Plate XIX

49. Concerning the ebb and flow of the ocean

I have already explained, in the Meteorology, the causes of the winds, by which the ocean is agitated in various irregular ways. But there remains another regular movement of the ocean, by which, twice a day in each place, it is raised up and driven down, and meanwhile always flows from the East toward the West. In order to explain the cause of this movement, let us visualize that small vortex of the heaven which has the earth at its center, and which is carried along in a larger vortex around the sun with the earth and the moon. Let ABCD be that small vortex; EFGH, the earth; 1234, the surface of the ocean, which, for the sake of greater clarity, we are supposing completely covers the earth; and 5678, the surface of the air encompassing the earth. Now, if there were no moon in this vortex, point T, which is the center of the earth, would be at point M, which is the center of the vortex; but when the moon is situated near B, this center T must be between M and D. Since the heavenly matter of this vortex is moved somewhat more rapidly than the moon or the earth, which it carries along with it, if point T were not somewhat more distant from B than D, the presence of the moon would impede this heavenly matter from being able to flow as freely between B and T as between T and D. And since the location of the earth in this vortex is determined only by the equality of forces of the heavenly matter flowing around it, it is evident that the earth must therefore approach D to some extent. And in the same way, when the moon is at C, the center of the earth will have to be between M and A; and thus the earth will always recede slightly from the moon. Further, in this way, not only is the space through which the heavenly matter flows between B and T made narrower by the moon at B, but so is the space through which the heavenly matter flows between T and D. It follows that this heavenly matter flows more rapidly in those spaces and therefore presses down more upon the surface of the air at 6 and 8, and upon the surface of the water at 2 and 4, than it would if the moon were not on diameter BD of the vortex. And since the bodies of air and water are fluid and easily obey this pressure, those bodies must be less deep above parts F and H of the earth than if the moon were not on diameter BD; and, on the contrary, they must be deeper at G and E, so that the surfaces of the water 1,3 and of the air 5,7 swell there.

50. Why water ascends in 6$\frac{1}{5}$ hours, and descends in 6$\frac{1}{5}$ hours.

51. Why the ocean's tides are greater when the moon is full or new.