

References

- Boyd, R. 1973. "Realism, Underdetermination and a Causal Theory of Evidence." *Nous* 7: 1–12.
- . 1979. "Metaphor and Theory Change." In *Metaphor and Thought*, edited by A. Ortony, 356–408. Cambridge: Cambridge University Press.
- . 1981. "Scientific Realism and Naturalistic Epistemology." In *PSA 1980*, vol. 2, edited by P. D. Asquith and R. N. Giere, 613–62. East Lansing, Mich.: Philosophy of Science Association.
- . 1983. "On the Current Status of the Issue of Scientific Realism." *Erkenntnis* 17: 135–69.
- Buchberger, M., ed. 1954. *Lexikon für Theologie und Kirche*. Freiburg.
- Darwin, C. 1859. *On the Origin of Species by Means of Natural Selection*. London: John Murray.
- Demopoulos, W. 1982. Review of *The Scientific Image*, by Bas C. van Fraassen. *Philosophical Review* 91: 603–7.
- Fine, A. 1984. "The Natural Ontological Attitude." In *Essays on Scientific Realism*, edited by J. Leplin.
- Goodman, N. 1973. *Fact, Fiction and Forecast*. 3d ed. Indianapolis and New York: Bobbs-Merrill.
- Gould, S. J., and N. Eldredge. 1977. "Punctuated Equilibria: The Tempo and Mode of Evolution Reconsidered." *Paleobiology*, 1977, 115–51.
- Gould, S. J., and R. Lewontin. 1979. "The Spondrels on San Marco and the Panglossian Paradigm: A Critique of the Adaptationist Programme." *Proc. R. Soc. Lond.* 3.205, 581–98.
- Hamilton, W. D. 1964. "The Genetic Theory of Social Behavior," I, H. *Journal of Theoretical Biology* 7 (1): 1–52.
- Harman, G. 1965. "The Inference to the Best Explanation." *Philosophical Review* 74: 88–95.
- Kuhn, T. 1970. *The Structure of Scientific Revolutions*. Chicago: University of Chicago Press.
- Putnam, H. 1975. *Mind, Language and Reality: Philosophical Papers*, vol. 2. Cambridge: Cambridge University Press.
- . 1978. *Meaning and the Moral Sciences*. London: Routledge and Kegan Paul.
- Van Fraassen, B. 1980. *The Scientific Image*. Oxford: Clarendon Press.
- . 1982. "The Charybdis of Realism: Epistemological Implications of Bell's Inequality." *Synthese* 52: 25–38.

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The Ontological Status of Observables: In Praise of the Superempirical Virtues

Paul M. Churchland

At several points in the reading of van Fraassen's book, I feared I would no longer be a realist by the time I completed it. Fortunately, sheer doxastic inertia has allowed my convictions to survive its searching critique, at least temporarily, and, as we address you today, van Fraassen and I still hold different views. I am a scientific realist, of unorthodox persuasion, and van Fraassen is a constructive empiricist, whose persuasions currently define the doctrine. I assert that global excellence of theory is the ultimate measure of truth and ontology at all levels of cognition, even at the observational level. Van Fraassen asserts that descriptive excellence at the observational level is the only genuine measure of any theory's truth and that one's acceptance of a theory should create no ontological commitments whatever beyond the observational level.

Against his first claim I will maintain that observational excellence or 'empirical adequacy' is only one epistemic virtue among others of equal or comparable importance. And against his second claim I will maintain that the ontological commitments of any theory are wholly blind to the idiosyncratic distinction between what is and what is not humanly observable, and so should be our own ontological commitments. Criticism will be directed primarily at van Fraassen's *selective* skepticism in favor of observable ontologies over unobservable ontologies and against his view that the 'superempirical' theoretical virtues (simplicity, coherence, explanatory power) are merely pragmatic virtues, irrelevant to the estimate of a theory's truth. My aims are not merely critical, however. Scientific realism does need reworking, and there are good reasons for moving it in the direction of van Fraassen's constructive empiricism, as will be discussed in the closing section of this paper. But those reasons do not support the skeptical theses at issue.

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I. Observation and Ontological Commitment

Before pursuing our differences, it will prove useful to emphasize certain convictions we share. Van Fraassen is already a scientific realist in the minimal sense that he interprets theories literally and he concedes them a truth value. Further, we agree that the observable/unobservable distinction is entirely distinct from the nontheoretical/theoretical distinction, and we agree as well that all observation sentences are irredeemably laden with theory.

Additionally, I absolutely reject many sanguine assumptions common among realists. I do not believe that on the whole our beliefs must be at least roughly true; I do not believe that the terms of 'mature' sciences must typically refer to real things; and I very much doubt that the reason of *homo sapiens*, even at its best and even if allowed infinite time, would eventually encompass all and/or only true statements.

This skepticism is born partly from a historical induction: so many past theories, rightly judged excellent at the time, have since proved to be false. And their current successors, though even better founded, seem but the next step in a probably endless and not obviously convergent journey. (For a most thorough and insightful critique of typical realist theses, see the recent paper by Laudan [1981].)

Evolutionary considerations also counsel a healthy skepticism. Human reason is a hierarchy of heuristics for seeking, recognizing, storing, and exploiting information. But those heuristics were invented at random, and they were selected for within a very narrow evolutionary environment, cosmologically speaking. It would be *miraculous* if human reason were completely free of false strategies and fundamental cognitive limitations, and doubly miraculous if the theories we accept failed to reflect those defects.

Thus some very realistic reasons for skepticism with respect to any theory. Why, then, am I still a scientific realist? Because these reasons fail to discriminate between the integrity of observables and the integrity of unobservables. If anything is compromised by these considerations, it is the integrity of theories generally. That is, of *cognition* generally. Since our observational concepts are just as theory-laden as any others, and since the integrity of those concepts is just as contingent on the integrity of the theories that embed them, our observational ontology is rendered *exactly as dubious* as our nonobservational ontology.

This parity should not seem surprising. Our history contains real examples of mistaken ontological commitments in both domains. For example, we have had occasion to banish phlogiston, caloric, and the luminiferous ether from our ontology—but we have also had occasion to banish witches and the starry sphere that turns about us daily. These latter items

were as 'observable' as you please and were widely 'observed' on a daily basis. We are too often misled, I think, by our casual use of *observes* as a success verb: we tend to forget that, at any stage of our history, the ontology presupposed by our observational judgments remains essentially speculative and wholly revisable, however entrenched and familiar it may have become.

Accordingly, since the skeptical considerations adduced above are indifferent to the distinction between what is and what is not observable, they provide no reason for resisting a commitment to unobservable ontologies *while allowing* a commitment to what we take to be observable ontologies. The latter appear as no better off than the former. For me, then, the 'empirical success' of a theory remains a reason for thinking the theory to be true and for accepting its overall ontology. The inference from success to truth should no doubt be severely tempered by the skeptical considerations adduced, but the inference to *unobservable* ontologies is not rendered *selectively* dubious. Thus, I remain a scientific realist. My realism is highly circumspect, but the circumspection is uniform for unobservables and observables alike.

Perhaps I am wrong in this. Perhaps we should be selectively skeptical in the fashion van Fraassen recommends. Does he have other arguments for refusing factual belief and ontological commitment beyond the observational domain? Indeed he does. In fact, he does not appeal to historical induction or evolutionary humility at all. These are *my* reasons for skepticism (and they will remain, even if we manage to undermine van Fraassen's). They have been introduced here to show that, while there are some powerful reasons for skepticism, those reasons do not place unobservables at a selective disadvantage.

Very well, what are van Fraassen's reasons for skepticism? They are very interesting. To summarize quickly, he does a compelling job of deflating certain standard realist arguments (from Smart, Sellars, Salmon, Boyd, and others) to the effect that, given the aims of science, we have no alternative but to bring unobservables (not just into our calculations, but) into our literal ontology. He also argues rather compellingly that the superempirical virtues, such as simplicity and comprehensive explanatory power, are at bottom merely pragmatic virtues, having nothing essential to do with any theory's truth. This leaves only empirical adequacy as a genuine measure of any theory's truth. Roughly, a theory is empirically adequate if and only if everything it says about *observable* things is true. Empirical adequacy is thus a necessary condition on a theory's truth.

However, claims van Fraassen, the truth of any theory whose ontology includes unobservables is always radically underdetermined by its empirical adequacy, since a great many logically incompatible theories can all be empirically equivalent. Accordingly, the inference from empirical ade-

quacy to truth now appears presumptuous in the extreme, especially since it has just been disconnected from additional selective criteria such as simplicity and explanatory power, criteria which might have reduced the arbitrariness of the particular inference drawn. Fortunately, says van Fraassen, we do not need to make such wanton inferences, since we can perfectly well understand science as an enterprise that never really draws them. Here we arrive at his positive conception of science as an enterprise whose sole intellectual aims are empirical adequacy and the satisfaction of certain human intellectual needs.

The central element in this argument is the claim that, in the case of a theory whose ontology includes unobservables, its empirical adequacy underdetermines its truth. (We should notice that, in the case of a theory whose ontology is completely free of unobservables, its empirical adequacy does not underdetermine its truth: in that case, truth and empirical adequacy are obviously identical. Thus van Fraassen's *selective* skepticism with respect to unobservables.) That is, for any theory *T* inflated with unobservables, there will always be many other such theories incompatible with *T* but empirically equivalent to it.

In my view, the notions of "empirical adequacy" and its cognate relative term "empirically equivalent" are extremely thorny notions of doubtful integrity. If we attempt to explicate a theory's 'empirical content' in terms of the observation sentences it entails (or entails if conjoined with available background information or with possible future background information or with possible future theories), we generate a variety of notions which are variously empty, context-relative, ill defined, or flatly incompatible with the claim of underdetermination. Van Fraassen expresses awareness of these difficulties and proposes to avoid them by giving the notions at issue a model-theoretic rather than a syntactic explication. I am unconvinced that this improves matters decisively (on this issue, see Wilson 1980; also Musgrave [chap. 9], Hooker [chap. 8], Glymour [chap. 5], and Wilson [chap. 10], this volume). In particular, I think van Fraassen has not dealt adequately with the problem of how the so-called 'empirical equivalence' of two incompatible theories remains relative to *which* background theories are added to the evaluative context, especially background theories that in some way revise our conception of what humans can observe. I intend to sidestep this issue for now, however, since the matter is complex and there is a much simpler objection to be voiced.

Let me approach my objection by first pointing out that the empirical adequacy of any theory is itself something that is radically underdetermined by any evidence conceivably available to us. Recall that, for a theory to be empirically adequate, what it says about observable things must be true—all observable things, in the past, in the indefinite future, and in the most distant corners of the cosmos. But, since any actual data possessed by

us must be finite in its scope, it is plain that we here suffer an underdetermination problem no less serious than that claimed above. This is Hume's problem, and the lesson is that even observation-level theories must suffer radical underdetermination by the evidence. Accordingly, theories about observables and theories about unobservables appear on a par again, so far as skepticism is concerned.

Van Fraassen thinks there is an important difference between the two cases, and one's first impulse is to agree with him. We are all willing to concede the existence of Hume's problem—the problem of justifying the inference to unobserved entities. But the inference to entities that are downright unobservable appears as a different and *additional* problem.

The appearance is an illusion, as the following considerations will show. Consider some of the different reasons why entities or processes may go unobserved by us. First, they may go unobserved because, relative to our natural sensory apparatus, they fail to enjoy an appropriate spatial or temporal *position*. They may exist in the Upper Jurassic period, for example, or they may reside in the Andromeda galaxy. Second, they may go unobserved because, relative to our natural sensory apparatus, they fail to enjoy the appropriate spatial or temporal *dimensions*. They may be too small or too brief or too large or too protracted. Third, they may fail to enjoy the appropriate *energy*, being too feeble or too powerful to permit useful discrimination. Fourth and fifth, they may fail to have an appropriate *wavelength* or an appropriate *mass*. Sixth, they may fail to 'feel' the relevant fundamental forces our sensory apparatus exploits, as with our inability to observe the background neutrino flux, despite the fact that its energy density exceeds that of light itself.

This list could be lengthened, but it is long enough to suggest that being spatially or temporally distant from our sensory apparatus is only one among many ways in which an entity or process can fall outside the compass of human observation, a way distinguished by no relevant epistemological or ontological features.

There is clearly some *practical* point in our calling a thing "observable" if it fails *only* the first test (spatiotemporal proximity) and "unobservable" if it fails any of the others. But that is only because of the contingent practical fact that humans generally have somewhat more *control* over the spatiotemporal perspective of their sensory systems than they have over their size or reaction time or mass or wavelength sensitivity or chemical constitution. Had we been less mobile than we are—rooted to the earth like Douglas firs, say—yet been more voluntarily plastic in our sensory constitution, the distinction between the 'merely unobserved' and the 'downright unobservable' would have been very differently drawn. It may help to imagine here a suitably rooted arboreal philosopher named (what else?) Douglas van Fraassen, who, in his sedentary wisdom, urges an antirealist

skepticism concerning the spatially very *distant* entities postulated by his fellow trees.

Admittedly, for any distant entity, one can in principle always change the relative spatial position of one's sensory apparatus so that the entity is observed: one can go to it. But equally, for any microscopic entity, one can in principle always change the relative spatial *size* or *configuration* of one's sensory apparatus so that the entity is observed. Physical law imposes certain limitations on such plasticity, but so also does physical law limit how far one can travel in a lifetime.

To emphasize the importance of these considerations, let me underscore the structure of my objection here. Consider the distinction between

- (1) things observed by some human (with unaided senses),
- (2) things thus observable by humans, but not in fact observed, and
- (3) things not observable by humans at all.

Van Fraassen's position would exclude (3) from our rational ontology. This has at least some initial plausibility. But his position would not be at all plausible if it were committed to excluding both (3) and (2) from our rational ontology. No party to the present discussion is willing to restrict rational ontology to (1) alone. Van Fraassen's position thus requires a *principled* distinction between (2) and (3), a distinction *adequate* to the radical difference in epistemic attitude he would have us adopt toward them. The burden of my argument is that the distinction between (2) and (3), once it is unearthed, is only very feebly principled and is wholly inadequate to bear the great weight that van Fraassen puts on it.

The point of all this is that there is no special or novel problem about inferences to the existence of entities commonly called "unobservables." Such entities are merely those that go unobserved by us for reasons *other* than their spatial or temporal distance from us. But whether the 'gap' to be bridged is spatiotemporal or one of the many other gaps, the logical/epistemological problem is the same in all cases: ampliative inference and underdetermined hypotheses. I therefore fail to see how van Fraassen can justify tolerating an ampliative inference when it bridges a gap of spatial distance, while refusing to tolerate an ampliative inference when it bridges a gap of, for example, spatial size. Hume's problem and van Fraassen's problem collapse into one.

Van Fraassen attempts to meet such worries about the inescapable ubiquity of speculative activity by observing that "it is not an epistemological principle that one may as well hang for a sheep as for a lamb" (1980, 72). Agreed. But it is a principle of *logic* that one may as well hang for a sheep as for a sheep, and van Fraassen's lamb (empirical adequacy) is just another sheep.

Simply to hold *fewer* beliefs from a given set is of course to be less ad-

venturous, but it is not necessarily to be applauded. One might decide to relinquish all one's beliefs save those about objects weighing less than five hundred kilograms, and perhaps, one would then be logically safer. But, in the absence of some relevant epistemic difference between one's beliefs about such objects and one's beliefs about other objects, that is perversity, not parsimony.

Let me summarize. As van Fraassen sets it up, and as the instrumentalists set it up before him, the realist looks more gullible than the non-realist, since the realist is willing to extend belief beyond the observable, while the nonrealist insists on confining belief within that domain. I suggest, however, that it is really the nonrealists who are being the more gullible in this matter, since they suppose that the epistemic situation of our beliefs about observables is in some way superior to that of our beliefs about unobservables. But in fact their epistemic situation is not superior. They are exactly as dubious as their nonobservational cousins. Their *causal history* is different (they are occasioned by activity in the sensory pathways), but the ontology they presuppose enjoys no privilege or special credibility.

II. Beliefworthiness and the Superempirical Virtues

Let me now try to address the question of whether the theoretical virtues such as simplicity, coherence, and explanatory power are *epistemic* virtues genuinely relevant to the estimate of a theory's truth, as tradition says, or merely *pragmatic* virtues, as van Fraassen urges. His view promotes empirical adequacy, or evidence of empirical adequacy, as the only genuine measure of a theory's truth, the other virtues (insofar as they are distinct from these) being cast as purely pragmatic virtues, to be valued only for the human needs they satisfy. Despite certain compelling features of the account of explanation that van Fraassen provides, I remain inclined toward the traditional view.

My reason is simplicity itself. Since there is no way of conceiving or representing 'the empirical facts' that is completely independent of speculative assumptions, and since we will occasionally confront theoretical alternatives on a scale so comprehensive that we must also choose between competing modes of conceiving what the empirical facts before us *are*, then the epistemic choice between these global alternatives cannot be made by comparing the extent to which they are adequate to some common touchstone, 'the empirical facts'. In such a case, the choice must be made on the comparative global virtues of the two global alternatives, T_1 -plus-the-observational-evidence-therein-construed, versus T_2 -plus-the-observational-evidence-therein-(differently)-construed. That is, it must be

made on *superempirical* grounds such as relative coherence, simplicity, and explanatory unity.

Van Fraassen has said that to 'save the appearances' is to exhibit them as a fragment of a larger unity. With this I wholly agree. But I am here pointing out that it is a decision between competing 'larger unities' that determines what we count as "the true appearances" in the first place. There is no independent way to settle that question. And, if such global decisions can only be made on what van Fraassen calls 'pragmatic' grounds, then it would seem to follow that any decision concerning what the *observable* world contains must be essentially 'pragmatic' also! Inflationary metaphysics and 'pragmatic' decisions begin, it seems, as soon as we open our eyes.

Global issues such as these are reminiscent of Carnap's 'external' questions, and I think it likely that van Fraassen, like Carnap, does not regard them as decidable in any but a second-rate sense, since they can be decided only by second-rate (i.e., by 'pragmatic') considerations. If so, however, it is difficult to see how van Fraassen can justify a selectively realist attitude toward 'observables', since, as we have seen, pragmatic considerations must attend their selection, also. (These issues receive extended treatment in Churchland 1979, sec. 2, 3, 7, and 10.) What all of this illustrates, I think, is the poverty of van Fraassen's crucial distinction between factors that are 'empirical, and therefore truth-relevant', and factors that are 'superempirical, and therefore *not* truth-relevant'.

As I see it, then, values such as ontological simplicity, coherence, and explanatory power are some of the brain's most basic criteria for recognizing information, for distinguishing information from noise. And I think they are even more fundamental values than is 'empirical adequacy', since collectively they can overthrow an entire conceptual framework for representing the empirical facts. Indeed, they even dictate how such a framework is constructed by the questing infant in the first place. One's observational taxonomy is not 'read off' the world directly; rather, one comes to it piecemeal and by stages, and one settles on that taxonomy which finds the greatest coherence and simplicity in the world and the most and the simplest lawful connections.

I can bring together my protective concerns for unobservables and for the superempirical virtues by way of the following thought experiment. Consider a man for whom absolutely *nothing* is observable. All of his sensory modalities have been surgically destroyed, and he has no visual, tactile, or other sensory experience of any kind. Fortunately, he has mounted on top of his skull a microcomputer fitted out with a variety of environmentally sensitive transducers. The computer is connected to his association cortex (or perhaps the frontal lobe or Wernicke's area) in such a way as to cause in him a continuous string of singular beliefs about his local en-

vironment. These 'intellectual intuitions' are not infallible, but let us suppose that they provide him with much the same information that our perceptual judgments provide us.

For such a person, or for a society of such persons, the *observable* world is an empty set. There is no question, therefore, of their evaluating any theory by reference to its 'empirical adequacy', as characterized by van Fraassen (i.e., isomorphism between some observable features of the world and some 'empirical substructure' of one of the theory's models). But such a society is still capable of science, I assert. They can invent theories, construct explanations of the facts-as-represented-in-past-spontaneous-beliefs, hazard predictions of the facts-as-represented-in-future-spontaneous-beliefs, and so forth. In principle, there is no reason they could not learn as much as we have (cf. Feyerabend 1969).

But it is plain in this case that the global virtues of simplicity, coherence, and explanatory unification are what *must* guide the continuing evolution of their collected beliefs. And it is plain as well that their ontology, whatever it is, must consist entirely of *unobservable* entities. To invite a van Fraassenean disbelief in unobservable entities is in this case to invite the suspension of all beliefs beyond tautologies! Surely reason does not require them to be so abstemious.

It is time to consider the objection that those aspects of the world which are successfully monitored by the transducing microcomputer should count as 'observables' for the folk described, despite the lack of any appropriate field of internal sensory qualia to mediate the external circumstance and the internal judgment it causes. Their tables-and-chairs ontology, as expressed in their spontaneous judgments, could then be conceded legitimacy.

I will be the first to accept such an objection. But, if we do accept it, then I do not see how we can justify van Fraassen's selective skepticism with respect to the wealth of 'unobservable' entities and properties reliably monitored by *our* transducing measuring instruments (electron microscopes, cloud chambers, chromatographs, etc.). The spontaneous singular judgments of the working scientist, at home in his theoretical vocabulary and deeply familiar with the measuring instruments to which his conceptual system is responding, are not worse off, causally or epistemologically, than the spontaneous singular judgments of our transducer-laden friends. If skepticism is to be put aside above, it must be put aside here, as well.

My concluding thought experiment is a complement to the one just outlined. Consider some folk who observe, not less of the world than we do, but more of it. Suppose them able to observe a domain normally closed to us: the microworld of virus particles, DNA strands, and large protein molecules. Specifically, suppose a race of humanoid creatures each of whom is born with an electron microscope permanently in place over his left 'eye'.

The scope is biologically constituted, let us suppose, and it projects its image onto a human-style retina, with the rest of their neurophysiology paralleling our own.

Science tells us, and I take it that van Fraassen would agree, that virus particles, DNA strands, and most other objects of comparable dimensions count as observable entities for the humanoids described. The humanoids, at least, would be justified in so regarding them and in including them in their ontology.

But we humans may not include such entities in our ontology, according to van Fraassen's position, since they are not observable with our unaided perceptual apparatus. We may not include such entities in our ontology *even though we can construct and even if we do construct electron microscopes of identical function, place them over our left eyes, and enjoy exactly the same microexperience as the humanoids.*

The difficulty for van Fraassen's position, if I understand it correctly, is that his position requires that a humanoid and a scope-equipped human must embrace *different* epistemic attitudes toward the microworld, even though their causal connections to the world and their continuing experience of it be identical: the humanoid is required to be a realist with respect to the microworld, and the human is required to be an antirealist (i.e., an agnostic) with respect to the microworld. But this distinction between what we and they may properly embrace as real seems to me to be highly arbitrary and radically undermotivated. For the only difference between the humanoid and a scope-equipped human lies in the *causal origins* of the transducing instruments feeding information into their respective brains. The humanoid's scope owes its existence to information coded in his genetic material. The human's scope owes its existence to information coded in his cortical material or in technical libraries. I do not see why this should make any difference in their respective ontological commitments, whatever they are, and I must decline to embrace any philosophy of science which says that it must.

III. Toward a More Rational Realism

I now turn from critic of van Fraassen's position to advocate. One of the most central elements in his view seems to me to be well motivated and urgently deserving of further development. As he explains in his introductory chapter, his aim is to reconceive the relation of theory to world, and the units of scientific cognition, and the virtue of those units when successful. He says, "I use the adjective 'constructive' to indicate my view that scientific activity is one of construction rather than discovery: con-

struction of models that must be adequate to the phenomena, and not discovery of truth concerning the unobservable" (1980, 5).

The traditional view of human knowledge is that the unit of cognition is the sentence or proposition and the cognitive virtue of such units is truth. Van Fraassen rejects this overtly linguistic guise for his empiricism. He invites us to reconceive a theory as a set of models (rather than as a set of sentences), and he sees empirical adequacy (rather than truth) as the principal virtue of such units.

Though I reject his particular reconception and the selective skepticism he draws from it, I think the move away from the traditional conception is entirely correct. The criticism to which I am inclined is that van Fraassen has not moved quite far enough. Specifically, if we are to reconsider truth as the aim or product of cognitive activity, I think we must reconsider its applicability right across the board and not just in some arbitrarily or idiosyncratically segregated domain of 'unobservables'. That is, if we are to move away from the more naive formulations of scientific realism, we should move in the direction of *pragmatism* rather than in the direction of a positivistic instrumentalism. Let me elaborate.

When we consider the great variety of cognitively active creatures on this planet—sea slugs and octopi, bats, dolphins, and humans; and when we consider the ceaseless reconfiguration in which their brains or central ganglia engage—adjustments in the response potentials of single neurons made in the microsecond range, changes in the response characteristics of large systems of neurons made in the seconds-to-hours range, dendritic growth and new synaptic connections and the selective atrophy of old connections effected in the day-upwards range—then van Fraassen's term "construction" begins to seem highly appropriate. There is endless construction and reconstruction, both functional and structural. Further, it is far from obvious that truth is either the primary aim or the principal product of this activity. Rather, its function would appear to be the ever more finely tuned administration of the organism's *behavior*. Natural selection does not care whether a brain has or tends toward true beliefs, so long as the organism reliably exhibits reproductively advantageous behavior. Plainly, there is going to be *some* connection between the faithfulness of the brain's 'world-model' and the propriety of the organism's behavior. But just as plainly the connection is not going to be direct.

While we are considering cognitive activity in biological terms and in all branches of the phylogenetic tree, we should note that it is far from obvious that sentences or propositions or anything remotely like them constitute the basic elements of cognition in creatures generally. Indeed, as I have argued at length elsewhere (1979, chap. 5; 1981), it is highly unlikely that the sentential kinematics embraced by folk psychology and orthodox

epistemology represents or captures the basic parameters of cognition and learning even in humans. That framework is part of a commonsense theory that threatens to be either superficial or false. If we are ever to understand the *dynamics* of cognitive activity, therefore, we may have to reconceive our basic unit of cognition as something other than the sentence or proposition, and reconceive its virtue as something other than truth.

Success of this sort on the descriptive/explanatory front would likely have normative consequences. Truth, as currently conceived, might cease to be an aim of science. Not because we had lowered our sights and reduced our epistemic standards, as van Fraassen's constructive empiricism would suggest, but because we had *raised* our sights, in pursuit of some epistemic goal even *more* worthy than truth. I cannot now elucidate such goals, but we should be sensible of their possible existence. The notion of 'truth', after all, is but the central element in a clutch of descriptive and normative *theories* (folk psychology, folk epistemology, folk semantics, classical logic), and we can expect conceptual progress here as appropriately as anywhere else.

The notion of truth is suspect on purely metaphysical grounds, anyway. It suggests straightaway the notion of The Complete and Final True Theory: at a minimum, the infinite set of all true sentences. Such a theory would be, by epistemic criteria, the best theory possible. But nothing whatever guarantees the existence of such a unique theory. Just as there is no largest positive integer, it may be that there is no best theory. It may be that, for any theory whatsoever, there is always an even better theory, and so *ad infinitum*. If we were thus unable to speak of *the* set of all true sentences, what sense could we make of truth sentence by sentence?

These considerations do invite a 'constructive' conception of cognitive activity, one in which the notion of truth plays at best a highly derivative role. The formulation of such a conception, adequate to all of our epistemic criteria, is the outstanding task of epistemology. I do not think we will find that conception in van Fraassen's model-theoretic version of 'positivistic instrumentalism', nor do I think we will find it quickly. But the empirical brain begs unravelling, and we have plenty of time.

Finally, there is a question put to me by Stephen Stich. If ultimately my view is even more skeptical than van Fraassen's concerning the relevance or applicability of the notion of truth, why call it scientific *realism* at all? For at least two reasons. The term *realism* still marks the principal contrast with its traditional adversary, positivistic instrumentalism. Whatever the integrity of the notion of truth, theories about unobservables have just *as much* a claim to truth, epistemologically and metaphysically, as theories about observables. Second, I remain committed to the idea that there exists a world, independent of our cognition, with which we interact and of which we construct representations: for varying purposes, with varying

penetration, and with varying success. Lastly, our best and most penetrating grasp of the real is still held to reside in the representations provided by our best theories. Global excellence of theory remains the fundamental measure of rational ontology. And that has always been the central claim of scientific realism.

References

- Churchland, Paul M. 1979. *Scientific Realism and the Plasticity of Mind*. Cambridge: Cambridge University Press.
- . 1981. "Eliminative Materialism and the Propositional Attitudes." *Journal of Philosophy* 78, no. 2.
- . 1982. "The Anti-Realist Epistemology of van Fraassen's *The Scientific Image*." *Pacific Philosophical Quarterly* 63, no. 2.
- Feyerabend, Paul K. 1969. "Science without Experience." *Journal of Philosophy* 66, no. 22.
- Laudan, Larry. 1981. "A Confutation of Convergent Realism." *Philosophy of Science* 48, no. 1.
- Van Fraassen, Bas C. 1980. *The Scientific Image*. Oxford: Clarendon Press.
- . 1981. Critical notice of *Scientific Realism and the Plasticity of Mind*, by Paul Churchland. *Canadian Journal of Philosophy* 11, no. 3.
- Wilson, Mark. 1980. "The Observational Uniqueness of Some Theories." *Journal of Philosophy* 77, no. 4.