

**B.A. PART - 1 ( PHYSICAL GEOGRAPHY : PAPER - 1 )**

**TOPIC : NEBULAR THEORY OF ORIGIN OF SOLAR SYSTEM**

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**Nebular Hypothesis of Laplace:**

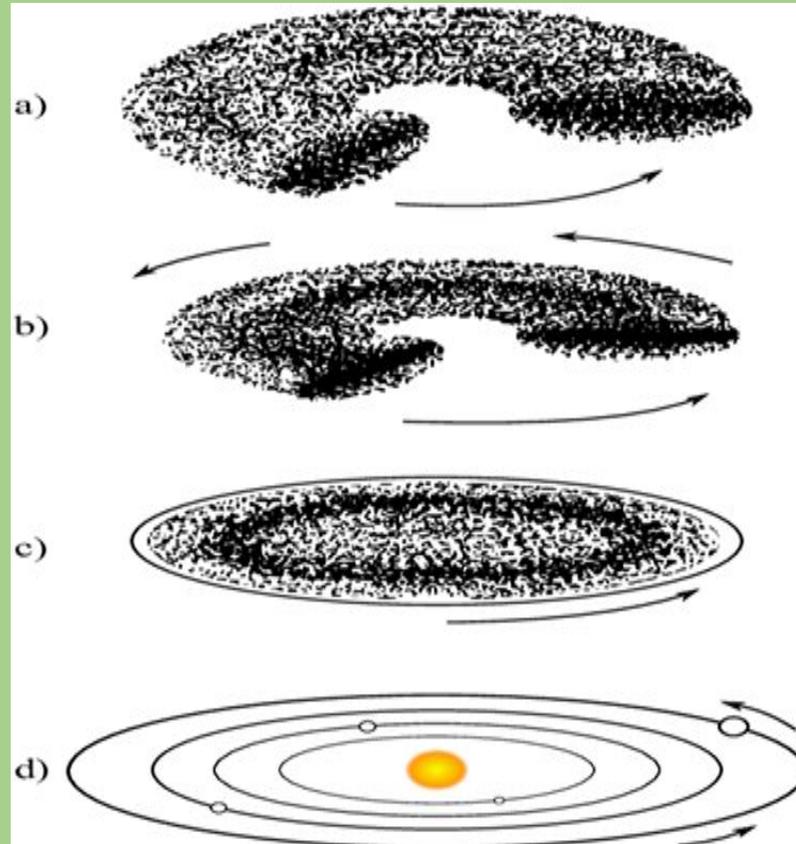
French mathematician Laplace propounded his 'nebular hypothesis' in the year 1796. He elaborated his concepts about the origin of the solar system and the earth in his book entitled 'Exposition of the World System'. Laplace's nebular hypothesis was in some way similar to the gaseous hypothesis of Kant.

It appears that Laplace's hypothesis is just the modified version of Kant's hypothesis. It may be pointed out that Laplace propounded his hypothesis without mathematical formulation.

**In order to remove the aforesaid defects Laplace assumed certain axioms for the postulation of his nebular hypothesis to solve the riddle of the origin of the earth:**

- (1) He assumed that there was a huge and hot gaseous nebula in the space. Thus, he solved the problem of heat of the nebula through this assumption.
- (2) From the very beginning huge and hot nebula was rotating (spinning) on its axis.

(3) The nebula was continuously cooling due to loss of heat from its outer surface through the process of radiation and thus it was continuously reducing in size due to contraction on cooling.



Based on aforesaid assumptions Laplace maintained that there was a hot and rotating huge gaseous nebula in the space. There was gradual loss of heat from the outer surface of the nebula through radiation due to circular motion or rotation of the nebula. Thus, gradual loss of heat resulted into the cooling of the outer surface of the nebula. Gradual cooling caused gradual contraction in the size of the nebula.

These processes e.g. gradual cooling and contraction, resulted in to continuous decrease in the size and volume of the nebula. Thus, reduction in the size and volume of the nebula increased the circular velocity (rotatory motion) of the nebula. As the size of the nebula continued to

decrease, the velocity of rotatory motion continued to increase. Thus, the nebula started spinning at very fast speed and consequently the centrifugal force became so great that it exceeded the centripetal force.

When this stage was reached the materials at the equator of the nebula became weightless. Consequently, the outer layer was condensed due to excessive cooling and so it could not rotate with the still cooling and contracting central nucleus of the nebula and thus the outer ring (layer) was separated from the remaining part of the nebula.

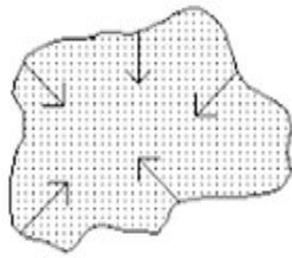
This separated ring of material started moving around the nebula. It is to be remembered that according to Laplace only one ring of material was separated from the nebula and not nine rings as conceived by Immanuel Kant. Laplace further maintained that the original ring was divided into nine rings and each ring moved away from the other ring.

All the materials of each ring condensed at a point or knot in the form of 'hot gaseous agglomeration'. Each such agglomeration was later on cooled and condensed to form planet. Thus, nine planets were formed from nine rings and the remaining central nucleus of the nebula became the sun. Satellites were formed from the planets due to repetition of the aforesaid processes and mechanism.

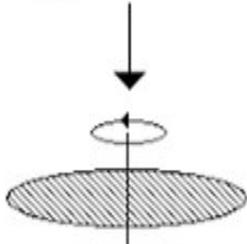
This simple hypothesis offered an explanation of the facts that (with a few exceptions among the satellites) each celestial body possesses acquired motions of rotation and evolution in one and the same sense, and that the several planetary orbits are nearly in the same plane'.

French scientist Roche suggested modification in the nebular hypothesis of Laplace during mid-19th century. He opined that nine rings were separated from the nebula itself and these rings were condensed to form nine planets.

## Nebular Hypothesis

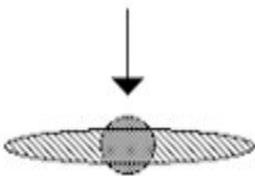


self-gravity contracts a gas cloud



conservation of angular momentum  
pulls cloud into a disk

disk begins to rotate



central mass forms (proto-Sun)

centrifugal force balances gravitational  
forces and a ring forms



ring forms into a planet

**\*However, the nebular hypothesis is rendered untenable on the basis of the following demerits:**

(1) Laplace assumed that initially there was a hot and rotating nebula but he did not describe the source of the origin of the nebula. Where did heat and motion in that nebula come from? He did not offer any explanation.

(2) What was the reason behind the formation of certain fixed number of planets from the irregular ring? Why did only 9 rings come out from the irregular ring detached from the nebula? Why not more or less rings? He could not explain the formation of fixed number of planets (9). It is quite

unreasonable to imagine the situation that all matter of one ring could condense into one incandescent gaseous mass to form one planet. According to dynamical theory the ring may break up into several parts and thus several planets may be formed due to condensation of small parts.

(3) 'The small degree of cohesion between the particles of the nebula would make the formation of rings a continuous not an intermittent process, as the theory requires'.

(4) If the sun is the remaining nucleus of the nebula as claimed by Laplace, it should have a small bulge around its middle part (equator) which would point out the probable separation of irregular ring from the sun but there is no such bulge in the middle part of the sun.

(5) If we accept the tenet of Laplace that the planets were formed from the nebula, then the planets must have been in liquid state in their initial stage. But the planets in liquid state cannot rotate and revolve around the sun properly because the rotatory motion of different layers of the liquid is not always equal. Only the solid mass of matter has the property to perform rotatory and revolutionary motions along a near circular path without losing its original shape.

(6) According to the nebular hypothesis all the satellites should revolve in the direction of their lather- planets but contrary to this a few satellites of Saturn and Jupiter revolve in the opposite direction of their father planets.

(7) About one hundred years later from the date of the postulation of Laplace hypothesis great British physicists James Clerk Maxwell and Sir James Jeans showed that the mass in the rings was not enough to provide gravitational attraction for condensation to form individual planets.

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