

Lecture 24

Comparison of Bacon and Copernicus

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Scientific Thought I
Fall 2009

Copernicus's method

Look for an alternative hypothesis [4.37]

I began to be annoyed that the movements of the world machine, created for our sake by the best and most systematic Artisan of all, were not understood with greater certainty by the philosophers, who otherwise examined so precisely the most insignificant trifles of this world. For this reason I undertook the task of rereading the works of all the philosophers which I could obtain to learn whether anyone had ever proposed other motions of the universe's spheres than those expounded by the teachers of astronomy in the schools. And in fact first I found in Cicero that Hicetas supposed the earth to move. Later I also discovered in Plutarch that certain others were of this opinion.

See if the consequences agree with observation [5.6]

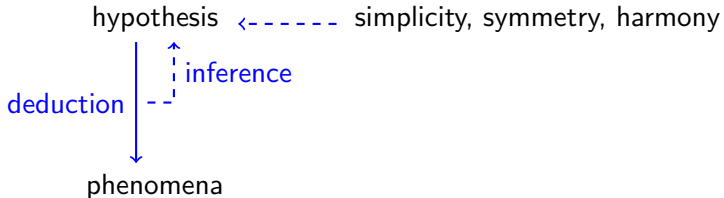
Having obtained the opportunity from these sources, I too began to consider the mobility of the earth. And even though the idea seemed absurd, nevertheless I knew that others before me had been granted the freedom to imagine any circles whatever for the purpose of explaining the heavenly phenomena. Hence I thought that I too would be readily permitted to ascertain whether explanations sounder than those of my predecessors could be found for the revolution of the celestial spheres on the assumption of some motion of the earth.

Having thus assumed the motions which I ascribe to the earth later on in the volume, by long and intense study I finally found that if the motions of the other planets are correlated with the orbiting of the earth, and are computed for the revolution of each planet, not only do their phenomena follow therefrom but also the order and size of all the planets and spheres, and heaven itself is so linked together that in no portion of it can anything be shifted without disrupting the remaining parts and the universe as a whole.

The method of hypothesis

I'll call Copernicus's method *the method of hypothesis*. It involves the following steps:

- Formulate a hypothesis, which is initially regarded as just a conjecture, not an established truth. Where it came from isn't important.
- Deduce what would be observed if the hypothesis were true, and compare that with what is actually observed.
- If they agree, and the hypothesis is simpler (etc.) than others that also agree with observation, conclude that the hypothesis is correct.



Bacon's two methods

- *There are and can be only two ways of searching into and discovering truth. The one flies from the senses and particulars to the most general axioms, and from these principles, the truth of which it takes for settled and immovable, proceeds to judgment and to the discovery of middle axioms. And this way is now in fashion. The other derives axioms from the senses and particulars, rising by a gradual and unbroken ascent, so that it arrives at the most general axioms last of all. [19]*
- *Both ways set out from the senses and particulars, and rest in the highest generalities; but the difference between them is infinite. For the one just glances at experiment and particulars in passing, the other dwells duly and orderly among them. The one, again, begins at once by establishing certain abstract and useless generalities, the other rises by gradual steps to that which is prior and better known in the order of nature. [22]*

Copernicus didn't use either of Bacon's methods

Not anticipation of nature:

- This method “just glances at experiment and particulars in passing,” whereas Copernicus made a detailed quantitative study of observed phenomena.
- Casual observation might suggest a hypothesis initially, but at that point it is just a hypothesis, not taken “for settled and immovable” as in anticipation of nature.

Not interpretation of nature:

- This method “rises by gradual steps” and “arrives at the most general axioms last of all.”
- Copernicus didn't go through a sequence of generalizations. He justified his hypothesis directly by deducing from it the phenomena we observe.

So Bacon was wrong to say “there are and can be” only his two methods; the method of hypothesis is a different one.

What Bacon said needed to be done

Let no one hope to decide the question whether it is the earth or heaven that really revolves in the diurnal motion until he has first comprehended the nature of spontaneous rotation. [5]

- Bacon assumed that whichever is rotating (either heaven or earth) does so spontaneously. He thought we need to find the form of spontaneous rotation to know which one is rotating.
- Copernicus didn't consider the form of spontaneous rotation.
- According to Bacon, Copernicus should have drawn up tables of instances where spontaneous rotation is present, similar cases where it is absent, and cases where it differs in degree. But that wouldn't have got him anywhere.

Bacon's crucial instance for rotation of Earth

The instance [36]

Let the nature investigated be the spontaneous motion of rotation, and in particular whether the diurnal motion whereby to our eyes the sun and stars rise and set, be a real motion of rotation in the heavenly bodies, or a motion apparent in the heavenly bodies, and real in the earth. We may here take for a crucial instance the following. If there be found in the ocean any motion from east to west, however weak and languid; if the same motion be found a little quicker in the air, especially within the tropics, where because of the larger circles it is more perceptible; if the same motion be found in the lower comets, but now lively and vigorous; if the same motion be found in planets, but so distributed and graduated that the nearer a planet is to the earth its motion is slower, the further a planet is distant from the earth its motion is quicker, and quickest of all in the starry sphere; then indeed we should receive the diurnal motion as real in the heavens, and deny such motion to the earth.

Critique

- This isn't a crucial instance.
 - What is observed is motion relative to us, not absolute motion.
 - So even if we observed Bacon's instance, it could be that Earth rotates daily from west to east, the ocean also rotates but slightly slower, the planets orbit west to east slower as they get further away, and the stars are stationary.
- It is inconsistent with a well known observation.
 - Bacon is talking about motion from the perspective of Earth.
 - From that perspective Mercury, Venus, and the Sun all have the same period of orbit.
 - This is easily observed and had been well known for thousands of years.

Questions

- 1 Was Copernicus using what Bacon calls the method of anticipation of nature, or the method of interpretation of nature, or something else? Justify your answer by explaining the method Copernicus used and how it differs from the other method(s).
- 2 What did Bacon say needs to be done to determine whether it is the earth or the heavens that rotates once per day? Did Copernicus do that?
- 3 What did Bacon propose as a crucial instance for determining whether it is the earth or the heavens that rotates once per day? Is this really a crucial instance? Could Bacon reasonably have thought that observation might give the result he says would prove the earth is stationary? Explain.

References



Francis Bacon.

Novum Organum.

London, 1620.

[English translation on the web](#); quotations are from this.

Numbers in brackets are aphorism numbers from Book II.



Nicholas Copernicus.

On the Revolutions of the Heavenly Spheres.

Johns Hopkins University Press, 1992.

Translation by Edward Rosen.

Numbers in brackets are page and line numbers of this edition.

[Text on the web](#) (without page or line numbers).