

Copernicus and the Aristotelians: A Debate:

Personae Dramatis:

Nicolaus Copernicus

Bombasticus, the Aristotelian

Interlocutor (narrator)

Time: 1521

Place: London, England

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Narrator: This is a public debate about the relative merits of the geocentric and the heliocentric models of the solar system. Nicolaus Copernicus of Krakow, Poland has been working on a new model of the solar system in which the sun is the center and the planets revolve around the sun. Monsignor Bombasticus of the Vatican has been an ardent defender of the Earth-centered solar system of Ptolemy. He uses the physics of Aristotle to back up his physical arguments for rejecting the sun-centered solar system. This debate is sponsored by the Vatican and has been presented in major cities, including Rome and Paris. Since both eminent scholars speak fluent English, the debate will be in English and not in Latin.

Briefly describes the two models, then turns to Copernicus. Copernicus and Bombasticus make comments.

Master Copernicus, could you tell us in a few words where you found your inspiration or insight to shift the center from the Earth to the sun?

Copernicus: I read Aristarchus in my youth. I decided to try whether, on the assumption of some motion of the Earth, like the daily revolution, better explanations of the revolutions of the heavenly spheres might not be found. Thus assuming the motions which I attribute to the Earth...I have found that when the motions of the other planets are referred to the circulation of the earth and are computed for the revolution of each star, not only do the phenomena necessarily follow therefrom, but also that the order and magnitude of the stars and all their orbits and the heaven itself are so connected that in no part can anything be transposed without confusion to the rest and to the whole universe.

Bombasticus: I have studied your theory or model very carefully. First, it seems that there are not observations that we make using the Ptolemaic system that are inferior to those you make with yours. Secondly, the accuracy of your predictions of planetary positions are not significantly better than those made using the earth-centered model. For example, retrograde motion can be explained by both, but I find the epicycle explanation more pleasing. Thirdly, your model does not make any new observations or prediction that the Ptolemaic does. Finally, and most importantly, your model contradicts all common sense and observation. And one other thing...

He is very upset and tries to continue but Copernicus interrupts him.

Copernicus: Common sense is not a good guide in astronomy...

Narrator: Perhaps this would be a good time to ask Master Copernicus, what basic assumptions he made for his system and then have the Monsignor respond to these.

Copernicus: I made the following assumptions. As expected, several of these do not sit well with some people.

1. There is no one precise, geometric center of all circles or spheres.
2. The center of the Earth is not the center of the universe.
3. All the spheres revolve in circles...in the midst of all, the sun reposes, unmoving.
4. The distance from the Earth to the sun is very small in comparison with the distance to the stars.
5. The motions in the sky we observe arise because of the double motion of the Earth.
6. The apparent retrograde motion of the planets arise because of the motion of the Earth.

Bombasticus: Let us look at some of your assumptions. The assumptions that the Earth is not the center of the universe and that all planets revolve around the sun not only contradicts common sense but is against the teachings of the bible. Moreover, there is no observable shift in the position of the stars when we make observations six months apart. Our instruments can measure to an accuracy of 1/10 of a degree of arc. That means that the stars must be at least 1000 times the distance between the sun and the Earth! That seems absurd! *He goes to the BB and shows how this can be calculated, shaking his head.*

Copernicus: I am sorry Monsignor, but we may have to accept the fact that the stars are immeasurably far away and that the center of the solar system is not the Earth! However, displacing the center of the solar system to the sun does not demean the stature of man. Who, indeed, in the most beautiful temple would place the light giver in any other part than whence it can illumine all other parts? We can find in this setting an expression of clear harmony in the motion and magnitude of the stars. This, I think, reflects the mind of God as well as the Ptolemaic system.

Narrator: Many of the arguments against your system, Master Copernicus, are based on physical reasoning. Monsignor Bombasticus who has studied the physics of Aristotle closely, has recently outlined these in detail.

Bombasticus: Yes, I will deal with only two of these, because I think they provide us with sufficient reason to reject your system. Master Copernicus. First, the atmosphere, birds and clouds would be left behind by the rotating Earth. Secondly, the rotating Earth would fly apart. Let me just demonstrate what I mean. (He jumps up and lands exactly on the same spot he was before jumping.) Now, if the Earth moved once every 24 hours the speed of the Earth here would be about 1000 feet per second. Since I was in the air about half a second the floor would have moved under me about 500 feet! Clearly it did not move.

Copernicus: Monsignor, you crossed the Channel on your way to England. You must have notices that when the sea was calm and the speed of the boat constant, the motion of the ship was imperceptible. You may even have notices that when sailors drop objects from the top of the mast, these objects fall straight down, as seen by people on the ship. Let me demonstrate. *He*

takes a piece of chalk, walks in a straight line and throws it in the air. What do I see? What do you see?

Narrator: That is very interesting. Could you please do it again.

Copernicus: As far as the rotating Earth falling apart is concerned, the following question should be asked. Why does the defender of the geocentric model not fear the same fate for his rotating celestial sphere – so much faster because it is so much larger?

Bombasticus: Aristotle clearly differentiated between celestial and terrestrial laws of physics. The motion of the heavenly bodies are perfect circles and constant speed and they are not subject to forces like the terrestrial bodies. Clearly, the divine Architect worked from a Ptolemaic blueprint.

Narrator: I am not a philosopher or knowledgeable in Aristotelian physics, but it seems to me that it really does not matter from which point of view, or what you may call “frame of reference”, you describe the motion in the heavens. It seems that this is true, because both models describe the motions to about the same accuracy.

Copernicus: First of all, we must reject the idea that celestial motion is governed by different laws. Secondly, in terms of motion, or kinematics, the two frames of reference must be considered equivalent. But in terms of dynamics, that is, when we consider the forces that must be acting on a large body like the sun in rotation, it is clear which model is to be preferred. In addition, my model it is possible to determine the actual distances between the sun and the planetary orbits in terms of the distance between the sun and the Earth!

Bombasticus: So you that your system is not just a mathematical-geometric model, it represents the actual solar system. In your model the small epicycles do not fill up the spaces between the planets. But Aristotle said that there the spaces must be filled because there can be no vacuum.

Copernicus: Maybe there is an invisible fluid filling up that space. Perhaps we can call this fluid Ether.

Bombasticus: Master Copernicus, the Church is against your model and even the protestant heretic Luther recently called you a fool that “would overturn the whole science of astronomy.”

Copernicus: I am not interested in what the Church of Martin Luther have to say about astronomy. I am interested in finding the simplest and most pleasing model that would faithfully reflect the mind of God.

Narrator: I am intrigued by the idea that, if other celestial bodies are made of Earth-like materials than they might even be inhabited by other beings.

Bombasticus: Perhaps inhabited by heathens or even by creatures more beloved by God than we are! What a heretical idea!

Narrator: Thank you Master Copernicus and Monsignor Bombasticus. This may be a good time to end the discussion. Perhaps we should heed the injunction of St. Augustine: “Ask not how the heavens go but rather ask how to go to heaven.”

Turning to the audience: “You are invited to ask questions of our distinguished guests. Make your questions short, succinct and serious.”

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