only in French and Cassini's report on the expedition to Cayenne was not published until 1684; Richer's measurements were nevertheless known to those at the Academy and Halley)

4. The basic point of the final paragraph concerns the need to refer projectile motion to a proper frame, and not a frame rotating with the earth (as in Galileo)
    a. (Note the concern with frames of reference here in the light of my proposal that this was the provocation for all of Version 3)
    b. The essence of Newton's "experiment" is the difference between a truly inertial frame and a rotating frame in free fall
    c. The insight underlying Coriolis forces generally, and why they are not real forces
5. Newton finally claims that the experiment works to prove diurnal motion, in effect completing the proof of the Copernican system
    a. No mention made of the vagaries in Hooke's measurements
    b. But Problems 4 through 7 and the following Scholium are just what is needed to address these vagaries, for they allow one to calculate a magnitude of the displacement
    c. That magnitude would have raised worries about Hooke's experimental results

IV. In the Aftermath of De Motu, Version 3

A. The Initial Exchange with Flamsteed

1. Sometime in mid or late December Newton initiates a correspondence with Flamsteed, pursuing reliable astronomical information; it ends abruptly with Flamsteed's letter of January 27
    a. First letter missing, and so exact date and contents unknown
    b. Flamsteed already aware that a document on orbital motion by Newton has been registered at the Royal Society, from the grapevine if not from Newton's letter
2. Based on Flamsteed's December 27 reply, Newton's primary concerns in his initial letter appear to have been with (1) the comet of 1680-81 and (2) whether the satellites of Jupiter (and Saturn) conform with the 3/2 power rule
    a. Strongly affirmative answer to latter from Flamsteed, in no small part because of Roemer's speed of light correction; notice too that Cassini's earlier predicted eclipses wrong by almost an hour (not a speed of light effect, but from vagaries in the motion of Jupiter)
    b. But Flamsteed unable to confirm Cassini's satellites of Saturn
    c. In effect, Flamsteed telling Newton that there is no reason to think that the 3/2 power rule does not hold to full precision for the satellites
    d. Notice also Flamsteed's remark about the complexity of our moon's motion versus the well-behaved motions of Jupiter's satellites!
3. Newton's December 30 reply: "your information about the Satellites of Jupiter gives me very much satisfaction;" shifts then to questions about anomalies in Saturn and Jupiter orbits when they are in conjunction with one another

a. One provocation: Kepler's numbers for Saturn fail to conform with 3/2 power rule to the desired percision

b. Newton has obviously made a calculation of the deviation -- one or two solar radii, greatest the year before conjunction

c. Finally asks for precise radii of Jupiter satellite orbits vis-a-vis Jupiter's diameter, probably because trying to obtain comparative measures of (absolute) centripetal force

4. Flamsteed replies that he has no evidence of such an anomaly in Saturn's orbit, and that he thinks any anomalies in Jupiter's orbit can be eliminated via better orbital parameters than Kepler had

   a. Admits that he has yet to be strict enough with Saturn's orbit to "affirme that there is no such exorbitation as you suggest," and promises to look into the matter

   b. Expresses some amazement at the very idea of these two planets affecting one another across such a broad distance (from 5.2 AU in the mean for Jupiter to 9.6 AU for Saturn)

   c. Gives elongations of the satellites of Jupiter, as requested (clearly using a micrometer)

5. Newton's January 12 reply finds him puzzled by failure to observe an anomaly in the orbit of Saturn, but now indicating that calculations based on Flamsteed's numbers had shown him that Jupiter's "vertue is less than I supposed" (presumably, after conversion to full astronomical units)

   "Your information about ye error of Keplers tables for Jupiter and Saturn has eased me of several scruples. I was apt to suspect there might be some cause or other unknown to me, wch might disturb ye sesquialtera proportion. For ye influences of ye Planets one upon another seemed not great enough tho I imagined Jupiter's influence greater than your numbers determin it."

   a. Main concern: apparent discrepancy too large to account for via interaction effect, and hence perhaps an indication of some further force at work

   b. Letter ends with request for best current orbital parameters "that I may see how the sesquiplicate proportion fills ye heavens together wth another small proportion wch must be allowed for," and says that he will get around to calculating the lines described by the comets of 1664 and 1680

   c. The reference to the small proportion is presumably to corrections that must be made to 3/2 power rule from two-body interaction effects: a^3/P^2 varies as $(1+c/C)$ – e.g. as $(1+C_j/C_h)$

   d. This small proportion provides basis for concluding that none of the planets for which the value cannot be inferred from satellites have an $[a^3/P^2]$ significantly greater than that of Jupiter, for if they did, the small proportion would be detectable!

6. Newton would appear to be pursuing a new line of evidential reasoning at this point: if can show that no other forces at work besides the inverse-square centripetal forces, then can use deviations from Keplerian motion -- especially deviations from planet interactions -- as evidence!

   a. Presumably as evidence in support of mutual interaction, and conclusion that inverse-square acclerations toward Jupiter and Saturn extend indefinitely far into space

   b. Thereby substantiating their effects on the sun