Philosophica 15, 1975 (1), pp. 57–66.

SCIENCE, COMMON SENSE, AND A PROBLEM FOR SCIENTIFIC REALISM*

Stephen J. Noren

In the following I will attempt to underscore Sellars' well-known view to the effect that there is an unbridgeable conflict between science and common sense, between the world as it falls under the 'manifest' and 'scientific' images. In so doing, I will make use of arguments put forward by Hanson and Heisenberg which claim that science assumes certain principles of explanation that logically preclude the possibility that its objects can have any of the sensuous, occurrent qualities common sense holds is exemplary of all things. But if this is the case it implies an important difficulty for scientific realism, for there is then a sense in which its ontology is conditioned *a priori* by such principles of explanation in conjunction with the descriptive categories of the manifest image. Hence, if a choice must be made between scientific and common sense realism, there is at least one good reason to side with common sense.

1. Science and Common Sense

According to our everyday, common sense view of the world, chairs, tables, desks and the like are paradigms of what is said to exist. Usual common sense objects are three dimensional solids having duration through time. Exemplary of such objects is a range of sensuous, occurrent properties which they are said to 'have'. Hence, common sense construes colors, odors, tastes, and indeed all of the 'secondary qualities' as objective, relatively permanent characteristics of public, easily perceived objects. A common sense realist would thus be ontologically committed to such objects and their sensuous properties. Color is of special importance here, for though common sense allows that this or that may lack odor or taste, all objects are taken as having some color or other[1].

Within the manifest image we are sometimes surprised when our expectations about things, written into our common sense descriptions, do not turn out as we had thought. Ordinary events and our generalizations about them stand in need of explanation. In order to explain the behavior of common sense objects we are frequently led to leave the manifest for the scientific image. We employ descriptions of events that purport to posit objects seemingly very different from the ordinary objects whose behavior they are introduced to explain. The exemplary objects of micro-physics, e.g. electrons, mesons, neutrinos, etc., seem unlike chairs and tables in some very basic ways. Their properties are quite esoteric and not easily associated with common things. Under the scientific image the world consists of such entities, interacting according to quantum theoretic laws. They are said to *constitute* the objects of common sense, yet they conspicuously lack the occurrent, sensuous properties common sense deems essential to *all* things. The scientific realist, then, is ontologically committed to just such entities and their esoteric properties[2]. For him, all the theoretic terms and predicates of atomic physics are taken as referring expressions.

There do seem, then, to be important differences between science and common sense. A first step in the direction of clarity is to appreciate the fact that our problems here are essentially metalinguistic ones, concerning the reference of different conceptual frameworks. As such, both physics and common sense may be viewed as frameworks for generating descriptions of what there is. Within this perspective, if one could imagine a complete list of the terms and predicates of physics, nowhere on that list would one find the predicates for the sensuous properties common sense paradigmatically predicates of all objects. So it seems that micro-particles lack those features which common sense deems essential to what there is. There thus appears to be an irreconcilable conflict between science and common sense. One cannot hold a realist position with respect to both their ontologies.

There does seem to be one possible way of avoiding the conflict. The absence of, say, color predicates from physics might merely be held to indicate that color is not an important ingredient in physical explanation. That is, it may just be possible that micro-entities do indeed have a range of common sense properties even though the language of physics systematically omits reference to them. Such a view would be consistent with a mild form of scientific realism which would leave open the possibility of the existence of entities and properties other than those to which physics is committed[3]. But despite the appeal of this position, it will not allow us to escape the

dilemma of choosing between science and common sense, for I believe it can be shown an *logical* grounds that the entities of physics *cannot* be colored, that they must lack the essential properties of common sense objects.

2. Why Micro-Entities Must Lack Color

The view that none of the basic particles of physics can be colored or have any of the so-called 'secondary qualities' is most forcefully stated by the physicist Werner Heisenberg :

> It is impossible to explain...qualities of matter except by tracing these back to the behavior of entities which themselves no longer possess these qualities. If atoms are really to explain the origin of color and smell of visable material bodies, then they cannot possess properties like color and smell... Atomic theory consistently denies the atom any such perceptible properties[4].

The late N. R. Hanson has stated a similar position :

> ...atomic particles *must* lack certain properties; electrons could not be other than unpicturable. The impossibility of visualizing ultimate matter is an essential feature of atomic explanation[5].

Note that both claim the *logical impossibility* of particles having color based upon what they take to be a proper understanding of how explanation proceeds in microphysics. But why should this be the case ? Hanson asks :

> Suppose you ask for an explanation of the properties of chlorine gas -- its colour and memorable odour. Would this satisfy you ? – 'the peculiar colour and odour of chlorine derive from this : the gas is composed of many tiny units, each one of which has the colour and odour in question[6].

The above does seem inadequate. To explain the greenness of chlorine in terms of particles that are themselves green either begs the question or delays proper explanation, for the question would still arise : "Why are the particles green ? " What requires explanation in the explanandum cannot, without circularity, be itself part of the explanans.

As an illustration of all this, both Hanson and Heisenberg discuss the competing atomic theories of the ancient Greeks. Thales, Empedocles, and Democritus all held that the colors, odors, and tastes could be explained by something more fundamental. But only Democritus saw that whatever explained the sensuous properties of objects could not itself have those properties, and the traditional Earth, Fire, Air, and Water do possess them ! It was thus inevitable that Democritus' explanation should win out against its rivals. As Hanson puts it :

> Democritus' atomic theory avoids investing atoms with those secondary properties requiring explanation. It provides a pattern of concepts whereby the properties the atom *does* possess -- position, shape, motion -- can, as a matter of course, account for the other 'secondary' properties of the objects[7].

But let us take a more modern example. We explain the color of ordinary things in terms of the atomic theory of matter. Very briefly, the color a thing has is explained by reference to the electromagnetic radiation given off by the atoms said to constitute the thing, i.e. given off by the atom's electrons as they 'move' from a higher to a lower energy state, etc. It follows, then, that neither the radiation nor the electrons *can* be colored. If color is *explained* by reference to atoms, electrons, and the like, such entities cannot themselves possess color properties. It is as if color were *made possible* by the electrons, etc., so the question, "What color are electrons ? " cannot sensibly arise.

Questions concerning whether micro-entities are colored, have odors, etc., are based on a failure to appreciate the force of certain assumed principles of explanation in micro-physics to which, I submit, Hanson and Heisenberg both appeal. These may be stated as follows :

> *The Principle of Micro-Reduction (PMR) :* The properties of *wholes*, their occurrence, that they have the properties they have, etc., are to be explained in terms of the properties of their *parts*, their occurrence, etc.

> *The Principle of Property Reduction (PPP) :* The properties of such parts must differ from the properties of the wholes they are invoked to explain, i.e. such parts *cannot have*, among their properties, those properties of

> the wholes they are invoked to explain[8].

Now if we suppose that ordinary objects are to be construed as wholes with color as one of their properties, and that atoms and micro-particles are to be taken as their constituent parts, then it follows as an instance of the above that

> The fact that ordinary objects have color as such cannot be explained in terms of parts or constituents of the objects which are themselves colored, i.e. whatever explains the possibility of color cannot itself be colored.

It thus follows that

> Micro-entities, constituents of ordinary objects whose presence and interaction explain why anything is colored (why and how color is possible) cannot themselves be colored.

The same is true for the other secondary qualities as well. Hence, the argument of Part 1 stands as correct. There is indeed an unbridgeable conflict between science and common sense which precludes realism with regard to both their ontologies.

It is important to note that the argument above does not depend on our holding PMR and PPR as necessary or even true, though they may be. It is merely held that they are in fact *assumed* by micro-physics. Indeed, it is not at all clear how one could justify such principles, or whether justification as such has any meaning in this context. A deductive justification would need to posit more basic principles from which the above are derived. But it is far from clear what these could be. On the other hand, such principles guide scientific explanation so that they are not themselves open to scientific scrutiny. Yet, no one could deny the utility of PPR and PMR in theory building. Even George Schlesinger, finding the principles "unjustifiable" and perhaps unwarranted, nevertheless acknowledges that

> ...it is a fact that the vast majority of theories in science which correlate the behaviour of wholes and their parts are micro-reductive. The long history of the search for basically simple elements of matter in terms of which everything can be explained, illustrates the great power of this conviction[9].

Indeed, the efficacy of these principles in securing for us broad, coherent, and eminently workable theories is quite well known. Perhaps their justification lies in this fact alone. And if, as Michael Friedman has lucidly claimed, the essence of scientific explanation lies in its ability in "reducing the total number of independent phenomena that we have to accept as ultimate or given"[10], it is not surprising that we have historically preferred micro-reductive explanation to other, less frequently used principles, and incorporated them into the very framework of atomic physics. To cross a metaphor with Max Otto, it is as if the coat of physics were buttoned in regard to PPR and PMR and thus will be buttoned in this manner to the very top. A reason for this is that the apparent goal of micro-reduction is to discover the unity in diversity by offering 'ultimate explanations' in which a wide variety of phenomena and their properties to be explained are seen as the product of more basic, intrinsically different but 'simpler' phenomena. That is, PMR and PPR enable one to 'reduce' a wide range of phenomena needing explanation to phenomena held more fundamental, and as Friedman pointed out, a world with fewer independent phenomena is more easily comprehended than one with more.

3. A Problem for Scientific Realism

But now, if all this is the case, important difficulties arise for the scientific realist. It appears that certain *a priori* needs for explanation make essential demands upon the structure of any possible empirical, scientific theory, i.e. upon the ontology of such theories. This is not to merely say, as enlightened scientific realists like Sellars freely admit, that common sense is methodologically or epistemologically 'prior' to science, but rather, that it may be 'ontologically prior' to science as well, in the sense that the entities posited by science owe their characterization and existence as entities, their 'entification', to the way objects are characterized under the manifest image.
That is, on the assumption of PMR and PPR, the fact that common sense construes its objects, the objects of the explanandum, as it does, places important *a priori* strictures on what could suffice as possible objects of the explanans. According to PMR, scientific entities, whatever their empirical properties, must be construed as 'parts' of whatever common sense happens to take as 'wholes'. Furthermore, whatever the entities of science, such entities cannot have among their properties the particular properties which common sense deems exemplary of its objects and which, under the manifest image, require explanation. This suggests that although our principles

make it possible to explain the familiar in terms of something more fundamental, the objects taken as fundamental must lack the properties of the familiar. Hence, what is fundamental must be radically *un*familiar.

It is thus not surprising that the Twentieth Century has witnessed the discovery of a profusian of micro-entities, now called 'elementary particles', themselves constituents of atomic 'wholes', whose *very* esoteric properties are again different in important respects from the entities they micro-reduce. Elementary particles are radically different from common sense things. Not only do they *not* have the paradigm properties of the manifest, but the properties they *do* have, e.g. strangeness, spin, etc., are *undefined* under the manifest image. Heisenberg states :

> What *is* an elementary particle ? We say, for instance, simply "a neutron" but we can give no well-defined picture and what we mean by the word. We can use several pictures and describe it at once as a particle, once as a wave or as a wave packet. But we know that none of these descriptions are accurate. Certainly the neutron has no color, no smell, no taste. In this respect it resembles the atom of Greek philosophy. But even the other qualities are taken from the elementary particle, at least to some extent; the concepts of geometry and kinematics, like shape or motion in space, cannot be applied to it consistently. If one wants to give an accurate description of the elementary particle... the only thing that can be written down as description is a probability function. But then one sees that not even the quality of being (if that may be called a "quality") belongs to what is described. It is a possibility for being or a tendency for being. Therefore, the elementary particle of modern physics is still for more abstract than the atom of the Greeks, and it is by this very property more consistent as a clue for explaining the behavior of matter[11].

Assuming the consistent use of PMR and PPR, all this could not be otherwise, for the forward march of micro-reduction inevitably results in the positing of objects which are further and further from those taken as paradigm, even to the point where our notions of entityhood are themselves challenged. As Hanson has suggested, that we cannot 'picture'[12] such fundamental entities or even imagine them is the price paid for intelligibility, coherence, and above all,

predictability. The Tractarian Wittgenstein seems to have anticipated all of this in his doctrine to the effect that the 'substance' of the world must consist of 'simples', entities which have no internal properties whatsoever, but do enter into propertied configurations or states of affairs. However, Wittgenstein reached this conclusion from a logical point of view, through his notion of 'analysis', and not by virtue of a study of the principles of explanation at work in physics.

4. Conclusion

The following facts thus emerge. There is indeed a massive conflict between science and common sense. If the arguments in Part 2 are correct, not only do the predicates for the exemplary properties of common sense objects have no place on the list of scientific predicates, they are *necessarily* banned from that list. The assumption by physics of PMR and PPR implies that the manifest world and its properties are to be understood in terms of constituents that necessarily lack such properties. Furthermore, the consistent use of these principles must inevitably lead to the positing of very esoteric entities, for the properties such entities do have are not normally associated with the manifest. This must be the case, for if common sense objects had such properties, they in turn would be ripe candidates for micro-reduction.

Once these facts are fully recognized, it follows that one cannot be a realist with regard to both science and common sense. We cannot accept the ontologies of both frameworks at once. But then, how ought we to be guided in being forced to choose between the two? What do we consign to appearance and what to reality? Ryle reminds us to think of the purposes or ends to which we employ our concept systems. Indeed, one can say that the purpose of employing scientific descriptions is to predict and thus explain the world as construed by common sense. But for the scientific realist, scientific descriptions are said to *replace* common sense descriptions of things. Yet if the real is constituted as science says it is, then we are forced to take much of the inventory of common sense as illusion and deny to common sense descriptions the status of being literally true of anything. But on the other hand, common sense phenomena are the *data* for micro-physical explanation. How could the scientific realist deny the full-plooded existence of the common sense items his esoteric atomic story was developed to explain? Indeed, if our reasoning has been correct, whatever science takes as real must conform to certain a priori strictures which depend on how common sense happens to construe *its* objects, and therein lies the problem

for the scientific realist.

University of Wisconsin/Steven Point

NOTES

*This paper has been made possible by a fellowship from the American Council of Learned Societies.

[1]There are, of course, some borderline cases. But even glass, for example, has color when viewed at certain angles, water in large quantities is blue, etc. Black and white may be construed as genuine colors, etc. But all this is peripheral to our concerns.

[2]Some scientific realists may prefer a more general commitment to 'what explains best' in the Peircean 'long run' in order to avoid being pinned down to the entities of a particular theory. But the alleged conflict between science and common sense arises chiefly from the atomic theory of matter, a theory so central to physics that it is impossible to conceive of science without it. Thus, little harm is done if, for our context, scientific realism is defined in regard to the entities of atomic physics.

[3]This has been suggested by James W. Cornman in his "Can Eddington's Two Tables Be Identical", *Australasian Journal of Philosophy* (1974), pp. 22-38.

[4]"Gedanken der Naturphilosophie in der modernen Physik", *Die Antike*, XIII (1937), 119. Quoted by N. R. Hanson, *The Concept of the Positron* (Cambridge : Cambridge Univ. Press, 1963), p. 50.

[5]*Patterns of Discovery* (Cambridge : Cambridge Univ. Press, 1961), p. 119.

[6]*Ibid.*, p. 120.

[7]*Ibid.*, p. 121-122.

[8]I owe this formulation to Gordon Britton's illuminating "Reduction and Explanation", *Journal of Philosophy*, LXVII, 13 (July 9, 1970).

[9]*Method in the Physical Sciences* (London : Routledge and Kegan Paul and New York : Humanities Press, 1963), p. 72.

[10]"Explanation and Understanding", *Journal of Philosophy*, LXXI, 1 (Jan. 17, 1974), p. 15.

[11]*Physics and Philosophy* (New York : Harper, 1958), p. 70.

[12] For additional remarks about picturing such objects, see my "The Picturability of Micro-Entities", *Philosophy of Science*, 40, 2 (June, 1973).