

A
T R E A T I S E
O F T H E
S Y S T E M
O F T H E
W O R L D.

B Y
Sir *I S A A C N E W T O N*.

Translated into E N G L I S H.

The S E C O N D E D I T I O N, wherein are
interspersed some Alterations and Improvements.



L O N D O N :

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M D C C X X X I.

way, we may estimate the effects thereof in more involved cases. For it would be endless and impossible to bring every particular to direct and immediate observation.

We said, *in a mathematical way*, to avoid all questions about the nature or quality of this force, which we would not be understood to determine by any hypothesis; and therefore call it by the general name of a centripetal force, as it is a force which is directed towards some center; and as it regards more particularly a body in that center, we call it circum-solar, circum-terrestrial, circum-jovial, and in like manner in respect of other central bodies.

THAT by means of centripetal forces, the Planets may be retained in certain orbits, we may easily understand, if we consider the motions of projectiles. For a stone projected by the pressure of its own weight forced out of the rectilinear path, which by the projection alone it should have pursued, and made to describe a curve line in the air; and through that crooked way is at last brought down to the ground. And the greater the velocity is with which it is projected, the farther it goes before it falls to the Earth. We may therefore

The effects of centripetal forces. P. 4, 5, 6. Vol. 1.

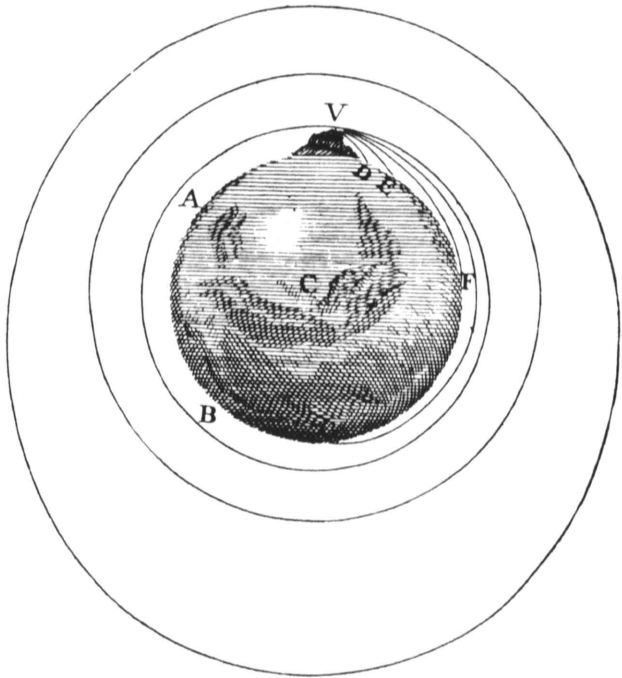
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fore suppose the velocity to be so increased, that it would describe an arc of 1, 2, 5, 10, 100, 1000 miles before it arrived at the Earth, till at last exceeding the limits of the Earth, it should pass quite by without touching it.

Let AFB represent the surface of the Earth, C its center, VD, VE, VF, the curve lines which a body would describe, if projected in an horizontal direction from the top of an high mountain, successively with more and more velocity. And, because the celestial motions are scarcely retarded by the little or no resistance of the spaces in which they are performed; to keep up the parity of cases, let us suppose either that there is no air about the Earth, or at least that it is endowed with little or no power of resisting. And for the same reason that the body projected with a less velocity, describes the lesser arc VD, and with a greater velocity, the greater arc VE, and augmenting the velocity, it goes farther and farther to F and G; if the velocity was still more and more augmented, it would reach at last quite beyond the circumference of the Earth, and return to the mountain from which it was projected.

Vid. Vol. II.
Princip.
p. 230.

And since the area's, which by this motion it describes by a radius drawn



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to the center of the Earth, are (by *Prop. 1. Book 1. Princip. Math.*) proportional to the times in which they are described; its velocity, when it returns to the mountain, will be no less than it was at first; and retaining the same velocity, it will describe the same curve over and over, by the same law.

But if we now imagine bodies to be projected in the directions of lines parallel to the horizon from greater heights, as of 5, 10, 100, 1000 or more miles, or rather as many semi-diameters of the Earth; those bodies, according to their different velocity, and the different force of gravity in different heights, will describe arcs either concentric with the Earth, or variously excentric, and go on revolving through the heavens in those trajectories, just as the Planets do in their orbs.

As when a stone is projected obliquely, that is, any way but in the perpendicular direction, the perpetual deflection thereof towards the Earth from the right line in which it was projected, is a proof of its gravitation to the Earth, no less certain than its direct descent when only suffered to fall freely from rest; so the deviation of bodies, moving in free spaces, from rectilinear

The certainty of the argument.