called the priming or the retardation of the tides. This is evidently equal to the time of the earth’s deſcribing in its rotation an angle equal to the motion of the high water in a day from the ſun. The ſmalleſt of theſe retardations is to the greateſt as the difference of the diſturbing forces to their ſum. Of all the phenomena of the tides, this ſeems liable to the feweſt and moſt inconſiderable derangements from local and accidental circumſtances. It therefore af­fords the beſt means for determining the proportion of the diſturbing forces. By a compariſon of a great number of obſervations made by Dr Maſkelyne at St Helena and at Barbadoes (places ſituated in the open ſea), it appears that the ſhorteſt tide-day is 24h. 37', and the longeſt is 25h. 27'. This gives M — S : M + S = 37 : 87, and S : M = *2 :* 4,96 ; which differs only 1 part in 124 from the propor­tion of 2 to 5, which Daniel Bernoulli collected from a va­riety of different obſervations. We ſhall therefore adopt the proportion of 2 to 5 as abundantly exact. It alſo agrees exactly with the phenomena of the nutation of the earth’s axis and the preceſſion of the equinoxes ; and the aſtronomers affect to have deduced this proportion from theſe phe­nomena. But an intelligent reader of their writings will per­ceive more finesse than juſtice in this assertion. The nuta­tion and precession *do not* afford phenomena of which we can aſſign the ſhare to each luminary with ſufficient preciſion for determining the proportion of their diſturbing forces ; and it is by means of many arbitrary combinations, and without neceſſity, that D’Alembert has made out this ratio. We cannot help being of opinion, that D’Alembert has accommodated his diſtribution of the phenomena to this ratio of 2 to 5, which Daniel Bernoulli (the beſt philoſopher and the moſt candid man of that illuſtrious family of mathematicians) had, with ſo much ſagacity and juſtneſs of inference, deduced from the phenomena of the tides. D’A­lembert could not but ſee the value of this inference ; but he wanted to ſhow his own addreſs in deducing it *proprio marte* forſooth from the nutation and preceſſion. His pro­cedure in this reſembles that of his no leſs vain countryman De la Place, who affects to be highly pleaſed with finding that Mr Bode’s diſcovery that Meyer had ſeen the Georgium Sidus in 1756, perfectly agreed with the theory of its motions which he (De la Place) had deduced from his own doctrines. Any well informed mathematician will ſee, that De la Place’s data afforded no ſuch precision ; and the book on the Elliptical Motions of the Planets, to which he alludes, contains no grounds for his inference. This observation we owe to the author of a paper on that ſubject in the Tranſactions of the Royal Society of Edinburgh. We hope that our readers will excuſe this occaſional obſervation, by which we wiſh to do juſtice to the merit of a modeſt man, and one of the greateſt philoſophers of his time. Our only claim in the preſent diſſertation is the ma­king his excellent performance on the tides acceſſible to an Engliſh reader not much versant in mathematical reſearches ; and we are ſorry that our limits do not admit any thing more than a ſketch or it. But to proceed,

Assuming 2 : 5 as the ratio of SC to CM', we have the angle CM'S = 23⁰ 34' nearly, and *m'oh' =* 11⁰ 47' ; and this is the greateſt difference between the moon’s place and the place of high water. And when this obtains, the moon’s elongation *m' o s* is 56⁰ 47' from the neareſt ſyzigy. Hence it follows, that while the moon moves uninformly from 56⁰ 47' west elongation to 56⁰ 47' eaſt, or from 123⁰ 13' eaſt to 123⁰ 13' west, the tide day is ſhorter than the lunar day; and while ſhe moves from 56⁰ 47' eaſt to 123⁰ 13', or from 123⁰ 13' weſt to 56⁰ 47', the tide-day is longer than the lunar-day.

We now ſee the reaſon why

The ſwelling tides obey the moon.

The time of high water, when the ſun and moon are in the equator, is never more than 47 minutes different from that of the moon’s ſouthing (+ or — a certain fixed quan­tity, to be determined once for all by observation.)

It is now an eaſy matter to determine the hour of high water correſponding to any poſition of the ſun and moon in the equator. Suppoſe that on the noon of a certain day the moon’s diſtance from the ſun is ms. The construction of this problem gives us s*h,* and the length of the tide day. Call this T. Then ſay 360⁰ sm = T : t, and *t* is the hour of high water.

Or, if we chooſe to refer the time of high water to the moon’s ſouthing, we muſt find the value of *mh* at the time of the moon’s ſouthing, and the difference *d* between the tide day and a mean lunar day L, and ſay 360 : *mh = d : δ,* the time of high water before the moon’s ſouthing in the firſt and third quarters, but after it in the ſecond and fourth. The following table by Daniel Bernoulli exhibits theſe times for every 10th degree of the moon’s elongation from the ſun. The firſt or leading column is the moon’s elon­gation from the ſun or from the point of oppoſition. The ſecond column is the minutes oſ time between the moon’s ſouthing and the place of high water. The marks — and + diſtinguiſh whether the high water is before or after the moon’s ſouthing. The third column is the hour and mi­nute of high water. But we muſt remark, that the firſt column exhibits the elongation, not on the noon of any day, but at the very time of high water. The two remaining columns expreſs the heights of the tides and their daily va­riations.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| *ms.* | *mh.* | *sh.* | MS. | Mv. |
| **0** | ***t*** | h.' |  |  |
| 0 | 0 | 0.0 | 10000 |  |
|  |  |  |  | 13 |
| **10** | 11½— | 0.28½ | 987 | 38 |
| 20 | 22 — | 0.58 | 949 | 62 |
| 30 | 31½ | 1.28½ | 887 | 81 |
| 40 | 40 — | 2.— | 806 | 91 |
| 50 | 45 — | 2.35 | 715 | 105 |
| 60 | 46½— | 3.13½ | 610 | 92 |
| 70 | 40½— | 3.59½ | 518 | 65 |
| 80 | 25 — | 4.55 | 453 | 24 |
| 90 | 0 | 6.— | 429 |  |
|  | + |  |  | 24 |
| 100 | 25 + | 7.5 | 453 |  |
| 110 | 40½+ | 8.0½ | 518 | 65 |
| 120 | 46½ + | 8.46½ | 610 | 92 |
| 130 | 45 + | 9.25 | 715 | 105 |
| 140 | 40 + | 10.— | 806 | 91 |
| 150 | 31½+ | 10.31½ | 887 | 81 |
| 160 | 22 + | 11.2 | 949 | 62 |
| 170 | 11½+ | 11.31½ | 987 | 38 |
| 180 | 0 | 12. — | 1000 | 13 |

The height of high water above the low water conſtitutes what is uſually called the tide. This is the intereſting circumſtance in practice. Many circumſtances render it almoſt impoſſible to ſay what is the elevation of high water above the natural ſurface of the ocean. In many places the surface at low water is above the natural ſurface of the ocean. This is the caſe in rivers at a great diſtance from