

AST 120 Activity 13.5

Realism and Phenomenalism

Name

In this activity you will think about some philosophical aspects of the nature and purpose of science. You should attempt to answer each question on your own, then discuss it with the other students at your table. Once you have answered all questions and discussed them with your group, we will discuss these questions as a whole class.

As you think about these questions, consider these things which we have seen so far in this class:

- The apparent movement of the stars can be equally well explained by a rotation of the Celestial Sphere, or a rotation of Earth.
 - The apparent motion of the Sun against the stars can be equally well explained by the Sun orbiting Earth or Earth orbiting the Sun.
 - The apparent motions of the planets can be accurately depicted by either the Ptolemaic or the Copernican system.
 - Uniform motion of a planet along a circle not centered on Earth can be described using an eccentric circle or by using a deferent centered on Earth with an epicycle - both constructions produce exactly the same effects.
1. If we judge scientific theories solely on the basis of how well they fit the observational data they were intended to explain, can we really decide between a rotating Earth and a rotating Celestial Sphere? Or between the Ptolemaic and Copernican systems?
 2. Is it possible for us to be *certain* about the truth of a particular scientific theory? In other words, can we prove things in science the way theorems are proved in math (absolutely and completely, with no room for any doubt)?

3. If we cannot determine with certainty which theory is true, is there some way we can determine which theory is more likely to be true? Consider the criteria listed below for determining which of two theories is the more likely to be true. Mark out those criteria you don't consider useful. Rank order the remaining criteria with 1 being the most useful.
 - whether or not the theory correctly predicts new observations that it was not originally intended to explain,
 - whether or not the theory fits with other theories that we think are correct (ie, Aristotle's physics for a 16th century natural philosopher),
 - whether or not the theory is aesthetically pleasing (ie, simple, beautiful, elegant, etc),
 - whether or not the theory fits with our religious beliefs, including relevant passages in sacred texts,
 - whether or not you have a high opinion of the person who proposed (or advocates for) the theory,
 - whether or not the theory is published in a book,
 - whether or not your friends believe the theory,
 - or whether or not the theory leads to interesting new research questions to pursue.
4. Which of the above criteria would a phenomenalist like Osiander consider important? Is the *truth* of a theory an important issue for a phenomenalist?
5. Copernicus accuses the Ptolemaic theory of being ugly, saying of the Ptolemaic astronomers that "their experience was just like some one taking from various places hands, feet, a head, and other pieces, very well depicted, it may be, but not for the representation of a single person: since these fragments would not belong to one another at all, a monster rather than a man would be put together from them." Clearly he believed that aesthetic criteria were important in judging a theory. What aspects of Copernicus' theory did he himself find aesthetically pleasing?
6. Do you think Copernicus believed in the *truth* of his theories? Why do you think this?

7. If we were to judge the Ptolemaic and Copernican systems on the basis of how well they fit with the other theories known in the 16th century (Aristotelian physics, etc), which theory would be considered best and which would be considered worst? Why?
8. Copernicus devised his theory to account for the motions of the planets on the sky, but his theory can be used to predict other things. For example, his theory can be used to predict changes in the brightness of a planet. Copernicus' system predicts that the distance from Venus to Earth changes by a factor of 6.7 from least to greatest.¹ This would imply that when Venus is at its most distant it should be $(6.7)^2 = 44.8$ times dimmer than when it is at its closest to Earth. Venus does get brighter and dimmer, but not by anything like a factor of 45! Should we reject Copernicus' theory on this account? Explain why or why not.
9. Ptolemy's theory of the Moon has a similar problem. It predicts that the angular size of the Moon on the sky should more than double over the course of a month. The angular size of the Moon does change very slightly, but it doesn't come anywhere close to doubling. Should we reject Ptolemy's theory on this account? Explain why or why not.
10. Should we really expect our theories to fit with *everything*, or should we just expect them to fit the data they were intended to explain? Which of these positions is more likely to be taken by a phenomenalist? Which is more likely to be taken by a realist? Which do you prefer?

¹Note: Ptolemy's theory predicts the same thing.

11. Who do you think is more likely to do the hard work of constantly improving scientific theories, making them more accurate and broader in scope: a realist or a phenomenalist? Explain your answer.
12. Who do you think is more likely to defend a theory at all costs, even in the face of blatantly contradictory evidence: a realist or a phenomenalist? Explain your answer.
13. Should science be a search for the truth about the natural world, or should it just try to “save the phenomena” and devise theories that conveniently fit (past and future) observations with no concern for what is “true”? Defend your answer.