Original letter from Isaac Newton to Richard Bentley

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Source: 189.R.4.47, ff. 7-8, Trinity College Library, Cambridge, UK

Published online: October 2007

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Sir

Because you desire speed I'l answer your letter with what brevity I can. In the six positions you lay down in the beginning of your Letter I agree with you. Your assuming the Orbis magnus 7000 diameters of the earth wide implies the Sun's horizontal Parallax to be half a minute. fflamsteed & Cassini have of late observed it to be but about 10″, & thus the Orbis magnus must be 21000 or in a rounder number 20000 diameters of the earth wide. Either assumption will do well & I think it not worth your while to alter your numbers.

In the next part of your letter you lay down four other positions founded upon the six first. The first of these four seems very evident supposing you take attraction so generally as by it to understand any force by which distant bodies endeavour to come together without mechanical impulse.

The second seems not so clear. ffor it may be said that there might be other systemes of worlds before the present ones & others before those & so on to all past eternity & by consequence that gravity might be coeternal to matter & have the same effect **{**from**}** all eternity as at present: unless you have somewhere proved that old systems cannot gradually wast & pass into new ones or that this system had not it's originall from the exhaling matte**{**r**}** of former decaying systems but from a chaos of matter eavenly dispersed throughout all space. ffor something of this kind I think you say was the subject of your sixt sermon: & the growth of new systems out of old ones without the mediation of a divine power seems to me apparently absurd.

The last clause of your second Position I like very well. Tis unconceivable that inanimate brute matter should (without the mediation of something else which is not material) operate upon & affect other matter without mutual contact; as it must if gravitation in the sense of Epicurus be essential & inherent in it. And this is one reason why I desired you would not ascribe **{**innate**}** gravity to me. That gravity should be innate inherent & **{**essential**}** to matter so that one body may act upon another at a distance through a vacuum without the mediation of any thing else by & through which their action or force **{**may**}** be conveyed from one to another is to me so great an absurdity that I beleive no man who has in philosophical matters any competent faculty of thinking can ever fall into it. Gravity must be caused by an agent **{**acting**}** <7v> consta**{**ntl**}**y according to certain laws, but whether this agent be material or immaterial is a question I have left to the consideration of my readers.

Your fourth assertion that the world could not be formed by inn**{**ate**}** gravity alone you confirm by three arguments. But in your first Argument you seem to make a petitio principij. ffor where**{**as**}** many ancient Philosophers & others as well Theists as Atheists have allowed that there may be worlds & parcels of matter innumerab**{**le**}** or infinite, you deny this by representing it as absurd as that there should be positively an infinite arithmetical summ or number which is a contradiction in terminis: but you do not prove it as absurd. Neither do you prove that what men mean by an infinite summ or number is a contradiction in nature. ffor a contradiction in terminis argues nothing more then an improperty of speech. Those things which men

understand by improper & contradictious phrases may be sometimes really in nature without any contradiction at all. A silver inkhorn a paper Lanthorn an iron whetstone are absurd phrases & yet the things signified thereby are really in nature. If any man should say that a number & a summ (to speak properly) is that which may be numbered & summed; but things infinite are numberless or (as we usually speak) innumerable & summless or insummable & therefore ought not to be called a number or summ: he will speak properly enough & your argument against him will I fear lose its force. And yet if any man shall take the words number & summ in a larger sense so as to understand thereby things which in the proper way of speaking are numberless & sumless (as you do when you seem to allow an infinite number of points in a line) I could readily allow him the use of the contradictious phrases of an innumerable number or summless summ without inferring **{**from thence**}** any absurdity in the thing he means by those phrases. However if by this or any other argument you have proved the finiteness of the universe it follows that all matter would fall down from the outsides & convene in the middle. Yet the matter in falling might concrete into many round masses like the bodies of the Planets & these by attracting one another might acquire an obliquity of descent by means of which they might fall not upon the great central body but on one side of it & fetch a compass about it & then ascend again by the same steps & degrees of motion and velocity with which they descended before, much after the manner that Comets revolve about the Sun. But a circular motio**{**n**}** in concentrick orbs about the Sun they could never aquire by gravity alone.

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And tho all the matter were at first divided into several systems & every system by a divine power constituted like ours: yet would the outward systemes descend towards the middlemost so that this frame of things could not always subsist without a divine power to conserve it. Which is your second Argument, & to your third I fully assent.

As for the passage of Plato, there is no common place from whence all the Planets being let fall & descending with uniform & equal gravities (as Gallileo supposes) would at their arrival to their several Orbs acquire their several velocities with which they now revolve in them. If we suppose the gravity of all the Planets towards the Sun to be of such a quantity as it really is & that the motions of the Planets are turned upwards, every Planet will ascend to twice its height from the Sun. Saturn will ascend till he be twice as high from the Sun as he is at present & no higher. Iupiter will ascend as high again as at present; that is, a little above the orb of Saturn. Mercury will ascend to twice his present height, that is to the orb of Venus & so of the rest. And then by falling down again from the places to which they ascended they will arrive again at their several orbs with the same velocities they had at first & with which they now revolve.

But if so soon as their motions by which they revolve are turned upwards, the gravitating power of the Sun by which **{**the**}**ir ascent is perpetualy retarded, be diminished by one half they will now ascend perpetually & all of them at all equal distances from the sun will be equally swift. Mercury when h**{**e**}** arrives at the orb of Venus will be as swift as Venus & h**{**e**}** & Venus when they arrive at the orb of the earth will **{**be**}** as swift as the earth & so of the rest. If they begin all of them to ascend at once & ascend in the same line they will constantly in ascending becom**{**e**}** nearer & nearer together & their motions will constantly approach to an equality & become at length slower then **{**any**}** motion assigneable. Suppose therefore that they ascended till they were almost contiguous & their motions inconsiderably little & that all their motions were at the same moment of time turned back again or (which comes almost to the same thing) that they were only deprived of their motions & let fall at that time: they would all at once arrive at their several orbs each with the velocity it had at first; & if their motions were then turned sideways & at the same time the gravitating power of the Sun doubled that it might be strong enough to retain them in their Orbs, they would revolve in them as before their ascent. But if the gravitating power of the Sun were not doubled, they would go away from their Orbs into the highest heavens in Parabolical lines. These things follow from my Princip. Math. lib. 1. Prop. 33, 34, 36, 37. I thank you very kindly for your designed present & rest.

Your most humble Servant to command

Is. Newton.

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For M^{r} Bently at the Palace in

Worcester

A 4th Lett. from M^{r} Newton