part), nor its meridians, are circles. The moſt depreſſed part of its equator will be in that ſection through the axis which is perpendicular to the plane in which the luminaries are ſituated. And this greateſt depreſſion, and its ſhorteſt equatorial diameter, will be constant, while its other dimensions vary with the moon’s place. We need not inquire more minutely into its form ; and it is ſufficient to know, that all the sections perpendicular to the plane paſſing thro’ the ſun and moon are ellipſes.

This conſtruction will afford us a very ſimple, and, we hope, a very perspicuous explanation of the chief phenome­na of the tides The well informed reader will be pleaſed with observing its coincidence with the algebraic ſolution of the problem given by Daniel Bernoulli, in his excellent diſſertation on the Tides, which ſhared with M'Laurin and Euler the prize given by the Academy of Sciences at Paris, and with the eaſe and perſpicuity with which the pheno­mena are deducible from it, being in ſome sort exhibited to the eye.

In our application, we ſhall begin with the ſimpleſt cases, and gradually introduce the complicating circumſtances which accommodate the theory to the true ſtate of things.

We begin, therefore, by ſupposing the earth coveted, to a proper depth, with water, forming an ocean concentric with its ſolid nucleus.

In the next place, we ſuppoſe that this ocean adopts in an inſtant the form which is conſiſtent with the equilibrium of gravity and the diſturbing forces.

*Thirdly,* We ſuppoſe the ſun ſtationary, and the moon to move eaſtward from him above 12½⁰ every day.

*Fourthly,* We ſuppoſe that the ſolid nucleus turns round its proper axis to the eaſtward, making a rotation in 24 ſolar hours. Thus any place of obſervation will ſucceſſively experience all the different depths of water.

Thus we ſhall obtain a certain Succession of pheno­mena, preciſely ſimilar to the ſucceſſion obſerved in nature, with this ſole difference, that they do not correſpond to the contemporaneous ſituations of the sun and moon. When we ſhall have accounted for this difference, we ſhall pre­sume to think that we have given a juſt theory of the tides.

We begin with the ſimpleſt caſe, ſuppoſing the ſun and moon to be always in the equator. Let the ſeries begin with the ſun and moon in conjunction in the line Os. In this caſe the points *s, m,* and *h* coincide, and we have high water at 12 o’clock noon and midnight.

While the moon moves from s to O*m* cuts the upper semicircle in M ; and therefore CH, which is always paral­lel to MS, lies between MC and C*s.* Therefore *h* is be­tween *m* and *s,* and we have high water after 12 o’clock, but before the moon’s ſouthing. The ſame thing happens while the moon moves from *o* to *q,* during her third quar­ter.

But while the moon moves from her firſt quadrature in Q to oppoſition in *o* (as in fig. 5.), the line *mO* drawn from the moon’s place, cuts the lower semicircle in M and CH, parallel to SM, again lies between M and *s,* and there­fore *h* lies between *m* and o. The place of high water is to the eaſtward of the moon, and we have high water after the moon’s ſouthing. The ſame thing happens while the the moon is moving from her laſt quadrature in q to the next iyzigy. In ſhort, the point H is always between M and *s,* and the place of high water is always between the moon and the *nearest* ſyzigy. The place of high water overtakes the moon in each quadrature, and is overtaken by the moon in each ſyzigy. Therefore during the firſt and third quarters, the place of high water gradually falls be­hind the moon for ſome time, and then gains upon her again, ſo as to overtake her in the next quadrature. But during the second and fourth quarters, the place of high water advances before the moon to a certain diſtance, and then the moon gains upon it, and overtakes it in the next ſyzigy.

If therefore we ſuppoſe the moon to advance uniformly along the equator, the place of high water moves unequally, ſloweſt in the times of new and full moon, and swifteſt in the time of the quadratures. There muſt be ſome intermediate ſituations where the place of high water neither gains nor loses upon the moon, but moves with the ſame velocity.

The rate of motion of the point *h* may be determined as follows : Draw C*i, Sn,* making very ſmall and equal angles with HC and MS. Draw *n*C, and about S, with the di­ſtance S*n,* deſcribe the arch n*v,* which may be conſidered as a ſtraight line perpendicular to *n*S, or to MS.

Then, becauſe SM and Sn are parallel to CH and C*i,* the points *n* and *i* are contemporaneous ſituations of M and H, and the arches *n*M, *i*H, are in the ratio of the angular motions of *m* and *h.* Alſo, becauſe n*v* and nM are perpen­dicular to *n*S and *n*C, the angle *vn*M is equal to the angle S*n*C, or SMC. Alſo, becauſe the angles *nv*M and MIC are right angles, and the angles *vnM,* CMI, are also equal, the triangles *vn*M, CMI, are ſimilar. Therefore

nM : nv = MC : MI. And

*nv : iH = S* : iC, or = MS : MC ; therefore

*n* M ; *i*H = MS ; MI. Therefore the angular mo­tion of the moon is to the angular motion of the place of high water as MS to MI.

Therefore, when M'S is perpendicular to SC, and the point I coincides with S, the motion of high water is equal to that of the moon. But when M'S is perpendicular SC, H'C is alſo perpendicular to C*s,* and the angle *h'*O*s* is 45', and the high water is in the octant. While the moon paſſes from *s* to *m',* or the high water from *s* to h', the point I falls between M and S, and the motion of high wa­ter is flower than that of the moon. The contrary obtains while the moon moves from m' to Q, or the high water from the octant to the quadrature.

It is evident, that the motion of *h* in the third quarter of the lunation, that is, in paſſing from o to *q,* is ſimilar to its motion from *s* to Q. Alſo, that its motion from Q to o muſt retard by the same degrees as it accelerated in paſſing from *s* to Q, and that its motion in the laſt quarter from *q* to *s* is ſimilar to its motion from Q to o.

At new and full moon the point I coincides with C, and the point M coincides with s. Therefore the motion of the high water at full and change is to the motion of the moon as *s*C to sS. But when the moon is in quadrature, I coincides with C, and M with o. Therefore the motion of the moon is to that of high water as OS to OC or JC. Therefore the motion of high water at full and change is to its motion in the quadratures as OS to Ss, or as the dif­ference of the diſturbing forces to their ſum. The motion of the tide is therefore ſloweſt in the ſyzigies and ſwifteſt in the quadratures ; yet even in the ſyzigies it passes the ſun along with the moon, but more ſlowly.

Let the interval between the morning tide of one day and that of the next day be called a *tide-day* This is al­ways greater than a ſolar day, or 24 hours, becauſe the place of high water is moving faſter to the eaſtward than the ſun. It is leſs than a lunar day, or 24h. 50', while the high water passes from the ſecond to the third octant, or from the fourth to the firſt. It is equal to a lunar day when high water is in the octants, and it exceeds a lunar day while high water passes from the firſt to ths ſecond octant, or from the third to the fourth.

The difference between a ſolar day and a tide day is