advanced ſrom the perpendicular, ſo far, to wit, that the force of gravity may be able in an inſtant to undo the infi­nitely ſmall elevation produced by the turning.

We are very anxious to have this circumſtance clearly conceived, and its truth firmly eſtabliſhed ; becauſe we have obſerved it to puzzle many perſons not unaccuſtomed to ſuch diſcuſſions: we therefore hope that our readers, who have got over the difficulty, will indulge us while we give yet another view of this matter, which leads to the ſame conclusion.

It is certain that the interval between high and low wa­ter is not ſufficient for producing all the accumulation ne­ceſſary for equilibrium in an ocean ſo very ſhallow. The horizontal motion neceſſary for gathering together ſo much water along a ſhallow sea would be prodigious. Therefore it never attains its full height; and when the waters, already raiſed to a certain degree, have paſſed the ſituation imme­diately under the moon, they are ſtill under the action of accumulating forces, although theſe forces are now dimi­niſhed. They will continue riſing, till they have ſo far paſt the moon that their ſituation subects them to depressing forces. If they have acquired this ſituation with an accele­rated motion, they will rise ſtill farther by their inherent motion, till the depressing forces have deſtroyed all their ac­celeration, and then they will begin to sink again. It is in this way that the nutation of the earth’s axis produces the greateſt inclination, not when the inclining forces are greateſt, but three months after. It is thus that the warmeſt time of the day is a conſiderable while after noon, and that the warmeſt ſeaſon is conſiderably after midſummer. The warmth increaſes till the momentary waſte of heat exceeds the momentary ſupply. We conclude by saying, that it may be demonſtrated, that, in a ſphere fluid to the centre, the time of high water cannot be leſs, and may be more, than three lunar hours after the moon’s ſouthing. As the depth of the ocean diminiſhes, this interval alſo diminiſhes.

It is perhaps impoſſible to aſſign the diſtance By at which the ſummit of the ocean may be kept while the earth turns round its axis. We can only ſee, that it muſt be leſs when the accumulating force is greater, and therefore leſs in ſpring tides than in neap tides ; but the difference may be inſenſible. All this depends on circumſtances which we are little acquainted with : many of theſe circumſtances are local ; and the ſituation of the ſummit of the ocean, with reſpect to the moon, may be different in different places.

Nor have we been able to determine theoretically what will be the height of the summit. It will certainly be lessthan the height necessary for perfect equilibrium. Daniel Bernoulli ſays, that, after very attentive conſideration, he is convinced that the height at new or full moon will be to the theoretical height as the coſine of the angle BCy to radius, Cα or that the height at *y* will be Bb *× C*α/Cb.

The reſult of all this reaſoning is, that we muſt always ſuppoſe the ſummit of the tide is at a certain diſtance eastward from the place aſſigned by the theory. Mr Bernoulli concludes, from a very copious compariſon of obſervations at different places, that the place of high water is about 20 degrees to the eaſtward of the place, aſſigned by the theory. Therefore the table formerly given will correſpond with obſervation, if the leading column of the moon’s elongation from the ſun be altered accordingly. We have inſerted it again in this place, with this alteration, and added three co­lumns for the times of high water. Thus changed it will be of great uſe.

We have now an explanation of the acceleration of the neap tides, which ſhould happen 6 hours later than the

ſpring tides. They are in fact tides correſponding to positions of the moon, which are 20⁰ more, and not the real ſpring and neap tides. Theſe do not happen till two days after ; and if the really greateſt and leaſt tides be obſerved, the leaſt will be found 6 hours later than the first.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Elong. of Moon. | High Water before or after Moon’s Southing. | | | Time of High Water. | | |
| Perigee. | Μ. Dist. | Apogee. | Perigee. | Μ. Dist. | Apogee. |
| 0 | 18 after. | 22 after | 27½ after | 0.18 | 0.22 | 0.27½ |
| 10 | 9½ do. | 11½ | 14 | 0.49½ | 0.51½ | 0.54 |
| 20 | 0 do. | 0 | 0 | 1.20 | 1.20 | 1.20 |
| 30 | 9½ bef. | 11½ bef. | 14 bef. | 1.50½ | 1.48 | 1.46 |
| 40 | 18 do. | 22 | 27½ | 2.22 | 2.18 | 2.12 |
| 50 | 26 | 31½ | 39½ | 2.54 | 2.48 | 2.40 |
| 60 | 33 | 40 | 50 | 3.27 | 3.20 | 3.10 |
| 70 | 37½ | 45 | 56 | 4.02½ | 3.55 | 3.44 |
| 80 | 38½ | 46½ | 58 | 4.41½ | 4∙33 | 4.22 |
| 90 | 33½ | 40½ | 50½ | 5.26½ | 5.19 | 5.09 |
| 100 | 22 | 25 | 31 | 6.19 | 6.15 | 6.09 |
| 110 | 0 | 0 | 0 | 7.20 | 7.20 | 7.20 |
| 120 | 22 after | 25 after | 31 after | 8.21 | 8.25 | 8.31 |
| 130 | 33½ after | 40½ | 50½ | 9.12½ | 9.20 | 9.30 |
| 140 | 38½ | 46½ | 58 | 9.58½ | 10.06 | 10.18 |
| 150 | 37½ | 45 | 56 | 10.37½ | 10.45 | 10.56 |
| 160 | 33 | 40 | 50 | 11.13 | 11.20 | 11.30 |
| 170 | 26 | 31½ | 29½ | 11.46 | 11.51 | 11.59 |
| 180 | 18 | 22 | 27½ | 0.18 | 0.22 | 0.27 |

This table is general ; and exhibits the time of high wa­ter, and their difference from thoſe of the moon’s ſouthing, in the open ſea, free from all local obſtructions. If there­fore the time of high water in any place on the earth’s equator (for we have hitherto considered no other) be dif­ferent from this table (ſuppoſed correct), we muſt attribute the difference to the diſtinguiſhing circumſtances of the ſi­tuation. Thus every place on the equator ſhould have high water on the day that the moon, ſituated at her mean di­ſtance, changes preciſely at noon, at 22 minutes paſt noon ; becauſe the moon paſſes the meridian along with the ſun by ſupposition. Therefore, to make uſe of this table, we muſt take the difference between the first number of the column, intitled time of high water, from the time of high water at full and change peculiar to any place, and add this to all the other numbers of that column. This adapts the table to the given place. Thus, to know the time of high water at Leith when the moon is 50⁰ eaſt of the ſun, at her mean diſtance from the earth, take 22' from 4h. 30', there remains 4.08. Add this to 2h. 48', and we have 6h. 56' for the hour of high water. (The hour of high water at new and full moon ſor Edinburgh is marked 4h. 30' in Maſkelyne’s ta­bles, but we do not pretend to give it as the exact determi­nation. This would require a ſeries of accurate obſerva­tions.)

It is by no means an eaſy matter to aſcertain the time of high water with preciſion. It changes ſo very ſlowly, that we may eaſily miſtake the exact minute. The beſt method is to have a pipe with a ſmall hole near its bottom, and a float with a long graduated rod. The water gets in by the ſmall hole and raises the float, and the ſmallneſs of the hole prevents the ſudden and irregular starts which waves would occaſion. Inſtead of oblerving the moment of high water, obſerve the height of the road about half an hour before, and wait after high water till the rod comes again to that height: take the middle between them. The water riſes