Reading Guide: Tycho Brahe and Johannes Kepler

Quick summary and context: This week, we study the developments of the Copernican hypothesis affected by Brahe and Kepler. We saw in class that there were clear advantages and disadvantages with regards to Copernicus's theory. In brief, it was vastly explanatorily superior to Ptolemaic astronomy, but it also conflicted with Aristotelian dynamics. In this context, Brahe develops a system that takes the best of both worlds; his system retains the explanatory power of Copernicus's theory while also putting the earth back at rest in the center of the universe. Kepler, on the other hand, constructs an astronomical theory that conflicts with the Aristotelian worldview to an even greater extent than does Copernicus's theory. The advantage for Kepler is that he makes remarkable progress with regards to the predictive accuracy of astronomy and his theory is simple – given that it does away with such "monstrosities" as epicycles, eccentrics, and equant points.

Recommended order of reading

1. Dewitt, chs. 15-16 (required summary of Brahe's and Kepler's astronomical theories)
2. PS, pp. 98-100 (required summary, similar to the above, with more attention given to historical context and the relations between these thinkers)
3. PS, 2.4 (required; excerpts from Tycho Brahe's *The New Star*. See reading guide below)
4. PS, 2.6 (required; excerpts from Kepler's *New Astronomy*. See reading guide below)
5. PS, 2.5, 2.7; SEP: "Johannes Kepler" (recommended supplementary reading)

Brahe's *The New Star* (PS 2.4)

In 1572, Brahe observed the appearance in the heavens of a new star. This was groundbreaking news! As we have seen, the prevailing Aristotelian worldview of the time held to the absolute changeless perfection of the Heavens. This finding obviously didn't sit well with that framework.

1. Note in the first section where Brahe explicitly sets his new finding up against the Aristotelian belief that "in the ethereal region of the celestial world no change, in the way either of generation or of corruption, takes place."
2. Why is Brahe so concerned with showing that the new star doesn't reveal any parallax effects? (What is the conclusion that he draws from his investigation into the question of whether the new star "has parallax"?)
3. Brahe makes mention of comets and "fiery meteors" toward the end of this excerpt. He asks God to bring a comet about so that he can study the features of such a phenomenon. Later in his life, Brahe's prayer is answered (or his wish comes true, depending on how you view things). From your other readings (the secondary sources), make sure you understand what Brahe argues from his study of a comet.

Kepler's *New Astronomy* (PS 2.6)

1. Kepler's statement, "I have mingled celestial physics with astronomy in this work," is very revolutionary for his day. Why?
2. Which astronomical system is "the most ancient" according to Kepler?
3. What does Kepler mean by "all of the eccentrics intersect in no other place than the very center of the solar body (not some nearby point)"? And why is this important?

4. What fact and principle does Kepler point to in order to argue that Brahe's system should be accepted over Ptolemy's astronomy?
5. Do you best to understand each of the six arguments that Kepler gives in favor of Copernicus over Brahe (pp. 127-28). Do you find these arguments convincing?
6. How does Kepler argue against Aristotle's notion of weight / gravity?
7. What does Kepler think gravity is? Why does it follow for Kepler that "If the earth should cease to attract its waters to itself, all the sea water would be lifted up, and would flow onto the body of the moon"?
8. The section titled, "To the objection that objects projected vertically fall back to their places" is **very** important. Remember that the Aristotelian dynamics is still widely accepted at this time and so Kepler has to make sense of a moving earth by changing the current dynamics. Work hard to understand this section well. Why, according to Kepler, do things fall back to the same place when they are thrown vertically upward? And how does this alleviate the problems for his astronomical theory?
9. What is so great about Brahe's astronomical theory, according to Kepler (p. 131)?
10. How does the sun exercise an influence on each of the planets (look at the last two sections of the reading)? Try to work Kepler's thoughts here out in detail.