

nebulae were examined in 1869 by Huggins and Miller, and the results indicated the presence of vapour, of water, and in addition an element which, unknown in the earth, has been determined in the sun's spectrum and termed "helium."

Next to the red stars may be grouped the so-called new and variable stars, sometimes brilliantly luminous, sometimes growing rapidly obscure or quite vanishing from observation. These probably represent bodies in a far-advanced stage of cooling, but which, owing to collision with other bodies in the universe, or to internal changes, temporarily ignite, emit eruptions of glowing gases, and perhaps in some cases also eruptions of molten rock-masses.

By mathematical calculations astronomers have determined that in addition to luminous stars, there must be completely cooled dark bodies in the vault of heaven. Thus the sidereal world exhibits all phases from the nebulous, incandescent, gaseous, and vaporous states to the cooled and solid condition.

The further history of a cooled celestial body surrounded by a firm crust is displayed in the various conditions of the planets and satellites of our solar system, and these have therefore a closer interest for geology. The planets move round the sun in slightly elliptical paths at definite distances from it. Of the six planets that were known in early astrology, Mercury is nearest the sun in position, and has itself a diameter of 648 miles; Venus (diam. 1,613 miles) follows Mercury, then the Earth (diam. 1,719 miles), then Mars (diam. 909 miles), Jupiter (diam. 19,000 miles), and Saturn (diam. 16,675 miles). Herschel in 1780 discovered on the farther side of Saturn the planet Uranus with a diameter of about 8000 miles, and Leverrier in 1846 discovered, by mathematical calculation, the outermost planet, Neptune, with four and a half times the diameter of the earth.

The paths of Mars and Jupiter are separated by a much greater distance from one another than the paths of the inner planets. Piazzi in 1801 discovered the small planet Ceres in this gap, and later there have been discovered more than 400 small planetoids or asteroids, a number which is continually being added to by new researches. The Earth has one satellite, Mars two, Jupiter five, Uranus four, Saturn eight, Neptune one. Saturn is also further distinguished by the possession of a broad ring freely suspended over the equator and separated into three parts.