# ADVANCED LEVEL

# PHYSICAL GEOGRAPH

## CHAPTER ONE

## ORIGIN OF THE SOLAR SYSTEM AND THE UNIVERSE

### THE SOLAR SYSTEM

The solar system consists of the sun and its nine planets. The planets revolve around the sun in elliptical orbits where the light of the sun falls on each of the planets and the planets reflect this light. The planets do not produce lights of their own.

All the energy of the solar system is derived from the sun.

Mercury, the smallest planet is nearest to the sun; Pluto is smaller than the earth and is the furthest away from the sun. Some of the planets, like Earth, Jupiter and Saturn have smaller celestial bodies called satellites in orbit around them. The moon is a satellite of the earth and the illuminated part of the moon appears to vary in size as it revolves around the earth.

The sky at night often appears to be full of stars each of which seems to be no bigger than the earth. It comes as a surprise to learn that every star is much bigger than the earth; indeed some are several million times bigger.

Stars tend to make clusters which are known as galaxies and galaxies form groups our local group, that in which the earth is located contains 27 galaxies. Out of the sun, earth, moon arid stars other elements of the solar system include comets, meteors, asteroids and inter- planetary dust and gases.

### THE EARTH

This is a planet in which life exists. It is one of the nine planets in the solar system and it is the third in the chronological arrangement of the planets.

### ORIGIN OF THE EARTH

Scientists have discussed the origin of the earth and have come out with various theories but none of them satisfy the requirements. The way the earth came into existence is therefore still the matter of debate among the scientists. The theories or hypotheses which have been advanced to explain how the earth has came into existence may be grouped into two broad categories.

a) Encounter hypotheses (theories).
b) Nebular hypotheses (theories).

### A. Encounter hypothesis.

This was firstly suggested by a French scientist called Count Buffon in 1749 who suggested that there was a great encounter (collision) in the heaven between some heavenly bodies. It appears that nearly 5 billion years ago some heavenly objects collided with the sun and broke away into

several elements of the solar system including planets, stars and the moons. Encounter hypothesis was supported by Planetesimal theory.

By 1895 Chambelin and Moulton American scientists brought up slight changes in Buffon's theory. According to these scientists the planets are thought to have evolved from the collision between the sun and another star and not a comet. This collision caused a great quantity of gas from the sun to shrink into cold solid masses called ***planetesimal*** which further grew together by collisions to form the planets and the moons.

**(ii) Tidal theory.**

By 1917 two English men, Jean and Jeffery emphasized on collision but the collision was between the moon and another star. This encounter was so close that gravitational attraction caused a great tidal bulge in the sun. This bulge split up to form the planets.

**Criticisms of encounter hypothesis.**

1. The close meeting of two stars is extremely unlikely.
2. If there was such an encounter the stars and planets could be more close to the sun than they are now.
3. It fails to explain why the sun rotates slowly.
4. It fails to give clear explanations to account for the moons of the planets.

**B. Nebular hypothesis.**

This was suggested by a German scientist called Kant in the year 1855. The entire Nebular hypotheses begin with the sun not yet in existence. It states that "a huge cloud of gas greater than the entire solar system was rotating slowly in the space. This body of cloud had a denser core that revolved about a common axis. After millions of years this great cloud or ***Nebular*** as he named it, contracted, becoming more denser and finally assumed a shape. All the particles of this body obeyed the universal law of gravity. Its rotation generated a certain centrifugal force directed away from the axis of rotation, thus making two opposing forces.

When its speed increased centrifugal forces became more stronger than the force of attraction (gravity) forcing the Nebular unfold its arms and throw off nine rings one inside the other. Meanwhile the clouds at the center shrunk greatly resulting into firely burning hot gas which becomes the star we call the ***"sun".*** The other nine rings split open and shrunk causing them to become the core of various planets and the moons, earth inclusive.

Nebular hypothesis was supported by: Protoplanet theory.

By the year 1914 Von Weizsacher a. Germany astronomist came out with ***protoplanet*** theory to support Nebular hypothesis. He also began with the great spinning disk of cloud of gas and dust where, about five billion years ago the cloud begun to shrink and condense under its own gravity into solid material. Due to gravitational force generated, some matters gathered at the centre. The

huge amount of convergent pressure made temperature to rise until when it became hot enough to form the ***sun.***

Some matters in the cloud formed a single disk around the sun and rotate slowly with the sun. Friction within the disk caused collection of materials which compacted to form protoplanets, which later split into ***planets*** and the ***moons.*** Uncollected materials came to form ***comets, meteors and planetoids.*** As the earth begun to form, heavier materials like iron and nickel sunk to the centre and form ***core,*** the lighter materials like silicate remained on the outside and formed ***mantle*** while the lightest substances formed the ***crust.*** However gases were attracted to the mass and remained as an external envelope that constituted ***atmosphere.*** This is the most accepted theory of the origin of the universe as it tries to account for the other elements of the solar system.

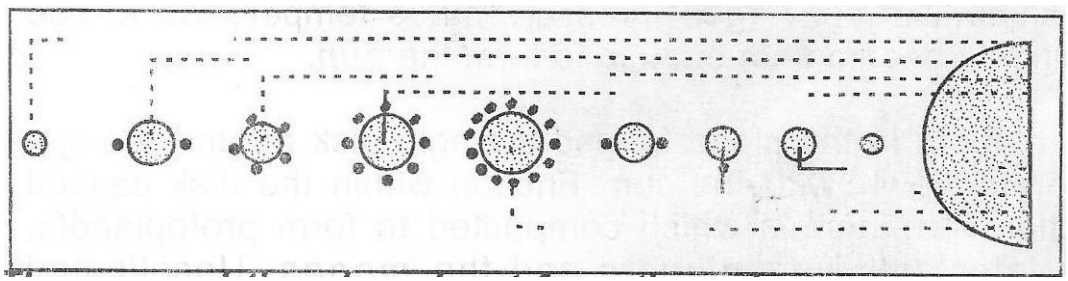
**The Big Bang Theory**

This theory was advanced by two prominent scientists Lamaitre George and Hubble Edwin in 1927. Lamaitre George was a Belgian astronomist while Hubble George was an American scientist. According to them in the very beginning there was totally nothing. In about 15 billion years ago however an explosion occurred and speck of matter was produced. This explosion is what was named ***Big bang.***

From this explosion the speck of matter generated started to expand and therefore producing the earth and all that is in it including atmosphere, lithosphere, hydrosphere and biosphere. But the wonderful thing is how could nothing produce something?

**The Biblical Theory**

This is the most commonly known and ordinarily accepted theory particularly among the Christians. This theory is generated from the Bible in the book of Genesis chapter one. According to the theory there was totally nothing, it is the power of God which created the earth ad everything in it. There was total darkness and God ordered1ighto appear and it appeared. Other things also followed God's command for six days of creation and on the 6th day God finished his job. On the $7^{th}$ day God had finished his job of creating the earth and therefore rested. It is this day we call Sabbath.



***The sun and the nine planet prom tile solar system***

**THE SHAPE OF THE EARTH**

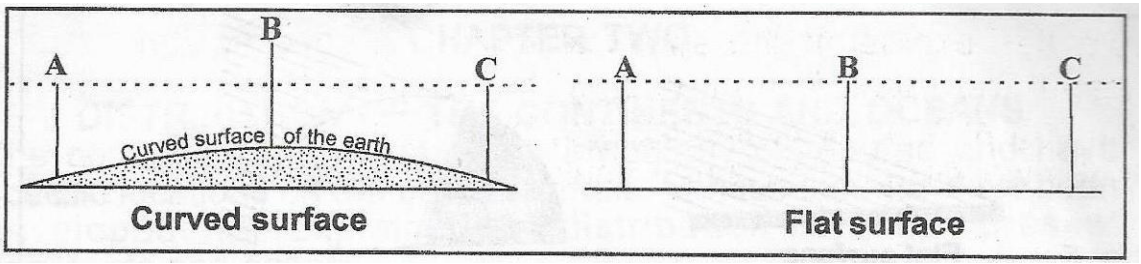
At one time the earth was thought to be flat just like a table. But later on Galileo Gahlaya came to prove that the earth is not flat, it is round but almost sphere. The sphericity of the earth is called ***geoid*** or ***spheroid.***

**Evidences to show the sphericity of the earth**

There are some theories that tries to explain that the earth is sphere:

**1. Ranging poles**

It has been observed by surveyors that when they tried to insert three ranging poles in the ground of the same height in the distance of about one kilometer one apart another in a straight line they found that, the middle one stands above the other two poles. Thus, this proves the sphericty of the earth.

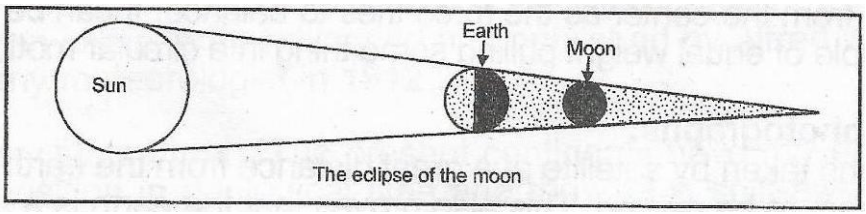



**2. Circumnavigation**

The earth has been circumnavigation may the times by land, sea and air. The first voyage around the earth was made by Magellan and his crew between 1519 and 1522. When navigators sail in the sea or ocean, it has been proved that if they travel from one part following the same latitude they always come to back at the same points (initial point).

**3. Lunar eclipse:**

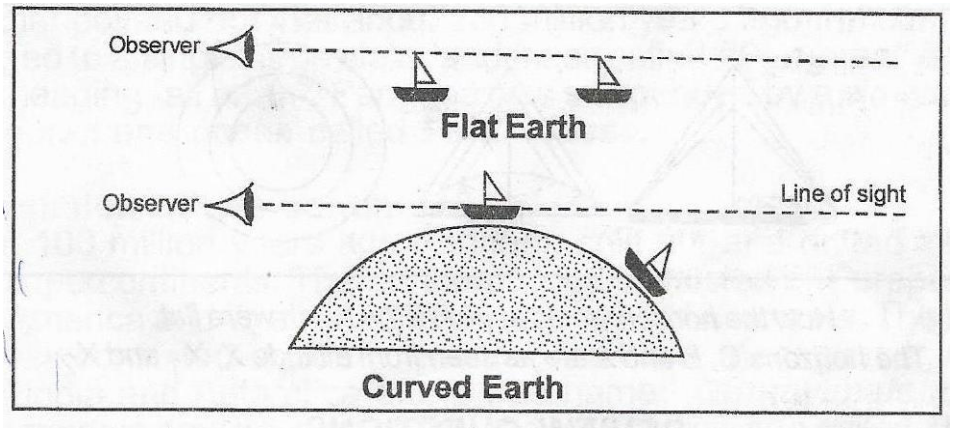
During the moon eclipse the shadow of the earth is seen in the moon as a semicircle showing that the earth is round.




**4. Ship's visibility:**

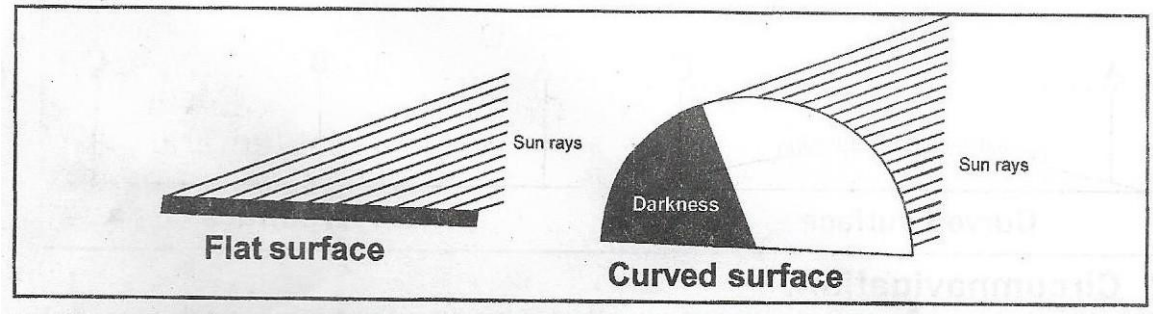
When a ship is coming along the coast, the smoke will be seen first followed by the chimney, and then the ship itself appears at last. On the other hand where two ships are coming along the

coast the observer will be able to see only one of them, but if the earth were flat he would see both ships.




**5. Sun rise and sun set:**

The earth rotates from west to east, which means that places in the east sees the sun before the west. If the earth was flat the sun would be seen at the same time all over the earth's surface and the sun rise and sun set would be the same in all places.




**6. Observation of polar stars:**

When someone is at the equator using a microscope observing the polar stars, they are seen to be very low near the Earth's crust. But as he goes towards them they seem to be located about and about. And at the polar region they are seen above in a straight line.

**7. Measuring weight using a spring balance:**

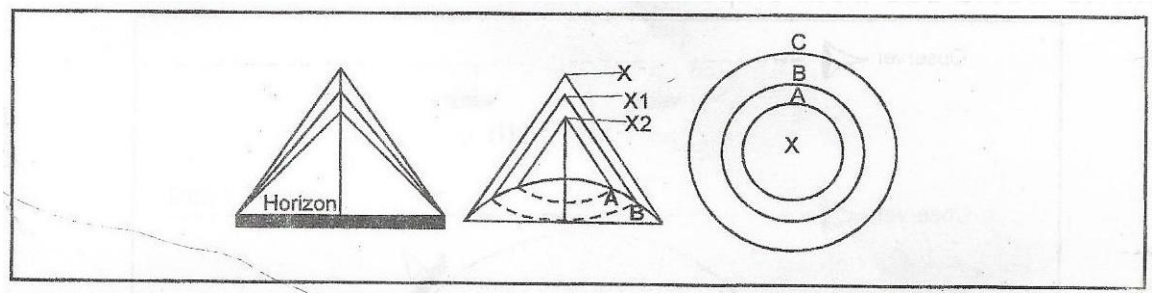
This means that the weight of something at the Equator changes a little bit at the poles since weight depends on gravitational pull. It is as if people are pulling from the center as the force tries to balance. It can be related as the people of equal weight pulling something in a circular motion.

**8. Aerial photographs:**

Photographs taken by satellite at a great distance from the earth's surface seem to be curved. This also proves that the earth is a sphere.

**9. The earth curved horizon**

The earth horizon when seen from a ship, a plane or a high appears curved. The curved horizon widens as the observers altitude increases until it becomes circular, If the earth were not spherical there would be no circular horizon.




***How the horizon would appear if the Earth were flat.***

***The horizons C, B and A are as seen from altitude X, $X_1$ and $X_2$***

**REVIEW QUESTIONS**

1. Discuss the origin of the universe.

2. The way the earth came into existence has been and is still a matter of debate among scientists. Discuss.

6. (a) Why is earth not exactly a spheroid?

   (b) Provide evidence of the earth's sphericity.

3. Discuss the controversy on the origin of the universe.