

yet been discovered, carrying all the planets and comets of which it has the direction along with it, the idea of a bond of union subsisting through the illimitable extent of the material creation is thus suggested—Sun revolving round Sun, and system round system—all being under the unerring guidance of Him without whose cognizance not even a sparrow falls to the ground!

The principal planets—we give them in the order of their proximity to the Sun—are Vulcan,—if it really exists—Mercury, Venus, the Earth, Mars, Jupiter, Saturn, Uranus, and Neptune. They all approach the form of a sphere, or perfectly round globe; are all in motion, and not only pursue their journeys in their respective orbits in the same direction, but also revolve on their axes from west to east. They are all opaque or dark bodies, and shine by reflecting the light they receive from the Sun. The distinguished Astronomer, Kepler, first proved that the planets move in ellipses; he also proved that they describe equal axes in equal times. In accordance with the principles of gravitation their velocity is greatest at those parts of their orbits which lie nearest the Sun. Were the orbit of the earth a perfect circle, and the Sun in the centre, its motion would be the same at all points; but since the Sun is not in the centre of the ellipse, and as the diameter of the ellipse differs at various points of the earth, it comes much nearer the Sun at certain parts of its course than at others. Hence when it is at its perihelion or nearest point to the Sun it moves quickest, and when at its aphelion or most distant point it moves slowest. But how comes it that since its motion is so irregular it describes equal areas of space in equal times? Let us try to make this important law plain. What is meant by describing equal areas in equal times is, that on the supposition of a line being attached from the centre of the Sun to the earth which shortens as the earth neared the Sun, and lengthened as it departed from it, the amount of space which the line would travel over in a given time would be equal at all times. It is clear that at its perihelion the extent of the orbit described by the earth is much greater than at its aphelion, but the area or amount of space tra-

versed by the line is the same, for the obvious reason that the rapidity of the earth's motion when comparatively near the Sun adds the actual ground traversed by the line, just in proportion as its slower motion when at a greater distance from the Sun diminishes it. Without a diagram it is difficult to convey our meaning, but we hope we have succeeded in making it intelligible.

We have said that the velocity of the planets is in proportion to their distance from the Sun. A familiar illustration of this fact is furnished when having attached a bullet to a string we whirl it round, allowing the string to coil about the finger, in which case the rapidity of the bullet's progress is increased in proportion as it nears the center of motion. There is also a clearly ascertained connection, for the discovery of which we are also indebted to Kepler, betwixt the distances and periods of the planets. These elementary laws common to all the planets are easily expressed, but the amount of labour involved in their discovery and demonstration was incredible. For eight years did Kepler work to determine the curve in which the planets move, and it was only after nineteen hypothesis were tested with the utmost mathematical severity, and were all rejected, that the ellipse or oval figure, which when but little flattened nearly resembles a circle, was found to be the true form of the orbits. Having by the discovery of his three great laws reached the elevation on which for many years his eye was fixed, and to attain which he had brought a brilliancy of genius, in combination with a degree of energy and industry which have rendered his name famous, his enthusiasm found vent in the following words, "nothing holds me. I will indulge my sacred fury! If you forgive me I rejoice; if you are angry I can bear it. The die is cast. The book is written, to be read even now, or by posterity, I care not which. It may well wait a century for a reader, since God has waited six thousand years for an observer."

Standing on the firm astronomical platform which Kepler with so much hard work had framed, Sir Isaac Newton aspired to reach the loftiest intellectual point ever attained by man, and succeeded. The power to which the un-