COMMENTARIES ON THE PRINCIPIA OF SIR ISAAC NEWTON RESPECTING HIS THEORY

JOSEPH DENISON

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PRINCIPIA OF SIR ISAAC NEWTON,

RESPECTING HIS THEORY

THAT THE FORCES OF THE GRAVITATION OF THE PLANETS

ARE INVERSELY AS THE SQUARES OF THEIR

MEAN DISTANCES FROM THE SUN:

WHICH THEORY IS CALLED IN QUESTION IN THESE COMMENTARIES.

BY THE AUTHOR OF

" A NEW THEORY OF GRAVITATION," &c.

" A short access has been made to much knowledge, at which Sir Isaac Newton arrived through arduous and circuitous paths. Yet we look with peculiar reverence on the Principia."—Mr. MACAULAY'S ESSAYS.

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RIGHT HONOURABLE LORD BROUGHAM,

&c. &c. &c.

My Lord,

In dedicating these Commentaries to your Lordship, it is due from me to state that they have not been seen by your Lordship, and that I am not aware that you have ever given any opinion contrary to the doctrines of the Principia. I offer my Commentaries on the Principia to your Lordship's notice and protection, as a tribute to the zeal and ardour with which your Lordship has ever promoted the interests of science; but more particularly

as a tribute of respect and admiration of your Lordship's great and acknowledged proficiency in these abstruse and recondite investigations.

I have the honour to be,

My Lord,

Your Lordship's very obedient Servant,

THE AUTHOR.

Sunbury Park,
Middlesex, June 4, 1846.

CHAPTER I.

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In a work published by me in 1844, entitled, "A New Theory of Gravitation," the main proposition which I advanced was this : viz., that the forces of the gravitation of the planets towards the sun are inversely as the *square-roots* (that is, in the *sub-duplicate* ratio,) of their mean distances from the sun ; a proposition very much at variance with the received doctrine of Sir Isaac Newton, viz., that the forces of the gravitation of the planets towards the sun are inversely as the *squares* (that is, in the duplicate ratio) of their mean distances from the sun. To exhibit the difference between these two theories, one instance

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may suffice :—According to the Newtonian Theory, if one of two planets were at four times the distance of the other from the sun, the force of gravitation of the nearer planet would be sixteen times that of the more distant one (that is, the *square* of four times); but according to the new theory, the force of gravitation of the nearer planet would be only twice that of the other (that is, the *square-root* of four times).

The investigations which led me to the adoption of this new theory did not originate in any preconceived doubt of the truth of the received theory of Newton; on the contrary, I began those investigations under the impression that the received theory was true, being part of that great system of gravitation, the discovery of which had been made by Newton. But Kepler had, about forty-seven years prior to that discovery, discovered his famous analogy that the squares of the periodic times of the planets are as the cubes of their mean distances from the sun; whence it

had been inferred by Newton (Coroll. 6 to Proposition iv.—Principia) that the mean *velocities* of the planets are inversely as the square-roots of their mean distances from the sun ; an inference adopted by La Place in his "System of the World," vol. i. p. 236, but neither he nor Newton has given any demonstration of it : (in commenting on Coroll. 6, to Prop. iv.—Principia, I propose to demonstrate this inverse analogy of the velocities to the distances from Kepler's Analogy.)   Taking the estimated distances of the planets to be true, and their orbits to be circular (which they are, nearly), I easily computed their respective velocities, and by comparing the velocities of the planets with their distances from the sun, I found that the velocities are (according to the inference from Kepler's Analogy) inversely as the square-roots (that is, in the sub-duplicate ratio) of the distances.   In 1842 I published the results of this investigation in another work, entitled, "A New Analogy for discovering the the Distances of the Planets

from the Sun," &c.   Thus, by showing
that the analogy derived from Kepler's
is conformable to the observed pheno-
mena, both analogies became more fully
established.

It subsequently occurred to me that the
gravitating forces of the planets must be
as their velocities ; and therefore (by equa-
lity of ratios) inversely as the *square-roots*
of their mean distances from the sun ; in-
stead of being (according to the Newtonian
doctrine) inversely as the *squares* of their
mean distances from the sun.   For (by the
Scholium to Proposition iv.—Principia) the
centrifugal and centripetal forces of each
planet are equal to each other ; and the
revolution of each planet round the sun is
the resultant of the composition of these
two equal forces.   This resultant, if we
consider the orbit as circular, is a given
quantity, with regard to all the planets
and the satellites ; for their periodic times
are known by observation, and the dis-
tances of the planets from the sun, and
of the satellites from their primaries, have