

PROJECT 6: DEFENDING THE NEWTONIAN SYNTHESIS

1 General Description of the Assignment

Before you had even completed your Ptolemaic and Copernican models of your new solar system, you and the other colonists were shocked to discover that you are not alone on your new planet. Scouts on a routine surveying mission came across a settlement of intelligent beings who call themselves the Jez'vit. Since that time several more Jez'vit towns have been discovered. The Jez'vit are roughly humanoid in appearance but with a pair of short horns on their foreheads. The Jez'vit culture is a relatively primitive agrarian culture, not unlike that of Renaissance Europe. Their population is small and they lack all but the most simple technologies, which is why you were unable to detect them in your space-based surveys of the planet. However, the Jez'vit seem quite intelligent and their culture is sophisticated and values knowledge of the natural world.

The linguists in your colony have managed to decipher the Jez'vit language so that communication between humans and Jez'vit is now possible. The Jez'vit leaders have many questions that they wish to ask of the human colonists, and the governor of your new colony has committed to sharing human knowledge on almost any non-military topic. As your colony's lead astronomer, you have been asked to respond to the following letter (already translated into English by the linguists) from the Jez'vit scholar Riq'ioly. She is very interested in human astronomical knowledge, but is having a hard time reconciling what she hears with the long-established traditional knowledge of the Jez'vit.

Esteemed Human Astronomer,

I relish this opportunity to query you about astronomical matters. The Jez'vit are hungry for human knowledge and particularly knowledge of the natural world. I am particularly anxious to learn what you know of the heavens, as the motions of the night sky have fascinated me since my childhood and I have undertaken their study as my profession. I have had the opportunity to speak (through a translator) with some of your human colleagues who have knowledge of what you call "astronomy". They have informed me that your home world spins about an axis and also orbits, along with several other "planets," around a bright central star you call the Sun. They tell me that these orbits follow a set of rules known as "Kepler's Laws" and I was able to get some idea of what that entails.

Furthermore, they assure me that our home planet (which we Jez'vit call Bolo'nya) likewise spins and orbits around our Ro'ma (which you humans know as Barnard's Star, among other names). I have been shown your models of our "solar system" and I have managed to gain an understanding of how both your Ptolemaic and Copernican models account for what I myself have seen in our night sky. Yet, I cannot get this idea of a moving, spinning Bolo'nya between my horns. This teaching is so different from the knowledge we Jez'vit have that it seems impossible for me to believe in it. I am writing to you in the hope that you can provide me with evidence by which I can come to accept your human view. In that hope I will discuss several ways in which your idea that we live on a rotating and orbiting planet conflicts with the long-held traditions of the Jez'vit.

The first set of conflicts might be classified as philosophical. The Jez'vit have always held that the heavens are perfect and immutable, while our Bolo'nya is corrupt and changeable and composed of several elements which can mix together. But you humans place our home world, and the spheres of the elements, in the midst of the heavens! Surely it would be better to separate the elemental world which encases our home world from the unchanging celestial realm. Only by placing Bolo'nya in the center can this separation be achieved.

Moreover, how can our massive Bolo'nya and its elemental sphere spin around in a single day, and fly at even greater speed through the heavens as it orbits Ro'ma? Circular motion is not natural for a heavy body, and what body is heavier than our home world? A corruptible and heavy body such as Bolo'nya cannot have perpetual motion but must quickly come to a stop unless it is continually propelled by some force. What force, then, could cause our home world to spin on its axis? And what force could possibly make it hurl through space in an orbit?

The next set of conflicts involves the motion of objects here on Bolo'nya, and how this motion seems to argue against your view that our home world is spinning and moving through space. Consider a heavy ball of iron dropped from a tall tower. If Bolo'nya is spinning about, carrying all points on its surface around in an enormous circle at a terrific speed, then this ball must surely land well to the west of the tower. For the surface of our world, and the tower with it, will move out from beneath the ball as it falls, and when the ball finally strikes the ground the tower will be found far to the east of that spot. Likewise, an object flung straight up into the sky should return to the ground far to the west of its thrower. The very air that surrounds us could not keep pace with this rapid motion, and thus we would feel a wind like a tornado or hurricane blowing us constantly to the west.

Indeed, why should a body fall to the ground at all if Bolo'nya is not located at the center of the Universe? The Jez'vit have long believed that what you call gravity is simply the natural tendency for a heavy object to move toward the center of the Universe. How do you humans explain the tendency of heavy bodies to fall to the ground even though, according to your notions, this world is both spinning and hurtling through space? Should not heavy bodies instead fall away from Bolo'nya, thus to seek out the true center of the Universe (wherever that may be)? But never have we observed such behavior.

Furthermore, in your human picture of the world we could only cling to the ground with great difficulty. If one ties a piece of string onto a stone and then whirls the stone about in a circle, the stone will remain in the circle only because the string keeps it there. If the string is cut the stone will fly outward. The faster the stone is whirled the more readily is it flung outward if the string is cut. In much the same way a child playing on a spinning platform must hold on tightly or else be flung off and to the ground. If our home world were to spin with such a speed as you humans claim we would certainly all be thrown into the sky! Yet none of these things are seen to occur. How is it that we are not thrown off the ground and into the heavens?

There are additional conflicts of an astronomical nature. How, if our world is racing through the heavens to orbit Ro'ma, does our Moon manage to keep up with this motion and not be left behind? Do you humans claims that there are two centers of motion: Bolo'nya for the Moon and for gravity, and Ro'ma for the motion of the planets? How can the Universe have multiple centers? Surely such an arrangement is unnecessarily complicated.

I have discovered a few technical problems with your "Copernican model" as well. We have found that of the planets we can see in our night sky some remain close to Ro'ma (we call these "tethered planets") while others are continually bypassed by Ro'ma (we call these "free planets"). Your Copernican model predicts that the distance between our home world and these planets will change over time as Bolo'nya and the other planets orbit about Ro'ma. For the free planets the model seems to account well for the changes that we have noticed in the apparent brightness of these planets. But for the tethered planets your Copernican model predicts much larger changes in brightness than we see in our night sky. Does this not refute your idea of an orbiting Bolo'nya?

The stars, too, speak out against Copernicus. If our world orbits about Ro'ma, then some stars would get brighter and others dimmer as Bolo'nya moves closer to one side of the Celestial Sphere and away from the side opposite. Stars seen separated by, let us say, a degree of arc at the one equinox should be found separated by a degree and a half at the opposite equinox. If Bolo'nya moves such a great distance then it cannot remain at the center of the zodiac, so that at one time of year we might see six signs of the zodiac but in another only four and in another eight! Yet no such changes have ever been observed among the fixed stars.

I have been told that you humans think that the stars are much farther away than we Jez'vit believe. Indeed, you claim to have come from a world that orbits one of the nearest of the stars (a claim I can hardly credit, but I will leave that for others to argue!). But to claim that the stars are so far away that we cannot detect in them the motions of Bolo'nya is to claim that the stars themselves are immense in size. Indeed they must be vastly larger

than our Ro'ma, or even your Sun. For the stars have a size that is visible to the eye and if they are as far away as Copernicus must claim them to be then they must be so large as to swallow up our entire "solar system." What is more, there would have to be a great expanse of empty space between the outermost planet of our system and the nearest of the stars. Why should the Creator build a Universe with such a tremendous empty space that serves no purpose?

I am truly hard pressed to believe your human picture of our home world. Even you must admit that you can account for what we observe in the night sky just as well by assuming that Bolo'nya sits still at the center (in what you call your Ptolemaic model) as by assuming that it spins and orbits. Why, then, should we choose to believe in this radical Copernican view that conflicts with so much of our ancient Jez'vit wisdom? What advantages does this Copernican view possess that the Ptolemaic (or perhaps some other view in which Bolo'nya is allowed to remain motionless) does not?

I apologize for this lengthy letter, but I assure you it is only through great restraint that I kept it so short. I am sure that the more I learn of your human "astronomy" the more questions I will have. Yet I hunger and thirst for the knowledge you can provide. I hope that as we Jez'vit learn from you humans, in astronomy and in other areas of knowledge, we will come to understand each other better and perhaps we Jez'vit can even provide useful knowledge to you. I look forward to your response with great anticipation.

Your Most Devoted Student Among the Jez'vit,

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(G'vany Riq'ioly)

2 Your Reply

Your reply may be written in the form of a letter to Riq'ioly, or else you may simply write it as an open essay addressing the concerns raised in her letter. You realize that the Jez'vit have beliefs eerily similar to those of 16th century European natural philosophers, so it is important that your reply be made in terms that are understandable to such an audience. If you stick to topics that were discussed in the Copernican Revolution course you should be fine, but writing about rockets and lasers and interstellar travel is likely to be more confusing than helpful.

Your letter/essay should ideally address all of the points raised by Riq'ioly. In addition you should provide other arguments that you think strengthen the case for what might be called the Newtonian synthesis (which incorporates ideas from Copernicus, Kepler, Galileo and others). There is no set page or word limit for this assignment. If you have adequately addressed all of the points then the length doesn't matter. My estimation is that this will take you about 4 pages or so. I really don't see how you could do it in just 2 pages. I'll also warn you that if you plan to make me read 10 pages you had better make all 10 of those pages REALLY GOOD.

You are free to make use of whatever resources you want for this assignment. I certainly encourage you to use the textbook and the activities, as well as any of the computer simulations. You may use outside sources as well, but please cite any such sources that you use (I don't care about citation style - if I can find the source, then you cited it properly). Remember that you probably shouldn't use any arguments that would not have been available to a contemporary of Isaac Newton. Anything in the text or activities is fair game, but you will need to be more selective if you make use of internet or print sources not associated with this class.

I am providing you with a detailed grading rubric for this assignment, so please read that rubric carefully *before* writing your letter/essay. If you have any questions send me an email (ttimberlake@berry.edu) or stop by to see me in my office. I hope you enjoy completing this assignment (even though I know this is a stressful time). Just think: if you can do a good job on this then it shows that you really know *why* we believe that the earth orbits the sun and not vice versa. And that's powerful stuff...

The paper is due at 5:00 PM on 10 December, 2013. You can turn in your paper by bringing it when you come to take the Fact Check that morning at 10:30 AM, or you can drop it in my mailbox outside MAC 338. If necessary, you can email an electronic file to me instead - but I would prefer to receive a hard copy.