an hour and a half, and yet collected from observations at the same place.

In the determination of the establishment little accuracy is to be expected, unless numerous observations be used ; and in this case, the mean of the morning and evening tide- hours may be taken, the effect of the intervals by which the conjunctions and oppositions of the moon precede and suc­ceed noon being supposed to compensate each other. But when the establishment is to be collected from only a few observations, it will be proper to calculate in each case the lunitidal interval or hour-angle by which the tide is distant from the moon.

The time of high water does not follow the moon’s transit by the same interval at every period of the lunation ; on the contrary, this lunitidal interval is sometimes greater and sometimes less than that corresponding to the new and full moon, and is regulated by the distance of the moon from the sun. The difference between this and the mean inter­val is called the half-monthly or scmimenstrual inequality. When the moon and sun are in conjunction, the corre­sponding tide follows the moon by its mean interval. When the moon is at various hour-angles after the sun, the fol­lowing are the mean corrections of the mean interval, ne­gative and positive. But the law and magnitude of such numbers depend on the relative effect of the sun and moon upon the tides : the amount is different at different places, and varies with the declinations and parallaxes of the lumi­naries.

Hour-angle of the moon. 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12 hours.

Correction of establishment...0, —16, —31, —41, —44, —31, 0, +31, +44, +41, +31, +16, 0 minutes.

Thus, if the establishment corresponding to the new and full moon be six hours, the time of the high water, when the moon is one hour from the sun, will be 5h∙ 44m. after the moon’s transit ; when the moon is two hours from the sun, the time of tide will be 5h. 29m. after the transit ; and so on. When the moon is six hours from the sun, the cor­responding time of high water will again coincide with the mean, after which the lunitidal interval will exceed the mean, till the next conjunction or opposition, and then the same cycle recurs. Hence if the establishment were col­lected from any observation of the tide not corresponding to the day of new or full moon, it would be liable to an error. If the establishment were six hours by an observation made when the moon’s hour-angle was four hours, and compared with the time of the moon’s transit, it would appear to be 5h∙ 16m.; but by an observation made when the moon’s hour- angle was eight hours, it would appear to be 6h∙ 44m∙ This difference in the results would be avoided by taking the tide which corresponds to new or full moon, or by applying the proper correction according to the preceding table when any other tide was observed. Some authors make this cor­rection depend on the day of the moon’s age ; but as this is a very inaccurate mode of determining the angular distance of the sun and moon, the proper way is to make the cor­rection depend on the difference of right ascensions of the Sun and moon, that is, on the time of the moon’s transit expressed in apparent time as above. The chance of error would be removed more effectually by taking the mean of all the intervals between tide and transit, during a half lu­nation, or any whole number of half lunations.

Although, according to theory, the semimenstrual ine­quality of the time depends on the ratio of the force of the moon to that of the sun, yet the observations shew it to be different at different places. The total amount of this ine­quality, that is, the difference between the greatest and least lunitidal intervals, is 95 minutes at Plymouth and 93 at Bristol, which exceed its values at many other places. It is 90 minutes at London and Sheerness, 86 at Liverpool and Howth, 84 at Leith, 83 at Portsmouth and Pembroke, 82 at Ramsgate, and only 80 at Brest. Each of these is determined from observations so numerous as to be certain within a minute or two. We see, therefore, how different the mass of the moon would be found to be when deduced from the observations of different places; so that the near agreement of the mass deduced by Laplace from the tides of Brest, with the mass obtained from other phenomena, must have been merely accidental ; and this also puts an end to all attempts to correct the tables of the tides by means of the mass of the moon.

The semimenstrual inequality of the height of the tides, when compared at different places, gives a similar result. It is not, however, the actual amount of this inequality, but its proportion to the mean tide, that is to be taken. At Portsmouth, the mean range of the tide is 12∙5 feet ; the total semimenstrual inequality, or difference between the high waters at neap and spring tides, is 2∙5 feet ; that is, only ]∙th of the mean tide. But at Plymouth, where the mean tide is also 12∙5 feet, the total semimenstrual inequa­lity is 3∙4 feet, and thus the fraction is 1/3·4 At Bristol, again, where the mean range of the tide is 33 feet, the semi- menstrual inequality is 10 feet, or of the mean tide. In tide records, as formerly kept, it is often uncertain whe­ther the height marked, mean that of the stream tide, or only the high water on the days of new or full moon.

From the general observations made simultaneously in Europe and America in June 1835, it appears that the amount of the semimenstrual inequality of the time is very different at different parts of the world ; and though these observations were of too rude a kind to give the amount of the difference, they are sufficient to prove its existence ; especially when coupled with a reason for the difference, namely, that the spring tides being higher than the neaps, the tides of the two kinds may travel with velocities which at different places have different relations. Mr Whewell conceives that the observations afford evidence of a local as well as a general semimenstrual inequality. The changes of this inequality are not obviously explicable. On the coast of North America, the amount of the difference of the greatest and least lunitidal intervals is small, being ge­nerally less than 80 minutes, and at Newport as low as 56. On the coast of Portugal, at several places, this difference is so small as almost to throw doubt on the accuracy of the observations. At Pera in Algarve it is only 42, at Lagos Bay 24, while at Peniche it is 130. On the greater part of the French coast it ranges with great steadiness from 80 to 100, except at the little harbour of Abrevrak, where it is 125 minutes. At Torr Head, on the north coast or Ireland, it is 146, and at Rachlin Island 240 ; but these are cases of extreme irregularity. On many parts of the south coast of England it is small, being from 70 to 74, as at Exmonth, Weymouth, St Alban’s Head, St Lawrence, Swanage Bay, Brighton, and Hastings.

From the same observations, it appears that the amount of the semimenstrual inequality of the height also varies. In general, the greatest range is twice or twice and a half the smallest ; but this is so far from being a universal rule, that many of the cases which at first seem to agree with it, really differ widely when allowance is made for the diurnal inequality. Thus, at Mount Desert Island, near the coast of America, the whole amount of the semimenstrual inequa­lity of high water is about three feet in a tide of thirteen feet, thus reducing the smallest range to eleven ; but the diurnal inequality reduces it further to eight feet.

If, as is generally believed, the most of the tides be ge-