

ical observations was admissible. While the hydraulic clock of Ctesibius, an improvement on the earlier clepsydra, must have yielded more exact measurements of time, determinations in space must likewise have improved in accuracy, in consequence of the better modes of measuring angles, which the Alexandrian astronomers gradually possessed, from the period of the ancient gnomon and the scaphe to the invention of astrolabes, solstitial armils, and linear dioptrics. It was thus that man, and step by step, as it were, by the acquisition of new organs, arrived at a more exact knowledge of the movements of the planetary system. Many centuries, however, elapsed before any advance was made toward a knowledge of the absolute size, form, mass, and physical character of the heavenly bodies.

Many of the astronomers of the Alexandrian Museum were not only distinguished as geometers, but the age of the Ptolemies was, moreover, a most brilliant epoch in the prosecution of mathematical investigations. In the same century there appeared Euclid, the creator of mathematics as a science, Apollonius of Perga, and Archimedes, who visited Egypt, and was connected through Conon with the school of Alexandria. The long period of time which leads from the so-called geometrical analysis of Plato, and the three conic sections of Menaechmus,* to the age of Kepler and Tycho Brahe, Euler and Clairaut, D'Alembert and Laplace, is marked by a series of mathematical discoveries, without which the laws of the motion of the heavenly bodies and their mutual relations in the regions of space would not have been revealed to mankind. While the telescope serves as a means of penetrating space, and of bringing its remotest regions nearer to us, mathematics, by inductive reasoning, have led us onward to the remotest regions of heaven, and brought a portion of them within the range of our possession; nay, in our own times—so propitious to extension of knowledge—the application of all the elements yielded by the present condition of astronomy has even revealed to the intellectual eye a heavenly body, and assigned to it its place, orbit, and mass, before a single telescope had been directed toward it.†

* Ideler, on *Eudoxus*, s. 23.

† The planet discovered by Le Verrier.