Galileo, *Regressus*, and Empiricism  
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The Problem

1. **Aristotle, *Posterior Analytics* I.31:**
   Nor can one understand through perception. For even if perception is of what is such and such, and not of individuals, still one necessarily perceives an individual and at a place and at a time, and it is impossible to perceive what is universal and holds in every case; for that is not an individual not at a time; for then it would not be universal ... The universal is valuable because it makes clear the explanation; hence universal demonstration is more valuable than perception ....

2. **Galileo, *Dialogo Sopra i Due Massimi Sistemi del Mondo* (1632):**
   It happened on this day that he was investigating the source and origin of the nerves, about which there exists a notorious controversy between the Galenist and Peripatetic doctors. The anatomist showed that the great trunk of nerves, leaving the brain and passing through the nape, extended down the spine and then branched out through the whole body, and that only a single strand as fine as a thread arrived at the heart. Turning to a gentleman whom he knew to be a Peripatetic philosopher, and on whose account he had been exhibiting and demonstrating everything with unusual care, he asked this man whether he was at last satisfied and convinced that the nerves originated in the brain and not in the heart. The philosopher, after considering for awhile, answered: "You have made me see this matter so plainly and palpably that if Aristotle’s text were not contrary to it, stating clearly that the nerves originate in the heart, I should be forced to admit it to be true.”

3. **Zabarella, *De Regressu* (1578)**
   Regressus, on the other hand [opposed to circular argument], is between cause and effect, when they reciprocate and the effect is more known to us than the cause. For since progressing always has to be from what is more known to us, we first demonstrate unknown cause from known effect; then, the cause [now] known, we regress from it to demonstrate the effect, with the result that we know scientifically what it is on account of (ut sciamus propter quid est). ... What regressus is, therefore, is manifest enough to have an understanding of the term: it is some sort of reciprocated demonstration (*reciprocate quaedam demonstratio*) ....

4. **Demonstratio quod**: Where there is generation, there is underlying subject matter there; in natural body there is generation; therefore, in natural body, there is matter.  
   **Demonstratio propter quid**: Where there is matter, there is generation; in natural body, there is matter; therefore, in natural body, there is generation.

5. And so, the first procedure, which is from effect to cause, having been performed, before we go back from it [i.e., the cause] to the effect, it is necessary that there intercede some third intermediate effort by which we are led into distinct knowledge of that cause, which was known only confusedly. Some, knowing that this is necessary, call it negotiation of the understanding (*negoziatio intellectus*). We can call it a mental examination (*examen mentale*) or a mental consideration (*consideratio mentale*).

6. What sort of thing this mental consideration is and how it is done, I have not seen made clear by anyone. For even though some say that this intermediate negotiation of [the] understanding is interposed, they nevertheless have not shown how we are led by means of it into distinct knowledge of the cause and what the power of this negotiation is. We will do something much worth the work, therefore, if we say something about this.

7. The other thing [that helps in knowing the cause distinctly] ... is a comparison of the discovered cause with the effect by means of which it was discovered—not, of course, by knowing that this is the cause and
that is the effect but only by comparing the latter thing with the former. For thus it happens that we are led little by little to knowledge of the characteristics of the former thing, and, once one characteristic has been discovered, we are helped to discover another, until finally we know that this is the cause of that effect.

**Galileo, Sidereus Nuncius (1610)**

8. When, both before and after conjunction, the Moon is found not far from the Sun, she offers to our sight not only that part of her globe that is adorned with shining horns, but also a thin, faint periphery that is seen to outline the circle of the dark part (that is, the part turned away from the Sun) ... But if we examine the matter more closely, we will see not only the extreme edge of the dark part shining with a faint brightness, but the entire face of the Moon—that part, namely, that does not yet feel the brightness of the Sun—made white by some not inconsiderable light.

9. Some have said that it is the intrinsic and natural brightness of the Moon herself; others that it is imparted to it by Venus, or by all the stars; and yet others have said that it is imparted by the Sun who penetrates the Moon's vast mass with his rays.
   a. **[Not Moon or stars:]** For if this light were either the Moon's own or gathered from the stars, she would retain it and show it especially during eclipses ...
   b. **[Not Venus:]** For who is so ignorant as not to know that near conjunction and with the sextile aspect it is entirely impossible for the part of the Moon turned away from the Sun to be seen from Venus?
   c. **[Not Sun:]** But it is equally inconceivable that this light is due to the Sun, who with his light penetrates and fills the solid body of the Moon. For it would never be diminished ... Yet the light is diminished when the Moon hastens toward quadrature ....
   d. **[Therefore, Earth:]** Since, therefore, this secondary light is not intrinsic and proper to the Moon, and is borrowed neither from any star nor from the Sun, and since in the vastness of the world no other body therefore remains except the Earth, I ask what are we to think? ... In an equal and grateful exchange the Earth pays back the Moon with light equal to that which she receives ...

10. In its various aspects to the Sun and Earth, the Moon receives more or less light by reflection from the Earth as she faces a larger or smaller part of the illuminated terrestrial hemisphere. For the relative positions of those two globes are always such that at those times when the Earth is most illuminated by the Moon the Moon is least illuminated by the Earth, and vice versa.

**Lunar Mountains**

11. **Galileo, Sidereus Nuncius (1610):**
    And on the earth, before the rising of the sun, are not the highest peaks of the mountains illuminated by the sun's rays while the plains remain in shadow? Does not the light go on spreading while the larger central parts of those mountains are becoming illuminated? And when the sun has finally risen, does not the illumination of plains and hills finally become one?

12. **Mathematicians of Collegio Romano to Bellarmine (April 24, 1611):**
    One cannot deny the great inequality of the moon; but it appears to Father Clavius more probable that it is not an uneven surface, but more likely that the lunar body is not of uniform density and that it has parts more dense and more rare; as are the ordinary spots, which are seen with natural vision.

13. **Clavius, De Sphaera in Opera Mathematica (1612):**
    This instrument [the telescope] shows ... when the moon is a crescent or halffull, it appears so remarkably fractured and rough that I cannot marvel enough that there is such unevenness in the lunar body. Consult the reliable little book by Galileo Galilei, printed at Venice in 1610 and called **Sidereus Nuncius**, which describes various observations of the stars first made by him.

14. **La Galla, De Phaenomenis in Orbe Lunae (1612):**
    Chapter X: Whether the Moon is one of the planets, of the same substance and nature as the rest of the heavens, that is, inalterable and incorruptible, as the Peripatetics hold, or whether there can truly be mountains and valleys [on the Moon], as the telescope shows.