ther from the moon than 15⁰, when ſhe is in apogee and the ſun in perigee. Therefore *if* a meridian be drawn thro’ the point of higheſt water to the equator, the arch *mh* of fig. 4. will be repreſented on the equator by another arch about 92/100 of this by reaſon of the inclination of the equa­tor and ecliptic. Therefore, to have the time of high wa­ter, multiply the numbers of the columns which expreſs the difference of high water and the moon’s ſouthing by 92/100, and the products give the real difference.

2∙ Let the moon be in her greateſt declination. The arch of right aſcenſion correſponding to *mh* will be had by multiplying mh, or the time correſponding to it in the table, by 102/92.

3. When the moon is in a middle ſituation between theſe two extremes, the numbers of the table will give the right aſcenſion correſponding to *mh* without any correction, the diſtance from the equator compenſating for the obliquity of the ecliptic arch mh*.*

The time of low water is not ſo eaſily found ; and we muſt either go through the whole trigonometrical process, or content ourſelves with a leſs perfect approximation. The trigonometrical proceſs is not indeed difficult : We muſt find, the position of the plane through the sun and moon. A great circle through the moon perpendicular to this is the line of high water ; and another perpendicular circle cutting this at right angles is the circle of low water.

But it will be abundantly exact to conſider the tide as accompanying the moon only.

Let NOSE (fig. 7.) be a ſection of the terraqueous globe, of which N and S are the north and ſouth poles and EOQ the equator. Let the moon be in the direction OM, having the declination BQ. Let D be any place on the earth’s ſurface. Draw the parallel LDC of latitude. Let B'F*b'f* be the ocean, formed into a spheroid, of which B*b* is the axis and fF the equator.

As the place D is carried along the parallel CDL by the rotation of the earth, it will pass in ſuccession through dif­ferent depths of the watery ſpheroid. It will have high water when at C and L, and low water when it croſſes the circle fOF. Draw the meridian N*d*G, and the great cir­cle B*db.* The arch GQ, when converted into lunar hours (each about 62 minutes), gives the duration of the flood *dc* and of the ſubſequent ebb *cd,* which happen while the moon is above the horizon ; and the arch EG will give the durations of the flood and of the ebb which hap­pen when the moon is below the horizon. It is evident, that theſe two floods and two ebbs have unequal durations. When D is at C it has high water ; and the height of the tide is CC'. For the ſpheroid is ſuppoſed to touch the ſphere on the equator fOF, ſo that of CC' is the difference between high and low water. At L the height of the tide is LL'; and if we deſcribe the circle L'N*q, C'q* is the dif­ference of theſe high waters, or of theſe tides.

Hence it appears, that the two tides of one lunar day may be conſiderably different, and it is proper to diſtinguiſh them by different names. We ſhall call that a *ſuperior tide* which happens when the moon is above the horizon during high water. The other may be called the *inferior tide.* The duration of the ſuperior tide is meaſured by 2GQ, and that of the inferior tide by 2EG, and 4GO meaſures the difference between the whole duration of a ſuperior and of an inferior tide.

From this conſtruction we may learn in general, I. When the moon has no declination, the durations and alſo the heights of the ſuperior and inferior tides are equal in all parts of the world. For in this case the tide equator fF coincides with the meridian NOS, and the poles B'*b'* of the watery ſpheroid are cn the earth’s equator.

2. When the moon has declination, the duration and alſo the height of a ſuperior tide at any place is greater than that of the inferior ; or is leſs than it, according as the moon’s declination and the latitude of the place are of the ſame or oppoſite names.

This is an important circumſtance. It frequently hap­pens that the inferior tide is found the greateſt when it ſhould be the leaſt ; which is particularly the case at the Nore. This ſhows, without further reaſoning, that the tide at the Nore is only a branch of the regular tide. The re­gular tide comes in between Scotland and the continent ; and after travelling along the coaſt teaches the Thames, while the regular tide is just coming in again between Scot­land and the continent.

3. If the moon’s declination is equal to the colatitude of the place, of exceeds it, there will be only one tide in a lu­nar day. It will be a ſuperior or an inferior tide, accord­ing as the declaration of the moon and the latitude of the place are of the ſame or oppoſite kinds. For the equator of the tide cuts the meridian in f and F. Therefore a place which moves in the parallel *cf* has high water when at c, and 12 lunar hours afterwards, has low water when at f. And any place *k* which is ſtill nearer to the pole N has high water when at *k,* and 12 lunar hours afterwards has low water at *m.* Therefore, as the moon’s declination ex­tends to 30⁰, all places farther north or ſouth than the la­titude 60⁰ will ſometimes have only one tide in a lunar day.

4. The sine of the arch GO, which meaſures ¼th of the difference between the duration of a ſuperior and inferior tide, is = tan. lat. × tan. decl. For in the ſpherical tri­angle *d*OG

Rad : cotan. *dOG =* tan. *dG* : sin. GO, and

Sin. GQ = tan. *d* OQ × tan. *d*G, = tan. decl. × tan. lat.

Hence we ſee, that the difference of the durations of the ſuperior and inferior tides of the ſame day increaſe both with the moon’s declination and with the latitude of the place.

The different ſituations of the moon and of the place of obſervation affect the heights of the tides no leſs remarkably. When the point D comes under the meridian NBQ in which the moon is situated, there is a ſuperior high water, and the height of the tide above the low water of that day is CC'. When D is at L, the height of the inferior tide is LL'. The elevation above the inſcribed ſphere is Μ × coſ. 2y, *y* being the zenith diſtance of the moon at the place of obſervation. Therefore at high water, which by the theory is in the place directly under the moon, the height of the tide is as the ſquare of the coſine of the moon’s zenith or nadir diſtance.

Hence we derive a conſtruction which ſolves all queſtions relating to the height of the tides with great facility, free from all the intricacy and ambiguities of the algebraic analyſis employed by Bernoulli.

With the radius CQ = M (the elevation produced by the moon above the inſcribed ſphere) deſcribe the circle QPE (fig. 8.) to repreſent a meridian, of which P and ρ are the poles, and EQ the equator. Effect CP in 0 ; and round 0 deſcribe the circle PBCD. Let M be the place over which the moon is vertical, and Z be the place of ob­ſervation. MQ is the moon’s declination, and ZQ is the latitude of the place. Draw MC*m,* ZCN, cutting the ſmall circle in A and B. Draw AGI perpendicular to CP, and draw CLμ, which will cut off an arch Eμ — QM. MZ and μN are the moon’s zenith and nadir diſtances. Draw the diameter BD, and the perpendiculars IK, GH, and AF. Alſo draw OA, PA, AB, ID.

Then DF is the ſuperior tide, DK is the inferior tide, and DH is the arithmetical mean tide.