

other, or, in other words, to those in which there exists a tendency of the *homogeneous* elementary substances to combine together.* John Philoponus, the Alexandrian, a pupil of Ammonius, the son of Hermias, who probably lived in the sixth century, was the first who ascribed the movement of the heavenly bodies to a primitive impulse, connecting with this idea that of the fall of bodies, or the tendency of all substances, whether heavy or light, to reach the ground.† The idea conceived by Copernicus, and more clearly expressed by Kepler, in his admirable work *De Stella Martis*, who even applied it to the ebb and flow of the ocean, received in 1666 and 1674 a new impulse and a more extended application through the sagacity of the ingenious Robert Hooke;‡ Newton's theory of gravitation, which followed these earlier advances, presented the grand means of converting the whole of physical astronomy into a true *mechanism of the heavens*.§

Copernicus, as we find not only from his dedication to the pope, but also from several passages in the work itself, had a tolerable knowledge of the ideas entertained by the ancients of the structure of the universe. He, however, only names in the period anterior to Hipparchus, Hicetas (or, as he always calls him, Nicetas) of Syracuse, Philolaüs the Pythagorean, the Timæus of Plato, Ecphantus, Heraclides of Pontus, and the great geometrician Apollonius of Perga. Of the two mathematicians, Aristarchus of Samos and Seleucus of Babylon, whose systems came most nearly to his own, he mentions only the first, making no reference to the second.|| It has

* See, regarding all that relates to the ideas of the ancients on attraction, gravity, and the fall of bodies, the passages collected with great industry and discrimination, by Th. Henri Martin, *Etudes sur le Timée de Platon*, 1841, t. ii., p. 272-280, and 341.

† Joh. Philoponus, *De Creatione Mundi*, lib. i., cap. 12.

‡ He subsequently relinquished the correct opinion (Brewster, *Martyrs of Science*, 1846, p. 211); but the opinion that there dwells in the central body of the planetary system—the sun—a power which governs the movements of the planets, and that this solar force decreases either as the squares of the distances or in direct ratio, was expressed by Kepler in the *Harmonices Mundi*, completed in 1618.

§ See *Cosmos*, vol. i., p. 48 and 63.

|| See op. cit., p. 177. The scattered passages to be found in the work of Copernicus, relating to the ante-Hipparchian system of the structure of the universe, are, exclusive of the dedication, the following: lib. i., cap. 5 and 10; lib. v., cap. 1 and 3 (ed. princ., 1543, p. 3, b.; 7, b.; 8, b.; 133, b.; 141 and 141, b.; 179 and 181, b.). Every where Copernicus shows a predilection for, and a very accurate acquaintance with, the views of the Pythagoreans, or, to speak less definitely, with those which were attributed to the most ancient among them. Thus