being totally the effect of M as modified by latitude and declination, may be taken as its proper meaſure, by which we are to calculate the other tides of the monthly ſeries from ſpring tide to neap tide.

In like manner, we muſt compute a value for S, as mo­dified by declination and latitude ; call this *s.* Then say,

M + S : A = m + s: A × (m + s)*(M + S).*

This fourth proportional will give the ſpring tide as modified for the given declination of the luminaries, and the latitude of the place.

Now recollect, that the medium tide, when the lumina­ries are in the equator, is A × cos.2 lat. Therefore let F be the ſpring tide *obſerved* at any place when the lumi­naries are in the equator ; and let this be the medium of a great many obſervations made in these circumſtances. This gives A × cos.2 lat. (as modified by the peculiar circumstances of the place) = F. Therefore the fourth proportional now given changes to F × (m + s)/(M + S) × cos.2 lat. And a ſimilar ſubſtitute for B is G × (m + s)/(M + S) × cos.2 lat.

Laſtly, To accommodate our formulæ to every diſtance of the earth from the sun and moon, let D and ∆ be the mean diſtances of the sun and moon, and *d* and δ their distances at the given time ; and then the two ſubſtitutes become

Δ3 d3 M + δ3 D3 S × *m + s.*

^~ArP (M⅛Sj~ x F x (M⅛S) cof.≈ht∙ ∆3j3M-∙t3D3S , *rn+s d\*D(JΛ--S)* xgx(M-S)cof.2lat.

The half sum of theſe two quantities will be the MC, and their half difference will be the SC, of fig. 4. with which we may now operate, in order to find the tide for any other day of the menſtrual ſeries, by means of the elongation *a* of the moon from the sun ; that is, we muſt ſay MC + CS : MC — CS = tan. *a* : tan. *b* ; then *x =* (a + b)/2, and *y = (a — b)/2*. And MS, the height of the tide, is MC × coſi. *2y +* CS × coſ. 2*x.*

Such is the general theory of the tides, deduced from the principle of univerial gravitation, and adjuſted to that proportion of the ſolar and lunar forces which is moſt con­fident with other celeſtial phenomena. The comparison of the greateſt and leaſt daily retardations of the tides was with great judgment preferred to the proportion of ſpring and neap tides, ſelected by Sir Iſaac Newton for this pur­poſe. This proportion muſt depend on many local circum­ſtances. When a wave or tide comes to the mouths of two rivers, and sends a tide up each, and another tide of half the magnitude comes a fortnight aſeer ; the proportion of tides ſent up to any given places of theſe rivers may be extremely different. Nay, the proportion of tides ſent up to two diſtant places of the ſame river can hardly be the same ; nor are they the same in any river that we know. It can be demonſtrated, in the ſtricteſt manner, that the farther we go up the river, where the declivity is greater, the neap tide will be ſmaller in proportion to the ſpring tide. But it does not appear that the time of ſucceſſion of the different tides will be much affected by local circumſtances. The tide of the second day of the moon being very little leſs than that of the firſt, will be nearly as much retarded, and the intervals between their arrivals cannot be very different from the real intervals of the undiſturbed tides ; according­ly, the ſucceſſion of the higheſt to the higheſt but one is found to be the ſame in all places, when not diſturbed by *different* winds. In like manner, the ſucceſſion of the loweſt and the loweſt but one is found equally invariable ; and the higheſt and the loweſt tides obſerved in any place *must* be accounted the ſpring and neap tides of that place, whether they happen on the day of full and half moon or not. Nay, we can see here the explanation of a general deviation of the theory which we formerly noticed. A low tide, being leſs able to overcome obſtructions, will be ſooner ſtopped, and the neap tides ſhould happen a little earlier than by the undiſturbed theory.

With all theſe corrections, the theory now delivered will be found to correſpond, with obſervation, with all the exactness that we can reasonably expect. We had an oppor­tunity of comparing it with the phenomena in a place where they are very ſingular, viz. in the harbour of Biſſeſtedt in Iceland. The equator of the watery ſpheroid frequently pasſes through the neighbourhood of this place, in a variety of poſitions with respect to its parallel of diurnal revolution, and the differences of ſuperior and inferior tides are moſt remarkable and various. We found a wonderful conformity to the moſt diversified circumſtances of the theory.

There is a period of 18 years, reſpecting the tides in Iceland, taken notice of by the ancient Saxons ; but it is not diſtinctly deſcribed. Now this is the period of the moon’s nodes, and of the greateſt and leaſt inclination of her orbit to the equator. It is therefore the period of the poſitions of the equator of the tides which ranges round this ifland, and very senſibly affects them.

Hitherto we have suppoſed the tides to be formed on an ocean completely covering the earth. Let us see how thoſe may be determined which happen in a ſmall and con­fined ſea, ſuch as the Caſpian or the Black Sea. The de­termination in this case is very ſimple. As no ſupply of water is ſuppoſed to come into the baſon, it is ſuſceptible of a tide only by sinking at one end and riſing at the other. This may be illuſtrated by fig. 6. where C *s,* Cy, are two perpendicular planes bounding a ſmall portion of the natu­ral ocean. The water will sink at z and rise at *x,* and form a ſurface *otr* parallel to the equilibrated ſurface y*s.* It is evident that there will be high water, or the greateſt poſ­ſible rise at *r,* when the baſon comes to that poſition where the tangent is moſt of all inclined to the diamater. This will be when the angle *t*CB is 45⁰ nearly, and therefore three lunar hours after the moon’s ſouthing ; at the ſame time, it will be low water at the other end. It is plain that the riſe and fall muſt be exceedingly small, and that there will be no change in the middle. The tides of this kind in the Caſpian Sea, in latitude 45⁰, whoſe extent in longitude does not exceed eight degrees, are not above ſeven inches ; a quantity so ſmall, that a flight breeze of wind is ſufficient to check it, and even to produce a riſe of the waters in the oppoſite direction. We have not met with any accounts of a tide being obſerved in this ſea.

It ſhould be much greater, though ſtill very ſmall, in the Mediterranean Sea. Accordingly, tides are obſerved there, but ſtill more remarkably in the Adriatic, ſor a reaſon which will be given by and by. We do not know that tides have been obſerved in the great lakes of North America. Theſe tides, though ſmall, ſhould be very regular.

Should there be another great baſon in the neighbour­hood of *zx,* lying eaſt or west of it, we ſhould obſerve a curious phenomenon. It would be low water on one side of the ſhore *z* when it is high water on the other side of this partition. If the tides in the Euxine and Caſpian Seas, or in the American lakes which are near each other, could be obſerved, this phenomenon ſhould appear, and would be one of the prettieſt examples of univerſal gravitation that can