ference of different tides ; but another reason for some of them, we presume, is, that the luminaries, after generating the primary tides, are not, as they are usually assumed to be, mere idle spectators of the derivative tides, but often continue to act upon them in various ways, accelerating some and retarding others.

Although the observations make the parallax corrections both of height and time vary as the parallax, yet some of the observations do not make the height of the tide itself proportional to the cube of the parallax, as theory requires, but make it more nearly proportional to the square of the parallax, being as the 2-2 power. The declination correc­tions both of height and time are found by observation to vary as the square of the sine of the declination, which, ac­cording to theory, they should do.

But the difference between the tidal phenomena of the morning and evening of the same day, called the diurnal inequality, is often so considerable, and at some places so remarkable, that it is far less perfectly understood than any of the other inequalities, and furnishes, as we shall after­wards see, a source of far greater uncertainty in the de­termination of the establishment than any yet mentioned. It had not till of late been introduced, and still very spar­ingly, into tide-tables. To it, or rather to a want of the knowledge of it, are no doubt owing many of the uncer­tainties or ambiguities and errors which occur in recorded tide observations. It is of great importance both to the theory of the tides and to the purposes of navigation, that this diurnal inequality should be fully analysed. Mr Whewell’s researches have opened a wide field, but here we can only notice them in a very general manner.

Were the earth wholly covered by water, the diurnal inequality of the heights of high and low waiter would de­pend on the semidiurnal transits of the poles of the equili­brium spheroid being alternately north and south of the equator. For example, if the moon had 20° north declina­tion, the tide spheroid would have one pole in lat. 20° north, and the other in 20° south : and while the earth re­volved, a place in lat. 50° north would have the tide which belongs to these two poles alternately ; and being 30° from the one pole and 70° from the other, the two tides would be very unequal. On the same principles, in northern la­titudes the tide which belongs to an upper transit of the moon should be the greater (of the two on the same day) when the moon’s declination is north : when the moon crosses the equator, the difference of the two tides should vanish ; when she has south declination, the tide which be­longs to her upper transit should be the smaller. The con­trary (as to greater and smaller) should be true of the tide which belongs to the inferior transit. The diurnal inequality may therefore be conceived to arise from a wave oscillating in the direction of the meridian, and of which the maximum height comes to each place once in twenty-four lunar hours ; the minimum height arriving, of course, at the intermediate twelve hours. For such oscillations the Atlantic and Pacific both afford the most ample scope. If the time of the maxi­mum height of this wave arriving at any port coincide every day with the time of high water, the alternate high water be­ing at twelve hours interval, will be affected alternately with the greatest and least heights of the diurnal wave ; and the intermediate low waters will coincide with the mean height of this wave, and will not be at all affected. In this case there will be a decided diurnal inequality in the height of the high water, but none in that of the low water. In like man­ner, if the time of the maximum height of the diurnal wave coincide with the time of low water, the height of low wa­ter will be marked with a diurnal inequality, while the height of high water will exhibit no such feature. But if the di­urnal wave arrive every day at a time intermediate between high and low water, it will raise both the high and the low water which are nearest it, and will depress both the high

and the low water which happen in the other half of the day. Hence both the high waters taken separately, and the low waters taken separately, will be marked by a diur­nal inequality ; and this inequality will be greater for high water or for low water, according as the time of the maxi­mum of the diurnal wave is nearer to the time of high or low water.

There are various places at which it has long been known that there is commonly a difference in the morning and evening tide of the same day. It is stated by Colepress in 1668 (Phil. Trans. vol. iii. p. 633), that at Plymouth the tides, from about the end of March till the end of Septem­ber, are about a foot higher in the afternoon than in the fore­noon, and *vice versa* the rest of the year. But we shall soon see that this way of expressing the fact, by speaking of evening and morning tides, is quite inaccurate. The other inequalities of the tides having been found to follow the laws of the equilibrium theory (although the constant ele­ments, the magnitudes and epochs, can be determined only by observation), and Mr Whewell having found the diurnal inequality very clearly marked in the Plymouth observa­tions, he attempted to trace its laws by assuming a similar correspondence with the equilibrium theory. the result confirmed the assumption in a striking manner, the age or epoch of this inequality for Plymouth being about four days.

At Sincapore the diurnal inequality of low water is of a magnitude which could not have been anticipated, the height of the evening and morning tide often differing six feet ; although the whole rise of the mean tide is only seven feet at spring tides, and the difference of mean spring and neap tides not more than two feet. The epoch at that place is about a day and a half. It is a curious circumstance, that the sun affects the low water at Plymouth more than the high water ; and that the moon’s declination at Sinca­pore affects the low water four times as much as the high water, while at Plymouth it affects it less.

It is easy to conceive the diurnal inequality carried a little farther than it is at Sincapore, so that at a certain stage of it the alternate tides would entirely vanish. This is equivalent to supposing the highest low water and the lowest high water to have the same height, of which exam­ples will afterwards be given.

Captain Fitzroy having caused observations be made at King George’s Sound, on the south coast of New Holland, every half hour for some days, and for a portion of the time every quarter of an hour, found that on March 7th and 8th 1836 there were two very unequal tides, and that on the 9th and 10th there was only one tide ; but a recession and return in the high water, which had been barely percep­tible on the 11th, became more and more marked on the 12th, 13th, and 14th, so as again to give two tides each day. Thus at this place it appears to be only at one par­ticular period of the semilunation that we have a single-day tide. That of Tonquin was referred by Newton to the in­terference of two tides which arrive by different channels. The great diurnal inequality of Sincapore, which is in the same seas, appears to be clearly due to the effect of the moon’s declination ; and the determination of this point, and the circumstances ascertained to occur in the reputed single-day tide of King George’s Sound, throw some doubt on the explanation just referred to ; nor can this doubt be removed till the tides of those seas have been more fully observed.

That this inequality cannot properly be called an excess of the evening tide at one season of the year, and of the morning tide at another, must now be evident from the circumstance that the high water at Plymouth is on the average five hours after the moon's transit. Suppose the moon to move in the ecliptic, which is her average path when the sun’s right ascension is five hours (that is, about