

M0006377: Display board: The heliocentric revolution

Publication/Creation

12 October 1939

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THE HELIOCENTRIC REVOLUTION

Theories of the origin of the world and life depend on the current belief of the nature of the Universe. Until the sixteenth century speculation had concentrated on the earth, believed to be the centre of the Universe, and on Man, the most important living creature upon it. During the Renaissance the old system of the Universe as a series of solid concentric spheres was gradually destroyed by reasoning based on observed phenomena.

THE BREAKDOWN OF THE SCHOLASTIC SYSTEM

NICOLAUS COPERNICUS (1473-1543)

revolutionised the scholastic conception of the Universe. He demonstrated that the most reasonable, simple and coherent planetary theory was one which postulated the daily rotation of the earth on its own axis, and the motion of the planets, including the earth, round the sun; he supported this contention by an appeal mainly to reason and to the authority of certain classical authors, but also to some extent by the fact that the heliocentric theory could more easily account for the observed phenomena of the heavens.



NICOLAUS COPERNICUS
From du Radier, J.F., *L'Europe Illustrée*, Paris, 1777, vol. 5.



THE HELIOCENTRIC SYSTEM OF COPERNICUS
After Copernicus, N., *De Revolutionibus Orbium Coelestium*, Nuremberg, 1543, folio 9 verso.

EXPLANATION OF DIAGRAM

This diagram illustrates the simplest form of the Copernican theory, showing the relative positions of the planets and the duration of their revolutions.

The coloured circles represent not merely the orbits of the planets but the solid spheres wherein Copernicus believed they were set.

The sphere of the earth is shown by three lines, indicating the necessary space for the sphere of the moon.

Circular planetary motion Copernicus still thought essential because most perfect, but on his theory the sphere of the fixed stars remained motionless at the edge of the Universe, instead of revolving round a motionless earth.

TYCHO BRAHE (1546-1601)

the most accurate and systematic observer known to science, left records of his work which made possible great advances in astronomy. Finding that his observations were inconsistent with the Copernican system, he was led to adopt a modified geocentric system of his own, an apparently retrograde step; but by his century researches and his discovery of a new star he proved untenable the old belief in the planetary orbits as solid spheres, and in the immutability of the sphere of the fixed stars.



TYCHO BRAHE
Engraving from a scarce print.



THE GEOCENTRIC SYSTEM OF TYCHO BRAHE
After Brahe, T., *De Revolutionibus Stellarium Fixarum et Motibus Planetarum*, Witten, 1588, p. 189.

EXPLANATION OF DIAGRAM

This diagram illustrates the Tycho system of the Universe and its divergences from the Copernican.

The edge of the Universe is formed by the Region of the Fixed Stars (☉) and the centre by the motionless earth (⊕) which is encircled by the daily revolutions of the sun (☉) and the Fixed stars.

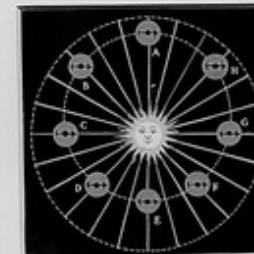
Since the remaining planets (Saturn ♄, Jupiter ♃, Mars ♂, Venus ♀ and Mercury ☿) revolve round the sun, they too necessarily share its diurnal motion round the earth. The diagram illustrates how the path of the sun cuts those of Mercury, Venus and Mars, and shows that Tycho realised the paths of the planets to be only mathematical orbits and not material substances.

JOHANN KEPLER (1571-1637)

worked out the modern theories of the motion of the planets on the basis of Tycho's observations of the heavenly bodies. After many false hypotheses Kepler found that the orbit of Mars (and afterwards of the other planets) was an ellipse and thus demolished the belief that circular motion was inevitable in the world of nature. Simultaneously he showed that the Copernican theory was more in accordance with his new facts than the geocentric system of Tycho, and henceforward the heliocentric system was not seriously disputed.



JOHANN KEPLER
Engraving by F. Mackenzie from picture in the collection of Godfrey Kilmer, Regensburg.



THE ORBIT OF A PLANET
After Kepler, J., *Epitome Astronomiae Copernicanae*, Linz, 1630, Frankfurt, 1622, p. 226.

EXPLANATION OF DIAGRAM

This diagram illustrates the orbit of a planet and Kepler's theory of the action of the sun upon it.

The sun, rotating on its own axis, sends out lines of force (→) which push the planet round from behind from A to B to C etc. following the sun's rotation. The planet acts as a magnet whose axis (↔) remains constant in space, one pole (→) being attracted by the sun, and the other (←) repelled.

As the planet moves it is attracted to the sun by the pole (→) until it reaches E, when the other pole (←) begins to be affected & the planet is pushed correspondingly further away until it reaches A. The resulting orbit is an ellipse with the sun in one focus. Although his explanation of the planetary motion was false, Kepler's laws regarding them were the basis of Newton's Gravitational Theory.

THE COSMOGONY OF RENE DESCARTES

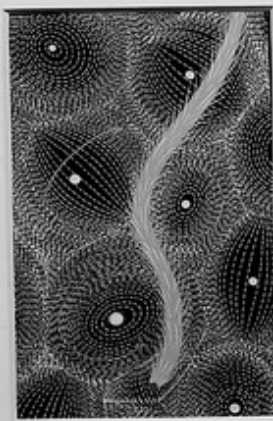
EXPLANATION OF DIAGRAM

This diagram forms a cross-section of part of the Universe as conceived of by Descartes. Each self-contained system of particles represents a Vortex revolving each in a different direction as is indicated on the diagram.

☉ The Sun, the centre of a Vortex. Stars, six of which are represented here, although in all there are as many vortices as there are stars in the sky.

These centres consist of First Matter which congregates there and being fine and volatile gives out Light.

• A star which has become crushed by particles of Third Matter, and whose motion is thereby retarded may either be swept along by the Vortex of the sun, forming a planet such as the earth, or may become a comet (☄) pursuing a path from one Vortex to the other.



DESCARTES' SYSTEM OF VORTICES
After Descartes, R., *Principes Philosophiques*, Amsterdam, 1644, p. 106.



RENE DESCARTES. Engraving by W. Kent from picture by Hans Holbein the Younger.

DESCARTES (1596-1650)

tried to provide a philosophic account of the origin of the world and life which should satisfy both the Copernicans and the orthodox scholastics. He took as the principles of the Universe EXTENSION, with which he identified Matter, & MOTION introduced by God. From these two principles the world evolved by mechanical means. Motion caused Matter to revolve in circular eddies, and to assume three forms—

- FIRST MATTER: the minute volatile particles rubbed off the original bodies by friction.
- SECOND MATTER: the smooth rounded bodies remaining.
- THIRD MATTER: the solid angular bodies too hard to lose anything by friction.

The earth was once a star which was overtaken by the Vortex of the Sun, and now revolves round it, though remaining at rest the centre of its own Vortex. Descartes intended to complete his work with an account of LIFE, vegetable, animal and human, and its origin, but never did so. His theories of sensation are entirely mechanistic, and suggest that he would have accounted for the origin of Life in a similar way.



THE FORMATION OF THE EARTH
After Descartes, R., *Principes Philosophiques*, Amsterdam, 1644, p. 106.

EXPLANATION OF DIAGRAM

These diagrams illustrate the formation of the earth after its change from a star into a planet.

- ☉ Fiery mass made of First Matter like the Sun.
- ☉ The first crust similar to sun-spots.
- ☉ A thick crust.
- ☉ Water.
- ☉ The surface of the earth.
- ☉ Air.

At first the various layers formed continuous spheres round the fiery centre, as in the upper diagram.

Later owing to the heat of the sun and other causes (☄) cracked in various places and collapsed upon the air and water beneath it.

The resulting confusion has formed the present world, with its mountains, seas and plains, as in the lower diagram.