dera and Maragnon, there are ſeven coexiſtent high waters, with six low waters between them. Nothing can more evi­dently show that the tides in theſe places are nothing but the propagation of a wave. The velocity of its ſuperficial motion, and the diſtance to which it will ſenſibly go, muſt depend on many circumſtances. A deep channel and gentle acclivity will allow it to proceed much farther up the river, and the diſtance between the ſucceſſive ſummits will be great­er than when the channel is ſhallow and ſteep. If we apply the ingenious theory of Chevalier Buat, delivered in the ar­ticle River, we may tell both the velocity of the motion and the interval of the ſucceſſive high waters. It may be imitated in artificial canals, and experiments of this kind would be very inſtructive. We have ſaid enough at preſent for our purpoſe of explaining the irregularity of the times of high water in different places, with respect to the moon’s ſouthing. For we now ſee clearly, that ſomething of the ſame kind muſt happen in all great arms of the ſea which are of an oblong ſhape, and communicate by one end with the open ocean. The general tide in this ocean muſt pro­ceed along this channel, and the high water will happen on its ſhores in succession. This alſo is diſtinctly ſeen. The tide in the Atlantic ocean produces high water at new and full moon at a later and later hour along the ſouth coaſt of Great Britain in proportion as we proceed from Scilly iſlands to Dover. In the ſame manner it is later and later as we come along the eaſt coaſt from Orkney to Dover. Yet even in this progreſs there are conſiderable irregularities, owing to the ſinuoſities of the ſhores, deep indented bays, promi­nent capes, and extenſive ridges and valleys in the channel. A ſimilar progreſs is obſerved along the coaſts of Spain and France, the tide advancing gradually from the ſouth, turn­ing round Cape Finiſterre, ranging along the north coaſt of Spain, and along the west and north coaſts of France.

The attentive conſideration of theſe facts will not only satisfy us with reſpect to this difficulty, but will enable us to trace a principle of connection amidſt all the irregularities that we obſerve.

We now add, that if we note the difference between the time of high water of ſpring tide, as given by theory, for any place, and the *obſerved time* of high water, we ſhall find this interval to be very nearly conſtant thro’ the whole series of tides during a lunation. Suppoſe this interval to be forty hours. We ſhall find every other phenomenon ſucceed after the ſame interval, And if we ſuppoſe the moon to be in the place where she was 40 hours before, the obſervation will agree pretty well with the theory, as to the succeſſion of tides, the length of tide day, the retardations of the tides, and their gradual diminution from ſpring to neap tide. We lay pretty well ; for there ſtill remain ſeveral ſmall irregularities, different in different places, and not fol­lowing any obſervable law. Theſe are therefore local, and owing to local cauſes. Some of theſe we ſhall afterwards point out. There is alſo a general deviation of the theory from the real series of tides. The neap tides, and thoſe ad­joining, happen a little earlier than the corrected theory points out. Thus at Breſt (where more numerous and ac­curate obſervations have been made than at any other place in Europe), when the moon changes preciſely at noon, it. is high water at 3h. 28'. When the moon enters her second quarter at noon, it is high water at 8h. 40', inſtead oſ 9h. 48', which theory aſſigns.

Something ſimilar, and within a very few minutes equal, to this is obſerved in *every* place on the ſea coaſt. This is therefore ſomething general, and indicates a real defect in the theory.

But this ariſes from the ſame cauſe with the other general deviation, viz. that the greateſt and leaſt tides do not happen on the days of full and half moon, but a certain time after. We ſhall attempt to explain this.

We ſet out with the ſuppoſition, that the water acquired in an inſtant the elevation competent to its equilibrium. But this is not true. No motion is inſtantaneous, however great the force ; and every motion and change of motion produ­ced by a ſenſible or finite force increaſes from nothing to a ſenſible quantity by infinitely ſmall degrees. Time elapſes before the body can acquire any ſenſible velocity ; and in order to acquire the ſame ſenſible velocity by the action of different forces acting ſimilarly, a time muſt elapſe inverſely proportional to the force. An infinitely ſmall force requires a finite time for communicating even an infinitely ſmall ve­locity ; and a finite force, in an infinitely ſmall time, com­municates only an infinitely ſmall velocity ; and if there be any kind of motion which changes by inſenſible degrees, it requires a finite force to prevent this change. Thus a buc­ket of water, hanging by a cord lapped round a light and eaſily moveable cylinder, will run down with a motion uniformly accelerated ; but this motion will be prevented by hanging an equal bucket on the other side, ſo as to act with a finite force. This force prevents only infinitely ſmall ac­celerations.

Now let ALKF (fig. 6.) be the ſolid nucleus of the earth, ſurrounded by the ſpherical ocean *b h d g.* Let this be raised to a ſpheroid BHDG by the action of the moon at M, or in the direction of the axis CM. If all be at reſt, this ſpheroid may have the form preciſely competent to its equilibrium. But let the nucleus, with its ſpheroidal ocean, have a motion round C in the direction AFKL from west to eaſt. When the line of water BA is carried into the situation s *q* infinitely near to BA, it is no longer in equili­brio ; ſor s is too elevated, and the part now come to B is too much depressed. There is a force tending to depreſs the waters at *s,* and to raiſe thoſe now at B ; but this force is infinitely ſmall. It cannot therefore reſtore the ſhape competent to equilibrium till a ſenſible time has elapſed; therefore the diſturbing force of the moon cannot keep the ſummit of the ocean in the line MC. The force muſt be of a certain determinate magnitude before it can in an inſtant undo the inſtantaneous effect of the rotation of the waters and keep the ſummit of the ocean in the ſame place. But this effect is poſſible ; for the depreſſion at *s* neceſſary for this purpoſe is nearly as the diſtance from B, being a de­preſſion, not from a ſtraight line, but from a circle deſcribed with the radius CB. It is therefore an infiniteſimal of the firſt order, and may be reſtored in an inſtant, or the conti­nuation of the depreſſion prevented by a certain finite force. Therefore there is ſome diſtance, ſuch as By, where the diſturbing force of the moon may have the neceſſary intenſity. Therefore the ſpherical ocean, inſtead of being kept conti­nually accumulated at B and D, as the waters turn round, will be kept accumulated at *y* and y', but at a height ſomewhat smaller. It is much in this way that we keep melted pitch or other clammy matter from running off from a bruſh, by continually turning it round, and it hangs protuberant, not from the loweſt point, but from a point beyond it, in. the direction of its motion. The facts are very ſimilar. The following experiment will illuſtrate this completely, and is quite a parallel fact. Conceive GDH, the lower half of the ellipſe, to be a ſupple heavy rope or chain hanging ſrom a roller with a handle. The weight of the rope makes it hang in an oblong curve, just as the force of the moon raiſes the waters of the ocean. Turn the roller very ſlowly, and the rope, unwinding at one side and winding up on the other side of the roller, will continue to form the ſame curve : but turn the roller very briſkly in the direction FKL, and the rope will now hang like the curve *uy'ν,* considerably