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PHIL 230

Should scientific models be true?

It is a commonly held view that the goal of science is to provide us with a true representation of what the world is like, to explain parts of reality. It is also widely believed that, by and large, modern science has achieved fantastic success in this goal. We now know that electrons behave as both waves and particles and the "force" of gravity is not actually a force at all, but rather a warping of space-time. But what facilitates these explanations that science provides us? Ask any scientist, take any science course and you will quickly discover the answer to be models. Scientific models are the tools that allow us to access scientific explanation. A popular conception of scientific models is that they can provide us with a true understanding of a given scientific phenomena and explain that phenomena at the same time. I would like to echo some arguments made against this commonly held realist position, and add my own voice into the fray. Namely, I'd like to reiterate that science often uses models that are completely false, but this should be of no concern for reasons I will spell out.

The primary purpose and use of scientific models is to explain phenomena. Models serve as tools that allow us to make sense of complicated phenomena we observe in the world around us; they allow us to understand. There is a belief common to a realist perspective of science, however, that models should serve to give us a literally true story of what the world is like. The argument goes that if science's purpose is to seek and find understanding and truth, then how could we possibly accept theories or models we know to be fictitious or false? Hardcore realists argue that since understanding requires truth, “science can provide understanding of the world only if its theories are (at least approximately) true descriptions of reality” (Regt). In order for models and theories to be literally true descriptions of the world, it seems that they must conform to what Dr.Bokulich calls the ontic conception of explanation, created by Jose ALberto Coffa and built upon by Wesley Salmon. The ontic conception of explanation posits that what explains an event is whatever produced it or brought it about. Explanations are fully objective and exist whether or not anyone ever discovers or describes them. Explanations do not have psychological components (Bokulic). I, echoing Dr. Bokulic, would like to reject that the ontic view of explanation is useful in any way. When creating models that serve to explain and bring about understanding, employing the ontic view of explanation would have us build a model that is an exact replica of the real world phenomena. This is fine insofar that the absolute truth of the matter is preserved, but it hardly allows our model to explain anything new to us because it confuses the cause of the phenomena with the explanation of the phenomena. A cause is fully objective and exists whether or not anyone ever discovers or describes it, but a cause is not an explanation. Explanations are human endeavors. Causes of phenomena don’t explain the phenomena, people do! (Bokulic) The ontic view of explanation cannot be fruitful at the very least because it does not allow us to distinguish between good “explanations” and bad “explanations”. If explanations are fully objective and have no psychological components, they cannot be good or bad, and distinguishing between good and bad explanations seems to be an important part of what a theory of explanation (such as the ontic conception of explanation) should do. Dr. Bokulic offers an alternative to the ontic conception called the eikonic conception. In the eikonic conception, explanations are representations of the phenomena contextualized within a particular research program, and there can be more than one scientific explanation of any given phenomena. According to Dr. Bokulic, the reason we seek explanations is to understand. To this end, much to the realist's dismay, fictional models serve science well. Sometimes in science, the fictional model better facilitates the sort of physical insight that is needed for a particular explanation. Sometimes the fictional model helps us understand reality better than the whole, completely true picture.

This may do fine to dispel the ontic conception of explanation, but it leaves the realist position untouched. "Yes," a realist might say, "of course the reason we seek explanations is to understand. But that understanding must be rooted in true descriptions of reality." I would like to call this claim into question. Is a realistic interpretation of models required for understanding? Is it always better to use the truest, most complete model that we've got? Let's take Bohr's model of the atom for example. Since the advent of Erwin Schrodinger's electron cloud model in 1926, we have known that electrons do not classically orbit the nuclei of atoms. So why would physics curriculums everywhere call for teaching the Bohr model of the atom which is a complete fiction? The answer is that although the model is not a literal description of reality, it is a legitimate and useful way to understand how electrons emit photons only of certain wavelengths. A realist may respond with an objection that it's just a coincidence that the Bohr model explains certain phenomena and its power is only an illusion because the true explanation lies in quantum mechanical theory. My, and Dr. Bokulic's, response is that this is a misguided objection. Why stop at the quantum model? Why should we be satisfied with that model as an explanation for these phenomena? Under a realist view, why not demand that we cannot explain anything until we have a grand unified theory? The point here is that we can never be certain any model is the truest description of a given phenomena and it's a mistake to think that only the truest model can explain adequately. As another example, let's take the model of gravity that Newton proposed and apply it to an oceanographic context. Gravity, under the currently accepted theory of relativity, is not a force. It is a warping of space time. However, when you reference real scientific literature about the cause and mechanics of tides, you won't find any references to the general relativity model. You'll find real scientists talking about gravity as if it were a force and using Newton's model of gravity successfully. Does this mean that these papers are misguided and wrong? Of course not! "The model of gravity as a force in this case facilitates what we are actually interested in (the tides)" (Bokulic). In the context of oceanography, using Newton's model of gravity serves as an "adequate representation that can succeed in giving genuine physical insight into, and factive understanding of, a phenomenon of interest" (Bokulic). These examples show us that science often uses models that aren't realistic or are completely fictitious or false. The realist position leaves us with a dilemma: either we must give up the realist thesis that understanding requires (approximate) truth, or we should allow for the possibility that in many if not all practical cases we do not have scientific understanding (Regt). I am not willing to say that we have little to no scientific understanding, so I think it's clear which alternative I find most appealing.

But if models are not evaluated on the basis of their truth, how else should we evaluate them? For example, Newton's model of gravity is still widely taught in physics curricula around the world, but the eighteenth-century phlogiston theory is not. Why is a force-based model of gravity better than a phlogiston-based model of chemical reactions? The answer is that some models are simply more useful than others. "The reason we do not use phlogiston anymore is that today there appears to be no context in which a 'phlogiston explanation' is empirically adequate and more intelligible than an 'oxygen explanation'" (Regt). Different models serve different interests better. This is why particle physicists will employ Einstein's model of gravity, and oceanographers will use Newton's. Even though Newtonian physics is strictly speaking wrong, Newtonian physics continues to be a required part of our science curriculum because it provides us with an understanding of our actual world, not just some hypothetical one. The physical oceanographers who offer Newtonian explanations of the tides are gaining an understanding of the real oceans, not just the oceans of some imaginary world (Bokulic).

The demand that scientific models be true representations of what the world is like is, in my opinion, a dysfunctional approach. I propose to think of scientific models in the same way as maps. In Regt's words, "Maps are representations but they never aim at a fully realistic picture. Instead, the respects and degrees in which they should be accurate are determined by the context in which they are used. A typical subway map, for example, is a highly distorted representation of the actual subway system, but these distortions facilitate its use: a fully accurate map (of which the topology is exactly isomorphic to that of the real system) would be far more difficult to use." Different models are useful in different contexts and the extent to which we should use models is the extent to which they are helpful to us in understanding phenomena, regardless of the "truth" of the model.

Regt, Henk W. de. "Scientific Understanding: Truth or Dare?" *Synthese*, vol. 192, no. 12, 2014, pp. 3781–97. *Crossref*, doi:10.1007/s11229-014-0538-7.

Bokulich, Alisa. “Fiction As a Vehicle for Truth: Moving Beyond the Ontic Conception.” *The Monist*, vol. 99, no. 3, 2016, pp. 260–79. *Crossref*, doi:10.1093/monist/onw004.