

distance from the earth than the moon as to have a much less effect upon the ocean, yet it cannot be altogether unnoticed in a theory of the tides, for it acts in the same manner, though in a less degree. There are times when the sun and moon act together upon the ocean, and it is then that the waters rise the highest, and we have spring tides ; there are other times when the moon acts in opposition to the sun, and there are then neap tides. If the moon moved in the plane of the equator, the highest tides would always be under the equator, and in the polar seas there would be no tide. But as the moon moves in a path inclined several degrees to the plane of the equator, various parts of the earth's surface must come successively under its influence. At the time of new and full moon, the two luminaries co-operate in raising the waters of the ocean, and spring tides are produced ; when the moon is in her quadratures, the luminaries oppose each other, and neap tides are the result. On account of the counteracting forces produced by the difference in the motions of the two attracting bodies, there must necessarily be a great irregularity in the tides ; and to determine the period and character of these requires the application of a precise analytical reasoning. But it may be mentioned, that to the existence of this opposition of forces we may trace the origin of the circumstance, that the highest tides are always within the tropics, and the lowest within the polar circles.

There are other irregularities in the tides besides those we have already mentioned, and we may especially notice the disturbance and obstruction of the water resulting from the obstacles offered by banks and projecting masses of land. The tides in bays, gulfs, or harbours, situated on the same shore, may be very different, though, if there were no such disturbing causes, they would be equal as to the circumstances of time and height. Local situation must, therefore, be considered in estimating the height and time of high tide. The tide of the German Ocean requires some hours to make its way up the narrow channel of the Thames to London Bridge. On some of the islands of the South Sea, the tide does not ordinarily rise more than two feet ; at Annapolis, in the Bay of Fundy, it has an elevation of 120 feet ; and at St. Maloes, in Bretagne, and at Bristol, there is a difference of fifty feet between high and low water. These facts will