Models, Sherlock Holmes and the Emperor Claudius

Abstract

Recently, a number of authors have suggested that we understand scientific models in the same way as fictional characters, like Sherlock Holmes. The biggest challenge for this approach concerns the ontology of fictional characters. I consider two responses to this challenge, given by Roman Frigg, Ronald Giere and Peter Godfrey-Smith, and argue that neither is successful. I then suggest an alternative approach. While parallels with fiction are useful, I argue that models of real systems are more aptly compared to works that portray real people, like the Emperor Claudius. This approach will allow us to avoid problems with fictional characters.

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1. Introduction

Modelling forms an important part of scientific practice. It also presents us with a number of ontological puzzles. Consider the standard Newtonian model of the orbit of the earth. This model makes many simplifying assumptions: it assumes that the sun and earth are perfect spheres, for example, and that they are isolated from the other planets in the solar system. These assumptions are known to be false of the sun and earth. Indeed, *no* actual, concrete objects satisfy these assumptions. And yet scientists often talk as if there were such objects and as if they can find out about their properties. A scientist might say that the model consists of two spheres with homogenous mass distribution, for example, or she might discover that the orbit of the earth in the model is perfectly elliptical.

Let us call the various assumptions and equations that scientists write down when they formulate a model the *model description* (Godfrey-Smith 2006; Weisberg 2007). When she uses the Newtonian model, the scientist wishes to understand a real system, namely the sun and earth. But not all models are like this. For example, a predator-prey model might invite us to consider a population consisting of two species, predator and prey, whose numbers are governed by certain equations, without claiming to represent any real population out in the world. And yet, even in these cases, scientists talk as if the model were an object whose behaviour they are investigating. For example, they might discover that in certain models general pesticides act to increase the proportion of prey to predator (Weisberg 2007, 223). Notice that often the very same model description is put to different uses. We might write down the equation for a simple harmonic oscillator simply in order to explore the properties of such a system, or we might use it to understand the motion of a pendulum or a chemical bond.

Modelling thus presents us with certain ontological puzzles. How are we to make sense of the fact that a large part of scientific practice involves talking and learning about things that do not exist? One way to answer these questions is to insist that, while no actual, concrete object satisfies the scientists' model description, there is some other object that does satisfy it. According to Ronald Giere (e.g. 1988), for example, theoretical models are abstract objects defined by scientists' modelling assumptions. While this view has seemed attractive to many, it is not without problems. For example, Martin Thomson-Jones (2010) asks how the abstract objects posited by Giere's account can possess the spatiotemporal properties we appear to attribute to models, such as following an elliptical orbit or oscillating with a certain time period (see also Hughes 1997; Godfrey-Smith 2006).

Recently, a number of authors have suggested that, rather than abstract objects, theoretical models should instead be understood in the same way as fictional characters, like Sherlock Holmes. The aim of this paper is to examine this proposal in detail. The most obvious challenge for such an approach concerns the longstanding controversy over the nature of fictional characters (Section 2.1). I shall consider two ways in which proponents of the view have sought to respond to this challenge, and argue that neither response is successful (Sections 2.2 and 2.3). I will then suggest an alternative approach. While parallels with fiction are useful, I will argue that models of real systems are more aptly compared to works that portray real people, like the Emperor Claudius (Section 3.1). This approach will allow us to avoid problems with fictional characters (Section 3.2).

2. The Indirect Fictions View

2.1. Models and Fiction

A number of authors have been struck by apparent parallels between the ontology of models and fiction (e.g. Godfrey-Smith 2006; Thomson-Jones 2007; Contessa 2010; Frigg 2010a, 2010b; on models and fiction in general, see Suárez 2009). Consider the following passage from *The Hound of the Baskervilles*:

> Holmes leaned forward in his excitement and his eyes had the hard, dry glitter which shot from them when he was keenly interested. (Conan Doyle 1902/2003, 22)

Like scientists' model descriptions, it seems, there is no actual, concrete object that this passage describes: there is no real, flesh-and-blood detective that satisfies the description Conan Doyle gives of Holmes. And yet, just as scientists talk as if there were objects that satisfied their model descriptions, so we talk as if there were a Sherlock Holmes: we say that Holmes is highly intelligent, that he smokes a pipe and plays the violin. We saw above that some have criticised Giere's view on the grounds that we often ascribe spatiotemporal properties to models. We certainly have no problem attributing spatiotemporal properties to fictional characters: we say that Holmes is tall and that he lived at 221B Baker Street.

These observations motivate what I will call the *indirect fictions view* of modelling (figure 1).[1] According to this view, scientists' model descriptions give rise to what are called

[1] Here I use 'indirect' in a different sense to Michael Weisberg (2007). Weisberg uses the term 'indirect' to describe the activity of modelling, in order to distinguish it from other forms of theorising. I use 'indirect' and 'direct' to distinguish between two different

model systems (or sometimes simply *models*), and these model systems are to be understood in the same way as fictional characters like Sherlock Holmes. When scientists represent a real system they do so by establishing some form of representation relation between the model system and the real system. Different views are advanced regarding the nature of this relation. Peter Godfrey-Smith (2006) follows Giere (e.g. 1988) in talking of resemblance between model systems and the world, while Roman Frigg (2010b) speaks of a 'key' which specifies how facts about the model system are translated into claims about the real system.

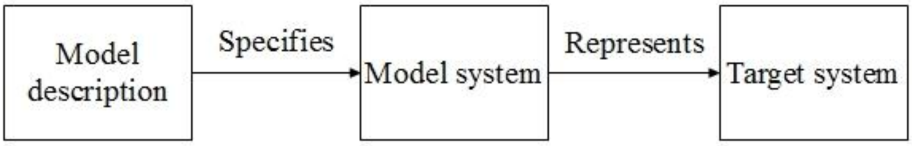

Figure 1: The indirect fictions view

The biggest challenge for the indirect fictions view concerns the ontology of model systems. After all, the nature of fictional characters is far from clear. *Realists* argue that, even if he is not a regular, flesh-and-blood detective, we must grant that Holmes exists in *some* sense. Holmes, along with Emma Bovary, Middle Earth and the rest, are therefore given a place in our ontology as *fictional entities*. Realists then offer different accounts of the nature of these entities. Meinong (1904/1960), for example, famously distinguishes *being* from *existence*. On this view, Holmes is an object possessing all the properties that we normally take him to have, such as being a detective and smoking a pipe; he simply lacks the property of existence. By contrast, *antirealists*, like Russell (1905/1956), aim to show how we can

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interpretations of the ontology of modelling: the former takes representation to occur via a model system, and the latter does not.

understand fictional characters, and our talk about them, without granting the existence of fictional entities.

Proponents of the indirect fictions view have responded to this problem in a number of ways. Some look to existing theories of fictional characters. Thus, Roman Frigg (2010a, 2010b) aims to fill out the view by drawing on an existing antirealist theory of fiction. Ronald Giere (2009) suggests a different strategy. Although, in his earlier work, Giere takes models to be abstract objects, he has recently suggested that he too is willing to think of models as akin to fictional characters. But Giere argues that philosophers of science need not be too concerned with the question of exactly what such entities are. Peter Godfrey-Smith (2006) appears to endorse a similar strategy.

Let us now consider both of these responses in turn.

2.2. Antirealism and the Indirect Fictions View

Roman Frigg (2010a, 2010b) has proposed a version of the indirect fictions view that draws on an influential theory of fiction due to Kendall Walton (1990). On Frigg's view, model descriptions give rise to model systems, and these model systems are 'akin to characters and places in literary fiction' (2010b, 100). Frigg acknowledges, however, that without a theory of fictional characters 'explaining model systems in terms of fictional characters amounts to explaining the unclear with the obscure' (2010a, 256). It is for this reason that he looks to Walton's theory.

According to Walton, the text of a novel functions as a 'prop' in games of make-believe: when we read the text, we are supposed to imagine things according to certain rules (1990, chap. 2). Frigg offers an application of Walton's theory to scientists' model descriptions. On

Frigg's view, when we read the model description given by the Newtonian model of the solar system, for example,

> [w]e imagine the entity described in the description.... We understand the terms occurring in the description and we imagine an entity which has all the properties that the description specifies. The result of this process is the *model system*, the fictional scenario which is the vehicle of our reasoning: an imagined entity consisting of two spheres, etc. (2010b, 133; author's emphasis)

Frigg calls the relationship between the model description and the model system 'p-representation' (2010a, 264). When scientists want to represent a real system, like the sun and earth, they must establish a second representation relation between their model system and the world, which he calls 't-representation' (*ibid*.).

Frigg's aim, then, is to flesh out the indirect fiction view by drawing on an existing theory of fictional characters. The choice of Walton's theory for this task is a little surprising, however. The reason it is surprising is that Walton is an antirealist about fictional characters (1990, chap. 10). In Walton's view, works of fiction may seem to ask us to imagine things about people like Sherlock Holmes, and we may seem to be able to talk about them. But there simply are no such things, not even as Meinongian nonexistent entities. So if we were to understand model systems in the same way that Walton understands fictional characters then it seems that we would conclude that there are no model systems.

Frigg intends to follow Walton in his antirealism (2010a, 264; 2010b, 120). An antirealist stance on model systems is difficult to reconcile with Frigg's overall, indirect account of modelling, however. Model systems have a central place in that account: scientists use model systems to represent real systems (t-representation). According to Frigg's account of t-representation, a model system *X* represents some real target system *Y* if and only if *X* denotes *Y* and '*X* comes with a key *K* specifying how facts about *X* are to be translated into claims about *Y'* (2010b, 126). This might involve, for example, specifying 'object-to-object correlations', such as that 'the sphere with mass m_e in the model system corresponds to the earth and the sphere with mass m_s to the sun' (*ibid*., 134). Once we have specified such correlations

> we can then start translating facts about the model system into claims about the world. For instance, calculations reveal that the model-earth moves on an ellipse, and given that the model system is an ideal limit of the target we can infer that the real earth moves on a trajectory that is almost an ellipse. (*ibid*., 135)

If taken literally, however, all of these claims about t-representation would seem to be inconsistent with antirealism. If there are no model systems then there can be no facts about them and we cannot establish an object-to-object relation between model systems and the world. If there is no model-earth then it cannot move on an ellipse.

One way to reconcile Frigg's account with antirealism would be to offer some antirealist reinterpretation of what Frigg says about t-representation, which explains away the apparent commitment to fictional entities. If we were to take this route, however, all talk of using model systems to denote real systems, or of specifying object-to-object correlations between the two, would now be construed merely as a way of talking, rather than as offering an account of how modelling actually works.

Another option would be to abandon antirealism. Frigg suggests that he is open to this possibility (2010b, 113). And, in fact, Frigg's analysis of model systems differs from Walton's analysis of fiction at a number of points, and sometimes seems at odds with antirealism. For example, he writes that 'the attribution of certain concrete properties to models … is explained as it being fictional that the model system possesses these properties' (2010b, 116; see also 2010a, 261). On Walton's theory, however, to say that it is fictional that the model system possesses certain properties is to say that we are to imagine that the model system possesses those properties. This would seem to conflict with antirealism: we cannot imagine things about model systems if there are none. However, if Frigg were to reject antirealism, and grant that we must posit fictional entities to serve as model systems, it seems that he would need to provide an account of what fictional entities are. And drawing on Walton's theory will not help to provide such an account.

2.3. Deferring the Problem

So the key challenge remains: can proponents of the indirect fictions view flesh out the comparison between model systems and fictional characters by providing a coherent account of what fictional characters are? As we saw earlier, however, some have argued that this challenge need not be met. In fact, they claim, worries about the ontology of fictional characters need not concern philosophers of science. For example, in his recent work, Ronald Giere grants that scientific models and fictional characters are ontologically 'on a par' (2009, 249). But he questions 'whether we, as philosophers of science interested in understanding the workings of modern science, need a deeper understanding of imaginative processes and of the objects produced by these processes' (*ibid.,* 250). Peter Godfrey-Smith (2006) appears to endorse a similar attitude. Rather than defending any particular account of the ontology of fictional characters, he suggests that we might accept such objects as part of the 'folk ontology' of scientific modelling, even if in the long run we require an account of these objects 'for general philosophical reasons' (2006, 735).

I am sympathetic to this attitude. Later (Section 3.2) I will suggest that philosophers of science may indeed defer questions concerning fictional characters to philosophers of fiction. The important point to notice, however, is that this route is not open to those who defend the indirect fictions view. This view gives fictional characters a central place in modelling: on the indirect fiction view, scientists represent the world *via* fictional characters. To understand scientific representation we must therefore understand the relationship between a fictional character and the world. It is difficult to see how we could understand how such things represent without first understanding what they are.

For example, both Giere and Godfrey-Smith describe the relationship between model systems and the world in terms of similarities or resemblances between the two. If their accounts of the model-world relationship are to be taken literally then this will clearly place constraints on the account of fictional characters we can adopt: it must be a realist account, on which there are fictional entities and these entities can be said to possess properties such as mass or velocity. If we wanted to take a different view of fictional characters then all talk of similarity or resemblance between model systems and the world would have to be radically reinterpreted. If defenders of the indirect fictions view wish their accounts of scientific representation to aspire to truth, rather than being merely convenient stories, then it seems that they cannot leave fictional characters to philosophers of fiction.

3. A Direct Fictions View

3.1. Models and Fiction Revisited

As we have seen, some models (like the model of the sun and earth) represent real systems while others (like our predator-prey model) do not. The indirect fictions view suggests that we understand both in the same way: in each case, it is argued, the function of the scientists' model description is to create a model system, which is akin to a fictional character. The only difference between the two sorts of cases concerns what the scientists do with the model system afterwards. When they model an actual system, scientists establish another representation relation between the model system and the world.

I think that these are the wrong parallels to draw between models and fiction. Rather than comparing all model descriptions to passages about fictional characters, I believe, we should distinguish carefully between cases where scientists model a real system and those where they do not. In the latter cases, model descriptions *are* like passages about fictional characters. In the former cases, however, scientists' model descriptions are more like works of historical fiction, that represent real people, places and events (for a similar suggestion, see Cartwright 1983, chap. 7). Consider the following passage, from Robert Graves' *I, Claudius*:

> Augustus assumed Antony's Eastern conquests as his own and became, as Livia had intended, the sole ruler of the Roman world. (Graves 1934/2006, 23)

As commonly understood, this passage is not about any fictional character, but about the real Emperor Augustus, as well as his wife Livia, Mark Antony and the Roman Empire.[2] According to Walton, for example, when we read fiction that uses the names of well-known figures like Augustus, the names take their usual referents (1990, chap. 3). On this view, a novel like *I, Claudius* represents real people, places and events, by asking us to imagine propositions about them. Some of these propositions are true, such as that Augustus defeated

[2] Not all will agree with this interpretation, of course. Fortunately, we need not enter into that debate here. (For a helpful review, see Friend 2007.)

Mark Antony. Others are, it seems, entirely fabricated by Graves and so probably false, such as that Augustus was manipulated by the scheming Livia.

This analysis of historical fiction suggests a better way to understand models of real systems. Recall Frigg's discussion of the solar system model. On his view, when we read the scientists' model description we first imagine an entity, the model system, which has all the properties given in the description. It is only in the 'next step', that we 'connect our model to the target-system' (2010b, 134), by specifying that the smaller sphere in the model system corresponds to the earth, the larger sphere to the sun, and so on. And yet it is surely more natural to regard the model description as asking us to imagine things *about the sun and earth themselves*. Frigg himself writes that the description 'tells us to regard the earth and sun as ideal homogeneous spheres' (*ibid*., 133), for example. Why not avoid excessive reconstruction and take the description at its word, as asking us to imagine things about the (actual) earth and the (actual) sun? Specifically, we are asked to imagine that the sun and earth are perfect spheres with certain masses, that they interact only with each other, and so on. Some of this is true (e.g. that the earth and sun are massive bodies) while some is known to be false (e.g. that they interact only with each other).

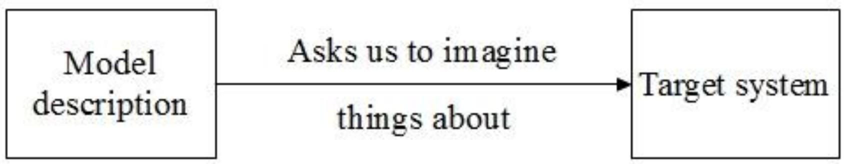

Figure 2: A direct fictions view

In place of the indirect fictions view, then, I propose a direct account (figure 2). When scientists model a real system they ask us to imagine things about that system directly, not via any fictional model system. As we saw in Section 1, sometimes the same model description may be used in different ways. We might first explore the properties of the simple harmonic oscillator without having any real system in mind, and only later use it to understand the motion of the pendulum in the grandfather clock. According to the indirect view, when we apply the model to the pendulum, we do so by comparing our imaginary model system with the real pendulum. My suggestion is that another, more plausible, interpretation remains open to us. When we apply our model to the pendulum we simply imagine that the pendulum satisfies our model description. That is, we imagine that the pendulum is a point mass, that the force exerted on it is proportional to its displacement, and so on.

The point being made here thus involves drawing a distinction between two different sorts of imaginings. Sometimes, we imagine people, places and objects that do not exist, like Sherlock Holmes or imaginary populations of predators and prey. Sometimes, however, we imagine things about real objects or people in the world, as when I imagine that the walls in my flat are painted a different colour, or that I play for Derby County. The mistake made by proponents of the indirect view, I believe, is to assume that all cases of modelling involve cases of the first sort of imagining. It is true that scientists sometimes conjure up imagined systems, just as novelists create fictional characters. But we need not assume that, when the scientist comes to represent the world, she must somehow use these imagined systems to do so. Another option remains open: the scientist may simply imagine things about the world.

3.2. Avoiding Fictional Characters

The direct view allows us to leave problems with fictional characters to philosophers of fiction. Recall that this deferral strategy is not open to the indirect view because, on that view, when scientists represent the world they do so *via* fictional characters. As a result, our account of scientific representation becomes dependent upon which view of the ontology of fictional characters we adopt. This is not the case on the direct account. On the view I have proposed, when scientists represent the world they do so by imagining propositions about it, not via a fictional character. Problems with fictional characters do still arise, but only for models that do not represent any real system, like our predator-prey model. And philosophers of science may legitimately defer these problems to philosophers of fiction. All that matters in these cases is that scientists are able to imagine things about objects that do not exist. Nobody doubts that we have this ability; the debate concerns how we are to explain it. And nothing in my account hinges on the outcome of this debate.

When scientists do not model a real system, then, I suggest that we remain neutral: perhaps we will need fictional entities to make sense of model descriptions, or perhaps not. Where scientists model a real system, however, we can be clear: there is no need to posit entities that satisfy the scientists' model descriptions. The model description asks us to imagine propositions about a real system, and many of these propositions are false. But nothing in this requires us to posit any fictional entity.

As we have seen, however, scientists often talk as if there were an object that satisfies their model description. How can the direct account make sense of this? One answer is suggested by Adam Toon (2010, 2012). Toon also draws on Walton's theory of fiction, but the main ideas behind his analysis may be summarised briefly here. When scientists talk about theoretical models as objects, Toon suggests, we should not take this talk too seriously. Instead, they are pretending, 'going along with' the model in order to tell us what we are to imagine. For example, suppose we say that in the model the sun and earth are isolated from the other planets. When we say this we are not describing any abstract or fictional object; we are simply saying that the model tells us to imagine that the sun and earth are isolated from the other planets.

Toon’s analysis also suggests a way in which the direct account might explain how it is that we can learn about a model. Our initial model description asks us to imagine that certain assumptions are true of the sun and earth, such as that they are perfect spheres and that the force between them obeys Newton’s law of gravitation. If we accept these initial assumptions, however, we are also required to imagine further things, which follow from those assumptions. For example, we are to imagine that the earth moves in an ellipse, since this follows from the equation of motion that we write down. That the earth moves in an ellipse is therefore part of the content of the model, even though this was not specified explicitly in the model description. On this view, then, learning about a model is not a matter of discovering facts about an abstract or fictional object. Instead, we learn about a model by exploring the intricate web of imaginings which it prescribes.

4. Conclusion

Parallels with fiction offer useful tools for understanding scientific models. But we should be careful what parallels we draw. Comparing all model descriptions to passages about fictional characters yields an implausible interpretation of what scientists are doing when they model a real system, and leads us to longstanding disputes over the nature of fictional characters. A more plausible approach looks to fiction about real people, places and events. On this view, when scientists model a real system, they represent that system directly by asking us to imagine it in a certain way, and not via any fictional character. As a result, philosophers of science may leave problems with Sherlock Holmes to philosophers of fiction.

References

Cartwright, Nancy. 1983. *How the Laws of Physics Lie.* Oxford: Clarendon.

Conan Doyle, Arthur. 1902/2003. *The Hound of the Baskervilles*. London: Penguin.

Contessa, Gabriele. 2010. "Scientific Models as Fictional Objects." *Synthese* 172(2): 215-229.

Friend, Stacie. 2007. "Fictional Characters." *Philosophy Compass* 2: 141-156.

Frigg, Roman. 2010a. "Models and Fiction." *Synthese* 172(2): 251-268.

———. 2010b. "Fiction and Scientific Representation." In *Beyond Mimesis and Convention: Representation in Art and Science*, ed. Roman Frigg and Matthew Hunter, 97-138. Dordrecht: Springer.

Giere, Ronald. 1988. *Explaining Science*. Chicago: University of Chicago Press.

———. 2009. "Why Scientific Models Should Not Be Regarded as Works of Fiction." In *Fictions in Science: Philosophical Essays on Modeling and Idealization*, ed. Mauricio Suárez, 248-258. London: Routledge.

Godfrey-Smith, Peter. 2006. "The Strategy of Model-Based Science." *Biology and Philosophy* 21: 725-740.

Graves, Robert. 1934/2006. *I, Claudius*. London: Penguin.

Hughes, R.I.G. 1997. "Models and Representation." *Philosophy of Science* 64: S325-S336.

Meinong, Alexius. 1904/1960. “The Theory of Objects.” In *Realism and the Background of Phenomenology,* ed. Roderick M. Chisholm, 76-117. New York: Free Press.

Russell, Bertrand. 1905/1956. “On Denoting.” In *Logic and Knowledge,* ed. Robert C. Marsh, 41-56. London: George Allen and Unwin.

Suárez, Mauricio, ed. 2009. *Fictions in Science: Philosophical Essays on Modeling and Idealization.* London: Routledge.

Thomson-Jones, Martin. 2007. “Missing Systems and the Face Value Practice.” Unpublished manuscript, retrieved from http://philsci-archive.pitt.edu/archive/00003519.

———. 2010. “Missing Systems and the Face Value Practice.” *Synthese* 172(2): 283-299.

Toon, Adam. 2010. “The Ontology of Theoretical Modelling: Models as Make-Believe.” *Synthese* 172(2): 301–315.

Toon, Adam. 2012. *Models as Make-Believe: Imagination, Fiction and Scientific Representation*. Basingstoke: Palgrave Macmillan.

Walton, Kendall. 1990. *Mimesis as Make-Believe.* Cambridge, Massachusetts: Harvard University Press.

Weisberg, Michael. 2007. “Who is a Modeler?” *British Journal for Philosophy of Science*, 58(2): 207-233.