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PERSPECTIVISM

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1 Locating perspectivism in the landscape of realism

Among the many varieties of realism in contemporary philosophy of science, perspectivism – or better, *perspectival realism* – is one of the latest attempts at a middle ground in between scientific realism and antirealism.[1] *What kind of middle ground* can perspectival realism possibly deliver which has not already been explored by structural realism, semi-realism, entity realism, and selective realism, among others? In this chapter, I clarify (i) what perspectivism is, (ii) whether it can be made compatible with realism, and (iii) what it has to offer in terms of novel middle ground.

Some definitions first. The term *perspectivism* is used to denote a family of positions that in different ways place emphasis on our *scientific knowledge being situated*. Thus, I take perspectivism to be first and foremost an *epistemic view* about the nature of our scientific knowledge. It is not intended to be a metaphysical view about scientific facts being perspectival or natural kinds being relative to scientific perspectives. *Scientific knowledge* is here broadly understood to include scientific representations, modeling practices, data gathering, data analysis, and, more in general, scientific theories involved in the production of scientific knowledge. *Being situated* is understood in two main ways:

(1) Our scientific knowledge is *historically situated*, that is, it is the inevitable product of the historical period to which those scientific representations, modeling practices, data gathering, and scientific theories belong.

And/Or

(2) Our scientific knowledge is *culturally situated*, that is, it is the inevitable product of the prevailing cultural tradition in which those scientific representations, modeling practices, data gathering, and scientific theories were formulated.

The "and/or" is important. Some authors (notably Ron Giere, the main advocate of the position) understand (1) and (2) as part of a unified picture about how scientific knowledge is situated. But several other authors would privilege and focus on either (1) or (2). Most of the recent discussions on perspectivism have indeed focused on (2) rather than on (1) for reasons that – as I explain in the next two sections – have got to do with two different and seemingly independent rationales for perspectivism.

Thus, the first distinction to draw is between a *diachronic* version of perspectivism, along the lines of (1), which places emphasis on the historical component, and a *synchronic* version of perspectivism, along the lines of (2), which explores how different research programmes or alternative modeling practices (within the same historical period) may give rise to perspectival knowledge. The arguments and rationales for endorsing the diachronic or synchronic version of perspectivism are sufficiently distinct and independent of each other (see sections 2 and 3). Some of the challenges that perspectivism (in either version) faces are similar, and similar are the answers that – in my view – perspectivism ought to give to these challenges, as I argue in section 4.

That our scientific knowledge is situated (either historically or culturally or both) may not strike as breaking news. It is at least as old as Kant's Copernican Revolution and Nietzsche's perspectivism. No wonder, then, that both are often indicated as forefathers to the position. Contemporary perspectivism shares indeed the same Kantian roots with Putnam's internal realism. Like Putnam's internal realism, perspectivism too is reacting against metaphysical realism and the so-called God's eye view that claims, "the world consists of some fixed totality of mind-independent objects. There is exactly one true and complete description of 'the way the world is'" (Putnam 1982: 49). There cannot be an objective, unique, true description of the way the world is as soon as we acknowledge that our scientific knowledge is always from a specific vantage point – either in the sense of (1) or (2) or both. Even more so, if we further acknowledge that these specific vantage points are often in conflict with each other (e.g. Ptolemaic astronomy vs. Copernican astronomy; electrons as corpuscles vs. electrons as elements of an ether in the nineteenth-century physics, and so on).

Kant's rediscovery of the human vantage point – the only vantage point from which knowledge of nature is possible for us – chimes with perspectivism's insistence on the situated nature of our scientific knowledge. In this sense, contemporary perspectivism and Putnam's internal realism are two branches of the same Kantian tree. Yet what is most interesting is not their (common) Kantian roots but their 'branching', so to speak. The two positions part their ways in the underpinning rationales and reading of Kant and his legacy.

Internal realism is primarily prompted by semantic considerations, namely by Putnam's famous permutation argument (Putnam 1982: ch. 2). The argument is designed to show that – even granted the truth-values of sentences can be held fixed in every possible world – the reference of the main terms would nonetheless be indeterminate. For it is possible to interpret the language so that 'cat*' refers to *cherries* and 'mat*' refers to *tree*. Thus, the sentence "A cat* is on a mat*" is still true in every possible world where "A cat is on a mat" is true, although the reference of cat* is permuted to pick out cherries and the reference of mat* is permuted to pick out tree (for a recent critical discussion, see Button 2013). No similar semantic concern prompts perspectivism in philosophy of science. Instead, epistemic and methodological concerns primarily motivate perspectivism (as we discuss in sections 2 and 3).

But there is more. Putnam read Kant as the first philosopher to advocate an 'internal realist' view of truth, whereby truth is "a statement that a rational being would accept on sufficient experience of the kind that it is actually possible for beings with our nature to have" (Putnam 1982: 64). Perspectivism – I take it – sees in Kant the first philosopher to defend the view that

> Reason, in order to be taught by nature, must approach nature with its principles in one hand, . . . and, in the other hand, the experiments thought out in accordance with these principles – yet in order to be instructed by nature not like a pupil, who has recited

> to him whatever the teacher wants to say, but like an appointed judge who compels witnesses to answer the questions he puts to them.
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> *(Kant 1781/87/1997: Bxiii–xiv)*

The relevance of Kant's Copernican Revolution for perspectivism lies in the emphasis placed on the *human vantage point* from which questions about nature can be asked. That Kant defended truth as idealized rational assertibility (à la Putnam) is not clear from textual evidence. That Kant advocated *objective* and *necessary* knowledge of nature – incompatible with perspectivism's pluralism – is also uncontroversial. Thus, the Kantian legacy for perspectivism lies, in my view, neither in the notion of truth nor in the notion of objectivity. It lies instead in the acknowledgement of the *human vantage point* (as opposed to the God's eye view) from which only knowledge of nature becomes possible for us. *Perspectival* knowledge is knowledge from a human vantage point (although not necessarily along the Kantian lines of postulating a priori conditions of possibility of experience in the faculty of sensibility and the faculty of understanding, of course). In the next two sections, I unpack the epistemic grounds (section 2) and the methodological grounds (section 3), which are respectively at work in motivating the two (diachronic and synchronic) versions of perspectivism.

2 Epistemic grounds for diachronic perspectivism: Giere's perspectivism

That scientific knowledge is perspectival is evident from historical records. Knowledge produced by different scientific communities across different historical periods is perspectival: it is the product of specific choices of instruments, theoretical apparatuses, and measurement techniques idiosyncratic to any given scientific community at any given historical time. Thomas Kuhn first brought to the general attention this perspectival feature of scientific knowledge. He did not quite call it such and opted for the idiom of 'scientific paradigms' or 'scientific lexicons' (rather than 'scientific perspectives'). Yet Kuhn's rationale is pretty much the same rationale that motivates the most prominent advocate of scientific perspectivism: Ron Giere (2006).

But it is not the late Kuhn of semantic incommensurability that provides the inspiration for Giere's perspectivism (2006: 83): "It is clear, I think, that there are no problems of linguistic incommensurability for perspectives". Instead, it is the early Kuhn, who defended epistemic incommensurability as rooted in perspectival theories, data, methodologies, and values of different historical communities. Key to Giere's perspectivism is the extension of the relational and perspectival metaphor of color vision to the whole body of scientific knowledge. Our ability to discern colors is due to our human vantage point and the ensuing relation among the refractive index of any given surface, light rays, and our retinas. Similarly, measurements in science are the outcomes of relations between the target system and our technical apparatus (i.e. with its settings, relevant parameters, etc.).

Giere argues that scientific knowledge is perspectival all the way up, not just at the level of observation and measurement. Models and scientific theories are perspectival too: "Newton's laws characterize the classical mechanical perspective; Maxwell's laws characterize the classical electromagnetic perspective; the Schrödinger Equation characterizes a quantum mechanical perspective" (Giere 2006: 14). According to Giere's model-based view of scientific theories, perspectivism affects each level of the hierarchy of models (from data models to representational models, all the way up to scientific principles). Experimental data are perspectival because they reflect the nature of the chosen measuring instrument (e.g. what counts as relevant or irrelevant parameter; how statistical errors and background noise are controlled, etc.). The representational models are themselves perspectival in idealizing some factors and abstracting from others (e.g. in the model of the harmonic oscillator, mass is idealized as a point-mass, and displacement from equilibrium abstracts from disturbing factors). Finally, the general principles (e.g. Newton's laws) that inform the choice of the representational models are themselves perspectival.

Giere's perspectivism shares with Kuhn's scientific paradigms the idea that "Claims about the truth of scientific statements or the fit of models to the world are made within paradigms or perspectives" (Giere 2006: 82). Or "truth claims are always relative to a perspective" (Giere 2006: 81). Giere's perspectivism takes on board the Kuhnian insight that there is no cross-paradigmatic (or cross-perspectival) notion of truth at the end of scientific inquiry. What counts as true (or false) is simply a function of how particular data models fit particular theoretical models. And since both kinds of models are perspectival, as a result, any model-based knowledge claim is either true or false only within the boundaries of the chosen scientific perspective. Under this influential epistemological reading of perspectivism, truth is *relativized* to scientific perspectives. Giere's *epistemological argument* for perspectivism can be summed up as follows:

(A) Our scientific knowledge is *perspectival* because scientific knowledge claims are only possible within a (historically) well-defined family of models (e.g. the Newtonian perspective, the Maxwellian perspective, etc.), which constrain both the data available (via data models) *and* the interpretation of those data (via theoretical models and principles of the scientific perspective adopted). No knowledge of nature is possible outside the boundaries of historically well-defined scientific perspectives.

Despite clear similarities with the Kuhnian picture, it should be clear that a "scientific perspective", in Giere's own use of the term, differs from a scientific paradigm in some relevant respects. A scientific paradigm – or, better, what Kuhn called a "disciplinary matrix" – is broader than a scientific perspective (Giere 2006: 82) in including (in addition to data models and representational models) also systems of values and metaphysical beliefs of a given community at any given time.

Beyond Kuhn, the second greatest influences for Giere's perspectivism are science studies, with the post-Vietnam disillusion about the liberating power of science, and the contingency thesis defended by sociology of scientific knowledge (SSK). From this second main source, Giere's perspectivism inherits the rejection of 'absolute objectivism', that is, the idea that scientific knowledge is the body of objective, non-contingent, socially neutral, and value-free truths. Diachronic perspectivism takes on board the lesson from the history of science and from scientific practice in acknowledging that no such objective, God's eye scientific knowledge is ever available to us. Hence, *perspectival realism* is defined by Giere as the view that says,

> "According to this highly confirmed theory (or reliable instrument), the world seems to be roughly such and such". There is no way legitimately to take the further objectivist step and declare unconditionally: "This theory (or instrument) provides us with a complete and literally correct picture of the world itself". The main thrust of the arguments to be presented in this book is to show that the practice of science itself supports a perspectival rather than an objectivist understanding of scientific realism.
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> *(Giere 2006: 6)*

To conclude, diachronic perspectivism is the view that takes the lessons from the history of science and scientific practice to support the conclusion that scientific knowledge is perspectival. The arguments behind this view are epistemic: they concern the elaboration and justification for scientific knowledge claims within scientific perspectives – broadly understood as hierarchies of models typical of any given historical period (e.g. Newtonian perspective, Maxwellian perspective, and so on). The realist's *truth* and *objectivity* are both called into question. Truth is relativized to perspectives and objectivity abandoned altogether. Is Giere's perspectival realism *realist enough* to qualify for the title 'realism'? Doubts arise as to whether relativizing truth to perspectives makes the position closer to relativism than to realism (Massimi 2015a raises and discusses this critique). We will go back to both truth and objectivity in section 4, where we discuss whether perspectivism can in fact be made compatible with realism. Before doing so, we must turn our attention to other methodological (more than epistemic) considerations at work behind perspectivism.

3 Methodological grounds for synchronic perspectivism: incompatible models

Engagement with the history of science is not the only possible avenue to perspectivism. After all, perspectivism in its synchronic version is a thesis about how – within the same historical period – different research programmes or alternative modeling practices may give rise to perspectival knowledge. Unsurprisingly, perspectivism has recently been advocated in the context of the vast literature on scientific models. In a seminal paper, Alexander Rueger (2005) addresses the problem of how scientific realism can handle the problem of incompatible models for the same target system. Consider for example atomic models. They come in at least four main families (quark models, cluster models, shell models, and liquid drop models). Each of these families provides a different (incompatible) description of the atomic structure, its properties, and dynamics. Scientific realism holds that there are mind-independent facts about atoms. Thus, one would expect our best models to deliver a description of these facts. Instead, we are left with a plethora of models providing incompatible representations of the atom and its intrinsic properties and dynamical processes.

To solve the problem, Rueger makes a *perspectival* move. For different models seem to offer different perspectives on the same target system (e.g. the atom, or else), whereby *intrinsic* properties of the target system turn out to be in fact *relational* properties. In this way, models do not deliver incompatible images of the same target system. Rather, they deliver only *partial and perspectival images* that can still be unified into a final coherent image, as realism would have it.

Along similar lines, Paul Teller (2011) has argued that since models are idealizations (hence, inevitably imprecise), it is possible to have more than one model for the same target system (e.g. hydrodynamics and statistical mechanics for the description of water's properties) without having to forgo realism. Neither of these models can legitimately be regarded as delivering the exact truth about the properties of water, because truth remains a non-attainable goal of scientific inquiry. (For a similar defense of the perspectival nature of scientific representation, see also van Fraassen 2008). In its place, science offers a series of partial, idealized, imprecise *perspectival images*, which nonetheless succeed in advancing our knowledge of nature. The Rueger–Teller argument for perspectivism – as I am going to call it – is then a *methodological argument* (rather than an epistemological one) that goes as follows:

(B) Our scientific knowledge is *perspectival* because scientific knowledge claims are only possible within (culturally) well-defined families of models of any given scientific perspective at any given time (e.g. hydrodynamics and statistical mechanics in the contemporary treatment of water; quark models, liquid drop models, shell models, and cluster models for the contemporary atomic theory). No knowledge of nature is possible outside the boundaries of culturally well-defined scientific perspectives with their pluralism about models.

There are analogies and disanalogies between (A) and (B). The epistemological and the methodological arguments share the Kantian insight about the central relevance of our conditions of possibility of knowledge. Our *human* (historical *and* cultural) vantage point shapes and makes possible our scientific knowledge claims about nature. Hence, the Kantian nature of perspectivism. However, (A) and (B) differ in the way they explicate the perspectival nature of our scientific knowledge. While (A) and (B) share a common rejection of *objectivity*, they diverge about scientific *truth*.

(A) argues that the truth of our scientific knowledge claims is *relative* to historically defined scientific perspectives (e.g. what was true for Ptolemy proved false for Copernicus). By contrast, (B) takes pluralism about models as an indication that truth is *either* (Bi) a non-attainable and (maybe not-so-desirable either) goal of scientific inquiry (Teller); *or*, (Bii) that truth can be preserved if we understand property assignment to a target system as *perspectival* (Rueger). I have briefly mentioned at the end of section 2 the somehow relativist flavor that seems to affect Giere's (A). Here I want to mention two responses to (B) that drive a wedge in the choice between (Bi) and (Bii), with the result of making perspectivism fall back onto either a form of instrumentalism or a form of scientific realism.

Margaret Morrison (2011) has challenged the claim behind (Bi) that partial, idealized, imprecise models can nonetheless expand our overall knowledge of the target system, even if truth remains a non-achievable goal. Consider nuclear physics. It currently features thirty alternative and inconsistent (not just incompatible) models that neither individually nor jointly are able to answer basic questions about the nature of nucleons and of the nuclear force. Morrison (2011: 351) concludes,

> So, we are left in an epistemic quandary when trying to evaluate the realistic status of these nuclear models and the information they provide. (. . .) What is perhaps significant for philosophical purposes is that this is not a situation that is resolvable using strategies like partial structures, paraconsistent logic or perspectivism. No amount of philosophical wizardry can solve what is essentially a scientific problem of consistency and coherence in theoretical knowledge.

On Morrison's reading then, the *methodological argument* for perspectivism (Bi), with its pluralism about models, slides onto a dangerous form of 'view from everywhere', which – like in Pirandello's play *One, No One and One Hundred Thousand* – make perspectivism akin to a sophisticated form of instrumentalism about science. Maybe none of the available models is the true model of the nucleus; and maybe that is not a problem insofar as practitioners can avail themselves of several models as they see fit to their purposes every time. Yet if this is indeed the situation, it is bad news for the prospect of cashing out perspectivism as a kind of *realism*.

The opposite risk with (Bii) is that by understanding all properties of scientific objects as perspectival/relational qualities, the door is open to the scientific realist's rejoinder made by Anjan Chakravartty (2010: 410) that "putatively perspectival facts may be straightforwardly understood as non-perspectival facts regarding how behavioural dispositions are manifested under different stimulus conditions. Let us label these 'dispositional facts'". The *prima facie* inconsistency among properties assigned by different models need not be understood in terms of perspectival images of the same target system, ascribing different relational properties to the same entity.

It can more easily be understood in the idiom of scientific realism – in terms of dispositional properties of objects manifesting themselves in various stimulus conditions. Different contexts of investigation, different measurement systems and modeling techniques can simply elicit different non-perspectival, dispositional facts about the scientific entities, their properties, and manifestations. *Prima facie* relational qualities are nothing over and above different manifestation conditions for the same non-perspectival, dispositional properties of scientific entities. Perspectivism along the lines of (Bii) falls back onto dispositional realism.

Trapped in between the charge of instrumentalism on the one hand and the risk of falling back onto dispositional realism on the other hand the chances of cashing out a promising version of perspectivism seem dwindling. Can perspectivism fulfill the Kantian promise of knowledge from a human point of view and, at the same time, be made compatible with realism? Can it deliver a middle ground in between realism and anti-realism in science? The next section explains why defenders of perspectivism might still have reasons for optimism.

4 Can perspectivism be made compatible with realism?

The epistemological argument for perspectivism left us with doubts about a lingering form of relativism (e.g. is truth really *relative to* perspectives, as Giere maintains?). The methodological argument landed perspectivism in the quandary of being either a form of instrumentalism about science (Bi) or collapsing onto dispositional realism (Bii). Where does the Kantian insight behind perspectivism go astray? And can it be made compatible with realism?

In what follows I offer my own diagnosis of the problem and suggest a possible way forward (programmatic as it is at this stage). Philosophers on either side of the debate on perspectivism have at best failed to draw a clear-cut distinction between *objectivity* and *truth*; at worst, they have conflated the two. For often enough perspectivism is presented as a view about *facts* being perspectival; or about *properties* being relational; or about *truth* being relative. Couched in this language, it is no surprise that perspectivism verges on either fact-constructivism or alethic relativism – and, needless to say, either option is a non-starter for cashing out a viable form of perspectival *realism* (if the title *realism* is still meaningful). If perspectivism has to be made compatible with realism, something ought to be said about facts not being shaped by scientific perspectives or truth relativized to them. The culprit of the muddy waters surrounding contemporary discussions of perspectivism is, in my view, the tendency to understand the rejection of scientific *objectivity* (qua God's eye view on nature) as tantamount to a much stronger (and *non sequitur*) claim about worldly states of affairs being *relative to scientific perspectives*. Perspectivism is often cast in the Kuhnian mould, whereby scientific communities are taken as producers and validators of their own knowledge claims, with no mind-independent states of affairs or norms for truth outside the boundaries of historically defined perspectives.

In my view, this is an erroneous take on the perspectivist insight that no God's eye view of nature is ever available to us. For one can accept and fully endorse that scientific inquiry is indeed pluralistic and that there is no unique, objective, and privileged epistemic vantage point without necessarily having to conclude that perspectives shape scientific facts or relativize truth. In fact, I have argued elsewhere (Massimi 2015b) that not even Kuhn endorsed these bold and questionable views. And certainly, no contemporary perspectivalist should endorse them either. As both the epistemological and the methodological arguments jointly show, all there is to the Kantian/Kuhnian perspectivalist stance is that no knowledge of nature is possible outside the boundaries of historically and culturally well-defined scientific perspectives. Epistemic pluralism speaks against 'objectivist' realism as the view that there is a unique, objective, privileged standpoint for scientific investigation. But epistemic pluralism – *per se* – does not also speak against truth or against perspective-independent facts. Thus, I suggest that we understand perspectival realism (PR) as a form of *realism* about science along the following threefold lines:

(I) PR endorses the realist *metaphysical* tenet about a mind-independent (and perspective-independent) world;[2]

(II) PR endorses the realist *semantic* tenet about a literal construal of the language of science;[3]
(III) Finally, PR endorses the realist *epistemic* tenet in thinking that acceptance of a theory implies the belief that the theory is true (and even shares the realist intuition that truth is correspondence with states of affairs in the world).[4]

PR – as I understand it – can share with scientific realism the view that worldly states of affairs, the language of science, and truth as correspondence with states of affairs are all perspective independent. What makes PR *perspectival* then? How does it differ from scientific realism? In my view, the rejection of the God's eye view in PR leads to a genuinely novel and fruitful notion of *perspectival truth* and *scientific progress across perspectives* (among several other relevant aspects). Let us take a quick look at both of them (more details can be found in Massimi 2016a, 2016b, respectively).

What is it like to be *true within a perspective?* Perspectival truth can be regarded as a form of *perspective sensitivity*, whereby scientific perspectives provides the circumstances or context of use defining the truth-conditions for knowledge claims in science. For example, we can interpret scientific models (with their inaccurate idealizations of the target system) as filling in contextual truth-conditions (understood as rules for determining the truth-values based on features of the context). Perspectival truth is then truth (qua correspondence with mind-independent states of affairs) but *contextualized* within the limits afforded by rival scientific models or rival historical perspectives. To use a toy example taken from Teller (2011), when asking what the properties of water are (for example, whether water is indeed a fluid with viscosity), one might get different answers depending on whether the context of use for this scientific knowledge claim is defined by hydrodynamics or by statistical mechanics (which treats water as a statistical ensemble of molecules). However, this is not a case of relativized truth, where the same propositional content can be assigned different truth-values (true or false) by different perspectives. It is in fact possible to retrieve true knowledge claims about what appears as a primitive property of water (viscosity) in hydrodynamics from the statistical properties of molecules' mean flow in the statistical-mechanical perspective without having to conclude that the very same knowledge claim is true in one perspective, and false in the other. There are facts about water and its properties that are independent of scientific perspectives. And, more to the point, a perspectival realist can get these facts right. Perspectives – under the reading I am suggesting – provide contextual truth-conditions, which often enough can be 'translated' so to speak from one scientific perspective to another.[5]

As a result, we need to rethink the semantic requirement (II). It is still the case that – under this reading of PR – the language of science is interpreted literally (pace Putnam's permutation argument) so that 'viscosity' refers to viscosity (and cannot be concocted to refer to electric charge, for example). However, contextual truth-conditions imply that the exact reference of the term 'viscosity' is somehow undetermined until the contextual truth-conditions are put in place.[6]

Thus, I take PR to share important aspects with contextualism. For truth-conditions for scientific knowledge claims vary in interesting ways depending on the context in which they are uttered and used. At the same time, PR differs from a linguistically geared view such as contextualism in acknowledging with (I) that there are perspective-independent worldly states of affairs that ultimately make our scientific knowledge claims true or false. There are worldly states of affairs about water's viscosity that ultimately make (X) <Water is a liquid with dynamic viscosity of 1.983×10^{-5} *Pa s*> either true or false. Yet *our ability* to *know* these states of affairs (and hence to ascribe a truth-value to the relevant knowledge claim) depends inevitably on the perspectival circumstances or context of use. For example, for me now to know that <Water is a liquid with dynamic viscosity of 1.983×10^{-5} *Pa s*>, some perspectival truth-conditions have to be met. For example, I may want to check that samples of water satisfy the Navier-Stokes equations; I can look at rheology for predicting the mechanical behaviour of water under the action of particular forces and stresses; I can run tests on water samples (relying on different viscoelastic models); and so forth.

Contextual truth-conditions can then be understood in terms of *perspectival standards of performance adequacy* that a scientific knowledge claim has to satisfy (for details on this notion, please see Massimi 2016a, 2016b). While perspective-independent states of affairs are ultimately the tribunal that decides whether any knowledge claim is true or false, for *us to know* that (X), for example, is true, it has to be the case not only that (X) matches some worldly state of affairs but also that it meets the relevant perspectival standards of performance-adequacy in its context of use.

This is where the perspectival story becomes salient. While a scientific realist would consider 'correspondence with the world' enough for the purpose of realism, a perspectival realist (who takes the situated nature of our scientific knowledge at heart) would not consider 'correspondence with the world' enough. After all, scientific knowledge claims are not truths *sub specie aeternitatis*. They are instead the expression of particular communities at particular historical times, working within well-defined intellectual traditions. Hence the importance of perspectival standards of performance adequacy in the original context of use in defining whether any scientific knowledge claim is (perspectivally) true.

Mutatis mutandis, perspectival standards of performance adequacy (in and of themselves) are not enough to define whether a scientific knowledge claim is true or false. PR has to be able to assess falsehood and to make sure that our perspectival knowledge claims do indeed latch onto perspective-independent states of affairs. Thus, the perspectival standards adopted by any given community at any given time *per se* are necessary but not sufficient to establish whether any given scientific claim is indeed true. Scientific perspectives cannot sanction their own scientific truths. For this reason, we need to bring in another element: the notion of *scientific progress across perspectives.*

Scientific progress can be characterized in perspectivalist terms if we take scientific perspectives not just as *contexts of use* —laying down specific standards of performance-adequacy for knowledge claims—but also, and most importantly, as *contexts of assessment* offering standpoints from which claims of other (past) scientific perspectives can be evaluated (in terms of their ongoing performance adequacy as set out by their original standards). Thus, scientific claims of our historical predecessors can be *retained* or *withdrawn*, depending on whether they continue to satisfy their original standards of performance-adequacy when assessed from another (subsequent) perspective. Fresnel's equations are still (to some extent) part of our current scientific perspective because of their ongoing performance adequacy when assessed from our current vantage point.

Ancient Greek crystalline spheres are no longer part of our current scientific perspective because they have long lost their performance adequacy with respect to their own original standards (e.g. stability of circular orbits, agreement with astronomical data, neat division between celestial and terrestrial phenomena, etc.). By the time of Kepler, Galileo, and Newton, crystalline spheres had proved incapable of delivering on their own original standards, since orbits turn out to be elliptic; the Prutenic tables replaced the Alfonsine tables, which could not deliver the right date for Easter; the orbital stability was now explained by the parallelogram law; and the rationale and evidence for the divide between terrestrial and celestial physics had been removed once and for all. Hence, crystalline spheres failed by their own standards (following Kuhn on anomalies and periods of crisis) and were eventually withdrawn (rather than retained) in the repertoire of the new Newtonian perspective. Were crystalline spheres ever (perspectivally) true in their own original scientific perspective? No, insofar as there are (as far as we can tell) no crystalline spheres in nature (the ancient Greek perspective cannot sanction its own truths).

Yet, crystalline spheres performed in the original perspective an important function in providing a first hypothetical mechanism for planetary motion, for which a more adequate mechanism was later provided by Newton's gravity (as a force acting at a distance), and an even more adequate mechanism was subsequently provided by Einstein's general relativity (in terms of mass-energy tensor curving spacetime). In what sense were these mechanisms 'more adequate' in subsequent perspectives? Simply because they took a primitive, hypothetical, non-further-explainable mechanism for orbital motion (crystalline spheres) and replaced it with new mechanisms which satisfied standards of performance adequacy such as *experimental accuracy* (e.g. via Brahe's observational data for Kepler's elliptical orbits or Eddington's solar eclipse expedition for general relativity), *projectibility* (e.g. Newton's law of gravity; Einstein's principle of equivalence), and so forth.

Thus, scientific progress tracks (to the best of our fallible and revisable knowledge in any given historical period) worldly states of affairs across scientific perspectives. Scientific knowledge claims of our predecessors are not discarded out of hand as simply false. Instead, their important role in the experimental, theoretical, and conceptual *evolution* of our current scientific toolkit is acknowledged and embraced. Most importantly, PR does not take our current scientific toolkit as *the privileged, unique* available one. It recognizes instead that our current vantage point is just one among many others that have preceded us and that will follow us. Hence, a defender of PR would not say, "our current scientific truths are the *best* ones, full stop. We got it right!" Instead, she ought to be saying, "our current scientific truths are the *best* ones we are entitled to *by our own lights* as of today". PR amounts to a form of epistemic humility when it comes to truth and progress in science.

5 Pluralism and pragmatism

Epistemic humility is not, however, a unique feature of PR. It is common to varieties of realism that share with PR a commitment to pluralism, more in general. John Dupré's (1981) *promiscuous realism*, Sandra Mitchell's (in Mitchell and Gronenborn 2017) *pragmatic realism*, Chakravartty's (2011) *sociability-based pluralism*, Kitcher's (1993) *real realism*, among many others, are all equally committed to a form of pluralism and hence to epistemic humility. What kind of pluralism is distinctive of PR? And how does it differ from the pluralism at stake in these other positions?

As the analysis in the preceding sections indicates, the pluralism at stake in PR originates from the perspective-sensitivity of our scientific knowledge claims. This is neither pluralism at the level of (perspective-independent) facts nor at the level of taxonomic classifications. It is instead a distinctively epistemic form of pluralism in bringing in the very many contextual/perspectival conditions of knowing. How does this form of *epistemic pluralism* square with others when it comes to metaphysical import? Consider the following three cases:

(i) Chakravartty's sociability-based pluralism can be regarded as a minimal pluralist requirement that can be made compatible with realism. Groupings of properties can be carved and re-carved in many ways (although some of these properties have a tendency to 'hang out' together more than others). Thus, pluralism about taxonomic classifications (qua sociable groups of properties) implies pluralism about mind-independent kinds in nature.

(ii) Dupré promiscuous realism embraces a form of taxonomic pluralism too, whereby the same object may feature in cross-cutting classifications (e.g. the gardener's and the botanist's classifications for lily; hemlock as a vegetable and a poison). Yet Dupré's taxonomic pluralism is non-committal as to the mind-independence of kinds. Indeed, it is best understood as realism about individuals (e.g. this particular lily) but not about natural kinds qua higher taxa (e.g. *Liliaceae*).

(iii) *Pragmatic realism* also embraces a form of taxonomic pluralism, which, on the face of it, seems very close to the contextualist considerations behind PR. For the pragmatic realist commits herself to different descriptions of the same target system, depending on the particular perspectival practice relevant to any given situation. For example, in the case of protein folding, there are three different models (in vivo, in vitro, and in silico) that can interchangeably be used to describe the same phenomenon for different purposes. The prima facie incompatibility of these different modeling practices does not undermine realism because of the purely *pragmatic* stance towards the metaphysics of science.

PR differs from (i) through (iii) as follows. By contrast with the ontological pluralism seemingly implied by Chakravartty's sociable properties, PR keeps epistemic pluralism safely detached from ontological pluralism. While agreeing with sociability-based pluralism about patterns of mind-independent properties in nature, PR's pluralism does not buy into its ontological implications. Our multiple *ways of knowing* do not track multiple mind-independent kinds in nature. At best, they track the same *historically and culturally evolving* kinds as per (A) and (B).
While promiscuous realism is ultimately *nominalist* about natural kinds, PR is committed to a realist view about kinds. Natural kinds are real because they map onto mind-independent clusters of properties in nature. It is our conditions of possibility of knowing these clusters of properties that depend (in relevant ways) on our scientific perspective.

Against pragmatic realism, PR holds that a commitment to pluralism is not purely pragmatic – that is it is not just in terms of utility or serving particular functions in particular contexts. The epistemic pluralism at the heart of PR serves instead the purpose of tracking truth across perspectives. As such, it is kosher to the realist plea for truth rather than to the pragmatist quest for fulfilling the epistemic needs of agents in scientific research.

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Notes

1 Other prominent middle grounds in this debate are structural realism (Worrall 1989) and semirealism (Chakravartty 1998), just to mention two.

2 This requirement is essential to avoid conflating PR with a form of constructivism or idealism. Scientific perspectives do not act as cookie cutters in the worldly dough; they do not shape facts or condition states of affairs. That electrons have negative charge or that carcinogenesis involves mutant K-ras genes has nothing to do with any currently accepted scientific perspective – these are perspective-independent facts that exist and would exist even if J. J. Thomson had not existed or we had not developed the medical theory about carcinogenesis that we have.

3 This second requirement captures the aforementioned semantic difference with Putnam's internal realism, which by contrast is motivated by the permutation argument (among others). A perspectival realist takes the language of science at face value, pretty much as a scientific realist would do (e.g. 'electron' has to refer to electron, and it cannot refer to *cherries* under some suitable construal of the language in some other possible world).

4 This third requirement safeguards PR from the threat of alethic relativism. See, for example, Rorty's (1993) famous objection to Putnam's internal realism, whereby the adoption of a theory of truth as idealized rational assertibility is vulnerable to the rejoinder that truth is nothing but assertibility 'for us at our best', as 'tolerant wet liberals' able to feel solidarity with a community that views *p* as warranted.
5 It is worth stressing that the mechanisms for 'translating' scientific knowledge claims between perspectives range from having inter-reduction rules (as in the example of water) to becoming a limiting case of a more general scientific knowledge claim in a new perspective among many other possible mechanisms.
6 For example, in hydrodynamics, 'viscosity' refers to a primitive dynamic property in the distribution of the liquid flow. But in statistical mechanics, 'viscosity' refers to the momentum transport across laminae of molecules. Reference being undetermined is very different from reference being indeterminate: 'viscosity' cannot be construed to refer to *cherries* in some other possible world, according to PR.

References

Button, T. (2013) *The Limits of Realism*, Oxford: Oxford University Press.
Chakravartty, A. (1998) "Semirealism," *Studies in History and Philosophy of Science* 29, 391–408.
——— (2010) "Perspectivism, Inconsistent Models, and Contrastive Explanation," *Studies in History and Philosophy of Science* 41, 405–412.
——— (2011) "Scientific Realism and Ontological Relativity," *The Monist* 94, 157–180.
Dupré, J. (1981) "Natural Kinds and Biological Taxa," *Philosophical Review* 90, 66–90.
Giere, R. (2006) *Scientific Perspectivism*, Chicago: University of Chicago Press.
Kant, I. ([1781–87] 1997) *Critique of Pure Reason*, Cambridge: Cambridge University Press.
Kitcher, P. (1993) "Real Realism: The Galilean Strategy," *Philosophical Review* 110, 151–197.
Massimi, M. (2015a) "Walking the Line: Kuhn between Realism and Relativism," in A. Bokulich and W. Devlin (eds.), *Boston Studies in the Philosophy of Science* (Kuhn's Structure of Scientific Revolutions: 50 Years On), New York: Springer, 135–152.
——— (2015b) "Working in a New World: Kuhn, Constructivism and Mind-Dependence," *Studies in History and Philosophy of Science* 50, 83–89.
——— (2016a) "Four Kinds of Perspectival Truth," *Philosophy and Phenomenological Research*. Doi: 10.1111/phpr.12300
——— (2016b) "Three Tales of Scientific Success," *Philosophy of Science* 83, 757–767.
Mitchell, S. D. and Gronenborn, A. M. (2017) "After Fifty Years, Why Are Protein X-Ray Crystallographers Still in Business?" *British Journal for the Philosophy of Science* 68, 703–724.
Morrison, M. (2011) "One Phenomenon, Many Models: Inconsistency and Complementarity," *Studies in History and Philosophy of Science* 42, 342–351.
Putnam, H. (1982) *Reason, Truth, and History*, Cambridge: Cambridge University Press.
Rorty, R. (1993) "Putnam and the Relativist Menace," *Journal of Philosophy* 90, 443–446.
Rueger, A. (2005) "Perspectival Models and Theory Unification," *British Journal for the Philosophy of Science* 56, 579–594.
Teller, P. (2011) "Two Models of Truth," *Analysis* 71, 465–472.
van Fraassen, B. (2008) *Scientific Representation: Paradoxes of Perspective*, Oxford: Oxford University Press.
Worrall, J. (1989) "Structural Realism: The Best of Both Worlds?" *Dialectica* 43, 99–124.