lique to the meridian, as stated in the beginning of this section.

For such a sea, the calculations would be somewhat com­plicated, except in the case of its being situated at or near the equator. We should then obtain, by proper reduction, for the volume of the force, putting D the sine of the du­ration, or of the angle formed by the length of the canal with the equator, and D' its cosine, the expression D sin. cos. *Decl.* cos. *Hor.* < + D' cos.2 *Decl.* sin. cos. *Hor. < ;* and the order of the phenomena would be less affected by the alteration of the situation of the canal than could easily have been supposed, without entering into the computation. This expression, when D = 0, becomes, as it ought to do, identical with the former, making l = 0. (l. l.)

the preceding theoretical part of this article is that which the late Dr Thomas Young contributed to the Supplement to the former edition of this work, nearly at the time when the concluding volume of the *Mécanique Céleste* appeared, treating on the same subject. But we presume that, on a close examination, Dr Young’s mode of investigation will be found to be of a far more elementary and intelli­gible description than that of Laplace ; and not only so, but it accords much more closely with the phenomena, with­out requiring the aid of certain very questionable assump­tions, which are indispensable in the method followed by this illustrious foreigner. Indeed, under so many different as­pects had Dr Young at one time or another studied the sub­ject, that even in his earlier writings are to be found some of the speculations on the tides, which have recently been advanced as entirely new. But in his time, as he was well aware, the real facts recorded and published were so scanty, and the rest so uncertain, that he had no proper data on which to speculate with confidence.

Considering how important it must be for the purposes of navigation and commerce that the tides should be predict­ed with some degree of certainty, it might have been ex­pected, that when once Newton had furnished a satisfactory mode of explaining in a general way the phenomena of the tides, attention would immediately have been directed, in the maritime parts of all civilized countries, to obtain if possible such an acquaintance with the actual state of the tides as might, with the aid of theory, have served for predicting them, at least approximately. So far, however, were Newton’s speculations from being immediately fol­lowed up by extensive and accurate observations in every trading port, that during a whole century which succeeded to his time, the subject had been most unaccountably ne­glected, observations having been made in but very few places, and those only during portions of that long period ; nor had any proper efforts been made to deduce from them so much as the empirical laws of the tides. Thus it was only in 1829 that the very general interest which is now taken in the subject may be said to have com­menced, with Mr Lubbock’s examination of the tide obser­vations which are regularly made and recorded at the Lon­don docks. The discussion of these he undertook with the view of obtaining correct tables for predicting the time and height of the tides for the British Almanac. When, how­ever, the principal inequality of the tides, the half-monthly or semimenstrual inequality, had been determined with suf­ficient accuracy for practical purposes, the further researches in this difficult problem could not have been so soon under­taken, but for the interest felt in the subject by some other distinguished men of science, particularly by Mr Whewell, and for the pecuniary assistance afforded by the British As­sociation.

The publication of the above-mentioned researches of Mr Lubbock in the Philosophical Transactions for 1831, drew the attention of mathematicians as well as of naviga­tors to the subject of the tides ; but it was Mr Whewell who aroused more general interest, and, assisted by the Admi­ralty, engaged the co-operation of observers in various parts of the world. The subject is well deserving the attention and assistance of every enlightened maritime and commer­cial nation ; for, to do it justice, the study of the tides ought to be pursued in the same manner as that of the other pro­vinces of astronomy ; that is, constant and careful observa­tions of the phenomena should be made, reduced, and dis­cussed, at the public expense, so as both to test the accu­racy of the tables already framed, and to supply the means of rendering them still more accurate. In this manner also any new corrections, and any changes in the elements of the old corrections, would be brought into view as soon as there were evidence of their existence. Till the problem of the tides is thus treated in a manner worthy of its scientific importance, and of the promise which it now holds forth, it must be regarded as a blot in that system of the national cultivation of astronomy, of which our public observatories afford, in other departments of that science, such effective and magnificent examples.

Mathematicians have not yet succeeded in referring the phenomena of the tides to mechanical principles by rigor­ous reasoning ; and, considering the difficulties of the sub­ject, there is reason to suppose it will be some time before this problem can be fully solved. In the mean while we have an intermediate type of comparison in the equilibrium theory of Daniel Bernoulli, as given in his treatise *Du Flux et Reflux de la Mer ;* for, by modifying the epochs and other elements which enter into the formulæ furnished by that theory, these may be made to represent in an approximate manner the laws of the phenomena.

The equilibrium theory supposes, that if the earth were a perfect sphere completely covered by water, this fluid would assume the same form at any given instant as it would do if the forces then acting upon each particle were invariable in magnitude and direction. Although our globe, being only partially covered by water, does not admit of this sys­tem accurately taking place, the distribution of the land is such as to allow a closer approximation to it in the southern hemisphere than in northern latitudes and on our coasts ; so that if we further suppose the tide-wave nearly to fol­low such a law at the Cape of Good Hope, or in some still more southern region, and that it is thence propagated northward along the Atlantic Ocean, and round our island, preserving all the while a certain proportion of the magni­tude and velocity which it had when first formed under the action of the sun and moon ; then, upon these suppositions, which are virtually those of Bernoulli, formulæ may be framed which will admit of being adjusted by comparison with observation, so as to express the variations in the time and height of high water at any given place, if the time in which the tide-wave is propagated do not vary. But although to a certain extent this equilibrium theory seems thus to suggest and express the laws of the various inequa­lities of the tides, it must not be rated above its value. It is not the true theory, but a very inaccurate and insufficient substitute for it, which we are compelled to adopt in the present imperfect state of the science of hydrodynamics. The tides are a problem of the motion, not of the equili­brium, of fluids ; and we can never fully explain the cir­cumstances of the phenomena till the problem has been solved in its genuine form. Mr Whewell however thinks it is not too much to expect that it may hereafter be rigorously shown from mechanical principles, that the form of an irre­gular fluid mass constantly dragged along by certain forces, shall at every instant resemble the form of equilibrium which the forces would produce at some anterior epoch, the anterior epoch being somewhat different for the different features of tl>e fluid form. If such a hydrodynamical pro­position could be established, almost all the facts hitherto discovered respecting the tides would be fully explained.