

of Columbus) in respect to our knowledge of terrestrial space. It not only infinitely extended our insight into creation, but also, besides enriching the sphere of human ideas, raised mathematical science to a previously unattained splendor, by the exposition of new and complicated problems. Thus the increased power of the organs of perception reacts on the world of thought, to the strengthening of intellectual force, and the ennoblement of humanity. To the telescope alone we owe the discovery, in less than two and a half centuries, of thirteen new planets, of four satellite-systems (the four moons of Jupiter, eight satellites of Saturn, four, or perhaps six of Uranus, and one of Neptune), of the sun's spots and faculæ, the phases of Venus, the form and height of the lunar mountains, the wintery polar zones of Mars, the belts of Jupiter and Saturn, the rings of the latter, the interior planetary comets of short periods of revolution, together with many other phenomena which likewise escape the naked eye. While our own solar system, which so long seemed limited to six planets and one moon, has been enriched in the space of 240 years with the discoveries to which we have alluded, our knowledge regarding successive strata of the region of the fixed stars has unexpectedly been still more increased. Thousands of nebulæ, stellar swarms, and double stars, have been observed. The changing position of the double stars which revolve round one common center of gravity has proved, like the proper motion of all fixed stars, that forces of gravitation are operating in those distant regions of space, as in our own limited mutually-disturbing planetary spheres. Since Morin and Gascoigne (not indeed till twenty-five or thirty years after the invention of the telescope) combined optical arrangements with measuring instruments, we have been enabled to obtain more accurate observations of the change of position of the stars. By this means we are enabled to calculate, with the greatest precision, every change in the position of the planetary bodies, the ellipses of aberration of the fixed stars and their parallaxes, and to measure the relative distances of the double stars even when amounting to only a few tenths of a seconds-arc. The astronomical knowledge of the solar system has gradually extended to that of a system of the universe.

We know that Galileo made his discoveries of Jupiter's satellites with an instrument that magnified only seven diameters, and that he never could have used one of a higher power than thirty-two. One hundred and seventy years later,