ence being 3/5 · 4/3 = 4/5, whence the fluent of the force is found 2*eπ* sin. cos. *φ* × 4/5 × 1/*n*, calling the density of the fluid 1/*n*, or, where it is greatest, sin. cos. *φ* being = 1/2, 4/5 *eπ*/*n*, while the attraction of the sphere itself is 4/3*π*, which is 4/5 *eπ*/*n* as 1 to 3*e*/5*n*; and since the elevation *e* expresses also the maxi­mum of the relative force of gravity depending on the tan­gent of the inclination (Theorem B), it is obvious that the disturbing attraction 3*e*/5*n* must be to the relative force *e* as 3/*n* to 5.

*Corollary* 1. If *n=* 1, as in a homogeneous fluid sphere or spheroid, the disturbing attraction becomes 3/5*e*, and this attraction, together with the primitive force *f*, must express the actual elevation *e*, or 3/5*e* + *f = e,* whence *f* = 2/5*e*, and *e* = 5/2*f*, giving 2·024 and 5∙042 for the magnitude of the solar and lunar tides, when *f* = ∙8097 and 2∙0166 respec­tively. But this is obviously far from the actual state of the problem.

*Corollary* 2. Supposing *n* = 5∙4 (see Quarterly Journal of Science, April 1820), we have 3*e*/27 + *f =e,* and e = 27/24*f* = 9/8*f*; so that the height of the primitive tides of an ocean of water, covering the whole surface of the earth, such as it actually is, ought to be ∙911 for the solar, and 2∙27 for the lunar disturbing force ; that is, supposing the sen with­out inertia, so as to accommodate itself at once to the form of equilibrium. But, in the actual state of the irregularities of the seas and continents, it is impossible to pay any re­gard to this secondary force, since the phenomena do not justify us in supposing the general form of the surface of the ocean such as to give rise to it.

Theorem D. [H.] When the horizontal surface of a liquid is elevated or depressed a little at a given point, the effect will be propagated in the manner of a wave, with a velocity equal to that of a heavy body which has fallen through a space equal to half the depth of the fluid, the form of the wave remaining similar to that of the original elevation or depression. Dr Young’s Elementary Illustra­tions of the Celestial Mechanics of Laplace, 378, p. 318.

*Scholium.* The demonstration of this theorem implies that water is incompressible, and that the pressure of each particle placed on the surface is instantaneously communi­cated through the whole depth of the fluid to the bottom. These suppositions are not indeed strictly accurate in any case, but they introduce no sensible error when the surface of the wave similarly affected is large in comparison with the depth of the fluid. A modern author of celebrity seems to have taken it for granted that the pressure is pro­pagated with the same velocity downwards and laterally ; at least, if such is not his meaning, he has been somewhat unfortunate in the choice of his expressions ; but there seems no reason whatever why water should communicate force more slowly when it is perfectly confined, than ice would do ; and the divergence of the pressure of a certain portion of the surface of water, elevated a little, for exam­ple, above the rest, may be compared to the *divergence* of a sound entering into a detached chamber by an aperture of the same size with the given surface, which is probably *small* in comparison with its direct motion, but *equally rapid,* and in both cases depending on the modulus of the elasti­city of the medium.

Theorem E. [I.] A wave of a symmetrical form, with a depression equal and similar to its elevation, striking against a solid vertical obstacle, will be reflected, so as to cause a part of the surface, at the distance of one fourth of its whole breadth, to remain at rest ; and if there be an­other opposite obstacle at twice that distance, there may be a perpetual vibration between the surfaces, the middle point having no vertical motion. Dr Young’s Natural Phi­losophy, vol. i. p. 289, 777.

*Scholium* 1. The elevation and depression of a spheroid, compared with the surface of the sphere of equal magni­tude, exhibits a symmetrical wave in the sense of the pro­position ; and it is not necessary that the shores should be very rocky or perpendicular, in order to produce a strong reflection ; for even the vibration of the water in the bot­tom of a common hemispherical basin is considerably per­manent.

*Corollary* 3. The vibrations of the water supposed to be contained in a canal, following the direction of the equator, and 90° in length, would be synchronous with the passage of a wave 180° in breadth, over any point of a canal of the same depth, and surrounding the whole globe.

*Scholium* 2. It has been usual to consider the elevation of the tides as identical with that of an oblong spheroid, measured at its vertex, and therefore as amounting to twice as much as the depression of the same spheroid at the equa­tor, considered in relation to the mean height belonging to a sphere of the same magnitude; but the supposition is by no means applicable to the case of a globe covered partially and irregularly with water, so that in almost all cases of ac­tual tides, the elevation must be considered as little if at all greater than the depression, as far as this cause only is con­cerned ; there are, however, some other reasons to expect that the elevation of the great wave might often arrive at a distant port in somewhat greater force than the depresssion.

Theorem F. [K.] The oscillations of the sea and of lakes, constituting the tides, are subject to laws exactly si­milar to those of pendulums capable of performing vibra­tions in the same time, and suspended from points which are subjected to compound regular vibrations, of which the constituent periods are completed in half a lunar and half a solar day [or in some particular cases a whole day].

Supposing the surface of the sea to remain at rest, each point of it would become alternately elevated and depressed, in comparison with the situation in which it might remain in equilibrium ; its distance from this situation varying ac­cording to the regular law of the pendulum (see Theorem B) ; and, like all minute vibrations, it will be actuated by forces indirectly dependent on, and proportional to, this distance ; so that it may be compared to a pendulous body remaining at rest in the vertical line, about which its point of suspension vibrates, and will consequently follow the motion of the temporary horizon, in the same manner as the pendulum follows the vibration of its point of suspen­sion, either with a direct or a retrograde motion, according to circumstances, which will be hereafter explained : the operation of the forces concerned being perfectly analogous, whether we consider the simple hydrostatic pressure de­pending on the elevation, or the horizontal pressure de­rived from the inclination of the surface, or the differential force immediately producing elevation and depression, de­pending on the variation of the horizontal pressure, and proportional to the curvature of the surface. It becomes therefore necessary, for the theory of the tides, to investi­gate minutely the laws of these compound and compulsory vibrations, which, together with the resistances affecting them, will be the subject of the next section.