namely the way in which different aspects interlock to form a system, so that many effects that have to be individually built into Ptolemaic theory are obtained "for free" in Copernican

a. E.g. why planets brightest during retrograde, why Venus and Mercury never far from sun, why motions on epicycles of outer planets have to be keyed to mean sun, etc.
b. A type of appeal that still carries weight in science today, and certainly was a major factor among converts in the century after *De Revolutionibus*
    (1) The "Pythagoreanism" of Copernicus (a term applied derogatorily by the Church at the time)
    (2) But methodological principle can be stated independently of appeals to classical authority
c. Principle: a theoretical move put forward to account for some one phenomenon gains support when it provides, as corollaries, answers to why-questions regarding other phenomena
    (1) The more such answers to why-questions "for free" and the wider the range of phenomena so covered by the answers, the better
    (2) Theoretical moves that do this preferable to ones that do not
d. An intuitively universally accepted methodological principle, but controversy in philosophy of science over why it is a proper principle
    (1) On view of science as inference to the best explanation: a unified explanation of many separate features better than separate explanations for separate feature
    (2) On a Popperian view of science: wider the range of items covered by a theoretical move, the more opportunites to falsify it

H. Another Answer: Opening a New Path for Research

1. Let me suggest an alternative, extremely sophisticated reason why Copernican ought to have been preferred to Ptolemaic before 1600
    a. Doubt that anyone at the time ever came close to verbalizing this reason, for too much at odds with how people talked about astronomy etc. at the time
    b. But still might have been what tacitly persuaded several of the most sophisticated astronomers to abandon Ptolemy well before decisive empirical evidence to do so started coming in
2. If one adopts the Copernican system, even provisionally, then in a position to use triangulation to infer at least rough sun-planet distances from observations, which ought to coincide with distances inferred from retrograde motions
    a. Inference theory-dependent, for need to use heliocentric longitudes from theory, and need to include eccentricity and varying distance from earth to sun
    b. At first glance, then, question-begging
    c. But suppose Ptolemaic true; then extremely unlikely that distances obtained via triangulation, using heliocentric longitudes that do not beg the question, will be well-behaved at all, much less will support conclusion that planets basically in circular orbits about sun

d. Then over time can use observations to keep checking distances inferred from retrograde loops, with expectation that if as far off the track as Ptolemaic, difficulties will emerge

3. More important, if heliocentric longitudes can be made precise and a large number of careful observations are then used to obtain triangulated sun-planet distances, may be able to bring evidence to bear on the precise trajectories of the planets
   a. E.g. a circle, as equant would have it, or a flattened circle, in accord with minor epicycle
   b. Difficult for two reasons: small errors in observations can lead to significant errors in computed distances; and small errors in orbital parameters can have the same effect
   c. Even so, by adopting Copernican, even provisionally, have at least a hope for beginning to assess basic circular motion hypothesis, as well as minor epicycle versus equant
4. Nothing like this in any way possible on Ptolemaic, for no way to use triangulation to look for whether distances conflict with circular motion assumption
   a. Circular motion assumption a working hypothesis, underlying both Ptolemaic and Copernican
   b. But with Copernican, a working hypothesis that in the long run may be open to systematic empirical assessment and refinement through triangulations
   c. In terms of its potential for developing further empirical evidence that will allow refinements of initial assumptions, Ptolemaic at a dead end in a way that Copernican is not
5. Reason for preferring Copernican, then, is not that it is true or more likely to be true, but that (1) it can be safely adopted and (2) by doing so, open the possibility of bringing empirical data to bear that will address some underlying assumptions
   a. Safe because, if Ptolemaic right, triangulated distances with independently determined heliocetric longitudes will likely be so poorly behaved that will see this promptly
   b. Of value because for first time potentially less at mercy of an initial assumption
   c. In other words, by adopting Copernican, just as a working hypothesis, there is a promise that everything will come out in the wash -- a promise that is not offered by Ptolemaic
6. Suggested methodological principle: if a theoretical claim opens the way to bringing (theory-mediated) empirical evidence to bear on questions that have heretofore resisted empirical answer, then the claim ought to be accepted as a working hypothesis and ongoing research be predicated on it, provided that there are adequate safeguards against being systematically misled (down a garden path) by the research in question
   a. Theory as tool in research, even when not exactly true
   b. Evidence accrues to it from the success of the research predicated on it in yielding stable convergent results
   c. Becomes entrenched in science, usually in a refined form, not because of the initial evidence for it, but because of this accruing evidence
   d. (The beginnings of a response to Kuhn's claim that evidence plays not so great a role in science)