

CHAPTER 15

INSTRUMENTALISM

Global, Local, and Scientific

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[A]ll thought processes and thought-constructs appear a priori to be not essentially rationalistic, but biological phenomena. . . . Thought is originally only a means in the struggle for existence and to this extent only a biological function.

—Hans Vaihinger, *The Philosophy of 'As If'* (xlvi)

1 PRELUDE: INSTRUMENTALISM, THE VERY IDEA

THE leading idea of instrumentalism is that ideas themselves, as well as concepts, theories, and other members of the cognitive menagerie (including the idea of instrumentalism itself, of course) are *most* fundamentally tools or instruments that we use to satisfy our needs and accomplish our goals. This does not imply that such ideas, theories, and the like cannot also be truth-apt or even true, but simply that we misunderstand or overlook their most important characteristics—including the most important questions to ask about them—if we instead think of them most fundamentally as candidate descriptions of the world that are simply true or false. Indeed, the American pragmatist John Dewey originally coined the term “instrumentalism” to describe his own broad vision of human beings as creatures whose cognitive activities are much more deeply entangled with our practical needs and our attempts to successfully navigate the world and its challenges than we usually recognize, creatures whose efforts to engage the world intellectually must proceed using cognitive tools that are no less a product of and no less conditioned by our long history of seeking to meet such practical needs and objectives than are the arms, legs, and eyes we use to find food or shelter. A natural contrast here is with the tradition of Cartesian rationalism in the Early Modern period,

which seemed (at least in caricature) to presuppose (and then discover to its evident surprise) that we are most essentially creatures of pure disembodied intellect and that the most fundamental question to ask about our ideas or beliefs is therefore whether or not they accurately describe or represent how things stand not only in our immediate physical environment, but also in far more remote realms of concern like pure mathematics and theology. Like empiricists, pragmatists view this rationalist tradition as having gone wrong at the very first step, having tried to derive substantive conclusions about how things stand in the world around us from the ideas we encounter in introspection without first asking just what those ideas are and how we came to have them in the first place. But where the empiricists simply proposed a competing (and deservedly influential) conception of where our ideas or beliefs come from and how they provide us with knowledge of the world when they do, pragmatists went on to defend a fundamentally and systematically distinct conception of the very point, purpose, role, and/or function of cognitive entities like ideas or theories and cognitive states like belief in the first place.

Indeed, the most enduring legacy of American pragmatism has been an influential philosophical account of truth that embodies this broad view of ideas and beliefs as instruments for satisfying our needs and goals. As pragmatist thinkers went on to emphasize, however, the centrality and significance they ascribed to understanding the role that such ideas or beliefs play in guiding our practical interactions with the world does not *compete* with the possibility that those same ideas and beliefs might “correspond to” or “agree with” reality. What they argued instead was that such verbal formulae serve simply to mask or even obscure the need for investigating, as William James was fond of putting the point, what truth is “known-as.” Such pragmatists held that “truth” is simply the name we give to what *works* for us in the cognitive arena, to the beliefs, ideas, theories, or other cognitions that do or would enable us to most effectively and efficiently satisfy our needs and realize our practical goals, whether or not we have yet managed to identify which particular cognitions those are. The verbal formula of “correspondence to” or “agreement with” reality certainly represents another way to pick out such ideas and beliefs, but it is extraordinarily misleading and unhelpful as a philosophical *theory* of truth because it makes a mystery out of both the nature of and our access to this supposed “correspondence” and, in the process, serves to obscure the central roles that thinking and talking about truth and falsity actually play in our cognitive engagement with the world. Such pragmatists argued that what we point to as evidence of the falsity of a belief invariably turns out to be one or more ways in which it fails to fully satisfy one or more of an extremely broad spectrum of our practical needs, concerns, and interests, including the need to effectively integrate that belief with others to guide our actions. Thus, when James famously argues that “the true” is only the expedient in our way of thinking, he hastens to add

expedient in almost any fashion; and expedient in the long run and on the whole, of course; for what meets expediently all the experience in sight won't necessarily

meet all further experiences equally satisfactorily. Experience, as we know, has ways of *boiling over*, and making us correct our present formulas. ([1907] 1978, 106)

Accordingly, true beliefs are not those that correspond to states of the world that are somehow independent of how we conceive of or conceptually engage with it (a correspondence whose very intelligibility seems open to question) but are instead those that correspond to the members of a privileged collection of beliefs that are specified or picked out in a distinctive way. Just how this privileged collection should be picked out was a matter of considerable and enduring controversy: C. S. Peirce suggested, for instance, that it was those that would be embraced by an ideal set of inquirers at the end of an idealized inquiry, whereas James himself held that it was the set of beliefs that no further experience would ever incline us to abandon. But, most fundamentally, pragmatists regarded the truth or falsity of any given belief as a matter of the correspondence between that belief and the members of a set of such beliefs that would maximally satisfy our embedded, situated, and unavoidably human needs and desires rather than the match between that belief and some raw, unconditioned, or unconceptualized reality. Of course, the pragmatists' philosophical opponents immediately accused them of simply conflating what is useful or pleasing to us in the way of belief with what is true, and the rest is history.

2 INSTRUMENTALISM GOES LOCAL: DEBATES CONCERNING SCIENTIFIC REALISM

Note that this pragmatist version of instrumentalism is a global doctrine: it asserts a distinctive view of ideas, beliefs, concepts, and the like *in general*. But some philosophers have been strongly attracted by the idea that we might embrace more *local* versions of the fundamental instrumentalist conception of cognitive entities or states, seeing it or something very like it as articulating the right view to take of just some specific class or category of those entities and states. In particular, the idea of embracing a localized form of instrumentalism has been persistently attractive to critics of the “scientific realist” view that the incredible practical and epistemic achievements of our best scientific theories should lead us to think that those theories must be at least probably and/or approximately true. Debates concerning scientific realism are as old as science itself, but in our own day those who resist such realism are typically (although not especially helpfully) characterized as “antirealists.” This heterogeneous category includes a motley collection of suspicious characters, undesirables, and degenerates with a wide variety of grounds for doubting whether we should or must join the realist in regarding even our best scientific theories as even approximately true. But prominent among them are what I will call “scientific instrumentalists” who argue that we

should instead regard *scientific theories in particular* merely as powerful cognitive instruments or tools.

The influential attempts of logical positivist and logical empiricist thinkers to articulate such scientific instrumentalism in the early and middle decades of the twentieth century often did so by proposing a distinctive analysis of the semantic content or role of theoretical discourse in science. Ernst Mach suggested, for example, that the point of such theoretical discourse was simply to “replace, or *save*, experiences, by the reproduction and anticipation of facts in thought” ([1893] 1960, 577), and a law of nature such as Snell’s “law of refraction is a concise, compendious rule, devised by us for the mental reconstruction of” large numbers of such observable facts or experiences ([1893] 1960, 582). The early Rudolph Carnap argued explicitly that the very meaning of theoretical scientific claims was simply exhausted by what we usually think of as the observable implications of those claims, and he devoted considerable effort and ingenuity to the attempt to actually carry out a convincing general reduction of the language of theoretical science to such a privileged phenomenological or observational basis. But these efforts rapidly encountered a daunting collection of both technical and philosophical obstacles, and this reductive project was ultimately abandoned even by its original architects including, most influentially, Carnap himself.

Later logical empiricist thinkers would respond to the failure of this attempted reduction by proposing alternative forms of scientific instrumentalism that nonetheless persisted in attributing a distinctive semantic role or linguistic function specifically to the claims of theoretical science. One particularly influential such alternative proposed, for example, that theoretical scientific claims were not even *assertoric*, insisting that such claims instead functioned simply as “inference tickets” allowing us to infer some observable states from others (or the truth of some observational claims from others), rather than themselves asserting anything at all or (therefore) even possessing truth values. Ernst Nagel famously argued, however, that this somewhat desperate semantic maneuver simply eviscerated any distinction between scientific realism and instrumentalism, suggesting that there was a “merely verbal difference” between the claim that a theory functions as a reliable “inference ticket” between some observable states and others and the supposedly competing realist contention that the theory in question is simply true (1961, 139).

Another alternative sought to avoid such counterintuitive construals of the semantic content of theoretical claims by proposing instead that although such claims are genuinely assertoric and their meaning is not reducible to that of claims about observations or observation statements, they can nonetheless be eliminated without loss from our scientific discourse. This proposal was supported by an influential theorem of William Craig (1953) showing that if we start with any recursively axiomatized first-order theory (T) and an effectively specified subvocabulary of that theory (O) that is exclusive of and exhaustive with the rest of the theory’s vocabulary, we can then effectively construct a further theory (T’) whose theorems will be all and only those of the original theory containing no nonlogical expressions in addition to those in the specified subvocabulary.

As Carl Hempel went on to point out in connection with his influential “theoretician’s dilemma,” if we restrict the relevant subvocabulary of T to its “observational” terms, Craig’s Theorem thus establishes that there is a “functionally equivalent” alternative to T that eliminates all nonobservational vocabulary but nonetheless preserves any and all deductive relationships between observation sentences expressed by T itself. In that case, Hempel noted, “any chain of laws and interpretive statements establishing [definite connections among observable phenomena] should then be replaceable by a law which directly links observational antecedents to observational consequents” (Hempel [1958] 1965, 186).

The significance of this result was immediately challenged, however, once again most famously by Ernst Nagel, who pointed out that the axioms of any such “Craig-transform” T’ would be infinite in number (no matter how simple the axioms of T), would correspond one-to-one with all of the true statements expressible in the language of T, and could actually be constructed only after we already knew all of those true statements expressible using the restricted observational subvocabulary of T. In more recent decades, the challenges facing such semantic and/or eliminative forms of instrumentalism have only increased in severity and number: philosophers of science have come to recognize an increasingly wide range of profound differences between actual scientific theories and the sorts of axiomatic formal systems to which tools like Craig’s Theorem can be naturally applied, and such phenomena as the “theory-ladenness of observation” have generated considerable skepticism regarding any attempt to divide the language or vocabulary of science into “theoretical” and “observational” categories in the first place.

Although this history makes the prospects for attempting to develop scientific instrumentalism by means of a distinctive semantic or eliminative analysis of the theoretical claims of science appear exceedingly dim, this strategy always represented just one possible way of articulating the fundamental instrumentalist idea that our best scientific theories are cognitive tools or instruments rather than accurate descriptions of otherwise inaccessible domains of nature. More recently, philosophers of science attracted by this fundamental idea have largely abandoned dubious proposals concerning the meaning of our theoretical discourse or the eliminability of that discourse from science altogether and instead tried to develop scientific instrumentalism by suggesting that although the claims of our best scientific theories mean just what they seem to and cannot be eliminated from science, we nonetheless do not have sufficient grounds for *believing* many of those claims when they are so regarded. That is, whether motivated by pessimistic inductions over the history of science, worries about the underdetermination of theories by the evidence, or something else altogether, such distinctively *epistemic* versions of scientific instrumentalism argue that we need not *believe* everything that our best scientific theories (really do) say about the world in order to use them effectively as tools for navigating that world and guiding our practical interactions with it. (For a broad discussion of the most influential motivations for such epistemic instrumentalism, see Stanford [2006, chap. 1].)

Such epistemic scientific instrumentalists cannot, however, see themselves as simply applying the pragmatist’s global instrumentalist attitude in a more local or restricted

way. The global instrumentalist holds that cognitive entities like ideas and theories are best conceived *quite generally* as tools or instruments we use to make our way in the world, and she insists that this conception does not compete with the possibility that those same cognitive entities might be true. By contrast, the epistemic scientific instrumentalist *denies* that the admittedly instrumentally useful theories of contemporary science are also true, or at least that we have rationally compelling reasons for believing that they are (a subtlety I will henceforth leave aside for ease of exposition)—indeed, it is the scientific *realist* who holds that many or all of the theories of contemporary science are *both* instrumentally powerful *and* (at least approximately) true! Thus, where the global instrumentalist could happily concede that many of the beliefs concerning which she advocated her instrumentalism could also be correctly (although less helpfully) characterized as “corresponding to the world” or “agreeing with reality,” the epistemic scientific instrumentalist insists instead that we should think of a particular set of our scientific beliefs simply as useful tools or instruments rather than thinking that they are true, and therefore the scientific instrumentalist cannot accept the global instrumentalist’s view that the correspondence formula is simply an especially unhelpful or obscure way to pick out the most instrumentally powerful of these ideas or claims.

It would seem, then, that the epistemic scientific instrumentalist must face a question that simply never arose for the global instrumentalist: she will have to identify precisely *which* ideas, claims, or theories are those she regards as *merely* instrumentally useful rather than also corresponding to or agreeing with reality. But it might also seem that she has a natural and obvious response to this demand: after all, she is a *scientific* instrumentalist, so she might suggest that it is all and only the claims of *science* that she regards as merely instrumentally useful in this way. Unfortunately, this proposal cannot pick out the class of claims toward which she advocates her distinctive epistemic form of instrumentalism because that very instrumentalism recommends that we make effective use of our best scientific theories in practical contexts, and it would seem that to do so *just is* to believe at least some of what they tell us about the world. That is, it would seem that when we put our best scientific theories to good instrumental use we do so *by* believing the claims they make concerning such matters as how much fuel the rocket will need to reach orbit, which drug will prevent transmission of the disease, and how existing weather patterns will change in response to global warming. The epistemic scientific instrumentalist therefore cannot regard the claims of science generally as merely instrumentally useful because she cannot make effective instrumental use of her best scientific theories without simply believing at least some of what they say about the world to be true.

Recognizing this problem suggests a natural refinement of this proposal, however. We might suggest instead that epistemic scientific instrumentalists accept the *predictions* and *recipes for intervention* offered by our best scientific theories, but not the *descriptions* of otherwise inaccessible parts of nature that they offer. Indeed, this proposal seems to capture the broad flavor of a number of prominent and influential forms of epistemic scientific instrumentalism. Thomas Kuhn famously denies, for example, that successive theoretical representations of some natural domain provide “a better

representation of what nature is really like,” but nonetheless holds that a later theory will typically be “a better instrument for discovering and solving puzzles,” offering more impressive “puzzle-solutions and . . . concrete predictions” ([1962] 1996, 206) than its historical predecessors. Similarly, Larry Laudan argues that the scientific enterprise is progressive because our theories improve over time in their ability to solve empirical and conceptual problems, but he nonetheless forcefully denies that this is because such theories are more closely approximating the truth about nature itself (1977, 1996). And Bas van Fraassen’s influential constructive empiricism (1980) holds that we should take our best scientific theories to be “empirically adequate,” meaning simply that the claims they make about observable matters of fact are true. To whatever extent solving Kuhn’s puzzles, addressing Laudan’s problems, or exhibiting van Fraassen’s empirical adequacy involve predicting and intervening in the world around us, these suggestions would seem to embody the broad idea that what we should believe are the predictions and recipes for intervention provided by our best scientific theories but not the descriptions of otherwise inaccessible parts of nature that they offer.

Notwithstanding the widespread intuitive appeal of this proposal, however, it likewise fails to distinguish those claims that the epistemic scientific instrumentalist regards as merely instrumentally useful from those that she instead believes to be true. One important reason for this failure is that many of what we regard as a scientific theory’s empirical predictions simply are descriptive claims about parts or aspects of nature that are difficult to investigate directly, a problem articulated in a characteristically elegant and enigmatic way by Howard Stein in paraphrasing Eugene Wigner’s observation that one also “uses quantum theory, for example, to calculate the density of aluminum” (1989, 49). To illustrate Stein’s point using a different example, we might note that some contemporary cosmological theories seek to explain the present rate of expansion of the universe by positing a field of “dark energy,” and among the most important predictions they make are those that specify the characteristics of that hypothesized field. Perhaps even more importantly, however, the predictions and recipes for intervention generated by our best scientific theories concerning perfectly familiar entities and events like eclipses, earthquakes, and extinctions are made using precisely the same descriptive apparatus with which those theories characterize the world more generally. That is, what our best scientific theories actually predict are such phenomena as the occlusion of one celestial body by another, the shifting of the Earth’s tectonic plates, or the elimination of all organisms belonging to a particular phylogenetic group, and such predictions cannot be treated as having a more secure claim to truth than the relevant theory’s own description of nature. If we do not believe what a theory says earthquakes or eclipses are, how are we to even understand its predictions concerning when and where the next earthquake or eclipse will occur? Nor is it open to us to try to evade the problem by seeking to couch our predictions and recipes for intervention in a mythical “observation language” of instrument-needle readings and colored patches in the visual field supposedly devoid of any theoretical commitment whatsoever. Not only did the attempt to articulate or develop such a pure language of observation come to ruin (see earlier discussion), but even if we had such a language it would not suffice to characterize the earthquakes,

eclipses, extinctions, and wide range of further empirical phenomena with respect to which the instrumentalist herself takes our best scientific theories to serve as effective tools for prediction and intervention.

It thus turns out to be considerably more difficult than we might have initially suspected for the epistemic scientific instrumentalist to specify just those claims she regards as merely instrumentally useful rather than true. But even if this problem can somehow be solved, another looms that would seem at least as difficult to surmount because critics of epistemic scientific instrumentalism have repeatedly suggested that there is simply no room to distinguish a sufficiently sophisticated commitment to the instrumental utility of our best scientific theories across the full range of instrumental uses to which we put them from the realist's own commitment to the truth of those same theories. Thus, to convince us that she is offering a coherent and genuinely distinct alternative to scientific realism, it seems that the epistemic scientific instrumentalist will have to be able to precisely specify not only which scientific claims are those toward which she adopts an instrumentalist attitude, but also what difference it makes for her to be an instrumentalist rather than a realist concerning those claims. The next section will examine this latter demand in greater detail before I go on to suggest that both of these foundational challenges can indeed be overcome if the epistemic scientific instrumentalist avails herself of what might seem a surprising source of assistance in characterizing the distinctive attitude she recommends toward some of even the most successful contemporary scientific theories.

3 FACING THE MUSIC: WHAT DIFFERENCE DOES IT MAKE?

The need for the scientific instrumentalist to clearly articulate the difference between regarding a given scientific claim or theory as a useful tool or instrument and simply believing that same claim or theory to be true arises largely in response to the persistent suggestion that any apparent substantive difference between these two possibilities simply dissolves under further scrutiny. Earlier, we saw Nagel raise this charge against the “inference ticket” version of semantic scientific instrumentalism popular with many of his contemporaries, but much the same criticism has been raised against epistemic versions of scientific instrumentalism as well. Paul Horwich (1991), for example, points out that some philosophical accounts of the nature of belief simply characterize it as the mental state responsible for use, and he suggests that epistemic instrumentalists are not entitled to conclude that their own position is really any different from that of their realist opponents until they show why such accounts of belief itself are mistaken. A much more detailed argument is offered by Stein (1989), who argues that once we refine both realism and instrumentalism in ways that are independently required to render them at all plausible in the first place, no room remains for any real difference between the

resulting positions. He proposes that realists must give up both the idea that scientific theorizing can achieve reference or truth of any metaphysically transcendent or noumenal variety and the idea that any property of a scientific theory can explain its empirical success without simply describing the uses to which the theory itself has been put. For their part, he argues, instrumentalists must recognize that the instrumental functions of a scientific theory include not only calculating experimental outcomes but also representing phenomena adequately and in detail throughout the entire domain of nature to which that theory can be usefully applied and (especially) serving as our primary resource for further extending our inquiry into that domain successfully. But, he suggests, this process of sophisticating realism and instrumentalism in ways that are independently required to make each view plausible or appealing simultaneously eradicates any substantive difference between them.

The most detailed and systematic version of this challenge, however, is offered by Simon Blackburn (1984, 2002), who uses Bas van Fraassen's (1980) influential constructive empiricism as his representative form of scientific instrumentalism. Instead of believing our best scientific theories to be true, van Fraassen's constructive empiricist instead simply "accepts" them as "empirically adequate," which is to say that she believes their claims concerning observable matters of fact while remaining agnostic concerning their further claims regarding the unobservable. Blackburn quite rightly points out, however, that the acceptance van Fraassen recommends involves much more than simply using theories to predict observable outcomes:

The constructive empiricist is of course entirely in favor of scientific theorising. It is the essential method of reducing phenomena to order, producing fertile models, and doing all the things that science does. So we are counselled to *immerse* ourselves in successful theory. . . . Immersion will include acceptance as empirically adequate, but it includes other things as well. In particular it includes having one's dispositions and strategies of exploration, one's space of what it is easy to foresee and what difficult, all shaped by the concepts of the theory. It is learning to speak the theory as a native language, and using it to structure one's perceptions and expectations. It is the possession of habits of entry into the theoretical vocabulary, of manipulation of its sentences in making inferences, and of exiting to empirical prediction and control. Van Fraassen is quite explicit that all of this is absolutely legitimate, and indeed that the enormous empirical adequacy of science is an excellent argument for learning its language like a native. . . . Immersion, then, is belief in empirical adequacy plus what we can call being "functionally organized" in terms of a theory. (Blackburn 2002, 117–119)

Blackburn thus sees van Fraassen's enthusiasm for our "immersion" in our best scientific theories as seeking to capture the wide and heterogeneous range of ways in which we make effective instrumental use of those theories, just as Stein suggested we must in order to render any form of scientific instrumentalism attractive. Like Stein, however, Blackburn further suggests that once the full range of such instrumentally useful functions is recognized, no room remains for any substantive difference between the

constructive empiricist's "immersion" in or "animation" by our best scientific theories and the scientific realist's own commitment to the truth of those same theories:

The problem is that there is simply no difference between, for example, on the one hand being animated by the kinetic theory of gases, confidently expecting events to fall out in the light of its predictions, using it as a point of reference in predicting and controlling the future, and on the other hand believing that gases are composed of moving molecules. There is no difference between being animated by a theory according to which there once existed living trilobites and believing that there once existed living trilobites. . . . What can we do but disdain the fake modesty: "I don't really believe in trilobites; it is just that I structure all my thoughts about the fossil record by accepting that they existed"? (Blackburn 2002, 127–128)

Here, Blackburn articulates the central challenge in an especially perspicuous way: once instrumentalists like van Fraassen have formulated the acceptance of, immersion in, or animation by a scientific theory in a way that recognizes the full range of useful instrumental functions that such theories perform for us, how will the acceptance, immersion, or animation they recommend be any different from simply believing those same theories to be true?¹

Blackburn goes on to argue that although there are indeed genuine forms of variation in the character of our embrace of particular scientific theories that might seem to be appealing candidates for capturing the contrast between realist and instrumentalist commitments, none of these is available to van Fraassen to use in distinguishing the constructive empiricist's attitude from that of her realist counterpart. We might naturally distinguish, for example, the past and present empirical adequacy of a theory from its complete or total empirical adequacy, but van Fraassen's fully immersed constructive empiricist is no less committed to the ongoing or future empirical adequacy of a theory she accepts than she is to its past and present empirical adequacy. Although we might well have reasons to doubt that some particular theory that has been empirically adequate to date will remain so in the future, any room we recognize for drawing such a distinction will have to be reconstructed from *within* the constructive empiricist's own more general commitment to the empirical adequacy of the theories she accepts and therefore cannot constitute the *difference* between the constructive empiricist's commitments and those of her realist opponent. And the same would seem to apply to any potential variation in our commitment to the *ongoing* ability of a given scientific theory to solve Kuhn's puzzles or Laudan's empirical and theoretical problems.

¹ At times, van Fraassen seems to suggest that such "immersion" is required only for working scientists themselves, rather than for philosophical interpreters of scientific activity. But he nonetheless insists that such immersion remains perfectly consistent with adopting the constructive empiricist's instrumentalism, arguing that even the working scientist's "immersion in the theoretical world-picture does not preclude 'bracketing' its ontological implications" (1980, 81). Moreover, many aspects of the immersion van Fraassen recommends to working scientists are matters on which the philosophical interpreter cannot afford to remain agnostic in any case, such as the propriety of using a theory as the foundation for our further investigation.

Similarly, although it is perfectly natural to contrast full and unreserved acceptance of a theory with acceptance in a more cautious or tentative spirit, Van Fraassen's fully immersed constructive empiricist embraces a given scientific theory's empirical adequacy no less fully or confidently than the realist embraces its truth, so this sort of difference between more and less cautious acceptance cannot be what distinguishes realism from constructive empiricism. That is, the constructive empiricist does not believe any less confidently than the realist, but instead believes with equal confidence only a theory's claims about observable phenomena. Once again, although we might well have good reasons to embrace *either* the truth *or* the empirical adequacy of some particular theory with varying degrees of confidence, any such room for variation in the strength of our conviction would have to be recognized from *within* both the realist's and constructive empiricist's respective forms of commitment to a theory (i.e., to all of its claims or only to its claims about observable phenomena) and therefore cannot constitute the difference between them. And, once again, it seems that we will need to recognize the same room for variation in the degree or extent of our confidence in a theory's ability to solve Kuhnian puzzles or Laudanian problems.

It would seem, then, that epistemic forms of scientific instrumentalism face formidable obstacles not only, as we saw earlier, in precisely specifying those claims toward which such an instrumentalist attitude is appropriate, but also in recognizing the full range of ways in which we rely on our best scientific theories instrumentally without simply collapsing any distinction between such an instrumentalist attitude and realism itself. I now want to propose, however, that by taking advantage of what might seem a surprising source of assistance, the epistemic scientific instrumentalist can articulate the difference between the realist's epistemic commitments and her own in a way that addresses both of these fundamental challenges in a convincing fashion.

4 SINGING A DIFFERENT TUNE: SCIENTIFIC REALISM AND INSTRUMENTALISM REVISITED

We might begin by noting that the fundamental idea that some scientific theories are useful conceptual instruments or tools despite not being even approximately true is one that the scientific realist needs no less than the instrumentalist; after all, this represents the realist's *own* attitude toward a theory like Newtonian mechanics. That is, the realist flatly rejects the claims of Newtonian mechanics concerning the fundamental constitution and operation of nature: she denies that space and time are absolute, she denies that gravitation is a force exerted by massive bodies on one another, and so on. But she knows perfectly well that we routinely make use of Newtonian mechanics to send rockets to the moon and, more generally, to make predictions and guide our interventions concerning the behavior of billiard balls, cannonballs, planets, and the like under an extremely wide (although not unrestricted) range of conditions.

We might begin by asking, then, what the realist means when she herself claims that Newtonian mechanics constitutes a useful conceptual tool or instrument that is not even approximately true. The answer, presumably, is that although she does not accept the theory's account of the fundamental constitution of nature, she nonetheless knows how to apply the theory just as a true believer would to a wide range of entities and phenomena whose existence she thinks can be established and that she thinks can be accurately characterized in ways that simply do not depend on Newtonian mechanics itself. That is, she can make use of other theories that she *does* regard as accurately describing the physical domain, as well as her own perceptual experience and perhaps other epistemic resources besides, to generate an *independent* conception of the billiard balls, cannonballs, and rockets to which she can then apply Newtonian mechanics, deploying the theoretical machinery of masses, forces, inelastic collisions, and the like to guide her prediction and intervention with respect to those independently characterized entities, processes, and phenomena. Such phenomena need not be observable, of course, as she knows how a Newtonian would characterize subatomic particles and their gravitational attractions in terms of masses and forces just as well as billiard balls and planets. And over *whatever* domain she believes the theory to be an instrumentally reliable conceptual tool, she can apply it just as a Newtonian would to guide her prediction and intervention concerning such *independently characterized* entities, events, and phenomena while nonetheless insisting that the theoretical description Newtonian mechanics gives of those entities, events, and phenomena is not even approximately true.

Indeed, the realist presumably takes this very same attitude toward other empirically successful theories of past science that are fundamentally distinct from contemporary theoretical orthodoxy. Of course, in the case of Newtonian mechanics, she can specify quite precisely just where she expects Newtonian mechanics to fail in application (and by how much), but this feature of the example is incidental, as is the fact that Newtonian mechanics is still actually used in a wide variety of engineering and practical contexts. What matters is that the realist herself regards Newtonian mechanics as a practically useful cognitive tool or instrument despite not being even approximately true, and it seems that she must regard this as an apt characterization of other empirically successful past theories that have been subsequently abandoned, whether or not they are still actually used and whether or not she can specify with mathematical precision what she expects the limits of the range or extent of their instrumental utility to be.

But, of course, this very same strategy is available to the scientific instrumentalist for characterizing her own attitude toward those theories she regards as “mere instruments.” She, too, can characterize billiard balls, cannonballs, and planets and form straightforwardly factual beliefs about them by relying on whatever sources of information she has concerning them that are simply independent of Newtonian mechanics or any other theory toward which she adopts an instrumentalist stance. At a minimum, of course, she can rely on the evidence of her senses concerning such entities and phenomena. But, crucially, the same strategy remains open to her even if she accepts W. V. O. Quine's influential suggestion that the familiar middle-sized objects of our everyday experience are no less “theoretical” entities hypothesized to make sense of the ongoing stream of

experience around us than are atoms and genes and that it is only by “the positing of the bodies of common sense” ([1960] 1976, 250) that we come to have any coherent picture of the world around us in the first place. If so, the instrumentalist will then simply need to decide just *which* theories are those toward which she will adopt an instrumentalist attitude, and the characteristics relevant to making this determination will surely depend on the more general reasons she has for adopting an instrumentalist attitude toward some or all of even our best scientific theories in the first place. If Quine is right, it may well be that a localized instrumentalism concerning any and all “theories” whatsoever is not a coherent possibility, but the epistemic scientific instrumentalist remains free to commit herself to realism concerning some theories (e.g., the hypothesis of the bodies of common sense) and instrumentalism concerning others in just the same way we found necessary in order to make sense of the realist’s own commitments.

These reflections suggest that it was a mistake all along not only to hold the epistemic scientific instrumentalist responsible for defending the coherence of some exotic and unfamiliar cognitive attitude that she alone adopts toward a subset of scientific claims, but also to think of her as adopting this attitude toward any and all theories or theoretical knowledge as such. *Both* realists and instrumentalists regard some theories (e.g., the hypothesis of the bodies of common sense) as providing broadly accurate descriptions of entities and events in the natural world, and both regard some theories (e.g., Newtonian mechanics) merely as useful instruments for predicting and intervening with respect to entities, events, and phenomena as they can be characterized independently of those very theories. The thinkers we have traditionally called “instrumentalists” have simply been those prepared to take the latter attitude toward a much wider range of theories than their “realist” counterparts, including most saliently those contemporary scientific theories for which we are not currently in a position to articulate even more instrumentally powerful successors. That is, we have tended to reserve the term “instrumentalist” for someone who is willing to regard even an extremely powerful and pragmatically successful theory as no more than a useful instrument even when she knows of no competing theory that she thinks does indeed represent the truth about the relevant natural domain. But we all take instrumentalist attitudes toward some theories and not others, and it is the very same attitude that the realist herself adopts toward Newtonian mechanics (and other instrumentally powerful past scientific theories) that the instrumentalist is putting into wider service: scratch a scientific realist and watch an instrumentalist bleed!

In some cases, of course, scientific theories posit the existence of entities, processes, or phenomena to which we simply have no routes of epistemic access that are independent of the theory itself. For example, contemporary particle physics does not allow quarks to be isolated and therefore posits “gluons” to bind quarks within a proton, but our only point of epistemic contact with gluons or reason for thinking that they exist is the theory’s insistence that *something* must play this role. Accordingly, an instrumentalist concerning particle physics will not believe any of its substantive claims concerning the existence and/or properties of gluons, although she will nonetheless typically be willing to make use of many of those claims in the course of arriving at new beliefs concerning

entities, processes, and phenomena that she can characterize in ways that do not depend on contemporary particle physics or any other theories toward which she adopts an instrumentalist attitude.

Accordingly, although this account neither appeals to a mythical observation language devoid of any theoretical commitment whatsoever nor ascribes any foundational epistemic role to observability as such, it nonetheless recognizes that the empiricist's cherished epistemic resources of observation and perception more generally will often figure prominently among the ways we characterize those entities, processes, and phenomena (like earthquakes, eclipses, or extinctions) concerning which we think a given scientific theory is able to provide effective instrumental guidance. On this view of the matter, a scientist who finds a new way of detecting entities or phenomena posited by a theory, of creating them in the laboratory, or of demonstrating their causal influence on other entities or phenomena has achieved something extremely important even by the lights of those who are instrumentalists concerning the theory in question, for she has expanded the range of *independent* empirical phenomena concerning which we may regard that theory as an effective guide to prediction and intervention, sometimes in ways that are largely of theoretical interest and sometimes in ways that serve as the foundation for extraordinary technological and practical achievements. Thus, the tracks in a cloud chamber, the patterns on an electrophoresis gel, and the distinctive sour taste ascribed to acids by early chemists are all phenomena whose existence and central features can be characterized in ways that are, although not free of any theoretical commitments altogether, nonetheless independent of the commitments of the particular theories in whose terms scientific realists interpret them. If we are instead instrumentalists concerning any or all of those theories, these points of epistemic contact will help *constitute* our independent epistemic grasp of the entities, events, and phenomena concerning which we think the theory in question offers effective prediction, intervention, and instrumental guidance quite generally.

It is not hard to imagine, however, an objector who insists that a subtle incoherence lurks at the heart of the proposed parallel between the epistemic scientific instrumentalist's attitude toward some of even the most successful contemporary scientific theories and the realist's own attitude toward a theory like Newtonian mechanics. In the latter case, she might suggest, the merely instrumental character of the realist's commitment to the theory simply *consists in* her unwillingness to make use of Newtonian mechanics with unrestricted scope. She will instead use theories like general and special relativity to make predictions and guide her interventions when even very small errors might be consequential, in cases where the approximate predictive equivalence of the two theories is either unknown or is known to fail, and to ground her further theoretical investigation and exploration of the relevant natural domain. But such restrictions of scope cannot capture the difference between realism and instrumentalism regarding the best of our own contemporary scientific theories because, in such cases, we do not have any competing theory to whose truth (or even just general applicability) we are more fully committed that we might fall back to in these ways and/or under these circumstances. Thus, the objection goes, an instrumentalist attitude characterized by means of such a

parallel will once again simply collapse back into realism itself in just those cases that actually divide scientific realists and instrumentalists.

This suggestion, however, ignores further crucial differences between the scientific realist's attitude toward the most powerful and successful theory we have concerning a given domain of nature and the form that even an extremely robust commitment to the mere instrumental utility of that same theory might take. Consider, for example, those scientific instrumentalists whose conviction is inspired in one way or another by reflection on the historical record of scientific inquiry itself. Such instrumentalists typically do *not* share the realist's expectation that the most powerful and successful theory we now have concerning a given domain of nature will retain that position indefinitely as our inquiry proceeds. Instead, such an instrumentalist expects that, in the fullness of time, even that theory will ultimately be replaced by a fundamentally distinct and still more instrumentally powerful successor that she is in no position to specify or describe in advance.

This expectation is, of course, connected to the two grounds we saw Blackburn recognize as intuitively plausible candidates for the difference between realism and instrumentalism that he argued were simply not available to van Fraassen's constructive empiricist: the distinction between a theory's empirical adequacy to date and its final or complete or future empirical adequacy and the distinction between embracing a theory fully and without reservation and embracing it in a more tentative or cautious spirit. Blackburn argued (quite rightly) that van Fraassen cannot characterize his constructive empiricist's instrumentalism in these terms because the constructive empiricist is no less committed to a theory's future empirical adequacy than to its past and present empirical adequacy, and she embraces this complete empirical adequacy of the theory (i.e., the truth of its claims about observable states of affairs) with no less confidence or conviction than the realist embraces its truth simpliciter; but the historically motivated scientific instrumentalist we are now considering simply does not share these commitments. She fully expects even the best conceptual tool we currently possess for thinking about a given natural domain to be ultimately discovered not to be fully empirically adequate and/or for future inquirers to eventually replace that tool with another that is even more instrumentally powerful and yet distinct from it in ways sufficiently fundamental as to prevent that successor from being counted as simply a more sophisticated, more advanced, or more completely developed version of existing theoretical orthodoxy. This instrumentalist's commitment to the ongoing instrumental utility of our best current theory is therefore *not* a commitment to its complete and total instrumental utility, and it is indeed systematically more cautious and tentative than that of the realist who believes that the theory itself is at least approximately true and therefore will not ultimately be replaced in this manner.

Blackburn may be right, then, to suggest that there is no room for a difference between van Fraassen's constructive empiricism and realism itself, but the grounds on which he rests this judgment help us to see why there are indeed profound differences between the provisional embrace of even the most powerful and impressive scientific theory we have concerning a given natural domain by a more historically motivated

form of scientific instrumentalism and the scientific realist's own attitude toward that same theory. Moreover, these differences in turn produce a further and equally profound divergence concerning the actual pursuit of scientific inquiry itself: a scientific instrumentalist of this historically motivated variety will be systematically more sanguine than her realist counterpart concerning the investment of time, attention, energy, taxpayer dollars, and other limited resources in attempts to discover and develop theoretical alternatives that diverge in fundamental ways from or even directly contradict the most powerful and impressive scientific theory we have in a given natural domain. Although the realist might encourage such exploration as a way of further developing our current theory in an existing domain, the prospect that such exploration and development will actually discover a fundamentally distinct alternative theory that ultimately overturns or replaces current theoretical orthodoxy is one that it seems she must regard as remote. The instrumentalist thus has all the same motivations that the realist has for investing in the search for fundamentally distinct and even more instrumentally powerful successors to our best scientific theories and at least one more that is far more compelling: in stark contrast to the realist, she fully expects this search to ultimately attain its intended object. Such an instrumentalist does not say, with Blackburn, "I don't really believe in genes, or atoms, or gluons; it is just that I structure all my thoughts by accepting that they exist." Her thoughts, her expectations, and even her pursuit of scientific inquiry itself are all structured quite differently than they would be if she believed that our best current theories of inheritance or of the minute constitution of matter were even approximately true.

5 CONCLUSION: REPRISE AND CODA

We may now return at long last to the two fundamental challenges that it seemed any epistemic version of scientific instrumentalism must face: the need to specify precisely which claims are those toward which it recommends an instrumentalist attitude and the need to articulate how adopting such an attitude toward any given scientific theory would substantially differ from the realist's own belief in the truth of that same theory. We have just seen how the second of these challenges can be answered by recognizing that epistemic scientific instrumentalists are simply adopting the same attitude that the realist herself takes toward a theory like Newtonian mechanics toward a much wider range of theories than realists themselves do, including some or all of the most instrumentally powerful and successful theories of contemporary science. But seeing how this challenge can be met makes clear that it was unnecessary (and perhaps always hopeless) to try to *divide* the claims of any given scientific theory into those we must believe in order to make effective instrumental use of that theory and those we need not. This is certainly not what the realist does in the case of Newtonian mechanics. Instead, she treats that theory as a mere tool or instrument for predicting and intervening with respect to entities, events, and phenomena as they can be conceived in ways that do not depend on Newtonian mechanics

itself, thus making use of not only the evidence of her senses but also of other theories concerning which she is not an instrumentalist (such as the hypothesis of the bodies of common sense, among others). Thus, it is always with respect to some independent conception of the world and its inhabitants that a scientific theory that is a “mere” conceptual tool or instrument exhibits its (sometimes remarkable) instrumental utility, and this simply does not require that the constituent claims of that theory should or even can be neatly separated into distinct categories consisting of those we must believe in order to make effective instrumental use of the theory and those we need not.

I conclude by pointing out the coherent (perhaps even attractive) possibility of combining such localized epistemic scientific instrumentalism with the global or pragmatic variety with which we began. Someone holding this distinctive combination of views would share the global instrumentalist’s insistence that ideas, beliefs, theories, and cognitive entities or states *quite generally* are tools or instruments for accomplishing the full range of our practical and pragmatic goals as effectively and efficiently as possible, and she will agree that this characterization simply does not compete with thinking of some of those same beliefs or cognitive states as also corresponding to or accurately describing the world itself. However, she will also deny that some of even the best scientific theories of our own day in fact correspond to or agree with reality in this way, meaning simply that she doubts that these particular theories will or would persist throughout the entire course of further inquiry. Although she grants that our current theory concerning some particular scientific domain represents the best cognitive or conceptual tool we presently have for guiding our prediction, intervention, and other practical engagement with entities, events, and phenomena in that domain, she nonetheless fully expects that cognitive tool to be replaced in the course of further inquiry by other, even more empirically impressive and instrumentally powerful successors that are fundamentally distinct from it. That is, she thinks that any such theories will not or would not ultimately be retained in the description of nature adopted by idealized inquirers at the end of a suitably idealized inquiry (Peirce), the set of beliefs that no further experience would lead us to abandon if we adopted it now (James), or in whatever way her favored version of global instrumentalism picks out the special class of beliefs constituting the truth about the world, and, by her lights, this is just what it is for such theories to turn out not to be true. Thus, although global and scientific instrumentalism are distinct and separable views, their combination holds evident attractions for those who find themselves with deep reservations about both the coherence of the classical scientific realist’s correspondence conception of truth *and* her conviction that the most empirically successful and instrumentally powerful scientific theories of the present day are or must be at least probably, approximately true.

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