It may be immediately inferred from this table, first, that the line of contemporary tides is seldom in the exact direction of the meridian, as it is supposed to be universally in the theory of Newton and of Laplace ; except, perhaps, the line for the twenty-first hour in the Indian Ocean, which appears to extend from Socotora to the Almirantes and the Isle of Bourbon, lying nearly in the same longitude. Secondly, the southern extremity of the line advances as it passes the Cape of Good Hope, so that it turns up towards the Atlantic, which it enters obliquely, so as to ar­rive, nearly at the same moment, at the Island of Ascension, and at the Island of Martin Vaz, or of the Trinity. Thirdly, after several irregularities about the Cape Verd Islands, and in the West Indies, the line appears to run nearly east and west from St Domingo to Cape Blanco, the tides pro­ceeding due northwards ; and then, turning still more to the right, the line seems to run north-west and south-east, till at last the tide runs almost due east up the British Chan­nel and round the north of Scotland into the Northern Ocean, sending off a branch down the North Sea to meet the succeeding tide at the mouth of the Thames. Fourthly, towards Cape Horn, again, there is a good deal of irregula­rity ; the hour-lines are much compressed between South Georgia and Tierra del Fuego, perhaps on account of the shallower water about the Falkland lslands and South Shet­land. Fifthly, at the entrance of the Pacific Ocean, the tides seem to advance very rapidly to New Zealand and Easter Island ; but here it appears to be uncertain whether the line of contemporary tide should be drawn nearly north and south from the Gallapagos to Tierra del Fuego, or north-east and south-west from Easter Island to New Zea­land ; or whether both these partial directions are correct : but on each side of this line there are great irregularities, and many more observations are wanting before the pro­gress of the tide can be traced with any tolerable accuracy, among the multitudinous islands of the Pacific Ocean, where it might have been hoped that the phenomena would have been observed in their greatest simplicity, and in their most genuine form. Lastly, of the Indian Ocean the northern parts exhibit great irregularities, and among the rest they afford the singular phenomenon of one tide in the day, ob­served by Halley in the port of Tonkin, and explained by Newton in the *Principia :* the southern parts are only re­markable for having the hour-lines of contemporary tides considerably crowded between New Holland and the Cape of Good Hope, as if the seas of these parts were shallower than elsewhere.

These inferences respecting the progress of the tides are not advanced as the result of any particular theory, nor even as the only ones that might possibly be deduced from the table. Thus the supposion that the direction in which the tides advance must be perpendicular to the hour-lines of contemporary tides, is not by any means absolutely with­out exception, since a quadrangular lake, with steep shores in the direction of the meridian, would have the times of high water the same for every point of its eastern or western halves respectively, and there could be no correctly defined direction of the hour-lines in such a case. But if any por­tion of the sea could be considered as constituting such a lake, its properties would be detected by a sufficient num­ber of observations of high water ; and the existing table does not appear to indicate any such cases that require to be otherwise distinguished than as partial irregularities. There may also be some doubt respecting the propriety of the addition of twelve and a half hours that has been made to the time of high water in the north-eastern parts of the Atlantic : but it seems extremely improbable that the same tide should travel north-easterly into the English Channel and into the Northern Ocean, and at the same time wes­terly across the Atlantic, as it must be supposed to do, if it were considered as primarily originating in the neighbour­

hood of the Bay of Biscay. On the other hand, the bending of the great wave round the continents of Africa and Eu­rope seems to be very like the sort of refraction which takes place on every shelving coast with respect to the common waves, which, whatever may have been their primitive ori­gin, acquire always, as they spread, a direction more and more nearly parallel to that of the coast which they are ap­proaching : and the suppositions which have been here ad­vanced respecting the succession of the tides in different ports, allowing for the effect of a multitude of irregularities proceeding from partial causes, appear to be by far the most probable that can be immediately inferred from the table, at least in its present state of imperfection.

Sect. II.—*Of the Disturbing Forces that occasion the Tides.*

Since the phenomena of the tides, with regard to their progress through the different oceans and seas, as they exist in the actual state of the earth’s surface, appear to be too complicated to allow us to hope to reduce them to compu­tation by means of any general theory, we must, in the next place, confine our attention to the order in which the successive changes occur in any single port ; and having determined the exact magnitude of the forces that tend to change the form of the surface of the ocean at different periods, and having also examined the nature of the vibra­tory motions of which the sea, or any given portion of it, would be susceptible, in the simplest cases, after the cessa­tion of the disturbing forces, we must afterwards endeavour to combine these causes, so as to adapt the result to the successive phenomena which are observed at different times in any one port.

Theorem A. (“ E.”—Nicholson’s Journal, July 1813.) The disturbing force of a distant attractive body, urging a particle of a fluid in the direction of the surface of a sphere, varies as the sine of twice the altitude of the body.

The mean attraction exerted by the sun and moon on all the separate particles composing the earth, is exactly compensated by the centrifugal force derived from the earth’s annual revolution round the sun, and from its monthly re­volution round the common centre of gravity of the earth and moon ; but the difference of the attractions exerted at different points of the earth, must necessarily produce a dis­turbing force, depending on the angular position of the point with regard to the sun or moon, since the centrifugal force is the same for them all ; the disturbing force being con­stantly variable for any one point, and depending partly on the difference of the distance of the point from the mean distance, and partly on the difference of the direction of the luminary from its direction with respect to the centre, or, in other words, on its parallax.

In the case of a sphere covered with a fluid, it will be most convenient for computation to consider both these forces as referred to the direction of the circumference of the sphere, which will differ but little from that of the fluid ; and it will appear that both of them, when reduced to this direction, will vary as the product of the sine and cosine of the dis­tance from the diameter pointing to the luminary, that is, as half the sine of twice the altitude : for the difference of gravitation, which depends on the difference of the distance, will always vary as the sine of the distance from the bisect­ing plane perpendicular to that diameter, and will be re­duced to the direction of the surface by diminishing it in the ratio of the cosine to the radius ; and the effect of the difference of direction will be originally proportional to the sine of the distance from the diameter, and will in like man­ner be expressed, when reduced, by the product of the sine and cosine ; and each force, thus reduced, will be equal, where it is greatest, to half of its primitive magnitude, since sin. cos. 45° = 1/2. “ Thus, the gravitation towards the