that the deflection of a particle of matter toward any distant ſphere is proportional to the quantity of matter in that ſphere directly, and to the ſquare of the diſtance of the particle from the centre of that ſphere inverſely: and having found that the heavineſs of a piece of terreſtrial matter is nothing but the ſuppoſed opponent to the force which we exert in carrying this piece of matter, we conceive it as possessing a property, that is, diſtinguiſhing quality, manifeſted by its being *gravis* or heavy. This is heavineſs, *gra­vitas,* gravity ; and the manifeſtation of this quality, or the event in which it is ſeen, whether it be directly falling, or deflecting in a parabolic curve, or ſtretching coiled spring, or breaking a rope, or simply pressing on its ſupport, is *gravitation,* gravitation; and the body is ſaid to gravitate. When all obſtacles are removed from the body, as when we cut the string by which a ſtone is hung, it moves directly downwards, *tendit ad terram. Si discindatur funis, tenderet lapis ad terram. Dum vero funis integer perstet, lapis ter­ram verfus niti cenſetur.* By ſome metaphyſical proceſs, which it is needleſs at preſent to trace, this *nisus ad motum* has been called a *tendency* in our language. Indeed the word has now come to ſignify the energy of any active qua­lity in thoſe caſes where its ſimpleſt and moſt immediate manifestation is prevented by ſome obſtacle. The stone is now ſaid to tend toward the earth, though it does not ac­tually approach it, being withheld by the firing. The stretching the firing in a direction perpendicular to the horizon is conceived as a full manifeſtation or this tendency. This tendency, this inergy of its heavineſs, is therefore named by the word which diſtinguiſhes the quality ; and it is called *gravitation,* and it is ſaid to *gravitate.*

But Sir Iſaac Newton discovered that this deflection of a heavy body differs in no reſpect from that general deflec­tion obſerved in all the bodies of the ſolar ſyſtem. For 16 feet, which is the deflection of a ſtone in one ſecond, has the very same proportion to 1/19th of an inch, which is the ſimultaneous deflection of the moon, that the ſquare of the moon’s diſtance from the centre of the earth has to the ſquare of the ſtone’s diſtance from it, namely, that of 5600 to I.

Thus we are enabled to compare all the effects of the mu­tual tendencies of the heavenly bodies with the tendency of gravity, whoſe effects and measures are familiar to us.

If the earth were a ſphere covered to a great depth with water, the water would form a concentric ſpherical ſhell ; for the gravitation of every particle of its ſurface would then be directed to the centre, and would be equal. The curvature of its ſurface therefore would be every where the ſame, that is, it would be the uniform curvature of a ſphere.

It has been demonſtrated in former articles, after Sir Isaac Newton, that the gravitation of a particle C (fig. 1.) to the centre O, is to that of a particle E at the ſurface as as CO to EO. In like manner the gravitation of *o* is to that of p as *oO* to *p*O. If therefore EO anc O*p* are two communicating canals, of equal lengths, the water in both would be in equilibrio, becauſe each column would exert the ſame total pressure at O. But if the gravitation of each particle in pO be diminiſhed by a certain proportion, ſuch as 1/100th of its whole weight, it is plain that the total preſ­ſure of the column *p*O will be 1/100th part leſs than that of the column EO. Therefore they will no longer be in equilibrio. The weight of the column EO will prevail ; and if a hollow tower Pp be built at the mouth oſ the pit po*,* the water will sink in EO and rise in Op, till both are again in equilibrio, exerting equal total preſſures at O. Or we may prevent the sinking at E by pouring in more water into the tower Pp. The ſame thing muſt happen in the canal *fc* perpendicular to EO, if the gravitation of every particle be diminiſhed by a force acting in the direction CF, and proportional to the diſtance of the particle from C, and ſuch, that when cC is equal to oO, the force acting on *c* is equal to the force acting on o. In order that the former equilibrium may be reſtored after this diminution of the gravitation of the column fC, it is plain that more water muſt be poured into the oblique tower F*f.* All this is evident when we consider the matter hydroſtatically. The gravitation of the particle *c* may be repreſented by oO ; but the diminution of the preſſure occasioned by this at O is repreſented by C*c.*

Hence we can collect this much, that the whole diminution of preſſure at C is to the whole diminution of preſſure at O as the ſum of all the lines *c*C to the ſum of all the lines *o*O, that is, as fC2 to *pO*2. But the weight of the small quantity of water added in each tower is diminiſhed in the ſame proportion ; therefore the quantity added at F*f* muſt be to the quantity added at Pp as fC to pO. There­fore we muſt have Ff : P*p = f*C : *pO*, and the points E, F, P, muſt be in the circumference of an ellipſe, of which PO and EO are the tranſverſe and conjugate ſemiaxes.

What we have here ſuppoſed concerning the diminution of gravity in theſe canals is a thing which really obtains in nature. It was demonſtrated, when treating of the *Preces­sion of the Equinoxes,* that if the ſun or moon lie in the di­rection OP, at a very great diſtance, there results from the unequal gravitation of the different particles of the earth a diminution of the gravity of each particle ; which diminution is in a direction parallel to OP, and proportional to the di­stance of the particle from plane paſſing through the centre of the earth at right angles to the line OP.

Thus it happens that the waters of the ocean have their equilibrium diſturbed by the unequal gravitation of their different particles to the ſun or to the moon ; and this equi­librium cannot be reſtored till the waters come in from all hands, and rise up around the line joining the centres of the earth and of the luminary. The ſpherical ocean muſt ac­quire the form of a prolate ſpheroid generated by the revo­lution of an ellipſe round its tranſverſe axis. The waters will be higheſt in that place which has the luminary in its zenith, and in the antipodes to that place ; and they will be moſt depreſſed in all thoſe places which have the luminary in their horizon. P and P' will be the poles, and EOQ will be the equator of this prolate spheroid.

Mr Ferguson, in his Aſtronomy, aſſigns another cauſe of this arrangement, *viz.* the difference of the centrifugal forces of the different particles of water, while the earth is turn­ing round the common centre of gravity of the earth and moon. This, however, is a miſtake. It would be juſt if the earth and moon were attached to the ends of a rod, and the earth kept always the ſame face toward the moon.

It is evident that the accumulation at P and P', and the depreſſion at the equator, muſt augment and diminish in the ſame proportion with the diſturbing force. It is alſo evi­dent that its abſolute quantity may be diſcovered by our knowledge of the proportion of the diſturbing force to the force of gravity.—Now this proportion is known ; for the proportion of the gravitation of the earth’s centre to the ſun or moon, to the force of gravity at the earth’s ſurface, is known ; and the proportion of the gravitation of the earth’s centre to the luminary, to the difference of the gravitations of the centre and of the surface, is also known, being very nearly the proportion of the diſtance of the luminary to twice the radius of the earth.

Although this reaſoning, by which we have aſcertained the elliptical form of the watery ſpheroid, be ſufficiently convincing, it is very imperfect, being accommodated to one condition only of equilibrium, *viz.* the equilibrium of the