

406 NEWTON TO BENTLEY

25 FEBRUARY 1692/3

From the original in Trinity College Library, Cambridge.
In reply to Letter 405

Cambridge. Feb. 25. 1692/3.

Sr

Because you desire speed I'll answer your letter wth what brevity I can. In ye six positions you lay down in ye beginning of your Letter I agree wth you. Your assuming ye *Orbis Magnus* 7000 diameters of ye earth wide implies ye Sun's horizontal Parallax to be half a minute. Flamsteed⁽¹⁾ & Cassini⁽²⁾ have of late observed it to be but about 10", & thus ye *Orbis magnus* must be 21000 or in a rounder number 20000 diameters of ye earth wide. Either assumption will do well & I think it not worth your while to alter your numbers.

In ye next part of your letter you lay down four other positions founded upon ye six first. The first of these four seems very evident supposing you take attraction so generally as by it to understand any force by wch distant bodies endeavour to come together wthout mechanical impulse.

The second seems not so clear. For 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 yt gravity might be coeternal to matter & have ye 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 ye exhaling matter of former decaying systems but from a chaos of matter evenly dispersed throughout all space. For something of this kind I think you say was ye subject of your sixt sermon: & ye growth of new systems out of old ones wthout ye 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 (wthout ye mediation of something else wch is not material) operate upon & affect other matter wthout mutual

contact; as it must if gravitation in the sense of Epicurus⁽³⁾ 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 yt one body may act upon another at a distance through a vacuum without the mediation of any thing else by & through wch 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 constantly according to certain laws, but whether this agent be material or immaterial is a question I have left to ye consideration of my readers.

Your fourth assertion yt ye world could not be formed by innate gravity alone you confirm by three arguments. But in your first Argument you seem to make a *petitio principij*. For whereas many ancient Philosophers & others as well Theists as Atheists have allowed that there may be worlds & parcels of matter innumerable or infinite, you deny this by representing it as absurd as that there should be positively an infinite arithmetical summ or number wch 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. For a contradiction *in terminis* argues nothing more then an impropriety of speech. Those things wch 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 ye things signified thereby are really in nature. If any man should say that a number & a summ (to speak properly) is that wch may be numbered & summed, but things infinite are numberless or (as we usually speak) innumerable & sumless 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 ye words number & summ in a larger sense so as to understand thereby things wch 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 ye use of ye contradictious phrases of an innumerable number or sumless 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 ye finiteness of ye universe it follows that all matter would fall down from ye outsides & convene in ye middle. Yet the matter in falling might concrete into many round masses like ye bodies of ye Planets & these by attracting one another might acquire an obliquity of descent by means of wch they might fall not upon the great central body but on one side of it & fetch a compass about it & then ascend again by ye same steps & degrees of motion and velocity wth

wch they descended before, much after ye manner that Comets revolve about ye Sun. But a circular motion in concentrick orbs about ye Sun they could never aquire by gravity alone.

And tho all ye matter were at first divided into several systems & every system by a divine power constituted like our's: yet would the outward systemes descend towards ye middlemost so yt this frame of things could not always subsist wthout a divine power to conserve it. Which is your second Argument, & to your third I fully assent.

As for ye passage of Plato,⁽⁴⁾ there is no common place from whence all the Planets being let fall & descending wth uniform & equal gravities (as Gallileo supposes) would at their arrival to their several Orbs acquire their several velocities wth wch they now revolve in them. If we suppose ye 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 ye Sun.⁽⁵⁾ Saturn will ascend till he be twice as high from ye Sun as he is at present & no higher. Jupiter will ascend as high again as at present; that is, a little above ye orb of Saturn. Mercury will ascend to twice his present height, that is to ye orb of Venus & so of ye rest. And then by falling down again from ye places to wch they ascended they will arrive again at their several orbs wth the same velocities they had at first & wth wch they now revolve.

But if so soon as their motions by wch they revolve are turned upwards, the gravitating power of the Sun by wch their ascent is perpetually retarded, [will] be diminished by one half they will now ascend perpetually & all of them at all equal distances from the sun will be equally swift.⁽⁶⁾ Mercury when he arrives at ye orb of Venus will be as swift as Venus & he & Venus when they arrive at ye orb of ye earth will be as swift as ye earth & so of ye rest. If they begin all of them to ascend at once & ascend in the same line they will constantly in ascending become 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 (wch comes almost to ye 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 wth ye velocity it had at first; & if their motions were then turned sideways & at ye same time the gravitating power of ye 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 ye Sun were not doubled, they would go away from their Orbs into the highest heavens in Parabolical lines.⁽⁷⁾ These things follow from my

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Princip. Math. lib. 1. Prop. 33, 34, 36, 37.⁽⁸⁾ I thank you very kindly for your
designed present & rest

Your most humble Servant to command

Is. NEWTON.