

- d. And in the process put the field in a position where further observations would continue to yield relatively unequivocal answers to other related questions
- 3. But Kepler was by no means the first to succeed in thus turning questions into empirical questions in the sense just given, for this is precisely what Ptolemy had done too
 - a. For example, Ptolemy used observations to generate the bi-section of eccentricity of Mars and Venus, as well as answers to a wide range of specific questions about orbital elements, etc.
 - b. Why *Almagest* was so extraordinarily compelling
 - c. I say this fully granting that Ptolemy may have played foot-loose-and-fancy-free with observational data, and recognizing that he worked with lower quality data, with less basis for setting bounds on precision; and his circular motion working hypothesis was more confining
- 4. The point is that Kepler represents a huge step forward because he wanted the "data-determined-answers" to such questions to do more than just be reasonably stable and not totally question-begging
 - a. He wanted either to eliminate all further systematic residual discrepancies between observation and theory or to be able to use them as data that could be turned into new, still further evidence for added refinements -- e.g. to refraction corrections
 - b. And he wanted to be able to use the "data-determined-answers" as at least an initial evidential basis for answering questions about the physical mechanisms underlying planetary motion
- 5. Still, do not lose sight of the fact that Kepler started from theories taken from Ptolemy, Copernicus, and Tycho: he can be looked on as the culmination of 1400 or more years of mathematical astronomy
 - a. Like them, he fully appreciated that some sort of theoretical assumptions were indispensable to drawing any conclusions from planetary observations
 - b. Indeed, he systematically used discrepancies between their theories and Tycho's observations as the evidential basis for his further conclusions
 - c. I.e. Kepler's total reformation can equally be viewed as proceeding by successive approximations from already existing theories of a highly advanced science
 - d. *Astronomia Nova* written in a way to carry those working in the old astronomy step by step into the new: the new is presented as built on the old, a refinement
- 6. Finally, keep in mind the extent to which Kepler consistently tried to cross-check each "data-determined answer" -- he fully recognized that observational data can be misleading, whether taken in their own right or in the context of a presupposed initial theory
 - a. Cross-check via alternative ways of yielding at least a rough answer to the same question
 - b. And cross-checking via considering whether the answer is physically at least reasonable
- C. Kepler: The Subsequent Years (1609-1630)
 - 1. In truth, Kepler was quite possibly the only person ever to have been influenced by the evidential argument in *Astronomia Nova*, for he was quite possibly the only person in the era to understand it, and anyway so few copies of the book circulated