

CHAPTER FIVE

A MODEL-THEORETIC REALISM¹

1. INTRODUCTION

The realism issue threads through all of the above, whether in the statement account context from Feigl's form of realism to Carnap's "neutralism", or in the non-statement context where mostly we find various forms of anti-realism, except when the notion of truth is addressed in terms of truthlikeness, such as in Niiniluoto's case. No examination of the nature of scientific theories can be complete without addressing the relations between these theories and reality. In a model-theoretic model of science such as mine the basic ontological assumption made is that science is about something that exists independently of it. This ontological assumption has however as little metaphysical content as is possible. Claiming that reality exists "outside" of human practice neither means that reality is unknowable nor, at the other extreme of the scale, that science simply mirrors it.

To determine whether science is about an independent reality or not, I believe one has to examine both the actions necessary for producing scientific knowledge and those aiming to apply such knowledge. From the previous chapters it should be obvious that I argue that at least some of the terms of a given scientific theory possibly refer to entities and relations of some system in reality if reference has been assigned to these terms via some empirical reduct of some interpretative model of the theory. In other words, a scientific theory can be said to be "about" the potential of entities in some system of reality to give reference to some terms or objects in this way. This potential however, is independent of the existence and knowledge of humans. It is the actualisation or realisation of this potential that requires human action. (See also Chapter 2.)

As has been mentioned before, any successful model of a theory is guided by contingent conditions which are context-specifically constructed. The range or content of these models thus cannot be established *a priori*, but has to be investigated *a posteriori* by means of historical studies of the development of science. We can however at least say (*a priori*) that formally, the abstract linguistic character of scientific theories allows the possible existence of (many different) models constructed to interpret them; and that these models (with the help of their empirical reducts) have the ability to realise the potential theories have to refer to real objects or relations and also the potential objects and relations in real systems have for being the referents of

terms in scientific theories. The human-independent potential of reality and its contingent context-specific realisations are thus conceptually speaking (in terms of human input) fundamentally different, even if they are epistemologically (and methodologically) related. "Reality" and "knowledge of reality" — i.e. ontology and epistemology in their general senses — are separate and not to be confused. The historical reality of theories and models is dependent on the actions of humans, while the reality of the ongoing potential of objects and relations in real systems for being the referents of terms in these theories and models is not. The need for acknowledging the conceptual stratification of the conceptual development of science should now be even more obvious, since at the level of the theory alone, all that is apparent is the multi-interpretability of the theory and some possibility of it finally referring to a variety of systems in reality.

In *The Scientific Image* (1980), Bas van Fraassen remarks that realists believe scientific theories offer "a faithful replica, in all detail, of our world". I am arguing (in contrast to Van Fraassen's somewhat straw man-realist) for a view of realism that is more sophisticated in the sense that the intricacies of the various semantic relations between reality — in terms of real systems — and scientific theories are taken into account and it is acknowledged that absolute universal statements about these relations fit as uncomfortably within a scientific realist framework as in any other framework.² The identification (discovery) of particular instances of the general terms of theories becomes possible only through interpretations of these general terms, such as mass, momentum, and so on, in context-particular models of the theories.

As acknowledged above, the possibility of discrepancies between theories, models and actual systems in reality has to be acknowledged and as Nancy Cartwright, Ronald Giere and their allies rightly advocate, the need for particular conditions to make "real" sense of general theories has to be accepted too. But this neither leads necessarily, for instance, to Van Fraassen's notion of empirical adequacy concerning only models and phenomena, nor to typical scientific realist claims that real systems are approximately captured by models of theories, nor to other problems such as the negative implications (for realists in my sense) of Putnam's model-theoretic paradox.

In contrast to all of these, I claim that there may be a set of models of some theory which fits some systems of reality and add that it is via historical studies concentrating on the context-specific models already constructed to interpret the relevant theories — and perhaps by constructing some new ones — that this can be determined. It is this inherent feature of science — that is the multi-interpretability of its theories — which should be emphasised if a sophisticated realist interpretation of the conceptual development of science is offered. And the multi-interpretability of scientific theories is the realist counter to the abstract nature of science. In this sense, it seems natural that it is so difficult to describe the relations between science and reality in simple unique terms.

Somehow Ronald Giere's (in Churchland & Hooker, 1985, p.82) remark that man is not the measure of all things but rather the measurer, seems very fitting in this sense. The structure of science's development hangs necessarily together with its theoretical nature. The content of verification procedures for the content of science

however are never given beforehand by fixed rules, but are a result of the context-specific actions and constructions of human scientists. Notions like "constructed reality" and "real science" should therefore not be viewed as representing opposing interpretations of science, but should rather be accepted as the two poles of one very complex time-bound relationship.

2. REALITY AND SCIENCE

Model-theoretically speaking science studies systems in reality. This refers to the abstracting/simplifying nature of science. As already often pointed out in the above, no-one, not even scientists, can study reality in all its fullness at once. Not only do scientists focus on some particular system of phenomena in reality, but also they aim to "adjust" that system in such a way that they can focus only on certain of its features. The kind of abstraction that Cartwright talks about and that I have discussed in a model-theoretic context in Chapter 2 is a necessary and sufficient condition for scientific knowledge. If certain abstractions are made from the richness of experiences that reality has to offer, scientific knowledge of the real system in question becomes possible. And, *vice versa*, if some knowledge claim is offered as part of science, the nature of that claim will (relative to the complexity of the universe) be simple and it will be about a sufficiently abstract version of some real system (even if that system is the cosmos!).

Reality is not unknowable, but rather only knowable in a certain way. I am aware that this sounds particularly Kantian, but that is, in a sense, my purpose. The basis of a model-theoretic methodology is Kantian in the qualified sense that it implies both that we can only know reality through science, and that scientific knowledge can only be achieved through certain abstractive actions. However, the Kantian *Ding-an-sich* is the reality we study via science. There is no other "underlying mechanism" or anything else that is somehow so fundamental to the ontology of reality that we cannot know it. Knowing through abstraction is knowing. There is no other kind of knowing, scientifically speaking. And, moreover, this kind of knowing is adequate in the sense that it does indeed allow us to study, discover, and utilise knowledge about reality.

Any kind of realism that decides how reality has to be in order for science to be possible — such as that of Bhaskar (1978) — is too metaphysical for my taste. I have been arguing all along — and pointed out many times — that a model-theoretic realism is one that focuses more on science than it does on reality. Connecting an ontology of science to an ontology of reality however often seems to be strangely lurking behind many philosophic accounts of science. It seems as if Cartwright (1989), for one, has also been seduced. Her hierarchy of "capacities" somehow seems to be offered as a kind of mirror image of her hierarchy of scientific laws — fundamental laws are capacity claims, phenomenological laws depict causal relations in reality, and the experimental stage of science focuses on "singular causings". Roy Bhaskar ((1979), (1981)) also seems to have been caught, albeit perhaps in a different, but not necessarily lesser, way. In Bhaskar's terms the mechanisms of reality form part of the lowest — ontologically deepest — level of reality and their scientific counterparts are

causal laws. The actual events produced by these mechanisms still form part of the "intransitive" (real) dimension of science but are conducive to the identification of constant conjunctions or patterns of events at the "transitive" (constructed) dimension of science.

From the above — as has already been implied in the introduction to Chapter 2 — it is obvious that I propose a distinction between the ontology of reality or of the physical world, on the one hand, and the ontology of science (which includes an epistemology of scientific knowledge) on the other. The reasoning behind disclaiming that such a distinction is possible seems to me as mainly based on the notion of science as a social construction. This is another of many contemporary echo's of Bachelard's (1934) point that it is difficult to see how science can be said to be about a human-independent reality if our notion of reality seems to be so very dependent on human action. One of the problems here, I think, is a certain vagueness of terminology.

In trying to clarify this confusion, let us first make it clear that in model-theoretic terms science is indeed also an individual and social construction. Science is "transitive" in Bhaskar's sense as against the "intransitivity" of reality. Scientific knowledge can change and is contingent on the actions of scientists formulating it. However the notion of "reality" is sometimes used as a group noun to refer to the immediate "stuff" or results of scientific knowledge. That is, the idealised pictures of the "external" world that science offers us are somehow seen as constructing a reality about which science is. Since these "images" are also still changeable because they are part of science, it is then perhaps concluded that reality too is changeable and therefore that a scientific epistemology is necessarily linked to an ontology of this (scientific) reality.³ The "immediate" pictures that models of scientific theories offer of some system in reality are however just *that* — i.e. representations of reality. The reality that is independent of science, in the sense that it exists regardless of whether its processes have already been "discovered", "explained", or "described" by science, is perhaps better denoted by the — somewhat outdated — term "Nature".

Reality in *this* sense is not *dependent* on human actions at all. It might indeed be a complex system of "mechanisms" (or "capacities") the processes of which continue now as they have done through the ages. And, it is the ontology of reality in this sense that *is* separate from scientific epistemological factors. The "reality" of science is an idealised version of this "Nature" and consists of already established theories and the various actions of scientists as well as the results of these actions. This "reality" is a social construction and this surely is the reality the more moderate constructivists claim to be constructing, in the sense that science cannot be studied without taking these matters — i.e. human activities, their context-dependent motivation driving the scientific process, and also already established theories — into account.

The ontology of this "scientific reality" and the epistemology of its generator — i.e. science — can indeed in a certain sense not be separated. In a model-theoretic account of science this becomes even more clear. The models that offer us these pictures are an integral part of the process of science. The set of conceptual models referred to as the "intended" models of scientific theories in the above, are shaped by the already established pictures of this kind. And, moreover, at the interpretative stage

of science the justification for, and evaluation of, scientific theories are offered and carried out within the context of this "scientific reality". The point is however, that in the final instance, although science is "social" and "constructivist" it is not a reflexive enterprise in the usual social constructivist meaning of the word. Science is not about something that it has constructed itself and that is inherently of the same nature as science itself. Science is about "Nature" and about discovering the intricacies of the mechanisms according to which "Nature" operates. In *this* sense, as pointed out above, ontology — in the sense of the ontology of that *about which* science is — and epistemology have to be separated.

The "game" of post-Kuhnian philosophy of science has one trick that has to be learnt if the realist quest is to be salvaged. This is the trick of keeping constant one of the changing factors at issue (i.e. "Nature" in this case) while acknowledging the variability of all the (transitive) others involved. Bhaskar (1978) claims that the relationship between science and reality seems problematic only if one either accepts the social character of science, but denies that its object of study is independent of all social activity (the so-called "epistemic fallacy"), or if one accepts the independence of reality, but denies the social nature of science (the so-called "ontic fallacy").⁴ A model-theoretic realism is not guilty of either of these fallacies. Bhaskar (1989) depicts the basis of a valid realist philosophy of science in terms of a choice between either an epistemological or an ontological relativism. He chooses an epistemological relativism and refers (ibid., p.57) to it as the "... correct thesis of epistemic relativity, which asserts that all beliefs are socially produced, so that all knowledge is transient, and neither truth values nor criteria for rationality exist outside historical time ...". To ontological relativism he (ibid.) refers as the "... incorrect thesis of judgmental relativism, which asserts that all beliefs are equally valid, in the sense that there can be no (rational) grounds for preferring one to the other".

Making the choice — as a model-theorist would also do — for Bhaskar's epistemological relativism, and thus acknowledging that truth criteria as well as criteria for (scientific) rationalism are part of the philosophy of science, does not mean that any criterium goes, but rather the opposite. The construction of these kinds of scientific criteria is, model-theoretically speaking, undeniably a function of the interpretative and empirical models of scientific theories. *Validating* them is the function of the various semantic relations that exist between reality as "Nature" and these models.

3. A MODIFIED IMAGE OF SCIENCE

Around 1960 philosophers of science found themselves in somewhat of a crisis. The logical empiricist inspired way of thinking about scientific knowledge as being the "crowning achievement" of human reason suddenly seemed horribly empty. It began to seem less than clear what exactly it is that determines the line of research science should pursue at a given time, and, consequently, to determine which scientific theories are finally getting at "the truth". Philosophers of science became obsessed with questions like "What do we really know?", "What should we believe?", "What is evidence?", "What are good reasons?", "Is science as rational as people used to think?".

A Model-Theoretic Realist Interpretation of Science

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