

English) turn to the website of the Institute and Museum of the History of Science in Florence (IMSS, Florence), www.imss.fi.it)

7. In a sense telescope extended the range of the observable and hence the range of observable phenomena (e.g. Jupiter's moons), but it did so in some respects problematically
 - a. Need for "interpretation" in order to decide which aspects of what was being seen were veridical, and which were not -- e.g. chromatic aberration
 - b. Some of Galileo's opponents dismissed telescopic observations as some sort of illusion -- natural observation the realm of phenomena
 - c. Kepler's *Dioptrice* (and later Descartes' *Dioptrique*) respond to this worry by providing a theory that shows the analogy with the human eye and allows the veridical to be distinguished from the non-veridical
- C. Further Telescopic Discoveries: 1610-1620
 1. Galileo made a number of further discoveries in the months, and then years, following the *Sidereal Messenger*, and others of course made ones in parallel (and competition) with him
 - a. Harriot and his friends in London, a group in Aix en Provence led by Fabri de Peiresc, Fabricius in northern Germany, Scheiner in Ingolstadt etc.
 - b. (And also Father Clavius at the Collegio Romano, the leading authority on Ptolemy, who certified Galileo's observations, though not his interpretations)
 2. Major new discovery: sunspots, revealing that the sun is not the perfect body Scholastic philosophers said it was
 - a. Shows that sun rotates (confirming Kepler's hypothesis), for multiple spots move uniformly in tandem (around 25 day period)
 - b. Published "Letters on Sunspots" reporting these discoveries plus the next two below, with increasingly open Copernicanism
 - c. Claims disputed by Scheiner, leading to exchanges
 3. Major new discovery: Venus displays a full cycle of phases, including a "full Venus", which is extraordinarily difficult to explain except by conceding that Venus orbits the sun (see figure in Appendix)
 - a. The most devastating blow to Ptolemaic theory, though trivially okay on Tychonic
 - b. Galileo tried and failed to observe phases of Mercury -- a comment on the quality of his telescopes and the difficulties of observing Mercury; still claimed to have seen them
 4. A further discovery: Saturn has two "small stars" on either side, seemingly tied to it that neither Galileo nor others can figure out (until Huygens in the 1650's, with far better telescopes)
 5. A determination of the periods of the four Galilean satellites to within 0.05% (correct mean Synodic values are 1.769, 3.551, 7.155, and 16.689 days with eccentricities 0.000, 0.000, 0.002, and 0.008)
 - a. Gets the idea of using eclipses of these satellites as a means of determining differences in local time and hence longitude on earth, but then discovers that synodic periods not quite

- uniform, requiring new tables regularly
 - b. Simon Mayr (Marius) obtained even more accurate mean periods (within 0.03%), but failed to detect variation in synodic periods
 - c. Perhaps because Mayr did not rush to print, but worked out orbits first, or perhaps for other reasons, his names for the satellites were adopted by the astronomical community
6. A new discovery: the Moon presents essentially the same face to us, save for a small variation that Galileo first announced in 1632 (the libration in longitude)
- D. Some Background to Galileo's *Dialogue*
1. Impact of all these discoveries, especially as reported by Galileo, was to underscore the limitations of the old dogmatism and, with it, the rapidly disappearing grounds for maintaining Ptolemy over Copernicus
 - a. Continuing excitement of new discoveries, exposing old dogmatic claims as never having had any merit in the first place
 - b. By implication, then, a threat to authority of Church doctrine based on Aristotelian natural philosophy, and even more so to the university Scholastic curriculum
 2. Opposition develops in Rome, especially after Foscarini's book defending Copernicanism (1615), leading to the decree of 1616 against Copernicanism
 - a. The step Galileo was trying to prevent, as in his widely circulated manuscript letter to the Duchess of Tuscany on "The Use of Biblical Quotations in Matters of Science"
 - b. Galileo called to audience with Cardinal Bellarmine, where he apparently promises not to defend Copernicanism in the future
 3. In 1621, Pope Paul V died (and Grand Duke Cosimo as well), to be replaced (1623) by Urban VIII (Cardinal Maffeo Barberini), a Florentine friend and former supporter of Galileo
 - a. Based on audiences with Pope, he decides to write *Letter to Ingoli*, responding to latter's 1616 physical arguments against Copernicanism
 - b. Urban VIII read this without objection, leading Galileo to conclude that so long as he steered clear of scriptural arguments and presented Copernicanism as a hypothesis, he could resume his defense of it in the new Vatican climate
 - c. 'Hypotheses': not theoretical conjectures, but propositions entertained without asserting their truth for purposes of drawing conclusions from them
 4. Publication of *The Assayer* in 1623 (dedicated to Urban VIII) turns open dispute with Fr. Grassi, a Jesuit in Rome, into something a good deal more intense, adding to the enmity toward Galileo among many in Rome
 5. Began work on the *Dialogue* in 1625, completing it in 1630 after some interruptions, but then taking 18 months to get it approved by the censors in Rome and Florence
 - a. An immediate big splash, drawing the attention of Rome and Galileo's enemies
 - b. Within 6 months the printer is ordered to suspend sales, and Galileo is ordered to Rome to stand trial