding unobservables. Thus, the form of relativism applicable here avoids the controversy of rationally sanctioned contradictions. It is this controversy that fuels debates about relativism, but it is of no interest in this case.²

With this digression on the nature of epistemic stances in hand, I believe we are now in a position to tackle the questions with which I began this chapter, concerning whether metaphysics plays a role in the modern sciences, and whether it properly has a role in the interpretation of modern scientific knowledge. In what follows, I will assume that the stances associated with metaphysics and the empiricisms that contest it are rational, and embrace the methodological relativism this appears to entail.

4. The sciences as inevitably metaphysical

I began this discussion by stating that I would argue for two conclusions. The first was that the sciences inevitably incorporate a degree of metaphysics, and the second was that there is no one, correct view as to how

much metaphysics one should invoke in giving a philosophical account of scientific knowledge. In this section I will focus on the first of these claims. I will argue for it by suggesting that even on the most metaphysically austere, contemporary conception of the sciences – that offered by empiricist philosophies of science – there is a metaphysical dimension to this sort of inquiry. If this suggestion is compelling, it will follow as a matter of course that on other, less austere conceptions, metaphysical claims are part and parcel of scientific work.

Admittedly, some forms of empiricism need have no tolerance for the epistemic policies characteristic of speculative metaphysics. Take for example a strict phenomenalism of the present moment, according to which knowledge claims are restricted to those describing current sensations. In restricting itself so acutely, such a position, it would seem, need make no recourse to metaphysical speculation. It is an interesting question whether such a view could be developed to support a coherent epistemology, but for present purposes, we may leave this question to one side. Contemporary empiricist philosophies of science, as it happens, are not so stingy: they extend the boundaries of what is knowable in various ways beyond impressions and ideas. Most empiricist philosophers interested in the sciences today tacitly embrace some metaphysical speculation in order to preserve the coherence of their positions, or so I will contend.

For the sake of illustration, let me take the most influential, current example of this sort of approach to the sciences, van Fraassen's 'constructive' empiricism, as representative. This position endorses claims not merely about sensations, but about that which is observed and indeed, about that which is observable. In this way it is representative of contemporary empiricist philosophies of science more generally. They are not versions of idealism that deny the existence of an external world, nor are they versions of quietism with respect to the world beyond impressions and ideas. On the basis of empirical evidence, their epistemic grasp extends to a knowledge of observable entities and processes that exist quite independently of ideas. They aspire to some knowledge of a world that is external to human cognition but nonetheless the subject of experience.

As soon as an empiricist claims knowledge of more than sensations and ideas and includes observable entities and processes, however, her epistemological landscape changes very significantly in comparison to her phenomenalist cousin. In the former case but not the latter, it is paramount that one have an error theory. It is a commonplace to note that the more ambitious empiricist does not ultimately believe, for

example, in the existence of 'objects' experienced in optical illusions and hallucinations, despite the fact that she clearly has sensations in connection with these events. Experiences are not always veridical in what they convey about things in the world external to cognitive processing. Not all observations are created equal; some lead to facts, others give misleading impressions, and yet others lead us into serious error. Through the mist clinging to the ice fall at Fox Glacier I see a large furry shape leap gracefully into a cavern of ice and disappear. Is it a play of the light, or the abominable snowman? In order to know something about observable things, not merely her sensations, the empiricist must have an understanding of what it means for some observations to be better than others, and how to differentiate the better from the worse. In making these judgements, we must also know how to describe our observations in terms of various categories of objects and events and their salient properties, in ways that allow us to communicate successfully with those with whom we interact, whether in scientific or everyday contexts. We must know how to draw implications from these experiences, as required by judgements of confirmation with respect to hypotheses and theories.

Again, the idea that empiricisms that endorse a knowledge of observable phenomena beyond mental phenomena require some sort of error theory is not new. Indeed, both the requirement of an error theory and the sorts of judgements this entails have been widely appreciated, not least by empiricists. Hence Wilfrid Sellars and others, for example, were keen to point out the 'myth of the given'. Facts about the world, they noted, are not things that can be simply or transparently read from raw experience, whatever that might be. In a similar vein, Norwood Russell Hanson, Thomas Kuhn, and Paul Feyerabend made interestingly related cases to the effect that scientific and everyday observations are theory laden, and this idea has long since been absorbed into the philosophy of science. What we see, they suggested, is importantly shaped by the cognitive and theoretical background we bring to observation. In Kuhn's terminology, this background inevitably includes the paradigmatic frameworks in which observation occurs, comprising exemplars for problem solving and metaphysical commitments regarding the various standards empirical investigation should meet.

So how does one distinguish veridical experiences from others about which one is more circumspect? How does one carve the referents of impressions and ideas into useful and communicable ontological categories, and extrapolate from these experiences in the ways required by

scientific hypothesis and theory testing? The answers to these questions do not come from experience. They have their source in intersubjective understandings or traditions exemplified by a community, which furnish standard or customary answers to questions such as these. These understandings or traditions are generally tacit, but presumably need not be in all cases. They are shared by the members of an epistemic community, unifying their practices of empirical investigation. For Kuhn, the disciplinary matrix and exemplars that unify normal science under the rubric of a paradigm perform precisely this role. As van Fraassen (2002) puts it, one must know *how* to experience things before one can derive knowledge from experience.

Now, one might well ask, what sorts of things are these understandings, or traditions, or paradigms? They are unobservable, cognitive, cultural, heuristic entities, which underlie the phenomenon of observation on which empiricism is partially grounded. Like many complex social entities, we posit them and speculate about them for important explanatory reasons, to account for various of our experiences: in this case, the successful judgements and interactive work typical of scientific investigation. This positing and speculation is by no means gratuitous. Indeed, on the very empiricist views of science that are dubious of these practices, they would appear to be essential: they furnish empiricism with an error theory. In scientific contexts they explain how, in van Fraassen's terms, we manifest the capacity to learn things about the observable. Note, however, that the tacit understandings and conventions that inform scientific observation are things *we bring* to observation. They are not read off from experience, but are rather preconditions of experience, and thus have an a priori dimension. It is in this sense that even a very determined empiricist, it seems, must admit some metaphysics in connection with the sciences after all. On even the most metaphysical austere, contemporary conception of the sciences, they are inherently metaphysical.

To be sure, I have taken some liberties in describing how the sciences inevitably incorporate metaphysics, but none of these liberties undermines the point at issue. One might wonder, for instance, whether a social, intersubjective thing such as a tradition or a paradigm is properly described as an entity *per se*, let alone an unobservable one. If disciplines as disparate as physics and sociology teach us anything, however, they demonstrate that not all entities are amenable to neat ontological packaging, and the complexity of social entities and practices presents no obvious bar to a discussion of them in these terms. Neither are such understandings strictly observable, though aspects of them may be suited

to study and detection. Those accustomed to applying the term 'a priori' to beliefs and propositions may balk at its use here in application to features of observation that are often tacit, but there would seem to be no obvious reason to restrict its use in this way. Others may wish to reserve the term for so-called analytic truths, and thus resist its application to things that are susceptible to change over time, but this too is a merely stipulated restriction. Still others may hope to disentangle the metaphysics from the a priori, and thus grant that there are a priori dimensions to scientific practice, while denying that they constitute any sort of metaphysics. But such disentangling, I submit, is impossible. The conventions we bring to the world of scientific experience make substantive contributions to our understandings of the natures of things that exist: they determine the ontological categories we employ and how we judge the coherence and confirmation of scientific claims. None of these conventions is read from experience – they are frameworks for experience itself.

5. The aims of science

Are the modern sciences devoid of metaphysics in the way that they are now free of certain other philosophical considerations that once infused natural philosophy? There is more to be said in affirming my negative answer to this question, but for the present, let me turn now to the second conclusion I hoped to reach in this chapter: the idea that there is no one or correct answer to the question of what degree of metaphysical speculation is properly considered essential to the interpretation of scientific knowledge. Different answers to this question have been championed by contemporary philosophers of science, with those expressing an antipathy towards metaphysics lined up on one side, and those who have been increasingly embracing it on the other. Here I will be brief, for it would appear that in just the way epistemic stances are susceptible to a form of methodological relativism, so too is the answer to this question.

Logical positivism engendered distaste for metaphysics within the philosophy of science with long-lasting influence, and van Fraassen's claim that the aim of science is not truth but empirical adequacy has also been influential, functioning as a slogan for anti-realists of various kinds concerning scientific knowledge. Those falling into these camps commonly subscribe either to a minimalist Humean metaphysic, or to quietism about metaphysical questions generally. In recent years, however, a resurgence in analytic metaphysics has been joined by a growing number of

philosophers of science. Authors engaged in what is nowadays called the 'metaphysics of science', for example, commonly make claims to the effect that scientific knowledge simply cannot be properly interpreted unless one gives an account of the implicit features of this knowledge. These accounts typically include elaborate ontological commitments to things such as laws of nature, essences, and causal powers.³

What philosophical presuppositions separate these two approaches to science? Can the opposition between them be resolved? I submit that the approach to science that one thinks best reflects its true character is simply a reflection of one's prior adoption of particular epistemic stances such as metaphysics or empiricism. What degrees of speculation and concomitant distances from empirical investigation one thinks are appropriate for anything calling itself science, and what degrees and distances one thinks are appropriate in interpreting scientific knowledge, are generally a clear function of the epistemic stances one adopts. I have suggested that certain metaphysical assumptions may be inescapable in the practice and interpretation of what we call science. Here is another example, to illustrate the present point: an acceptance of some conception of the uniformity of nature, many have suggested, may be a precondition for practices such as scientific generalization and prediction regarding empirical phenomena. But what more precisely this conception amounts to – whether it is properly understood in a minimalist, Humean fashion in terms of brute regularities, or more elaborately in terms of laws and *de re* necessity – is something that cannot be determined except from the perspective of stances like metaphysics and empiricism. And as I have suggested, the adoption of these sorts of stances is susceptible to variable choice, itself subject to an indissoluble relativism.

It is arguable, of course, that this conclusion is overly hasty. Some may hold hopes of discovering the true nature of science, and thus how metaphysical it and the knowledge it produces is, simply by studying it more carefully as a practice. Perhaps if we were simply more careful and objective observers of the nature of scientific practice, we would find definitive answers there. But this, I suggest, is hopeless. Among scientists who care to think about these questions, there is no consensus regarding how empirical or speculative an investigation must or may be in order to count as science (consider recent disputes over the scientific status of string theory), and neither is there consensus regarding whether theories should be interpreted realistically, instrumentally, or otherwise. And even if there were majority opinions among scientists regarding these questions one way or the other, it is highly unlikely that taking a vote

would yield the desired information. The sciences are human practices, and like any complex human practices, their nature and significance are open to interpretation. Look behind any particular interpretation here, and you will find the stances that condition it.

Ultimately, I suspect that there is little reason to suppose there *should* be any one, correct answer to the question of what degrees of metaphysical speculation are appropriate to the sciences, or to interpreting its products. Different epistemic agents inevitably draw the line in different places, and their choices are to a large extent conventional, made in accordance with standards that need not be shared among those who take an interest in the sciences as a subject of philosophical investigation. In just the way that historians may be rightly uncertain as to whether one should properly regard early modern natural philosophy as science or philosophy, I believe we should accept that just how metaphysical the modern sciences are, and how much of a metaphysician one needs to be in order to give an account of scientific knowledge, are questions open to different and ultimately indefeasible understandings of the aims of science.

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Notes

1. Due to constraints of space, the foregoing is a highly telescopic summary of the nature of stances, rationality, and values in connection with metaphysics and empiricism. For details spelling out and defending some of the assumptions made in this section, see Chakravartty (2007). For more background in support of the argument of section 4, see Chakravartty (forthcoming).
2. Consequently, I would distinguish the methodological relativism discussed here from relativisms associated with some approaches to the sociology of science and standpoint (and related) theory in feminist studies of science, both of which are embroiled in precisely this sort of controversy. Recent work in

epistemology also considers the idea that some beliefs may be rationally permissible but not obligatory, leading to rational differences in doxastic attitudes towards certain propositions. Cf. Rosen (2001), who affirms this in connection with nominalism and realism about abstract entities. White (2005) and Christensen (2007) both argue against the idea, but the arguments appear to leave untouched the present discussion: they consider only evidential reasons for belief, thereby ignoring non-evidential reasons including values as considered here; the arguments turn on cases of rationally sanctioned contradictions, thereby ignoring the contrast between belief and agnosticism paramount here; they employ emotive examples as intuition pumps (jurors placidly accepting contrary opinions while deliberating about a terrible crime, etc.), that seem inappropriate to the present context.

3. For just two prominent examples of this growing literature, see Ellis (2001) and Bird (2007). Cf. Psillos (2005), who argues that science does not imply a non-Humean conception of reality, and that debates between Humean and non-Humean conceptions are independent of other epistemological commitments concerning the sciences, such as scientific realism.

References

- Alston, W. P. (1954) 'Are Positivists Metaphysicians?', *Philosophical Review*, 63: 43–57.
- Barnes, B., D. Bloor, and J. Henry (1996) *Scientific Knowledge: a Sociological Analysis* (Chicago: University of Chicago Press).
- Bird, A. (2007) *Nature's Metaphysics: Laws and Properties* (Oxford: Clarendon Press).
- Burtt, E. A. (1959/1925) *The Metaphysical Foundations of Modern Physical Science: a Historical and Critical Essay* (London: Routledge & Kegan Paul).
- Chakravartty, A. (2007) 'Six Degrees of Speculation: Metaphysics in Empirical Contexts', in B. Monton (ed.), *Images of Empiricism: Essays on Science and Stances, with a Reply from Bas C. van Fraassen* (Oxford: Oxford University Press).
- Chakravartty, A. (forthcoming) 'A Puzzle about Voluntarism about Rational Epistemic Stances', *Synthese*.
- Christensen, D. (2007) 'Epistemology of Disagreement: the Good News', *Philosophical Review*, 116: 187–217.
- Collingwood, R. G. (1998/1940) *An Essay on Metaphysics*, ed. R. Martin (Oxford: Clarendon Press).
- Ellis, B. (2001) *Scientific Essentialism* (Cambridge: Cambridge University Press).
- Friedman, M. (1999) *Reconsidering Logical Positivism* (Cambridge: Cambridge University Press).
- Kuhn, T. S. (1962) *The Structure of Scientific Revolutions* (Chicago: University of Chicago Press).
- Lüthy, C. (2000) 'What to do with Seventeenth-Century Natural Philosophy? A Taxonomic Problem', *Perspectives on Science*, 8: 164–195.
- Marcum, J. A. (2005) 'Metaphysical Presuppositions and Scientific Practices: Reductionism and Organicism in Cancer Research', *International Studies in the Philosophy of Science*, 19: 31–45.
- Osler, M. J. (1996) 'From Immanent Natures to Nature as Artifice: the Reinterpretation of Final Causes in Seventeenth-Century Natural Philosophy', *The Monist*, 79: 388–407.
- Psillos, S. (2005) 'Scientific Realism and Metaphysics', *Ratio*, 18: 385–404.
- Rosen, G. (2001) 'Nominalism, Naturalism, Epistemic Relativism', *Philosophical Perspectives*, 15: 69–91.
- Ross, G. M. (1998) 'Okkulte Strömungen im 17. Jahrhundert', trans. A. Beriger, in J.-P. Schobinger (ed.), *Friedrich Ueberwegs Grundriss der Geschichte der Philosophie, Reihe 5, 17. Jahrhundert, Band 1* (Basel: Schwabe).
- van Fraassen, B. C. (2002) *The Empirical Stance* (New Haven: Yale University Press).
- van Fraassen, B. C. (2004) 'Replies to Discussion on *The Empirical Stance*', *Philosophical Studies*, 121: 171–192.
- White, R. (2005) 'Epistemic Permissiveness', *Philosophical Perspectives*, 19: 445–459.