

# EVOLUTION OF THE EARTH AND OCCURRENCE OF EARTHQUAKES

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## ABSTRACT

This paper attempts to study the evolution of the Solar System including the earth through various existing hypotheses and the occurrence of earthquakes on the earth. From the analysis of the various theories it can be inferred that the Mystery regarding evolution of Solar System is a complex problem which requires continuous research. The

occurrence of the earthquake is also affected by the earth's rotation, which produces Centrifugal Force, which together with convection current causes plate displacement resulting in earthquakes. The extent of displacement varies with the size and density of the plates.

**Key Words:** Brahamand, Earth, Earthquake, Parmeshwar, Planets, Plates, Puran,

## EVOLUTION OF THE SOLAR SYSTEM AND THE EARTH

The evolution of the solar system and the earth is an intriguing and unresolved mystery. Man has continuously struggled to unravel the hidden facts about the universe and its various facets. In ancient times when man did not have sophisticated techniques and tools his thoughts about the solar system and the earth were purely imaginative. He deduced what he observed from the naked eyes. The Greeks and the Romans considered earth to be in the center of the Universe with other celestial bodies including the sun revolving around it. This was the geocentric concept of the solar system. An important feature of the ancient cosmogony was the people's belief in creation of the universe and earth through a super natural force or creator. This can be described as the religious concept of the origin of the universe. The finest example of the origin of the universe by a super natural power can be discerned from the ancient religious texts of Vedas and Puranas from India. According to these religious texts the creation of this universe or Brahamand is Parmeshwar or God who with the help of Vishwakarma, a highly intellectual person created this universe.

These ancient views expressed during different periods become more scientific from 16th century onwards. The enunciation of different physical laws by scholars like Kepler, Newton etc. led to proposition of many new theories and hypothesis regarding the origin of universe. These can be broadly classified into Hot Origin

concepts and Cold Origin concepts. According to Hot Origin concept our solar system and the earth is believed to have formed from matter, which was initially very hot. The cold concept of the origin of the universe including our earth believe that the Universe was formed from matter which was either initially cold or remained cold throughout. These theories are further subdivided into Monistic, Dualistic and Binary Star concepts. The important theories to explain the origin of the Universe and the Earth include Kant's Gaseous Hypothesis. According to this hypothesis the sun and other planets originated from primordial matter, which was initially cold and stable. This primordial matter later became hot rotating Nebula from which rings got separated to form planets and left over mass became the sun. Laplace's Nebular Hypothesis suggests that initially there was a hot rotating nebula in the space, which began to cool and contract in size, its speed of rotation increased. The outer layer of the Nebula separated out as a ring and started moving around the Nebula. Nine rings then separated from the initial ring and formed the nine planets and central nebula the sun. The planetesimal Hypothesis of Chamberlain suggests that there were initially two heavenly bodies, Proto Sun and a Companion Star. The gravitational force exerted by the Companion Star detached infinite small particles from the outer surface of the Proto Sun called Planetesimals. These planetesimals formed Planets and the remaining Proto Sun became the present day sun. According to the new hypothesis the solar system developed in an orderly stages beginning with primeval cloud of gas and dust- the solar nebula, which contracted to a rotating disk like body with the sun occupying a central position. This concept is known as

condensation hypothesis of planetary formation. The different theories and hypothesis stated above show that there no one theory which can completely reveal the exact cause of the origin of the Universe and our Earth. The complexities present in the Universe are bound to renew them further with the inception of new facts.

## OCCURRENCE OF EARTHQUAKES

Geologically our earth is extremely dynamic in nature characterized by continual changes taking place within as well as over the surface. These changes are the result of the internal and external forces that are acting upon the earth. The internal forces are responsible for the occurrence to important phenomenon earthquakes and Volcanism. More than one million earthquakes are recorded by worldwide network of seismic stations and are analyzed with the aid of computers. However not all are felt by us and only a few having high intensity and relatively shallow depth are felt. Earthquakes because of their unique nature, restricted occurrence in a few regions and no indication of where and when they would occur have always kept mankind at bay. Its prediction still remains a speculation among scientists' even today when, with significant advances in science other natural phenomenon are easily predicted. According to W.K.Hamblin and E.H.Christiansen "Earthquakes are vibrations of earth caused by the rupture and sudden movement of rocks that have been strained beyond their elastic limits. According to A.N.Strahler and A.H.Strahler (1976)" An earthquake is a vibration or oscillation of the surface of the earth caused by a transient disturbance of the elastic or gravitational equilibrium of the rocks at or beneath the surface. From these definitions an earthquake is a tremor caused on the earth as a result of displacement of rocks within the earth's crust. These tremors travel in form of a series of waves analogous to the waves found in the lakes or ponds. The point within the earth surface from where the waves first originate is the Focus and the point lying perpendicular to the focus on the surface of the earth where the waves are first felt is the epicenter. The intensity of the shocks progressively weakens as the waves travel outwards from the focus and move away from the epicenter. Hence the epicenter and the region surrounding it is the most severely affected region by an earthquake.

The most plausible explanation of where they occur is provided by the plate tectonics theory. According to it the earthquakes are more susceptible in the zones of weakness. Such zones are found along plate margins. There are seven major plates and several minor plates on the earth. These are the margins along which Lithospheric plates move with respect to each other. There are three kinds of plates (a) Convergent Plates (b) Divergent Plates and (c) Conservative Plates. Convergent plates are the ones, which collide with each

other. On the earth the widest spread and intense earthquake activity occurs along subduction zones at the convergent plate boundaries. Divergent plate boundaries are those along which plates move away from each other. These are the zones of shallow focus earthquakes. Conservative plate boundaries are those along which plates move horizontally and parallel to each other the sites of transform faults where shallow focus earthquakes occur. Here the earthquakes occur within the margins of active faults. Seismic activity also takes place due to intra-plate movement i.e. where movement within a plate occurs.

There is a multiplicity of causes responsible for the occurrence of earthquakes. These can be broadly classified into (a) Major causes and (b) Minor causes. Collapses of underground cavities, sliding and slumping, Meteorite impact etc. are minor causes. In mid 19th Century a number of writers attributed earthquakes to collapse of underground cavities. The instance of a possible collapse earthquake is a small shock in Thuringia (Germany) in 1926. It caused minor damage at the town of Stadtrota and was felt to a distance of 40 kms. Galtizin attributed the 1911 earthquake at Pamir Plateau in Asia to sliding. Slumping on an enormous scale incidental to subsidence is yet another minor cause of an earthquake The 1933 Terminal Island California earthquake in Long Beach is considered to have occurred due to slumping. An interesting factor responsible for earthquake tremor is the impact of falling meteorite. There is only one recorded instance of earthquake due to Meteorite impact. It occurred on June 30, 1908 in Siberia. The Russians have called the Meteorite- Podkamennaya Tunguska (Stony Tunguska). Crustal fracturing caused due to tectonic forces is the major causes of seismicity on the earth. It goes to the credit of H.F. Reid for the precise theoretical formulation of fault displacement as cause. His theory called the Elastic Rebound Theory presently explains all the major earthquakes based on active faults.

## DISCUSSION

Tectonic Movements causing displacement along various plate margins are the most important cause for occurrence of earthquakes. A close observation of the regions of the proactive seismic activity shows that earthquakes occur more on the Intra plate zones. The recent Bhuj earthquake of 2001 bears a testimony to this fact. From the elastic rebound theory, when excessive stress accumulates within the rocks beyond their elastic limit it results in development of shears and strains which causes displacement of rocks. The various plates composed both of continental crust and oceanic crust varies in density within as well as between them. The energy that accumulates within the rocks of the plates near plate margins gets accumulated from the internal activity. The varying density of rocks at different locations on the same plate provides numerous

zones of weakness. In the process of accumulation of energy when it exceeds the limit of rocks of these weak zones secondary ruptures can get created causing intra plate movement or displacement thereby causing earthquakes of varying intensities. So far the plate motion has been considered to be independent of earth's rotation. The main driving force held responsible for plate movement is the convection currents that arise from beneath the surface of the earth. However plate movement is also affected by earth's rotation. The earth's rotation produces a centrifugal force, which is responsible for equilibrium as well as disequilibrium in the earth surface. Whenever the centrifugal force causes disequilibrium, it together with the conventional currents within the earth results in excessive movement along the plate boundaries. The movement varies with the density, thickness, shape and size of the plate. This excessive displacement results in the occurrence of earthquakes.

## RESULTS AND CONCLUSIONS

From the above discussion we can make the conclusions. The evolution of the solar System is a complex phenomenon that cannot be explained by a single theory. Continuous research will help us to better understand the mechanism. Regarding earthquakes the centrifugal force produced by earth's rotation plays an important role in causing plate displacement. This rotation of the earth from West to east creates a force within the interior of the earth. This force tries to exert itself outward in the form of energy. As this force becomes powerful the weaker zone of the earth experience an Earthquake. There is also difference in the earthquake shock absorbing capacity of different rocks due to difference in density. Softer rocks experience seismic activity more easily than the harder rocks.

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