career of trying to replicate Galileo's announced results during the 1630's and 1640's

3. Also, do not want to deny that Galileo made extraordinary contributions to the development of modern science
    a. *Two New Sciences* did indeed make giant strides toward giving us a mathematical physics of elementary motion, and it established a style for combining mathematics and physics
    b. Not so much the advent of the telescope, for others did so at virtually the same time, but the way in which he presented telescopic results did a great deal to end the old dogmatism
    c. And he constantly announced a commitment to resolving issues empirically, and to learning to live with ignorance until such answers were forthcoming (in contrast to the philosophers)
4. What bothers me so much is a certain loss of intellectual integrity in his disputes with others -- not just with those deeply opposed to his values, but also with such people as Mayr and Kepler
    a. Galileo perhaps the greatest polemicist of all time, and he clearly enjoyed polemics above anything else
    b. But his overwhelming desire to win disputes led to excesses, both in his attacks on others and in the confidence with which he expressed his own positions
5. This is visible in the *Dialogue*, but it reaches an extreme in *The Assayer*, which -- polemics aside -- is one of the more important early works on "scientific method"
    a. Father Grassi an advocate of view that comets are superlunary; Galileo "destroys" him without the least restraint
    b. (Not the last instance in which superior arguments about scientific methodology will be used to win arguments for the wrong side of a substantive issue)
    c. Grassi did not forget – appears to have been an important figure in the Vatican discussions leading to Galileo's trial

II. Galileo's Contributions to Astronomy, 1609-1633

A. *Sidereus Nuncius* -- The First Telescopic Results (1610)

1. Published in March, just months after first observations, in part because of desire to secure position in Florence, but also because of concerns that others might publish too
    a. Spyglass invented in Holland before 1608, and then surfaced in Paris
    b. But Galileo unquestionably perfected it, and he was among the first to use it astronomically even though Thomas Harriot made celestial observations before him in England
    c. And he was definitely the first to publish, making him an international celebrity
2. The second revolution in astronomy in 1609-10: a new, totally unanticipated form of data enters the discipline, which for 1500 years had been confined to assessing theory and calculations (e.g. of loops) against basically naked-eye positional observations of acuity no better than 1⌈
    a. Not the only time in the history of science in which a new entirely unanticipated form of data changed a field: chemistry with electrolysis following Volta's battery (1800), Fraun-hofer'' spectra (1814), Roentgen's x-rays (1895)
    b. *Siderius Nuncius*, however, unique in its impact on western civilization: shocking reali-

zation of how much less was known and understood than had been thought, driving home how much more ignorant we are than the learned at the time thought we were

3. First major discovery was the complexity of the surface of the moon -- in direct contrast to celestial perfection, as per Aristotelians
    a. Mountain ranges and craters, as drawn with a reasonable amount of skill
    b. Shadows in relationship to the sun used to infer that the indications seen were mountains and craters, including accurate mountain heights (roughly 4 miles) and "earth-shine"
    c. Opened the way to "exploration" of the moon and lunar selenography
4. Second major discovery was the huge number of additional stars revealed for the first time by the telescope, including fact that the Milky Way is made up of numerous stars
    a. Number of additional stars underscores the parochialism of human vision and the inappropriate emphasis laid in the past on what we happen to be able to see
    b. Also, small size of stars under magnification, versus size of planetary disks, gives new grounds for distrust of appearances and for accepting vast distance to stars, as required by the Copernican system
    c. Undercuts age-old dogmatism: we thought we knew so much about the celestial sphere, but now found we have just begun
5. Third major discovery was the four "planets" revolving around Jupiter: Io, Europa, Ganymede, and Callisto (Mayr's names)
    a. Galileo did not wait to determine periods or orbits of the four, though he did make clear that the periods were much shorter than those of our moon
    b. Strengthens plausibility of Copernicanism by removing oddity of our moon and showing rotation about bodies other than the earth
    c. Again undercuts age-old dogmatism: planetary astronomy has new work to do
6. Besides undercutting dogmatism (especially the dogmatic tendency to consider so many major questions long settled by Scholastic natural philosophy), *Sidereus Nuncius* opens the possibility of a whole new domain in which to pursue evidence in astronomy
    a. Another way of turning questions in astronomy into empirical questions -- expand the range of empirical observations
    b. Not just old questions, like which system, but also a whole new set of empirical questions, such as ones concerning the orbits of the "satellites" of Jupiter
    c. Not surprisingly, Kepler's reaction in his "Conversation with the Sidereal Messenger" (May, 1610) emphasized such things
7. Finally, note the paragraph announcing his book on the System of the World (p. 45) -- first use of 'system' in this regard?

B. Galileo's Telescopes: Design and Limitations
    1. Galileo describes three telescopes, one of roughly magnification 3, another of nearly 8, and another (he says) of 30, for which he ground the lenses himself