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A Very Short Introduction

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Chapter 4

Realism and anti-realism

There is a very ancient debate in philosophy between two opposing schools of thought called *realism* and *idealism*. Realism holds that the physical world exists independently of human thought and perception. Idealism denies this – it claims that the physical world is in some way dependent on the conscious activity of humans. To most people, realism seems more plausible than idealism. For realism fits well with the common-sense view that the facts about the world are ‘out there’ waiting to be discovered by us, but idealism does not. Indeed, at first glance idealism can sound plain silly. Since rocks and trees would presumably continue to exist even if the human race died out, in what sense is their existence dependent on human minds? In fact, the issue is a bit more subtle than this, and continues to be discussed by philosophers today.

Though the traditional realism/idealism issue belongs to an area of philosophy called *metaphysics*, it has actually got nothing in particular to do with science. Our concern in this chapter is with a more modern debate that is specifically about science, and is in some ways analogous to the traditional issue. The debate is between a position known as *scientific realism* and its converse, known as *anti-realism* or *instrumentalism*. From now on, we shall use the word ‘realism’ to mean scientific realism, and ‘realist’ to mean scientific realist.

Scientific realism and anti-realism

Like most philosophical 'isms', scientific realism comes in many different versions, so cannot be defined in a totally precise way. But the basic idea is straightforward. Realists hold that the aim of science is to provide a true description of the world. This may sound like a fairly innocuous doctrine. For surely no-one thinks science is aiming to produce a false description of the world. But that is not what anti-realists think. Rather, anti-realists hold that the aim of science is to provide a true description of a certain *part* of the world – the 'observable' part. As far as the 'unobservable' part of the world goes, it makes no odds whether what science says is true or not, according to anti-realists.

What exactly do anti-realists mean by the observable part of the world? They mean the everyday world of tables and chairs, trees and animals, test-tubes and Bunsen burners, thunderstorms and snow showers, and so on. Things such as these can be directly perceived by human beings – that is what it means to call them observable. Some branches of science deal exclusively with objects that are observable. An example is palaeontology, or the study of fossils. Fossils are readily observable – anyone with normally functioning eyesight can see them. But other sciences make claims about the unobservable region of reality. Physics is the obvious example. Physicists advance theories about atoms, electrons, quarks, leptons, and other strange particles, none of which can be observed in the normal sense of the word. Entities of this sort lie beyond the reach of the observational powers of humans.

With respect to sciences like palaeontology, realists and anti-realists do not disagree. Since fossils are observable, the realist thesis that science aims to truly describe the world and the anti-realist thesis that science aims to truly describe the observable world obviously coincide, as far as the study of fossils is concerned. But when it comes to sciences like physics, realists and anti-realists disagree. Realists say that when physicists put forward theories about

electrons and quarks, they are trying to provide a true description of the subatomic world, just as paleontologists are trying to provide a true description of the world of fossils. Anti-realists disagree: they see a fundamental difference between theories in subatomic physics and in palaeontology.

What do anti-realists think physicists *are* up to when they talk about unobservable entities? Typically they claim that these entities are merely convenient fictions, introduced by physicists in order to help predict observable phenomena. To illustrate, consider the kinetic theory of gases, which says that any volume of a gas contains a large number of very small entities in motion. These entities – molecules – are unobservable. From the kinetic theory we can deduce various consequences about the observable behaviour of gases, e.g. that heating a sample of gas will cause it to expand if the pressure remains constant, which can be verified experimentally. According to anti-realists, the only purpose of positing unobservable entities in the kinetic theory is to deduce consequences of this sort. Whether or not gases really *do* contain molecules in motion doesn't matter; the point of the kinetic theory is not to truly describe the hidden facts, but just to provide a convenient way of predicting observations. We can see why anti-realism is sometimes called 'instrumentalism' – it regards scientific theories as instruments for helping us predict observational phenomena, rather than as attempts to describe the underlying nature of reality.

Since the realism/anti-realism debate concerns the aim of science, one might think it could be resolved by simply asking the scientists themselves. Why not do a straw poll of scientists asking them about their aims? But this suggestion misses the point – it takes the expression 'the aim of science' too literally. When we ask what the aim of science is, we are not asking about the aims of individual scientists. Rather, we are asking how best to make sense of what scientists say and do – how to interpret the scientific enterprise. Realists think we should interpret all scientific theories as

attempted descriptions of reality; anti-realists think this interpretation is inappropriate for theories that talk about unobservable entities and processes. While it would certainly be interesting to discover scientists' own views on the realism/anti-realism debate, the issue is ultimately a philosophical one.

Much of the motivation for anti-realism stems from the belief that we cannot actually attain knowledge of the unobservable part of reality – it lies beyond human ken. On this view, the limits to scientific knowledge are set by our powers of observation. So science can give us knowledge of fossils, trees, and sugar crystals, but not of atoms, electrons, and quarks – for the latter are unobservable. This view is not altogether implausible. For no-one could seriously doubt the existence of fossils and trees, but the same is not true of atoms and electrons. As we saw in the last chapter, in the late 19th century many leading scientists did doubt the existence of atoms. Anyone who accepts such a view must obviously give some explanation of *why* scientists advance theories about unobservable entities, if scientific knowledge is limited to what can be observed. The explanation anti-realists give is that they are convenient fictions, designed to help predict the behaviour of things in the observable world.

Realists do not agree that scientific knowledge is limited by our powers of observation. On the contrary, they believe we already have substantial knowledge of unobservable reality. For there is every reason to believe that our best scientific theories are true, and our best scientific theories talk about unobservable entities. Consider, for example, the atomic theory of matter, which says that all matter is made up of atoms. The atomic theory is capable of explaining a great range of facts about the world. According to realists, that is good evidence that the theory is true, i.e. that matter really is made up of atoms that behave as the theory says. Of course the theory *might* be false, despite the apparent evidence in its favour, but so might any theory. Just because atoms are unobservable, that is no reason to interpret atomic theory as

anything other than an attempted description of reality – and a very successful one, in all likelihood.

Strictly we should distinguish two sorts of anti-realism. According to the first sort, talk of unobservable entities is not to be understood literally at all. So when a scientist puts forward a theory about electrons, for example, we should not take him to be asserting the existence of entities called ‘electrons’. Rather, his talk of electrons is metaphorical. This form of anti-realism was popular in the first half of the 20th century, but few people advocate it today. It was motivated largely by a doctrine in the philosophy of language, according to which it is not possible to make meaningful assertions about things that cannot in principle be observed, a doctrine that few contemporary philosophers accept. The second sort of anti-realism accepts that talk of unobservable entities should be taken at face value: if a theory says that electrons are negatively charged, it is true if electrons do exist and are negatively charged, but false otherwise. But we will never know which, says the anti-realist. So the correct attitude towards the claims that scientists make about unobservable reality is one of total agnosticism. They are either true or false, but we are incapable of finding out which. Most modern anti-realism is of this second sort.

The ‘no miracles’ argument

Many theories that posit unobservable entities are *empirically successful* – they make excellent predictions about the behaviour of objects in the observable world. The kinetic theory of gases, mentioned above, is one example, and there are many others. Furthermore, such theories often have important technological applications. For example, laser technology is based on a theory about what happens when electrons in an atom go from higher to lower energy-states. And lasers work – they allow us to correct our vision, attack our enemies with guided missiles, and do much more besides. The theory that underpins laser technology is therefore highly empirically successful.