MAP PROJECTIONS WITH SPECIAL REFERENCE TO ZENITHAL GROUP

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INTRODUCTION

- When we compare Geography with other disciplines, again we are little bit handicapped.
- Many disciplines have some subject matter and content to deal with e.g. Botanists deal with plants, zoologists deal with animals etc.
- Geographers are to deal with 'The EARTH'.
- To study earth Geographers have two options:-
  - To prepare a Globe
  - To prepare a Map.

Globe is a true replica of earth on which Geometric relationships are maintained but it has some drawbacks like-

- (a) It is not easy to handle (b) Difficult to store (c) Not easy portable
- (d) All countries are not visible at a glance, because we see only one half of the Globe at a time
- (e) Difficult to measure distances on a globe due to spherical nature of its surface.
- (f) Also expensive and difficult to reproduce it.
- (g) Even if a globe is split into various parts, it will not be convenient to canny and use them.

The Second option is to prepare maps because:-

- Easy to carry and handle.
- Easy to make measurements
- Easy to reproduce
- Also easy to use map as a tool in teaching.

- So, although Globe is a true replica of earth, it is 3-d where as, map is 2-D and more suitable option for teaching.
- Some problems are there when 3-D globle is transformed into 2-D map.
- This problem arises from one fundamental geometric truth i.e. the 3-d figure is not possible to transform on 2-D figure until modification are made in the geometric relationships.
- When we do this some geometric relationships are modified and other remains the same.

MAP PROJECTION

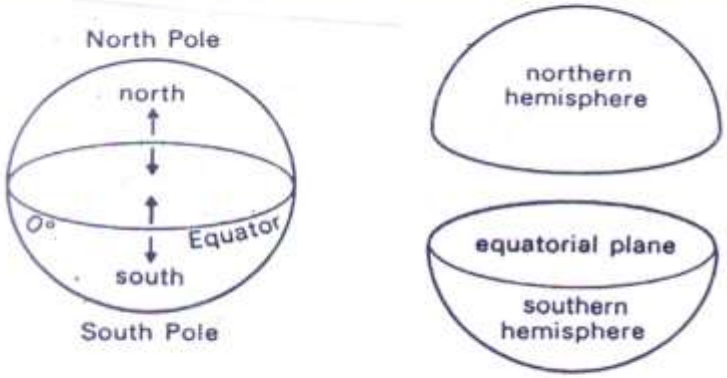
- Map Projection is transforming of Homologous points from a globe on a flat surface or it is a method of representing the parallels and the meridians of the earth on a plane surface or Map Projection is systematic drawing of parallels of latitudes and meridians of longitudes on a that surface.

LATITUDE AND LINES OF LATITUDES

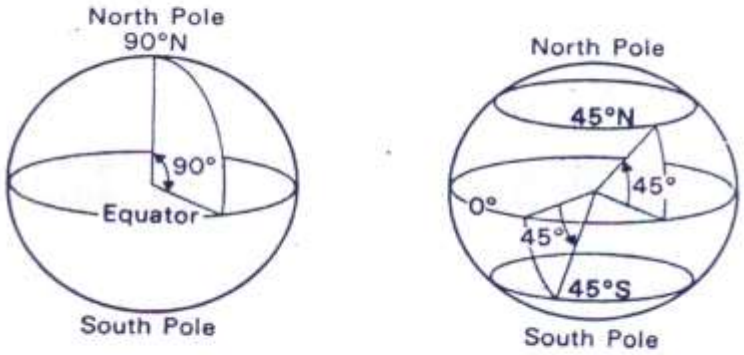
- “Latitude is the angular distance of a place north or south from the equator plane.” If we join all the places having equal angular distance north or south form equator plane with a line, then it is called line of latitude .

LATITUDE AND LINES OF LATITUDES

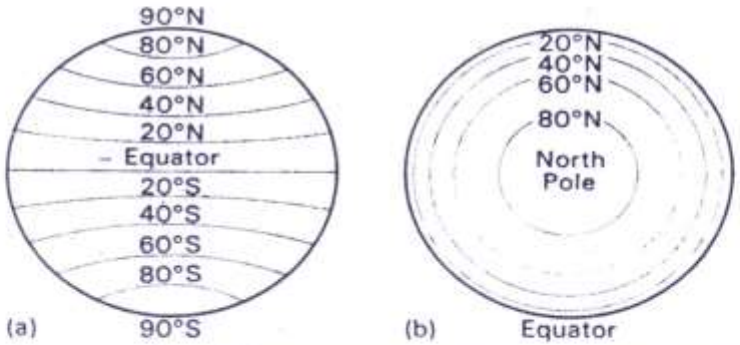
Fig. No. 1



The poles, the equator and the two hemispheres.



A line of latitude gives the angular distance of a place north or south from the equator.



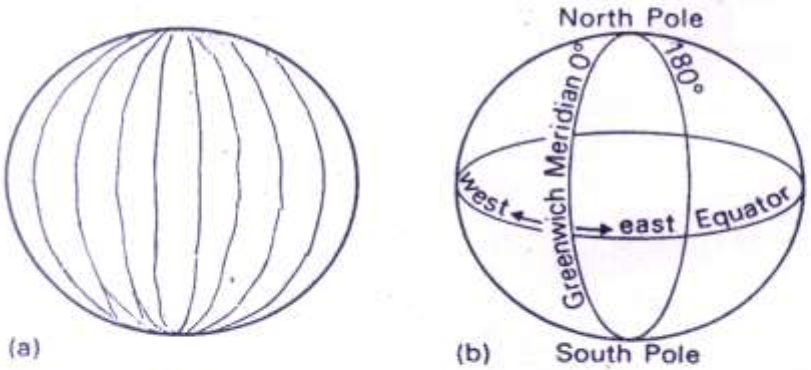
Parallels of latitude on a globe (a) from the side and (b) from the North Pole.

LONGITUDE AND LINES OF LONGITUDES

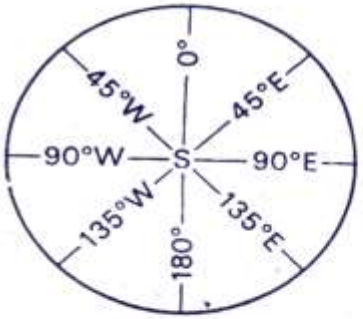
- “Longitude is the angular distance of a place east or west from the Greenwich Meridian.” If we join all the places having same angular distance east or east from the Greenwich meridian with a line meeting at poles, it will give us that degree line of longitude.

LONGTITUDE AND LINES OF LONGITUDES

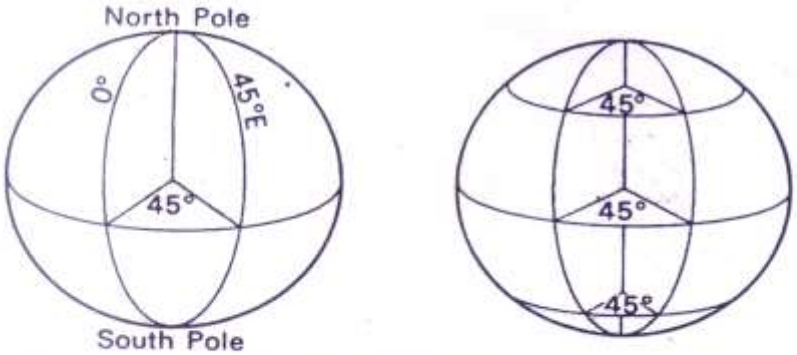
Fig. No. 2



(a) Lines of longitude; (b) the Greenwich Meridian.



Lines of longitude from above the South Pole.



A line of longitude gives the angular distance of a place east or west of Greenwich.

ZENITHAL PROJECTIONS

- The types of map projection in which a portion of the globe is projected upon a plane tangent to it; it may thus be regarded as a special case of the conical projection, in which the cone is so flattened that it finally becomes a plane.
- On this projection all points have their true compass directions from the center of the map. The tangent plane on which the projection is made is not always tangent at the pole; in fact it is usually tangential at some other point, which is to be the centre of the map.
- The word ‘zenithal’ is derived from ‘zenith’ means that point in the heaven’s i.e. the celestial sphere, which is vertically bared on the observer. There are two types of zenithal projections based on the mode of their development :-

TYPES OF ZENITHAL PROJECTION

(Based on the mode of development)

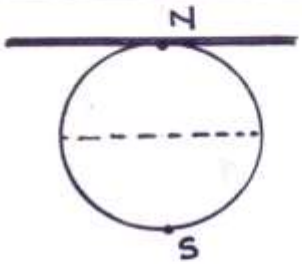
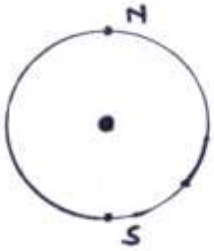
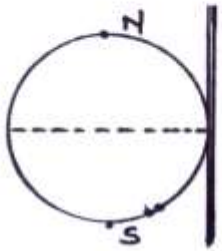
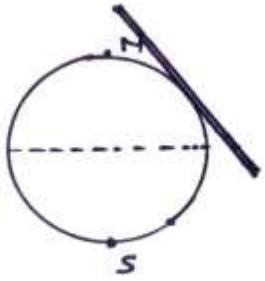
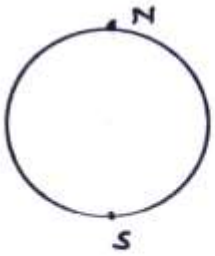
- Perspective Projections
- Non-Perspective Projections

***Perspective Projections*:-**

- The word perspective is the usual sense means the art of representing solid objects on a flat surface in such a way as to give the same impression of relative distance, size, etc, as the objects themselves do when viewed from a certain point. Thus in a perspective map projection the parallels and the meridians of the globe are represented on a surface geometrically from a point.
- In perspective zenithal projection a source of light and screen (plane) is assumed. On the basis of these two different types of projections are constructed .

PERSPECTIVE PROJECTION

Fig. No. 3

POSITION OF SCREEN (PLANE).	POSITION OF ASSUMED SOURCE OF LIGHT.
 POLAR ZENITHAL	• ASSUMED SOURCE OF LIGHT
	 AT CENTRE OF GLOBE OF "GNOMONIC"
 EQUATORIAL	 AT EITHER POLE "STEREOGRAPHIC"
 OBLIQUE	 AT AFFINITY "ORTHOGRAPHIC"
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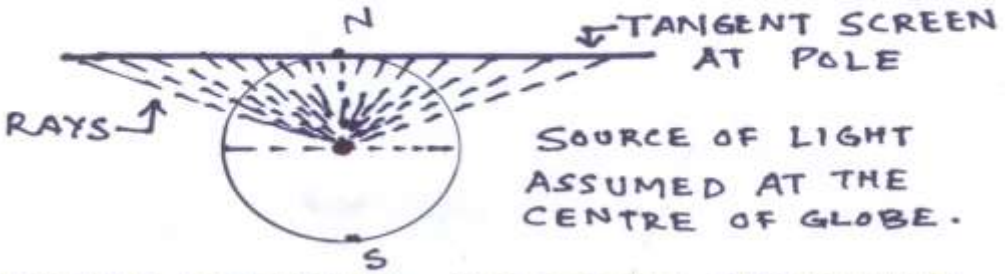
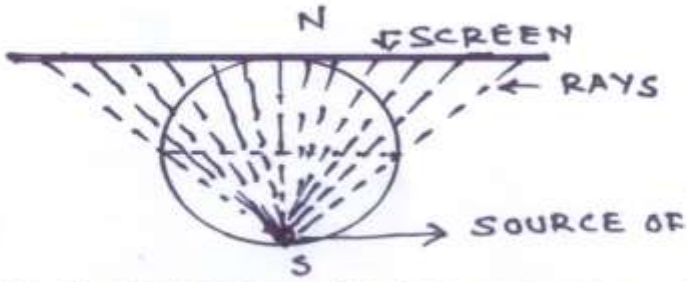
POLAR ZENITHAL PROJECTION

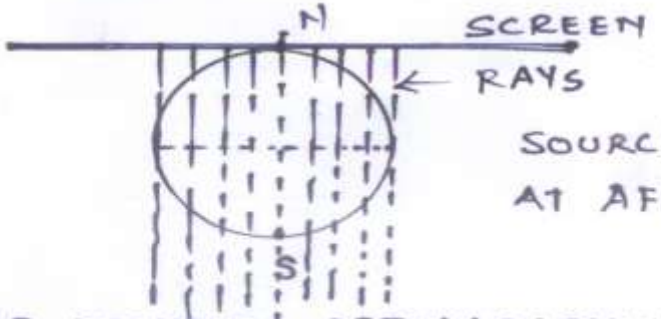
Fig. No. 4



POLAR ZENITHAL GNOMONIC PROJECTION.



POLAR ZENITHAL STEREOGRAPHIC PROJECTION.



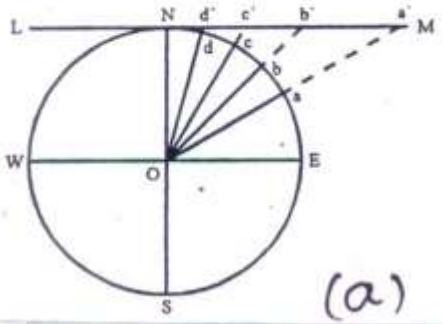
POLAR ZENITHAL ORTHOGRAPHIC PROJECTION

POLAR ZENITHAL GNOMONIC PROJECTION

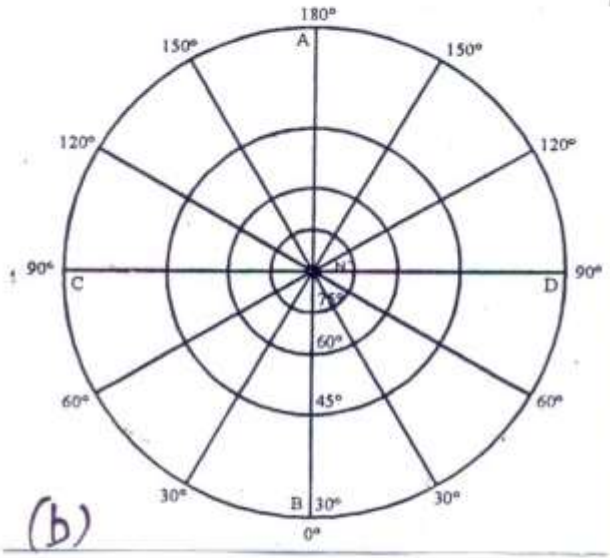
- A type of zenithal projection, in which the projection is made to the tangent plane (screen) from the center of the Globe Areas and shapes are so distorted that that it would be altogether valueless except for the useful quality that every great circle on the sphere is represented by a straight line on the map; this enables Great Circle routes to be plotted easily. Its name is derived from the Gnomon of a sundial.

POLAR ZENITHAL GNOMONIC PROJECTION

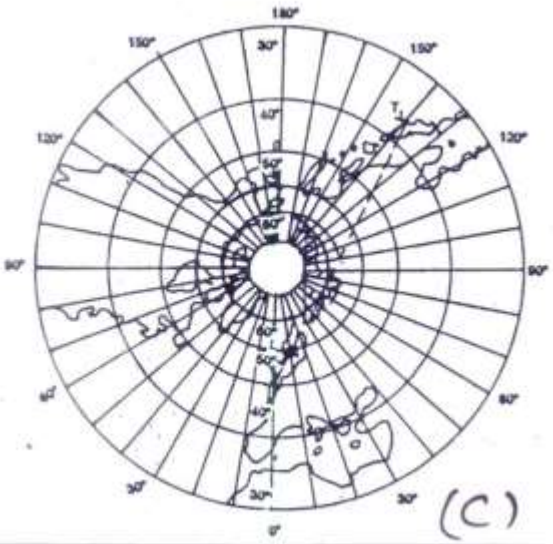
Fig. No. 5



(a)



(b)



(c)

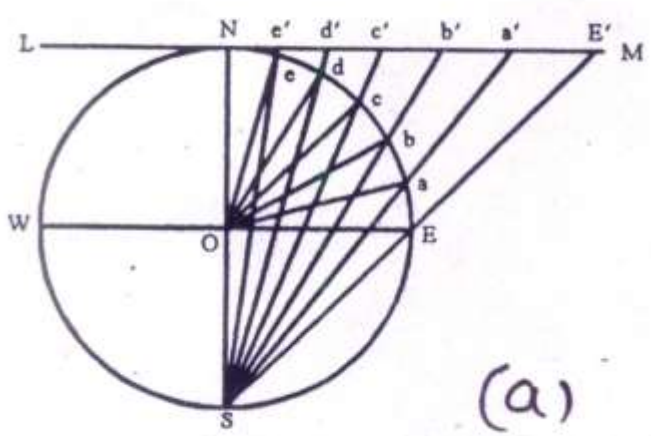
a → b → c

POLAR ZENITHAL STEREOGRAPHIC PROJECTION

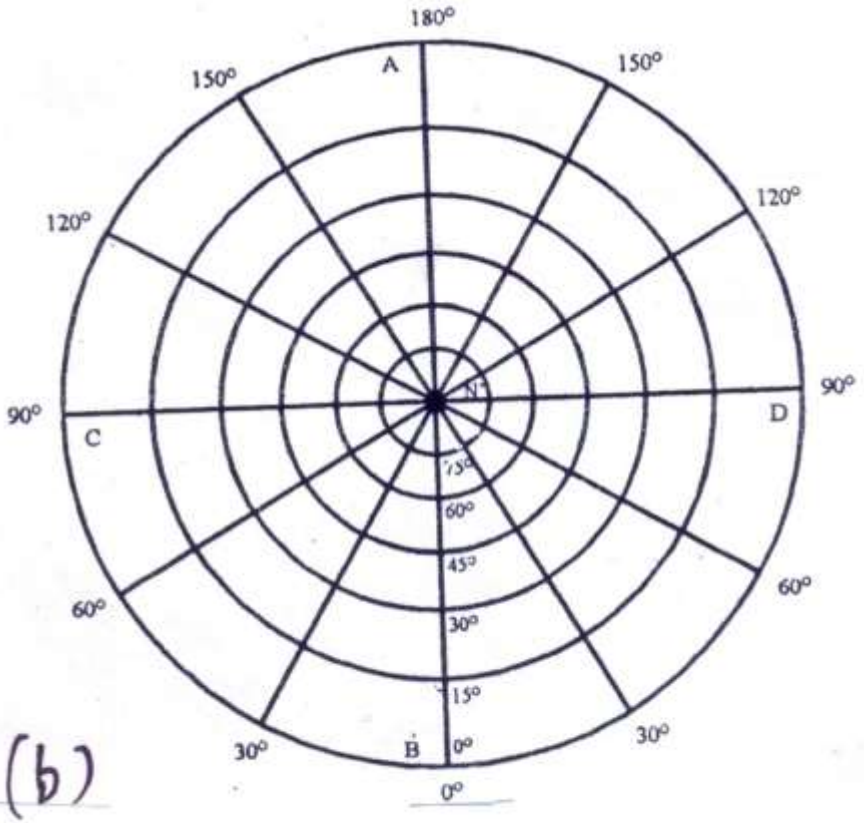
- In this zenithal projection source of light is assumed at one pole and plane on to the tangent on the other pole. The areas away from centre are exaggerated, though much less than in the Gnomonic projection, and the shapes of large areas are somewhat distorted.

POLAR ZENITHAL STEREOGRAPHIC PROJECTION

Fig. No. 6



(a)



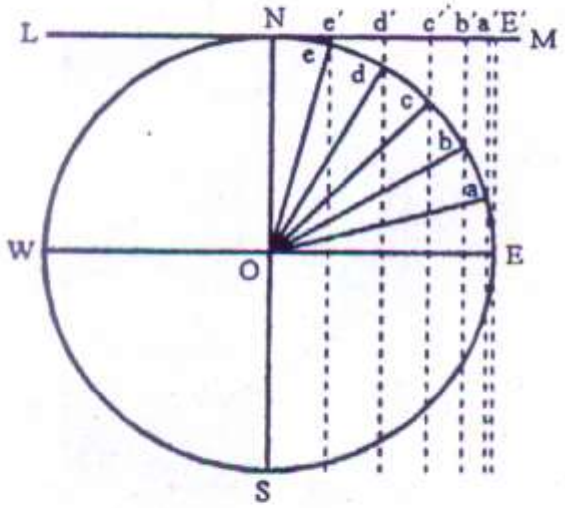
(b)

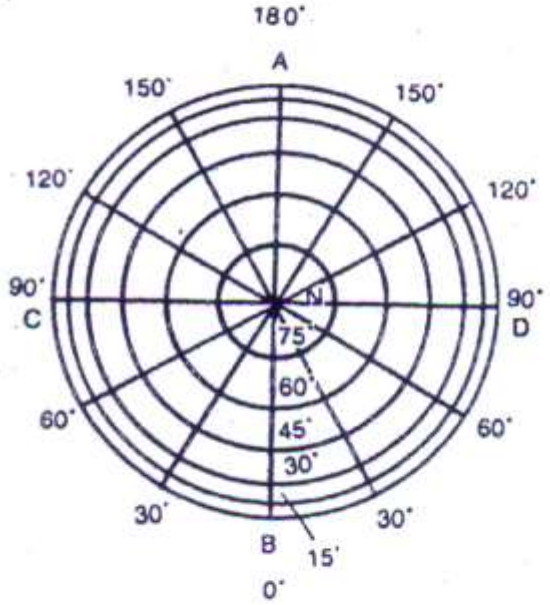
POLAR ZENITHAL ORTHOGRAPHIC PROJECTION

- In this projection globe is viewed as from an infinitive projection, so that only one hemisphere is depicted; the projecting rays are parallel and perpendicular to the plane of projection. At the margins there is considerable compression, at the centre expansion and distances, directions, shapes and areas are distorted. It is frequently used for charts of the heavens.

POLAR ZENITHAL ORTHOGRAPHIC PROJECTION

Fig. No. 7





NON PERSPECTIVE PROJECTION

- The perspective projections are modified to develop useful properties. These are modified by apply mathematical formulae, so they remain no longer perspective, therefore known as non-perspective projections.
- They are so modified as to acquire any one or more of the following properties like Equal – Area, Orthomorphism, General purpose. Non-perspective map projections are more useful and here we will take up two modified cases of polar zenithal projections.

POLAR ZENITHAL EQUI-DISTANT PROJECTION

- As the name suggests in this projection all the parallels are drawn at equal distance from the centre, meridians are straight lines and join at poles.
- The distance between parallels i.e. 'intercept' remains the same as like on a globe. Intercept is calculated by the formula

$$\frac{2\Pi r \times \text{Parallel Interval}}{360^{O}}$$

POLAR ZENITHAL EQUI-DISTANT PROJECTION

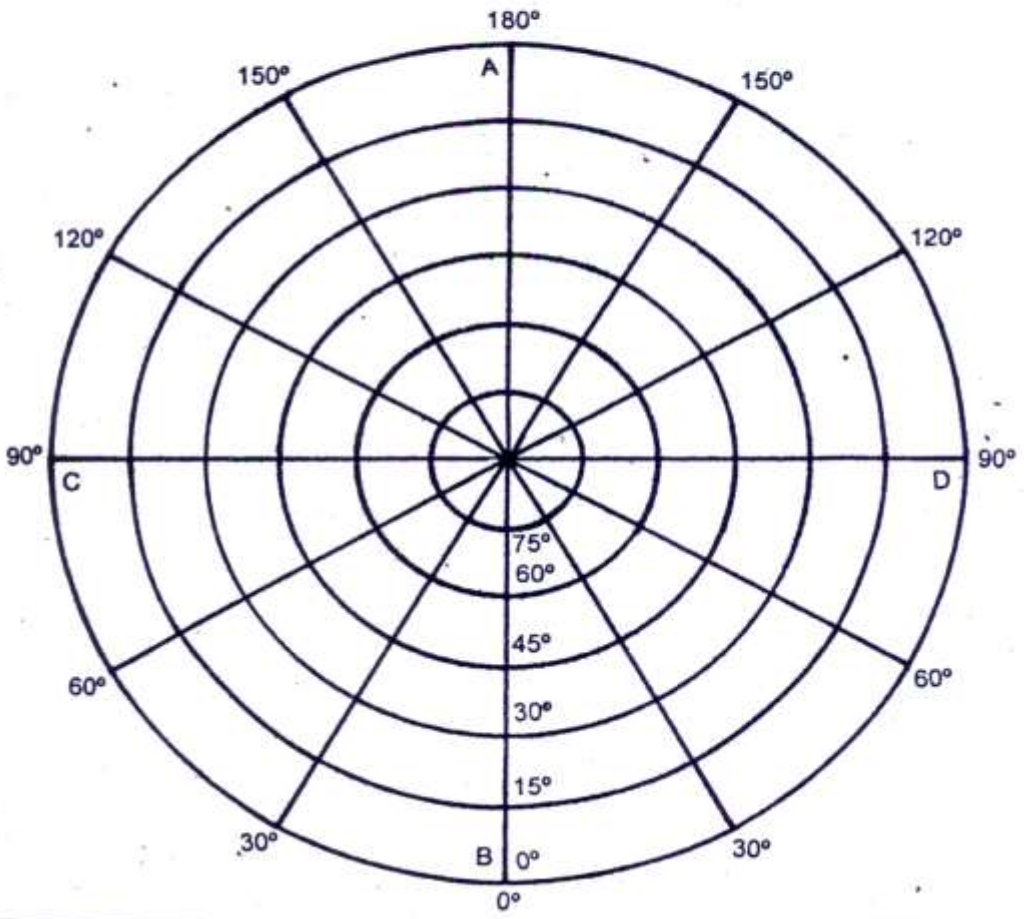
Fig. No.8

To calculate Intercept distance Formula is

$$2\pi R \times \frac{Interval}{360}$$

Here $\pi = \frac{22}{7}$

'R' = Radius of the reduced earth.

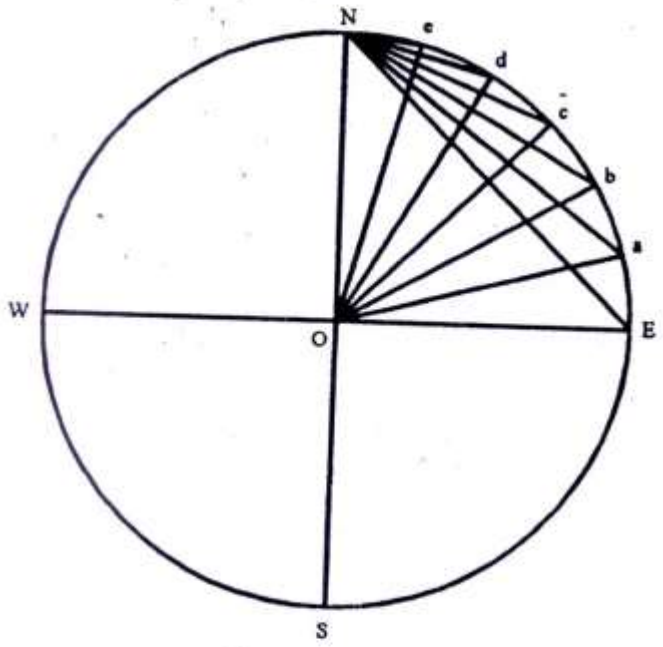


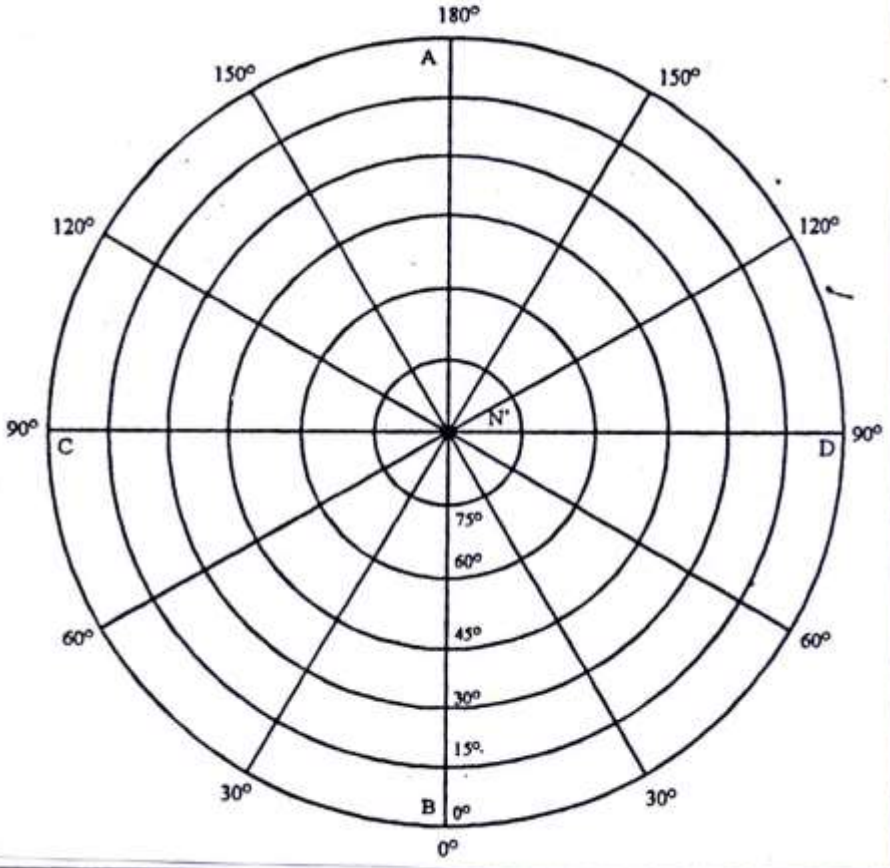
POLAR ZENITHAL EQUAL –AREA PROJECTION

- It was constructed by J.H. Lambert in 1772. Also known as Lambert's Azimuthal Projection.
- This projection tries to keep the area equal to globe.

POLAR ZENITHAL EQUAL -AREA PROJECTION

Fig. No. 9





COMMON PROPERTIES OF ZENITHAL PROJECTIONS

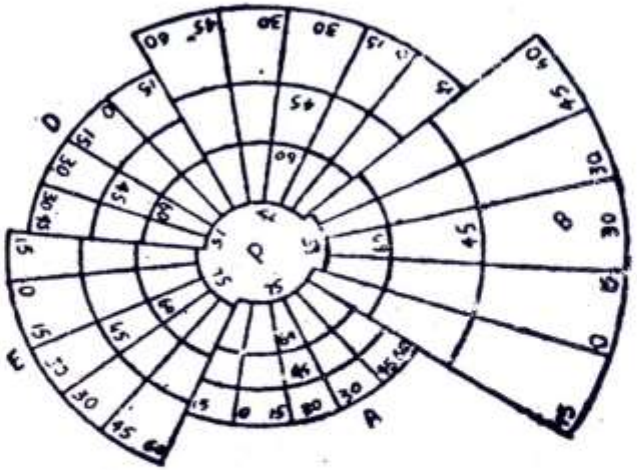
- Pole is the centre of a projection.
- Parallels are concentric circles.
- Opposite meridians create Great Circles on a globe, but here there are projected as straight lines.
- Meridians radiate from the centre of the projection. They are spaced uniformly at the correct angular interval.
- The bearings from the centre of all zenithal projections are true.
- The outlines of maps on these projections are circular.
- More suitable for polar areas.

COMPARISON OF POLAR ZENITHAL PROJECTIONS

- In all Polar Zenithal Projections discussed here, the shape of parallel is concentric circle where as meridians are straight lines.
- Scale along meridians is true in case of Polar Zenithal Equal - Area projections, whereas it is distorted in other cases.
- Scale along parallels is correct in case of Polar Zenithal Orthographic projections, whereas it is distorted in other cases.
- In all Polar Zenithal Projections meridians intersect parallels at right angle.
- Distance between parallels is constant in case of Equi-Distant, whereas it varies in all other four.
- All are Azimuthal Projections (True Bearings)
- Can show only one hemisphere at a time and able to show areas located near the poles correctly.

COMPARISON OF POLAR ZENITHAL PROJECTIONS

Fig. No.10



Scale 1 : 250,000,000

A.	Orthographic Projection	30°N to 90°N
B.	Gnomonic Projection	30°N to 90°N
C.	Stereographic Projection	30°N to 90°N
D.	Equal-Area Projection	30°N to 90°N
E.	Equi-distant Projection (Polar Cases)	30°N to 90°N

USES AND LIMITATIONS

- Polar Zenithal Projections are good to represent polar areas.
- Useful to Great Circle Route Charts which are near the poles.
- Useful for celestial chart.
- In most cases there is distortion in shape and size.


Thank You!