Demonstration.

[2.][2] If $ef = fg = gh = he = 2fa = 2fb = 2gc = 2ed$. And the globe b move from a to b then $2fa : ab :: ab : fa ::$ force or pression of b upon fg at its reflecting : force of b's motion. therefore $4ab = ab + bc + cd + da : fa ::$ force of the reflection in one round (viz: in b, c, d, and a) : force of

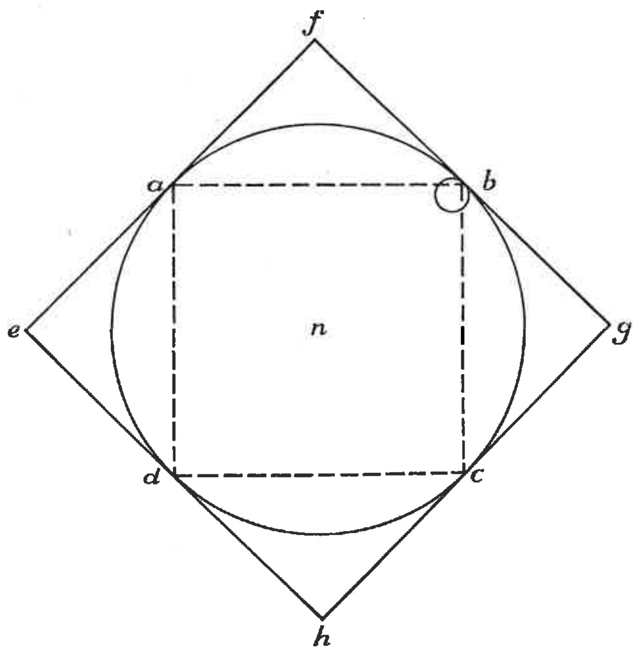


Figure 1.

b's motion. by the same proceeding if the Globe b were reflected by each side of a circumscribed polygon of 6, 8, 12, 100, 1000 sides etc. the force of all the reflections is to the force of the bodys motion as the sume of those sides to the radius of the circle about which they are circumscribed. And so if [the] body were reflected by the sides of an equilaterall circumscribed polygon of an infinite number of sides (i.e. by the circle it selfe) the force of all the reflections are to the force of the bodys motion as all those sides (*id est* the perimiter) to the radius.

[3.] If the body b moved in an Ellipsis[3] that its force in each point (if its motion in that point bee given) [will?] bee found by a tangent circle of Equall crookednesse with that point of the Ellipsis.

[4.] If a body undulate in the circle bd all its undulations of any altitude are performed in the same time with the same radius. Galileus.[4]

[5.] As radius ab to radius ac :: so are the squares of there times in which they undulate.[5]

[6.] If c circulate in the circle $cgef$ [Fig. 2], to whose diameter ce, $ad = ab$ being perpendicular then will the body b undulate in the same time that c circulates.[6]

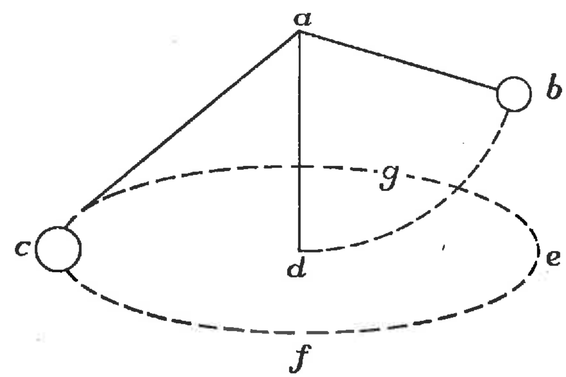


Figure 2.

[7.] And those bodies circulate in the same time whose lines drawne from the center a to the center d are equall.[7]

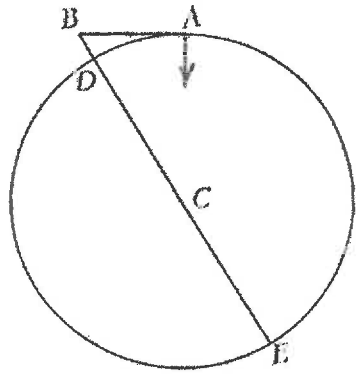
[8.] And $ad : dc ::$ force of gravity to the force of c from its center d.[8]

[9.] Coroll : hence may the force of gravity of the motion of things falling were they not hindered by the aire may very exactly [be] found[9] (viz. [?] $cd : ad ::$ force from d : force from a.

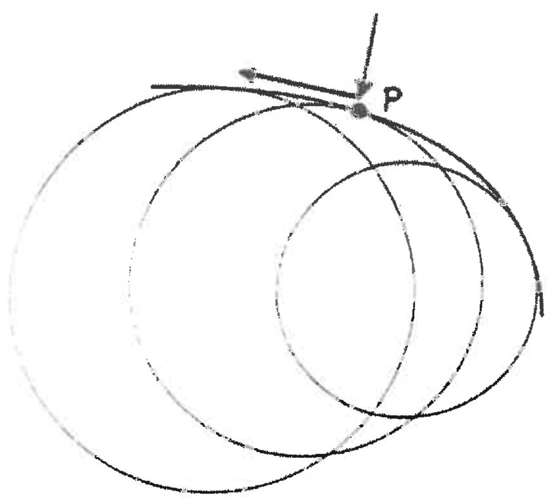
1. For an interpretation of this and the following subsection see above, Part I, Chapter 1.2, pp. 7–11. An equivalent result is derived by an entirely different method in MS. IVa. It seems probable that Newton used this result to derive the peculiar '$\frac{1}{2}R$' formula employed in the calculations of MS. III. See § 2 of the 'Commentary and Interpretation' to that manuscript.

2. This demonstration must have followed Newton's first estimate of the *force of the body's endeavour from the centre in half a revolution* given in Ax.-Prop. 22. Particularly interesting in this connexion is the cancellation of the figure 4+ in Ax.-Prop. 24 and its replacement by 6+ corresponding to the 2π of the present section. For a similar 'polygonal' treatment of circular motion see the demonstration of the law of centrifugal force at the end of the *Scholium* to Prop. 4, Theor. 4, Book, I, *Principia*. Ball ([1], p. 13) suggested that this latter demonstration was the one employed by Newton to calculate 'the force with which a ball revolving within a sphere presses the surface of the sphere' prior to his

What Newton Gained from Hooke on Curvilinear Motion



The Natural Generalization



Centripetal Force