RPS DEGREE COLLEGE

BALANA (MAHENDERGARH)-123029

Lab Manual

Geography (B.A 3rd Semester)

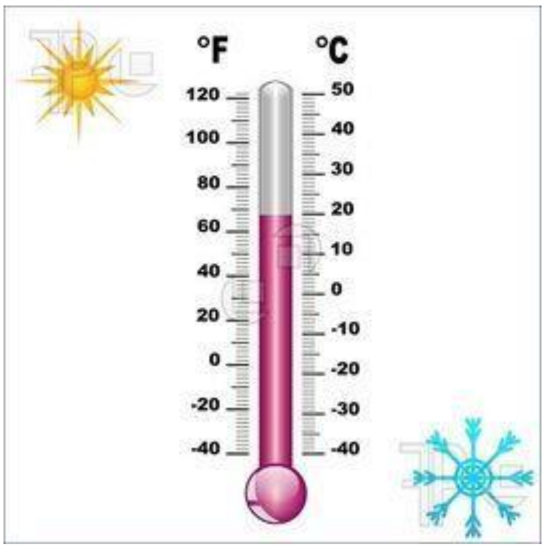
Department of Geography

Content

1. Measurement of Temperature:

A temperature is an objective comparative measurement of hot or cold. It is measured by a thermometer. Several scales and units exist for measuring temperature, the most common being Celsius (denoted °C; formerly called centigrade), Fahrenheit (denoted °F), and, especially in science, Kelvin(denoted K).

Here a equation for three unit- 0° C=32° F=273K



2. Measurement of Rainfall:

Rain is liquid water in the form of droplets that have condensed from atmospheric water vapor and then precipitated—that is, become heavy enough to fall under gravity. Rain is a major component of the water and is responsible for depositing most of the water on the Earth. It provides suitable conditions for many types of ecosystems, as well as water for hydroelectric power plants and crop irrigation.

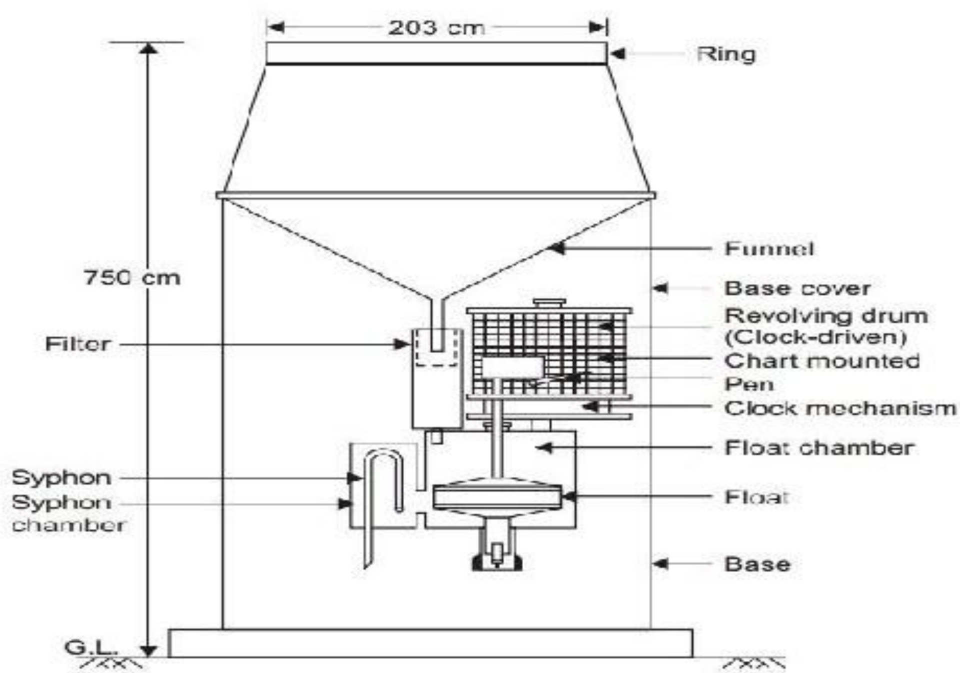
Three types of Rainfall

Orographic Rainfall

Convectional Rainfall

Cyclonic Rainfall

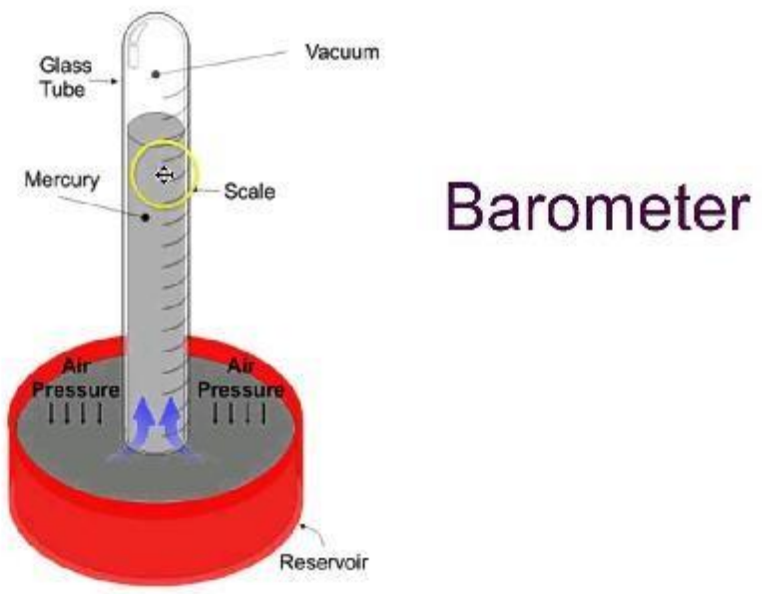
A **rain gauge** (also known as an udometer, pluviometer, or an ombrometer) is an instrument used by meteorologists and hydrologists to gather and measure the amount of liquid precipitation over a set period of time. Types of rain gauges include graduated cylinders, weighing gauges, tipping bucket gauges, and simple buried pit collectors. Each type has its advantages and disadvantages for collecting rain data.



Float type rain gauge

3. Measurement of Air Pressure:

Atmospheric pressure, sometimes also called **barometric pressure**, is the pressure exerted by the weight of air in the atmosphere of Earth (or that of another planet). Average sea-level pressure is 1013.25 mbar (101.325 kPa; 29.921 inHg; 760.00 mmHg). In aviation weather reports (METAR), QNH is transmitted around the world in millibars or hectopascals (1 hectopascal = 1 millibar), except in the United States, Canada, and Colombia where it is reported in inches (to two decimal places) of mercury. Many techniques have been developed for the measurement of pressure and vacuum. Instruments used to measure and display pressure in an integral unit are called **pressure gauges or** vacuum gauges. A **manometer** is a good example as it uses a column of liquid to both measure and indicate pressure.



4. Measurement of Humidity:

Humidity is the amount of water vapor present in the air. Water vapor is the gaseous state of water and is invisible.[1] Humidity indicates the likelihood of precipitation, dew, or fog. Higher humidity reduces the effectiveness of sweating in cooling the body by reducing the rate of evaporation of moisture from the skin. This effect is calculated in a heat index table or humidor. The amount of water vapor that is needed to achieve saturation increases as the temperature increases. As the temperature of a parcel of water becomes lower it will eventually not reach the point of saturation without adding or losing water mass. The differences in the amount of water vapor in a parcel of air can be quite large

Type of Humidity

Relative Humidity **Absolute Humidity** **Specific Humidity**

There are various devices used to measure and regulate humidity. A device used to measure humidity is called a psychomotor or hygrometer. A humidistat is a humidity-triggered switch, often used to control a dehumidifier.

5. Representation of Temperature And Rainfall

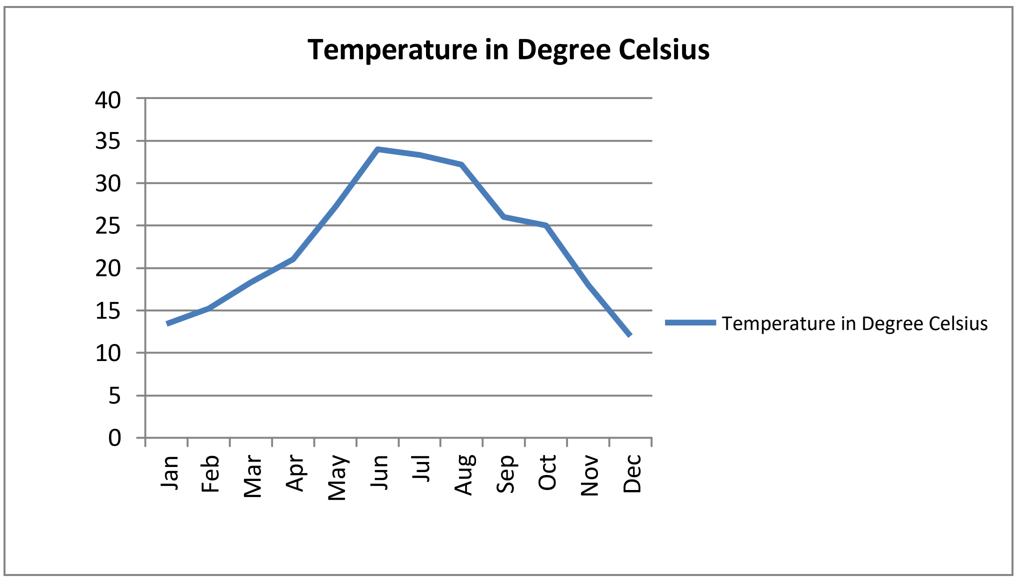
Line Graph:

A **line chart** or **line graph** is a type of chart which displays information as a series of data points called 'markers' connected by straight line segments.[1] It is a basic type of chart common in many fields. It is similar to a scatter plot except that the measurement points are ordered (typically by their x-axis value) and joined with straight line segments.

Example:

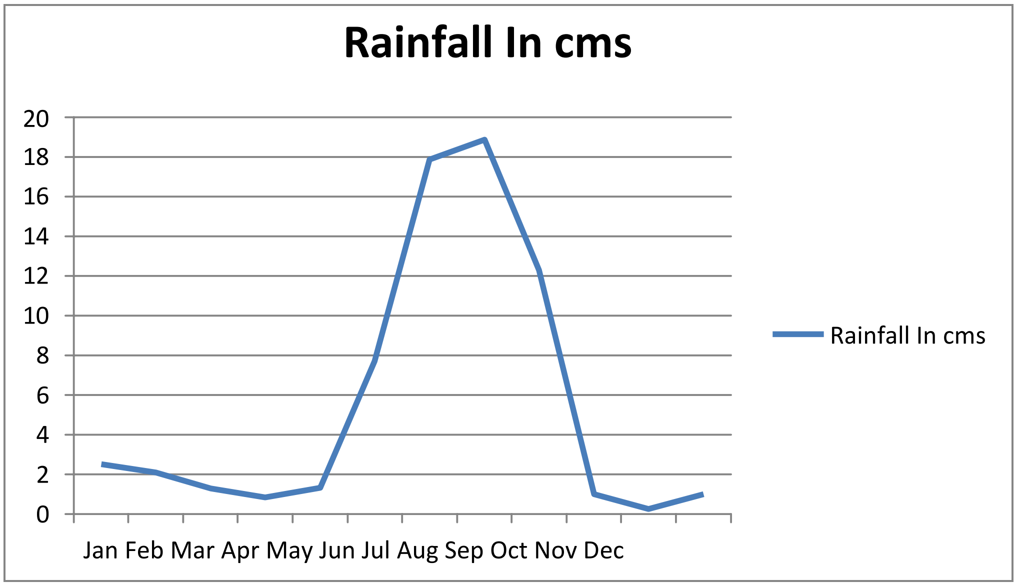
Q. Draw a line graph of Temperature with the help of following Data.

Months	Jan	Feb	Mar	April	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Temp. in◌̊◌̊ C	13.2	15.3	18.2	21	26	32	30	29.5	25.9	19.2	16.4	12.8



Q. Draw a line graph of Rainfall with the help of following Data.

Months	Jan	Feb	Mar	April	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Rainfall In cms.	2.51	2.11	1.29	0.84	1.32	7.70	17.86	18.86	12.29	1.02	0.25	1.09

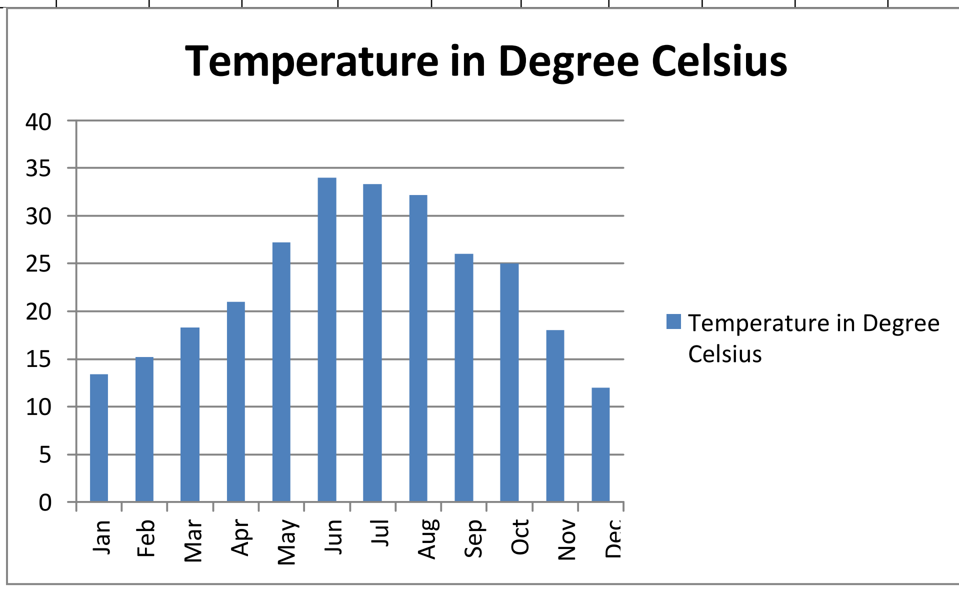


<u>Bar Graph</u>:

A **bar chart** or **bar graph** is a chart or graph that presents grouped data with rectangular bars with lengths proportional to the values that they represent. The bars can be plotted vertically or horizontally. A vertical bar chart is sometimes called a **Line graph**. Example:

Q. Draw a Bar graph of Temperature with the help of following Data.

Months	Jan	Feb	Mar	April	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Temp. in◌̊◌̊	13.2	15.3	18.2	21	26	32	30	29.5	25.9	19.2	16.4	12.8



Q. Draw a Bar graph of Rainfall with the help of following Data.

Months	Jan	Feb	Mar	April	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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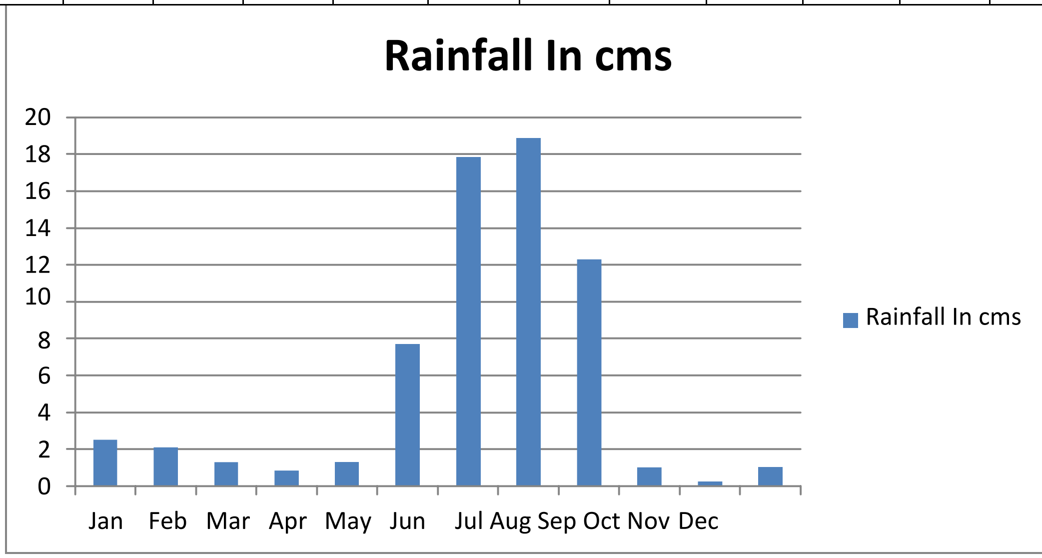
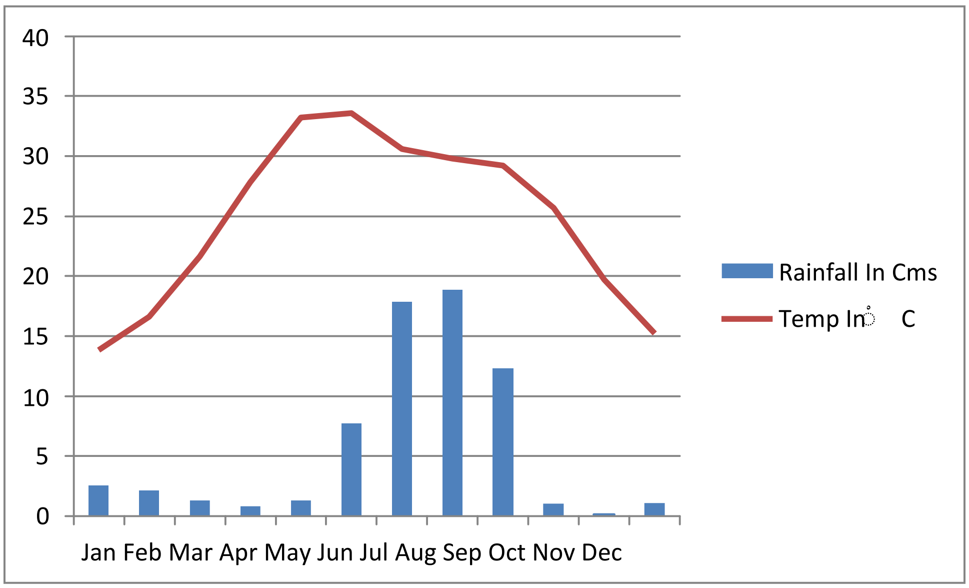


Combine Line and Bar Graph:

The combination chart is a visualization that combines the features of the bar chart and the line chart. The combination chart displays the data using a number of bars and/or lines, each of which represents a particular category. A combination of bars and lines in the same visualization can be useful when comparing values in different categories, since the combination gives a clear view of which category is higher or lower. An example of this can be seen when using the combination chart to compare the projected sales with the actual sales for different time periods.

Example:

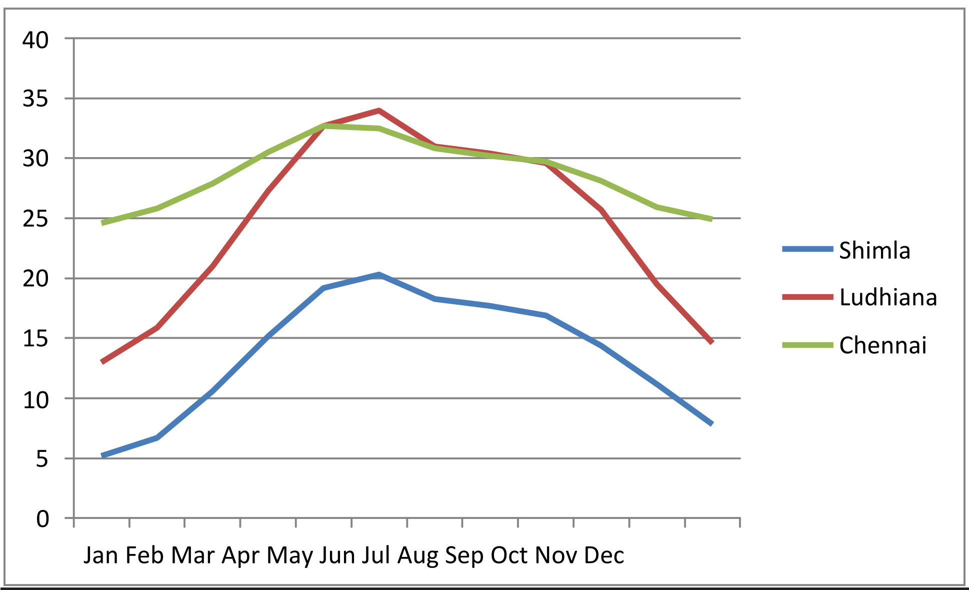
Months	Jan	Feb	Mar	April	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Temp In ̊ ̊ C	13.8	16.6	21.6	27.8	33.2	33.6	30.9	29.8	29.2	25.7	19.7	15.2
Rainfall In cms.	2.51	2.11	1.29	0.84	1.32	7.70	17.86	18.86	12.29	1.02	0.25	1.09



Polygraph:

A polygraph, popularly referred to as a lie detector, measures and records several physiological indices such as blood pressure, pulse, respiration, and skin conductivity while the subject is asked and answers a series of questions. The belief underpinning the use of the polygraph is that deceptive answers will produce physiological responses that can be differentiated from those associated with non-deceptive answers. The polygraph was invented in 1921 by John Augustus Larson, a medical student at the University of California, Berkeley and a police officer of the Berkeley Police Department in Berkeley, California. The polygraph was on the Encyclopedia Britannica 2003 list of greatest inventions, described as inventions that "have had profound effects on human life for better or worse.

Months	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Shimla	5.2	6.7	10.6	15.2	19.2	20.3	18.3	17.7	16.9	14.4	11.2	7.8
Ludhiana	13	15.9	21	27.3	32.7	34	31	30.4	29.6	25.7	19.5	14.6
Chennai	24.6	25.8	27.9	30.5	32.7	32.5	30.8	30.2	29.7	28.1	25.9	24.9

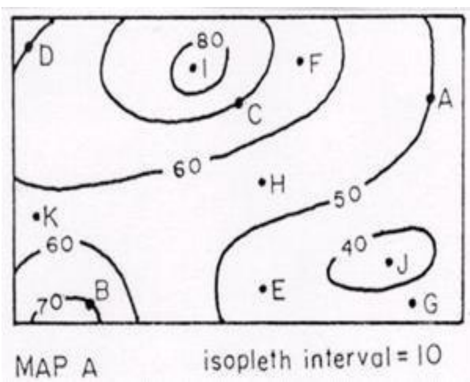


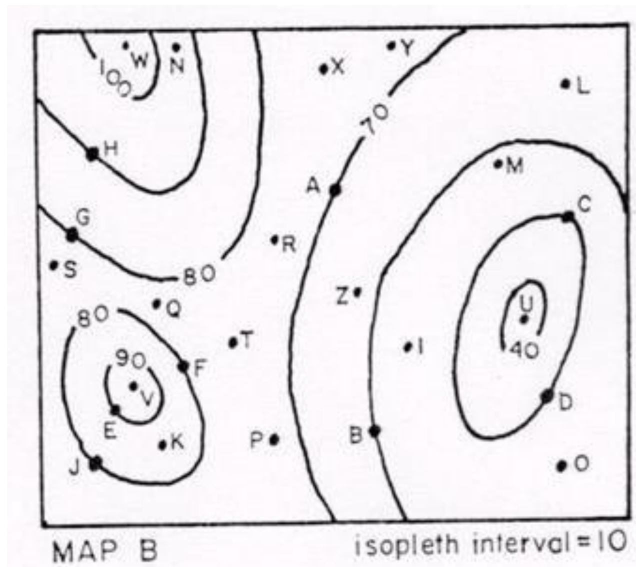
6. Isopleths:

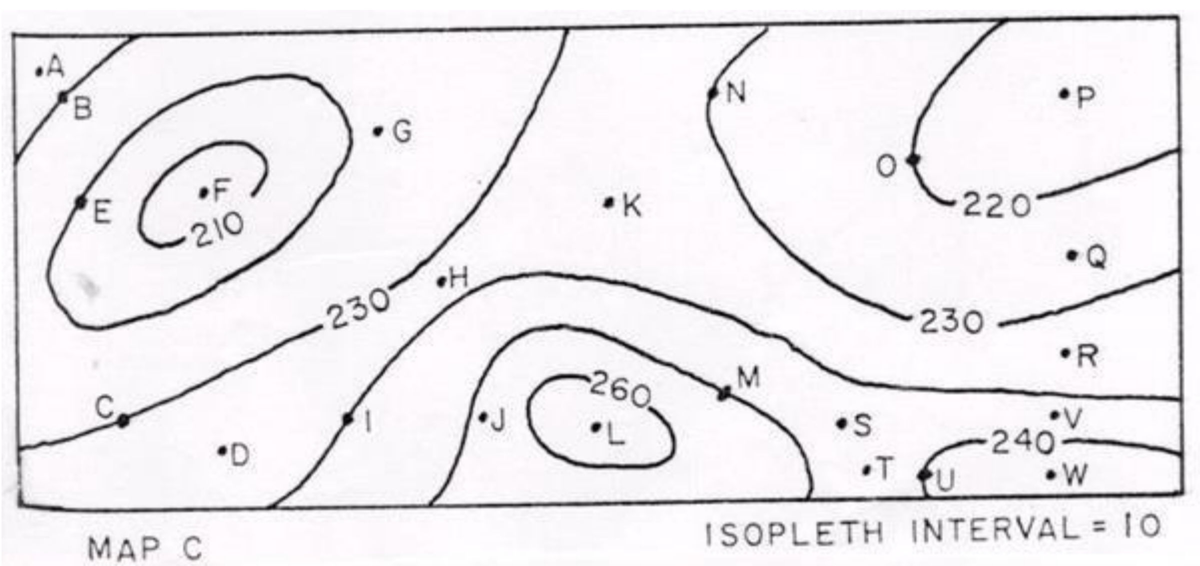
A line drawn on a map through all points having the same value of some measurable quantity.

6.1 Isopleths Map:

An isopleths map generalizes and simplifies data with a continuous distribution. It shows the data as a third dimension on a map, thus isopleths maps are more common for mapping surface elevations, amounts of precipitation, atmospheric pressure, and numerous other measurements that can be viewed statistically as a third dimension.







Some other name of Isopleths line according to different perspective are following:

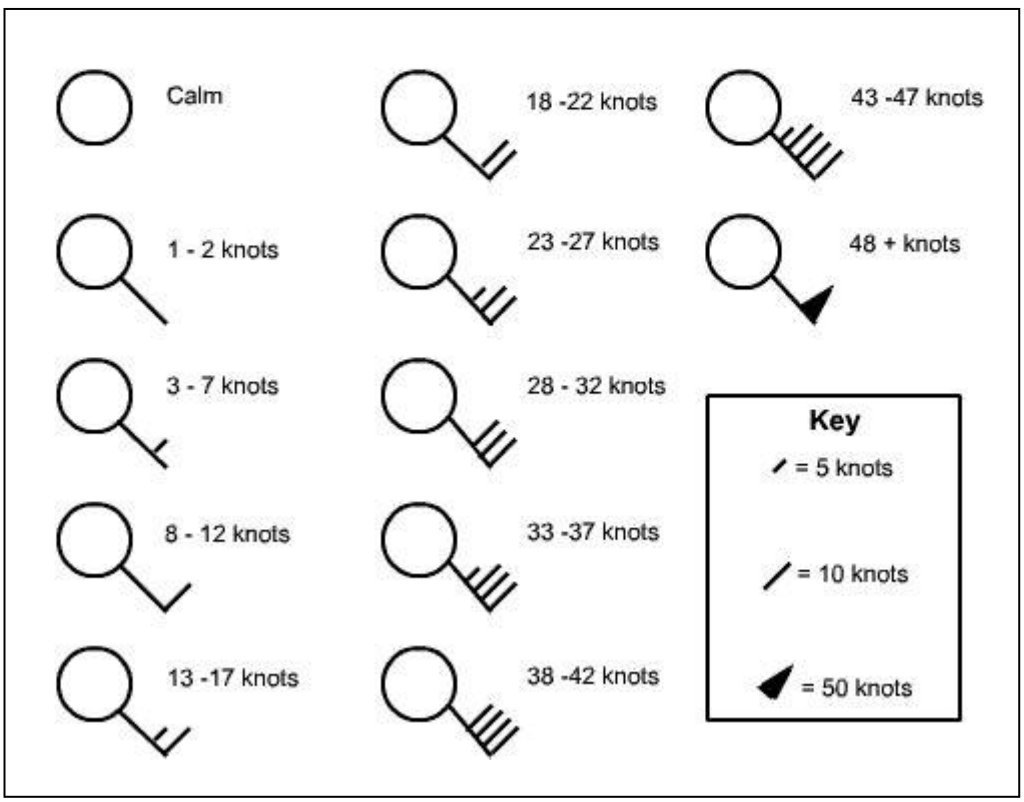
- Isobar : A line drawn on a map or chart connecting places of equal or constant pressure.
- Isochore: A line drawn on a pressure / volume / temperature graph through all points having the same value of the volume
- Isodrosotherm: A line of equal or constant dew point on a graph or chart, such as a weather map.
- Isogons: A line of equal or constant wind direction on a graph or chart, such as a weather map.
- Isohyets: A line of equal or constant rainfall on a graph or chart, such as a weather map.
- Isoquant: A line of equal or constant economic production on a graph, chart or map.
- Isotach: A line of equal or constant wind speed on a graph or chart, such as a weather map.
- Isotherm: A line of equal or constant temperature on a graph or chart, such as a weather map.

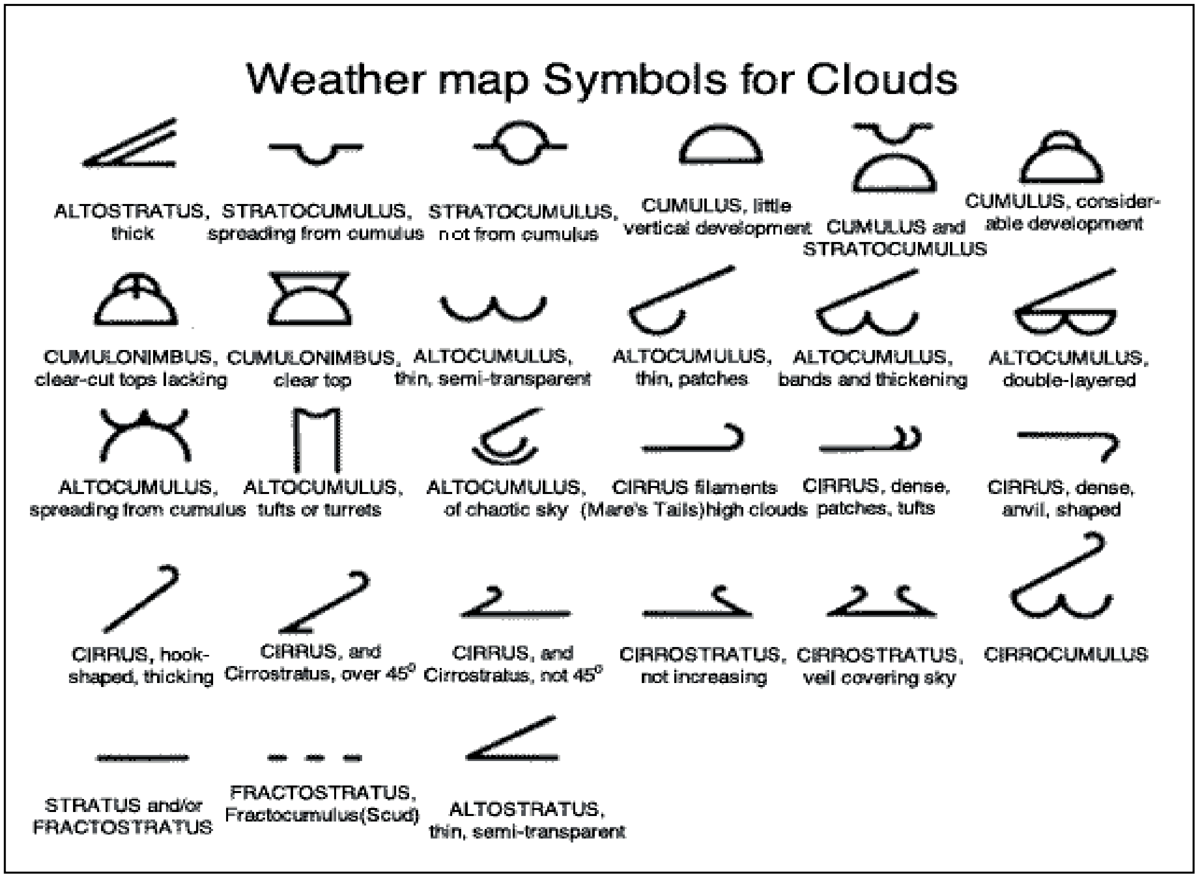
7. Weather Map:

A weather map displays various Meteorological features across a particular area at a particular point in time and has various symbols which all have specific meanings. Such maps have been in use since the mid-19th century and are used for research and weather forecasting purposes. Maps using isotherms show temperature gradients which can help locate fronts. Isotach maps, analyzing lines of equal wind speed on a constant pressure surface of 300 mb or 250 mb show where the jet stream is located. Use of constant pressure charts at the 700 and 500 hPa level can indicate tropical cyclone motion. Two-dimensional streamlines based on wind speeds at various levels show areas of convergence and divergence in the wind field, which are helpful in determining the location of features within the wind pattern. A popular type of surface weather map is the surface weather analysis, which plots isobars to depict areas of high pressure and low pressure. Cloud codes are translated into symbols and plotted on these maps along with other meteorological data that are included in synoptic reports sent by professionally trained observers.

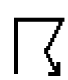
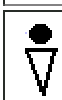
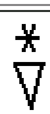
7.1 Weather Symbols: Metrological Departments create a lot of symbols for representing the elements of weather, like Clouds, Wind and Rainfall etc.

Symbol of Wind Direction and Speed





Symbols of Precipitation

Freezing Rain		Thunderstorm		Freezing Drizzle	
Rain Showers		Smoke		Haze	∞
Snow Showers		Fog	≡	Mist	=

8. Chain and Tape Survey

Surveying In Ancient

On the early age of discovery, ancient people were living on curve and later on, in town and city. You can hear somebody say ‘I was born and grown up in this town or city’ this is normal in our daily life because between and among us is usual to be found in different residential area at a village, sub-town, town, or in city. All these are fabricated environment whereby individual human beings are closely related with. Now what is a city? It can be explained as a well-surveyed and planned livelihood area, which involves well-established political, economical, cultural and social amenities.

About 200BC, Eratosthenes and associates (others) computed the dimensions of the earth (shape and size).During that age it was purposely for studying the shape and size of the earth. 120 BC Greeks developed the science of geometry and were using it for precise land division, on that time they advanced their technology as DIOPTER. They were standardized procedures for conducting surveys.

1800 A.D, It was the beginning of industrial revolution whereby people were looking for favorable environment(s) for construction of industries. The importance of exact boundaries and demand for public improvement of infrastructure) railroad (TAZARA), canals (Suez), roads, bridges (Slender bridge), telephone poles, electric poles) brought surveying into a prominent position. As the history of surveying is concern, instruments that are more accurate were developed, such as science of Geodetic and plane surveying and leveling technique.

SURVEYING TODAY

Surveying has been essential elements in the development of man’s environment for so many centuries. It is important in planning and execution of nearly every form of construction. The process of surveying involves measuring and recording; measuring and recording distances, angles, height and size of the earth surface features and drawing them on plan, section or map.

Nowadays surveying affects most everything in our daily lives. A few of the areas where surveying is being used are: to map the earth above and below the sea, prepare navigational map (land, air, sea), establish databases for natural resources managements, development of engineering data for huge buildings constructions, land development (settlements), roads, railways, bridge constructions and so forth.

WHAT SURVEYING IS

This is the science of measuring and recording distances, angles, heights and sizes on the earth’s surface to obtain data from which accurate plans and maps is made. The art and science (systematic process) of determining the position of natural and artificial features on, above the earth’s surface or establishing such point; and representing this information on paper plans, as figures, tables or computer based map. (Measure related positions and present them numerically and or graphically).

It is the measurement of dimensional relationships as of horizontal distances, elevations, directions and angles on the earth’s surface especially for use in locating property boundaries, construction layout, and map making. Also is a technique of measuring to determine the position of points or of making out points and boundaries. Generally, surveying is the systematic process of making measurements on the field from which maps are drawn. The map is the most essential piece of equipment which the geographer, engineer and architect uses, and their training is said to be incomplete without instruction on procedures of map making where surveying is most important. The geographer must learn to read, make and use map as an essential element on their carrier, in so doing he/she will be well equipped in geographical world.

THE MAJOR ELEMENTS OF SURVEYING

Surveying like other field of study has its own elements. There are four major elements of surveying. These elements are also known as methods of conducting surveying. In other textbook, these elements are termed as types of surveying cartographers).

(a) Chain or tape surveying
(b) Prismatic compass survey
(c) Plane table surveying
(d) Leveling technique

UNITS OF MEASUREMENTS

We need to notice that the process of surveying involves measuring and recording distances, angles, (magnetic compass, sextant, theodolite) and height of the earth surface. It is very important to determine the units used in measurements and below are among of those units used and described as follow:-

Horizontal Measurements

SI-units (metric system) are used (Km, m, and mm) in few cases, English Foot System can be used (Miles, feet and inches). For example:

1ft = 0.3048m;

1km = 0.62131miles;

1hectare = 2.471acres;

1km^2 = 1,000,000m^2;

1km^2 = 100hectare = 100 (ha).

Angular Measurements

Are angles between baselines or reference directions and survey lines or objects to be fixed out Degrees are usually used but in few cases- gradians/gons are used.

For Degrees:

1Revolution = 360^0,

1Degree = 60’;

1Minute = 60’;

1Minute 60" seconds.

For Gons: 1Revolution = 400gons;

1gon = 100mgon;

400gons = 360^0 =2Л radians.

CHAIN / TAPE SURVEY

Surveying is the making of measurement in the field from which maps are drawn. The map is the most essential piece of equipment that geographer, pilot and planner use. The method is the method of surveying in which only linear measurements are taken in the field. Its principle is built upon the framework of triangles. It aimed to measure a series of straight lines on the ground with a chain or tape. It is the simplest method and common of making linear or horizontal measurements for small area. The process involves fixing of two relatively measured lines called tie (ties) or by right angles (off - sets) (90˚).

The main equipment used in chain or tape survey are the chain or tape, arrows, ranging poles, a measuring rod, a cross staff, Pegs to mention a few.

CHAIN OR TAPE:

There are various types of chain such as metric, Günter’s, Surveyors, engineer, revenue chain, and steel band chains. The chain or tape is used for running chain lines, made of tempered steel wire links connected by rings. Gutter’s chain is 66 feet long is also used and is divided into 10links and each 0.66 feet or 7.92 inches long. The metric chain is also used. It is usually 20m long and is divided in 100 links each 200 millimeters long. A metric links is always 200mm long a 30m chain will therefore contain 150 links. The end of the chains are provided with brass handle at each end with swivel joint that can be turned without twisting.

Steel tapes are also used in measurement of distances. The brass handle at the end of the steel tape or chain is included in the measurement. Steel chain and tapes should be handled with the utmost care. It should be wiped with a very slightly oily rag after use. It should be wiped with a very slightly oily rag after use. Steel tapes can be easily cut the palm so handle with care. Tit is preferred for short distances.

ARROWS:

Arrows are pointed metal markers, which can be stuck into the ground. They are about 36cm long and are bent at the end to make a circle to which rag or cloth can be tied to make them easier seen. They are used to mark chain lengths. They are used to mark chain length. They are thin skewers for marking points on land.

RANGING POLES/RODS:

Ranging poles, at times referred rods are poles of circular section about 25mm in diameter and 2m long. Nevertheless, those that are graduated in the imperial system have heights ranging from 6ft to 10 feet. They have pointed ends, which are steel shed for pushing in the ground. They are painted red, black and white in bands each 500mm wide so that when they are used to make sections they can be easily seen at a distance. The method of placing ranging poles on a straight line between two points is known as ranging. It made of poles of wood or light metal. Sharpen on the end for driving in the ground.

CROSS STAFF:

Cross staff is made up of metal or wood with eye slits at right angles, it is used for marking angles, and used to measure right angles from the line of traverse. This instrument allows a right angle to be set out with reasonable accuracy. The head of a cross staff is mounted on a shortened version of a ranging pole and comprised a cross with vertical end members in each of which is a slits it can be easil**y** improvised.

OTHER EQUIPMENTS

Note book: Note book is used to record all data collected in the field .it should be good and quality book of about 150mm by 100mm.

Spiral: bound notebook is recommended. It is a good instrument for keeping record during survey.

Pencil: A good pencil that is sharp is needed for writing and drawing some strategic during survey

CHOICE OF STATION:

During the preliminary inspection, the following point must be born in mind as the criteria to improve / provide the best arrangement of survey lines:**-**

1. The number of survey lines should be as few as possible but the must be sufficiency for the survey to be supported.

2. If possible, a long line should positioned part across the site to form a base on which to build the triangles.

3. The triangles to be used should be well conducted no triangles should contain an angle which is less than 30 or greater 150.the angles used for plotting should intersect as close to 90 as possible so as to provide a sharp definition of the station point.

4. Every part of the survey should be provided with check lines. If in a triangle we measure a forth line from a know point from a one side of the triangle to a known point of a second side.

5. Whenever obstacles occur in course of the surveying proper measures, such as describing under chaining round obstacles must be employed to overcome them. In steep slopes also constitute need to employ the technique of step chaining.

6. Short offset line should kept close to the feature to be offset, ideally within 2 meters so that an offset measuring rod operated by one person can be used instead of tape which need to people.

7. It is usually convenient to position a station on the extension of a check line or on the side of the triangle. Such points can be plotted without the need for intersecting arcs.

RPS DEGREE COLLEGE

BALANA (MAHENDERGARH)-123029

Lab Manual

Geography (B.A 4th Semester)

Department of Geography

Content

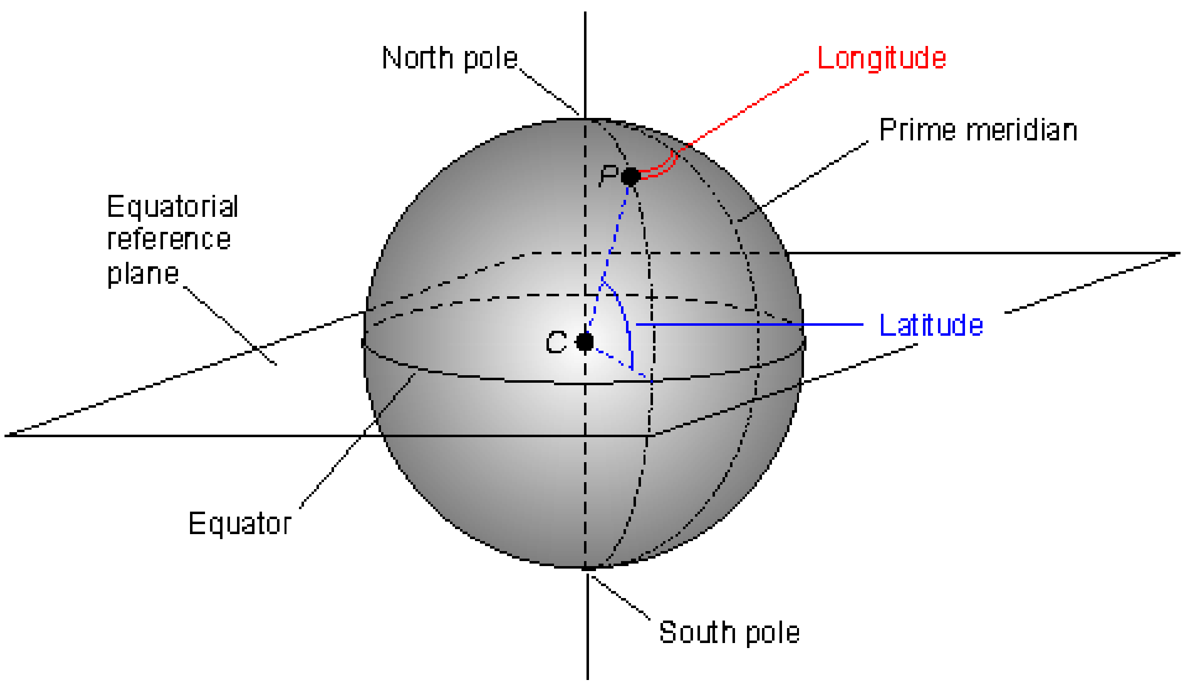
1. Introduction:

A **map projection** is a systematic transformation of the latitudes and longitudes of locations from the surface of a sphere or an ellipsoid into locations on a plane. Maps cannot be created without map projections. All map projections necessarily distort the surface in some fashion. Depending on the purpose of the map, some distortions are acceptable and others are not; therefore, different map projections exist in order to preserve some properties of the sphere-like body at the expense of other properties. There is no limit to the number of possible map projections. More generally, the surfaces of planetary bodies can be mapped even if they are too irregular to be modeled well with a sphere or ellipsoid; see below. Even more generally, projections are a subject of several pure mathematical fields, including differential geometry, projective geometry, and manifolds. However, "map projection" refers specifically to a cartographic projection.

2. Latitudes And Longitudes:

Latitude and longitude are angles that uniquely define points on a sphere. Together, the angles comprise a coordinate scheme that can locate or identify geographic positions on the surfaces of planets such as the earth.

Latitudes: - Latitude is defined with respect to an equatorial reference plane. This plane passes through the center *C* of the sphere, and also contains the great circle representing the equator. The latitude of a point *P* on the surface is defined as the angle that a straight line, passing through both *P* and *C*, subtends with respect to the equatorial plane. If *P* is above the reference plane, the latitude is positive (or northerly); if *P* is below the reference plane, the latitude is negative (or southerly). Latitude angles can range up to +90 degrees (or 90 degrees north), and down to -90 degrees (or 90 degrees south). Latitudes of +90 and -90 degrees correspond to the north and south geographic poles on the earth, respectively.



Longitudes: - Longitude is defined in terms of meridians, which are half-circles running from pole to pole. A reference meridian, called the prime meridian, is selected, and this forms the reference by which longitudes are defined. On the earth, the prime meridian passes through Greenwich, England; for this reason it is also called the Greenwich meridian. The longitude of a point *P*on the surface is defined as the angle that the plane containing the meridian passing through *P* subtends with respect to the plane containing the prime meridian. If *P* is to the east of the prime meridian, the longitude is positive; if *P* is to the west of the prime meridian, the longitude is negative. Longitude angles can range up to +180 degrees (180 degrees east), and down to -180 degrees (180 degrees west). The +180 and -180 degree longitude meridians coincide directly opposite the prime meridian.

3. Properties of Map Projections:

Many properties can be measured on the Earth's surface independent of its geography. Some of these properties are:

- Area
- Shape
- Direction
- Bearing
- Distance
- Scale

Map projections can be constructed to preserve at least one of these properties, though only in a limited way for most. Each projection preserves or compromises or approximates basic metric properties in different ways. The purpose of the map determines which projection should form the base for the map. Because many purposes exist for maps, a diversity of projections have been created to suit those purposes.

Another consideration in the configuration of a projection is its compatibility with data sets to be used on the map. Data sets are geographic information; their collection depends on the chosen datum (model) of the Earth. Different datums assign slightly different coordinates to the same location, so in large scale maps, such as those from national mapping systems, it is important to match the datum to the projection. The slight differences in coordinate assignation between different datums is not a concern for world maps or other vast territories, where such differences get shrunk to imperceptibility.

- **Conformal**: Preserves angles locally, implying that local shapes are not distorted.
- **Equal Area**: Areas are conserved.
- **Compromise**: Neither conformal nor equal-area, but a balance intended to reduce overall distortion.
- **Equidistant**: All distances from one (or two) points are correct. Other equidistant properties are mentioned in the notes.
- **Gnomonic**: All great circles are straight lines.

4. Classification of Projections:

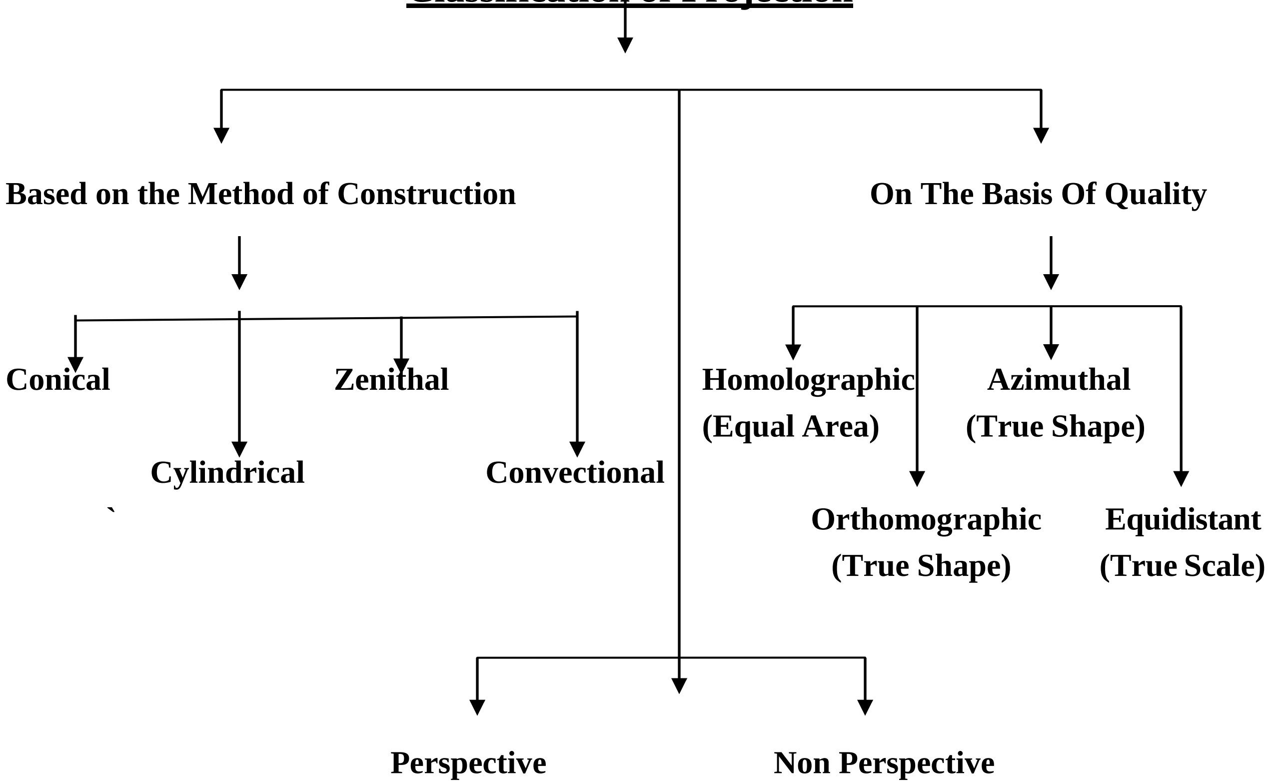
A fundamental projection classification is based on the type of projection surface onto which the globe is conceptually projected. The projections are described in terms of placing a gigantic surface in contact with the earth, followed by an implied scaling operation. These surfaces are cylindrical (e.g. Mercator), conic (e.g. Albers), or azimuthal or plane (e.g. stereographic). Many mathematical projections, however, do not neatly fit into any of these three conceptual projection methods. Hence other peer categories have been described in the literature, such as pseudo conic, pseudo cylindrical, pseudoazimuthal, retroazimuthal, and polyclone.

Another way to classify projections is according to properties of the model they preserve. Some of the more common categories are:

- Preserving direction (azimuthal or zenithal), a trait possible only from one or two points to every other point
- Preserving shape locally (conformal or orthomorphic)
- Preserving area (equal-area or equilateral or equivalent or authalic)
- Preserving distance (equidistant), a trait possible only between one or two points and every other point
- Preserving shortest route, a trait preserved only by the gnomonic projection

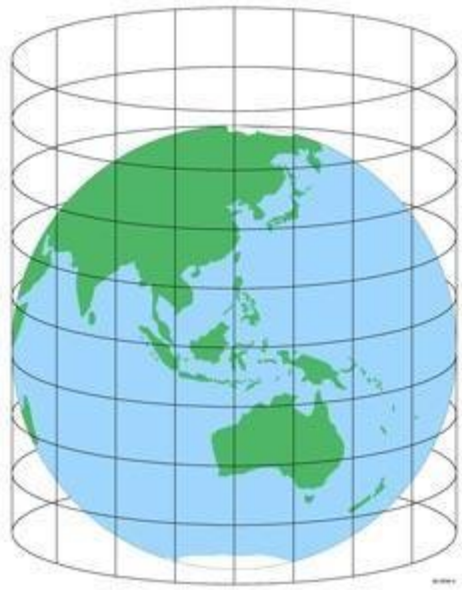
Because the sphere is not a developable surface, it is impossible to construct a map projection that is both equal-area and conformal.

Classification of Projection



5. Cylindrical Projection:

This projection is based on the concept of the 'piece of paper' being rolled into a cylinder and touching the Earth on a circular line. The cylinder is usually positioned over the Equator, but this is not essential.



Cylindrical projections are usually used for world maps or regional ⁄ national maps of Equatorial areas – such as Papua New Guinea.

These projections usually:

- Are rectangular or oval shaped – but this projection technique is very variable in its shape
- Have lines of longitude and latitude at right-angles to each other
- Have distortions increasing away from the central circular line (the 'touch point of the paper')
- Have very small distortions along the central circular line (the 'touch point of the paper')
- Show shapes correctly, but size is distorted.

Type of Cylindrical Projection

Simple Cylindrical projection

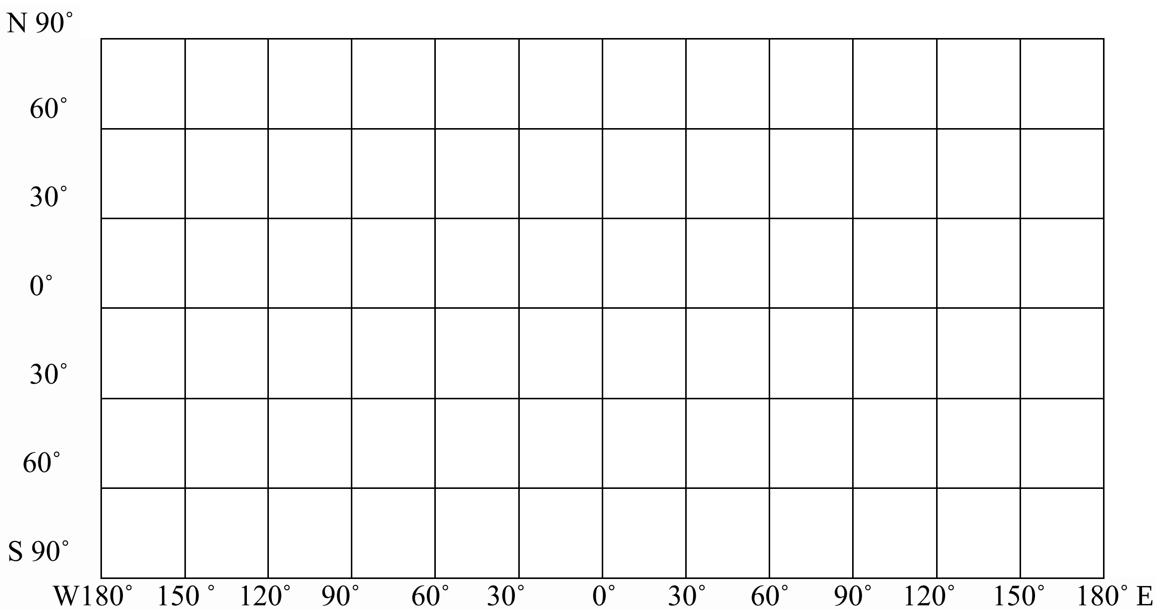
Mercator's Projection

Cylindrical Equal Area Projection

Simple Cylindrical projection:

Also known as equirectangular, simple cylindrical, rectangular, or Plate Carrée (if the standard parallel is the equator).This projection is very simple to construct because it forms a grid of equal rectangles. Because of its simple calculations, its usage was more common in the past. In this projection, the Polar Regions are less distorted in scale and area than they are in the Mercator projection.

Contraction: This simple cylindrical projection converts the globe into a Cartesian grid. Each rectangular grid cell has the same size, shape, and area. All the graticular intersections are 90°. The traditional Plate Carrée projection uses the equator as the standard parallel. The grid cells are perfect squares. In this projection, the poles are represented as straight lines across the top and bottom of the grid.



Simple Cylindrical Projection

Uses and applications:

Best used for city maps or other small areas with map scales large enough to reduce the obvious distortion. Used for simple portrayals of the world or regions with minimal geographic data. This makes the projection useful for index maps

Cylindrical Equal Area Projection:

The cylindrical equal area projection, also known as the Lambert's projection, has been derived by projecting the surface of the globe with parallel rays on a cylinder touching it at the equator. Both the parallels and meridians are projected as straight lines intersecting one another at right angles. The pole is shown with a parallel equal to the equator; hence, the shape of the area gets highly distorted at the higher latitude.

Example: Construct a cylindrical equal area projection for the world when the R.F. of the map is 1:300,000,000 taking latitudinal and longitudinal interval as 15º.

Calculation: Radius of the reduced earth $R = \frac{640,000,000}{300,000,000}$ =2.1 cm

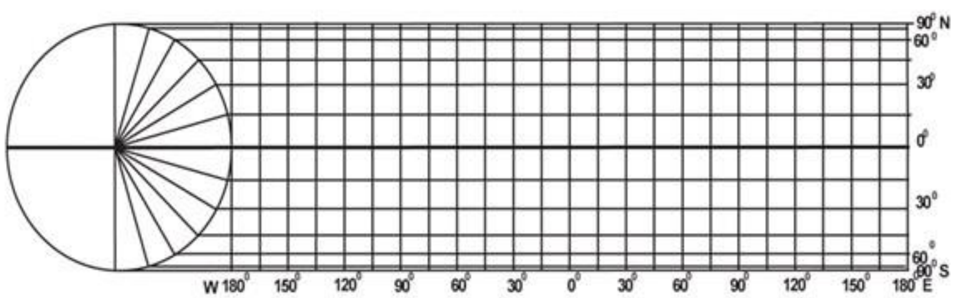
Length of the equator 2ðR or $\frac{2\times22\times2.1}{7}$ = 13.2 cm

Interval along the equator $\frac{13.2 \times 15}{360}$

Construction:

Draw a circle of 2.1 cm radius;
Mark the angles of 15º, 30º, 45º, 60º, 75º and 90º for both, northern and southern hemispheres;
Draw a line of 13.2 cm and divide it into 24 equal parts at a distance of 0.55cm apart.
This line represents the equator;
Draw a line perpendicular to the equator at the point where 0° is meeting the circumference of the circle;
Extend all the parallels equal to the length of the equator from the perpendicular line;
And Complete the projection as shown in fig

R.F. 1 : 300,000,000



Cylindrical Equal Area Projection

Properties:

1. All parallels and meridians are straight lines intersecting each other at right angle.
2. Polar parallel is also equal to the equator.
3. Scale is true only along the equator.

Mercator’s Projection:

A Dutch cartographer Mercator Gerardus Karmer developed this projection in 1569. The projection is based on mathematical formulae. So, it is an orthomorphic projection in which the correct shape is maintained. The distance between parallels increases towards the pole. Like cylindrical projection, the parallels and meridians intersect each other at right angle. It has the characteristics of showing correct directions. A straight line joining any two points on this projection gives a constant bearing, which is called a Laxodrome or Rhumb line.

Example: Draw a Mercator’s projection for the world map on the scale of 1:250,000,000 at 15º interval.
Calculation

Radius of the reduced earth is $= \dfrac{250,000,000}{250,000,000} = 1''$ inch

Calculation:

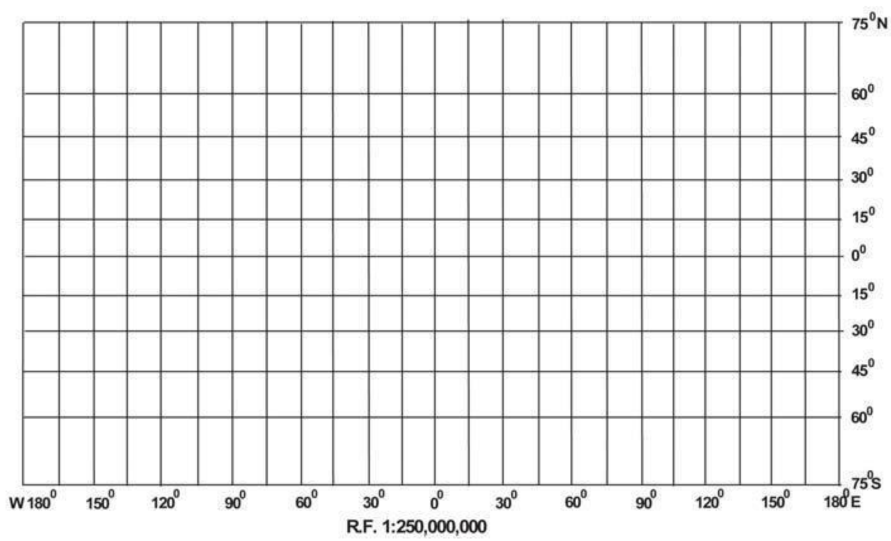
(i) Draw a line of 6.28”

(ii) Divide it into 24 equal parts. Determine the length of each division using the following formula:

$$\frac{\text{Length of Equator X interval}}{360}$$

(iii) Calculate the distance for latitude with the help of the table given below:-

Latitude	**Distance**
15º	0.265 x 1 = 0.265" inch
30º	0.549 x 1 = 0.549" inch
45º	0.881 x 1 = 0.881" inch
60º	1.317 x 1 = 1.317" inches
75º	2.027 x 1 = 2.027" inches



Properties:

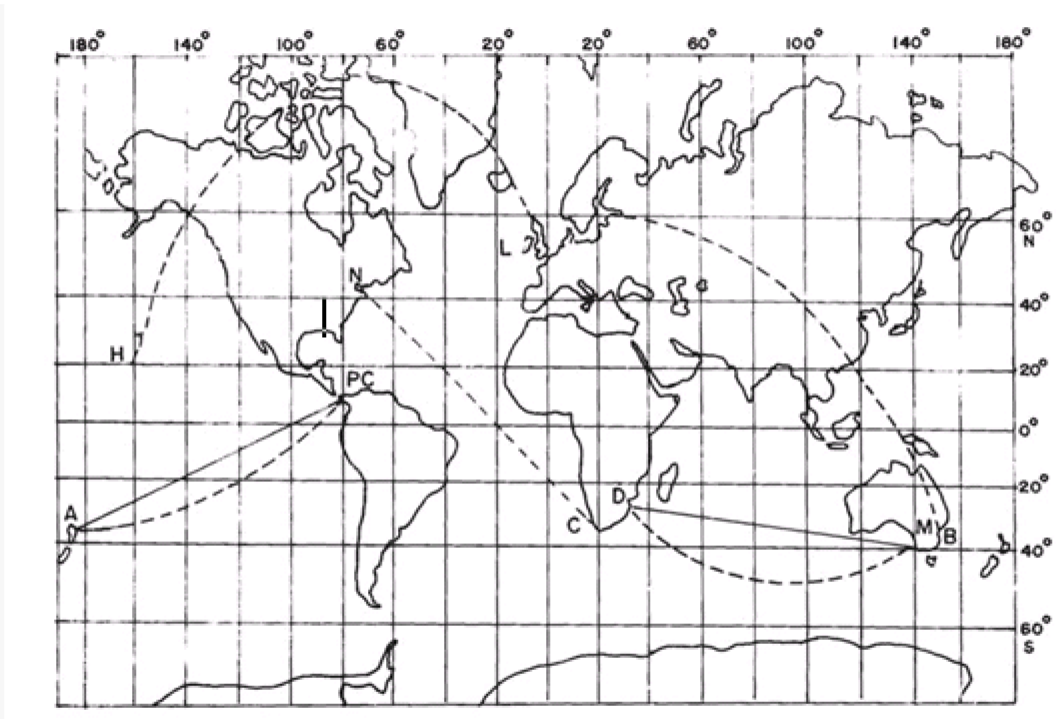
1. All parallels and meridians are straight lines and they intersect each other at right angles.
2. All parallels have the same length which is equal to the length of equator.
3. All meridians have the same length and equal spacing.
4. Spacing between parallels increases towards the pole.
5. Scale along the equator is correct as it is equal to the length of the equator on the globe;

6. For example, the 30º parallel is 1.154 times longer than the corresponding parallel on the globe.

7. Shape of the area is maintained, but at the higher latitudes distortion takes place.
8. The shape of small countries near the equator is truly preserved while it increases towards poles.
9. It is an azimuthal projection.
10. This is an orthomorphic projection as scale along the meridian is equal to the scale along the parallel.

Uses

1. More suitable for a world map and widely used in preparing atlas maps.
2. Very useful for navigation purposes showing sea routes and air routes.
3. Drainage pattern, ocean currents, temperature, winds and their directions, distribution of worldwide rainfall and other weather



Straight lines are Laxodromes or Rhumb lines and

Dotted lines are great circles

6. CONICAL MAP PROJECTIONS:

The parallel and the meridians of a globe are transferred to a cone placed on the globe in such a way that its vertex is above one of the poles and it touches the globe along a parallel. The parallel along which the cone touches the globe is called a standard parallel. Where the cone is unrolled into a flat surface the conical projection is formed.

The meridians are all straight lines converging to a point, the vertex of the cone, which is beyond the North Pole above the top of the map. They are at their true distance apart along the standard parallel. The parallels are all equidistant circular arcs drawn with the vertex of the cone as the centre. The distance between any two parallels represents the true distance between them on the globe.

PROPERTIES OF CONICAL PROJECTIONS:

- Parallels are arcs of circles which are concentric in most of the conical projections.
- The central meridian is a straight line.
- Other meridians are either straight line or curves.
- The distance between the meridians decrease towards the pole.
- They can represent only one hemisphere, at a time, northern or southern.
- The standard parallel is correct to the scale.

These projections are most suitable for representing middle latitudes.

TYPES OF CONICAL PROJECTIONS:

- Simple conical projections with one standard parallel.
- Simple conical projection with two standard parallels.
- Bonne’s projection.
- Polyconic projection
- International map projection.

6.1 Conical Projection with one Standard Parallel:

A conical projection is one, which is drawn by projecting the image of the graticule of a globe on a developable cone, which touches the globe along a parallel of latitude called the standard parallel. As the cone touches the globe located along AB, the position of this parallel on the globe coinciding with that on the cone is taken as the standard parallel. The length of other parallels on either side of this parallel are distorted.

Example:

Construct a conical projection with one standard parallel for an area bounded by 10º N to 70º N latitude and 10º E to 130º E longitudes when the scale is 1:250,000,000 and latitudinal and longitudinal interval is 10º.

Construction:

Draw a circle or a quadrant of 2.56 cm radius marked with angles COE as 10º interval and BOE and AOD as 40º standard parallel.

(ii) A tangent is extended from B to P and similarly from A to P, so that AP and BP are the two sides of the cone touching the globe and forming Standard Parallel at 40° N.

The arc distance CE represents the interval between parallels. A semi-circle is drawn by taking this arc distance.

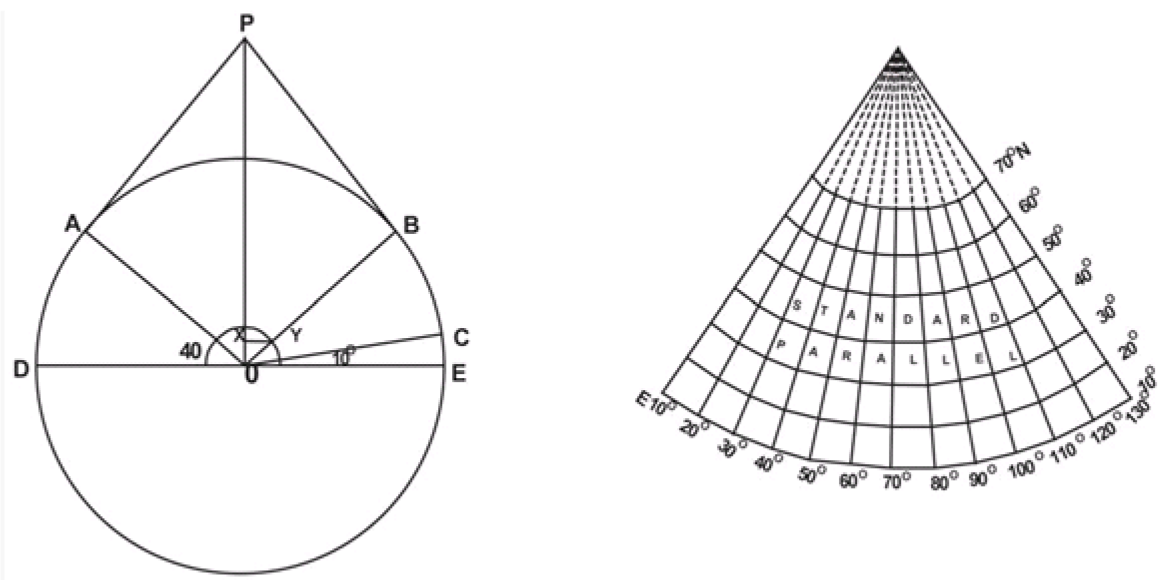
X-Y is the perpendicular drawn from OP to OB.

A separate line N-S is taken on which BP distance is drawn representing standard parallel. The line NS becomes the central meridian.

Other parallels are drawn by taking arc distance CE on the central meridian.

The distance XY is marked on the standard parallel at 40° for drawing other meridians.

Straight lines are drawn by joining them with the pole.



Simple Conical Projection with one standard parallel

Properties:

1. All the parallels are arcs of concentric circle and are equally spaced.
2. All meridians are straight lines merging at the pole. The meridians intersect the parallels at right angles.
3 The scale along all meridians is true, i.e. distances along the meridians are accurate.
4. An arc of a circle represents the pole.
5. The scale is true along the standard parallel but exaggerated away from the standard parallel.
6. Meridians become closer to each other towards the pole.
7. This projection is neither equal area nor orthomorphic.

Uses:

This projection is commonly used for showing areas of mid-latitudes with limited latitudinal and larger longitudinal extent.

A long narrow strip of land running parallel to the standard parallel and having east-west stretch is correctly shown on this projection.

Direction along standard parallel is used to show railways, roads, narrow river valleys and international boundaries.

This projection is suitable for showing the Canadian Pacific Railways, Trans-Siberian Railways, international boundaries between USA and Canada and the Narmada Valley.

6.2 BONNE'S PROJECTION:

It is a modified conical projection with one standard parallel. It was invented by Rigobert Bonne **(1727-1795**). A French cartographer.

CONSTRUCTION:

In construction it is very similar to the simple conical projection with one standard parallel. The central meridian is drawn straight and is divided truly, and through the points off division the parallels are drawn as concentric circles as in the simple conical, but the meridians are not straight lines joining the vertex of the cone to the points of division of the standard parallel. Instead of this al the parallels are made of the exact lengths of the corresponding parallels on the globe, and divided truly like the standard parallel. Then the meridians are formed by drawing curves through the corresponding points on each parallel.

EXAMPLE:

Radius of the earth = 250,000,000 inches.
Therefore, Radius (r) of the globe on the scale of 1/200,000,000.

r = 1/200,000,000 × 250,000,000

= 1.25 inches.

Construction:

1. Draw a circle with radius equal to the radius of the globe, i.e., 1.25 inches. This circle represents the globe. Let NS its polar diameter and WE its equatorial diameter intersect each other at right angles at O, the centre of the circle.
This projection is a modified simple conical projection with one-standard Parallel. Like the simple conical projection with one standard Parallel, Bonne's projection has one standard parallel.
The parallel running through the centre part of the projection will obviously be a suitable standard parallel. Therefore, we choose 45ºN parallel of latitude as the standard parallel.
Let radius OP make and angle of 45º with OE.
Also draw radii Or, Os, Ot and Ou making angles of 15º, 30º, 60º, and 75º respectively with OE.

We are required to draw meridians at an interval of 15º.

The length of the arc subtended by 15º = 2Πr × 1/360 × 15

= 2 × 22/7 × 1.25 × 15/360 inch.

= 0.328 inch.

With O as center and radius equal to 0.328 inch draw an arc a b c d e and f drop perpendiculars b l, c k, d j, e i and f h on ON.

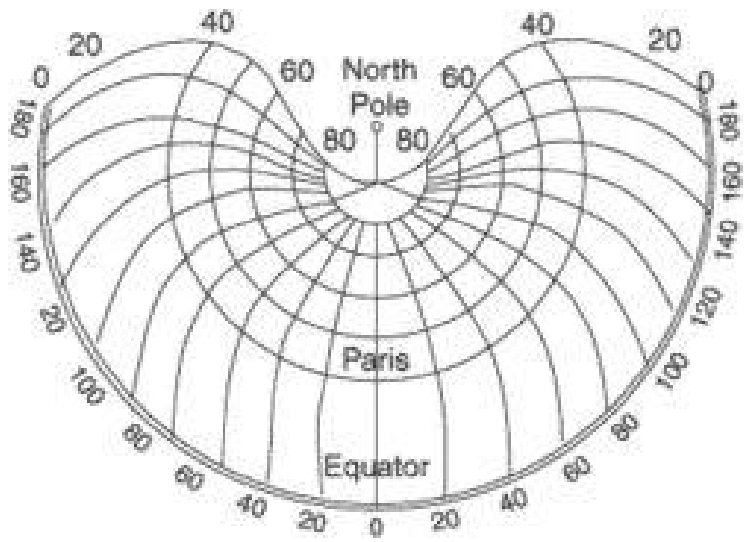
Draw perpendiculars to PO. Produce ON to meet PQ at Q. draws a line LM. This line represents

the central meridians. With L as centre and QP as radius draw an arc intersecting LM at N’. This arc will describe the standard parallel i.e. 45º N parallel.
To draw the parallels we have to find out the distance between the successive parallels. This distance is equal to the length of the arc subtended by the parallel interval which is 15º in this example.

Therefore the length of the arc subtended by 15º
= 2Πr × 1/360 × 15

= 2 × 22/7 × 1.25 × 15/360 inch.

= 0.328 inch



From the point N’, mark off distance N’w, wx and x 90º towards L and distances N’y, y z and z M towards M, each distance being equal to the arc subtended by 15º, i.e., 0.328 inch. With L as centre, draw arcs passing through the points x, w, y, z and M the equator.

Now a O, b l, c k, d j, e I and f h represent the spacing between the meridians along the equator, 15º, 30º, 45º, 60º and 75º parallels respectively. Since the area is bounded by 75º W and 75º E meridians and the meridians interval is 15º, we need to draw 75/15, i.e., 5 meridians to the west of the central meridian (Oº) and 75/15, i.e. 5 meridians to the east of the central meridian. Starting outwards from the central meridian mark off distances along the equator, each distance being equal to a O. similarly mark off distances b l, c k, d j, e I and f h along 15º, 30º, 45º, 60º and 75º parallels respectively. Join the points of divisions on the parallels by smooth curves and let these curves also pass through the pole and the points of divisions on the equator. The curves represent the meridians.
If the meridian interval been 25º instead of 15º in the above projection, the radius of the arc a b c d e f g in fig should have been equal to

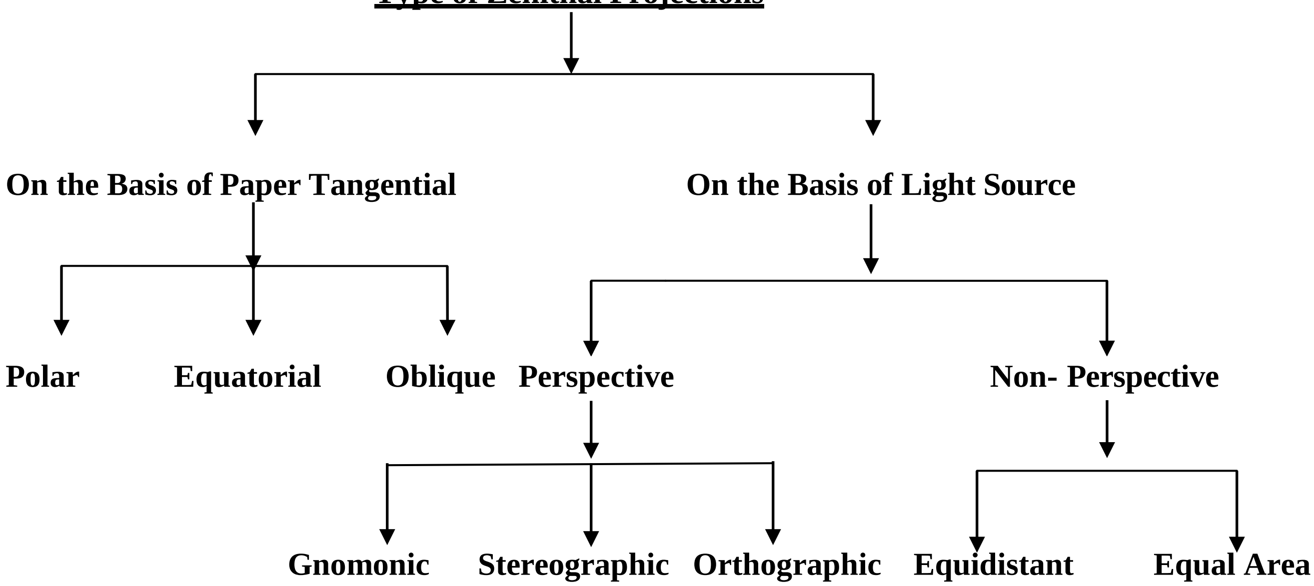
= 2 × 22/7 × 1.25 × 25/360 inch.

= 0.545 inch.

7 Zenithal Projections:

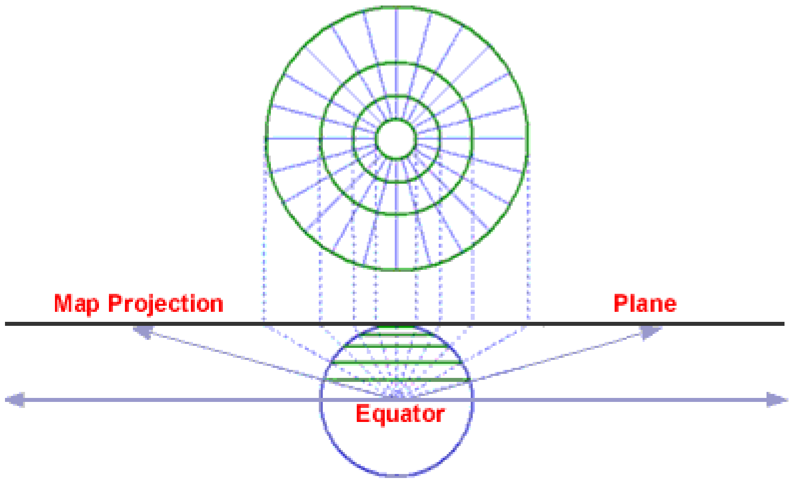
A map projection in which a globe, as of the Earth, isassumed to rest on a flat surface onto which itsfeatures are projected. An azimuthal projectionproduces a circular map with a chosen point on the globe that is tangent to the flat surfaceat center.When the central point is either of Earth's poles,parallels appear as concentric circles on the map andmeridians as straight lines radiating from the center.Directions from the central point to any other point onthe map are accurate, although distances and shapes insome azimuthal projections are distorted away fromthe center.

Type of Zenithal Projections



Polar Gnomonic Projection:

Projecting with a light source at the center of the generating globe to a tangent plane produces the gnomonic projection. One of the earliest map projections, the gnomonic projection was first used by the Greek scholar Males of Miletus in the sixth century BC for showing different constellations on star charts, which are used to plot planetary positions throughout the year. The position of constellations in the sky over the year was used as a calendar, telling farmers when to plant and harvest crops, and when floods would occur. Horoscopes and astrology also began with the ancient Greeks over two thousand years ago. Many believed that the position of the sun and the planets had an effect on a person's life and that future events in their lives could be predicted based upon the location of celestial bodies in the sky. The gnomonic projection is the only projection with the useful property that all great circles on the globe are shown as straight lines on the map. Since a great circle route is the shortest distance between two points on the earth's surface, the gnomonic projection is especially valuable as an aid to navigation. The gnomonic projection is also used for plotting the global dispersal of seismic and radio waves. Its major disadvantages are increasing distortion of shape and area outward from the center point and the inability to project a complete hemisphere.



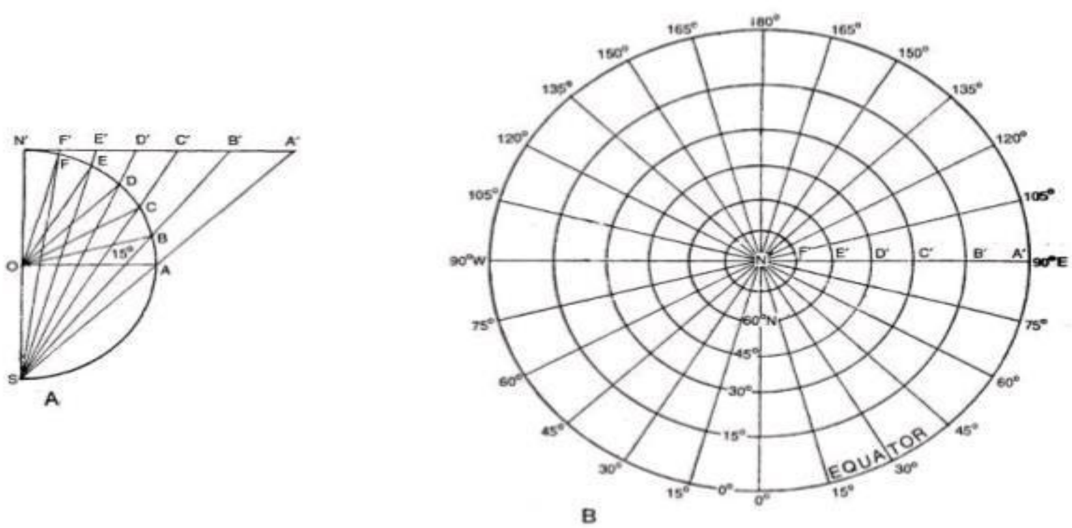
Gnomonic

Stereographic Projection:

The projection is equivalent to the polar aspect of the stereographic projection on a spheroid. The central point is either the North Pole or the South Pole. This is the only polar aspect planar projection that is conformal. The polar stereographic projection is used for all regions not included in the UTM coordinate system, regions north of 84° N and south of 80° S. Use UPS for these regions.

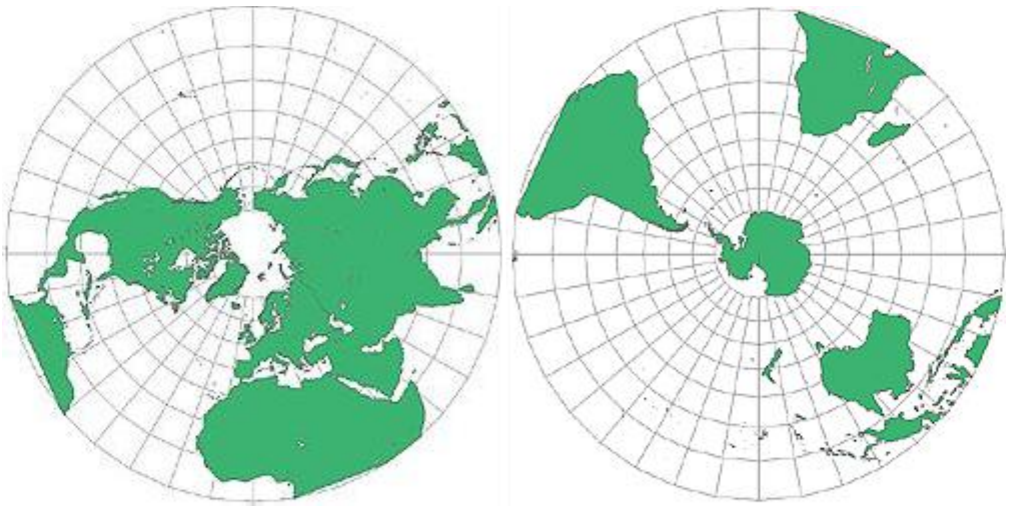
Method: Planar perspective projection, where one pole is viewed from the other pole. Lines of latitude are concentric circles. The distance between circles increases with distance from the central pole.

STEREOGRAPHIC POLAR ZENITHAL PROJECTION



Scale 1:200,000,000

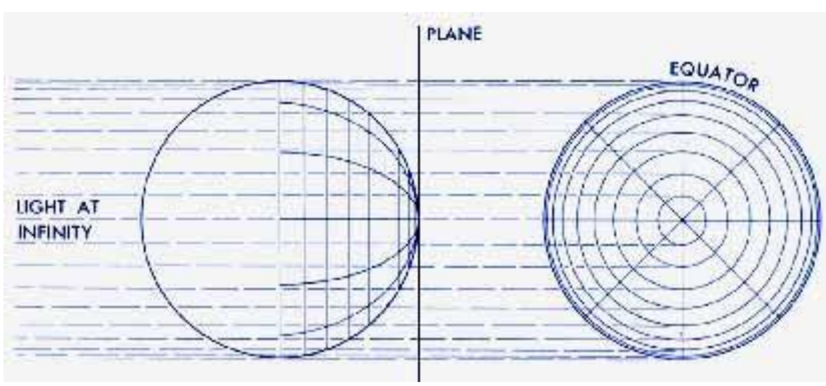
Graticule Interval 15°

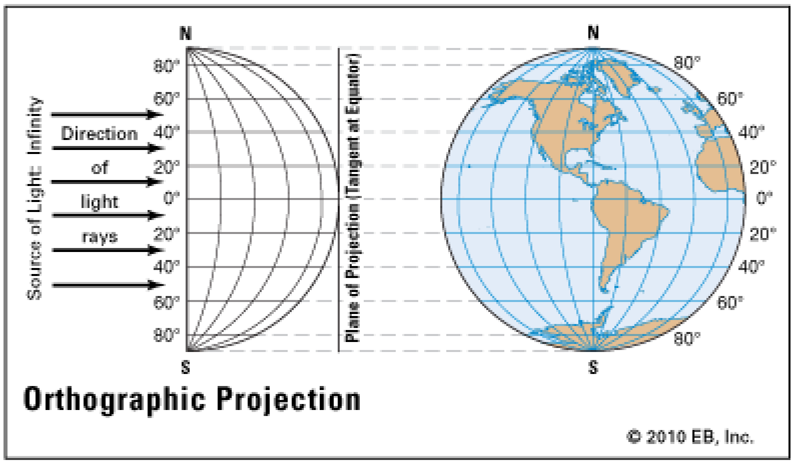


North Pole South Pole

Orthographic Projection:

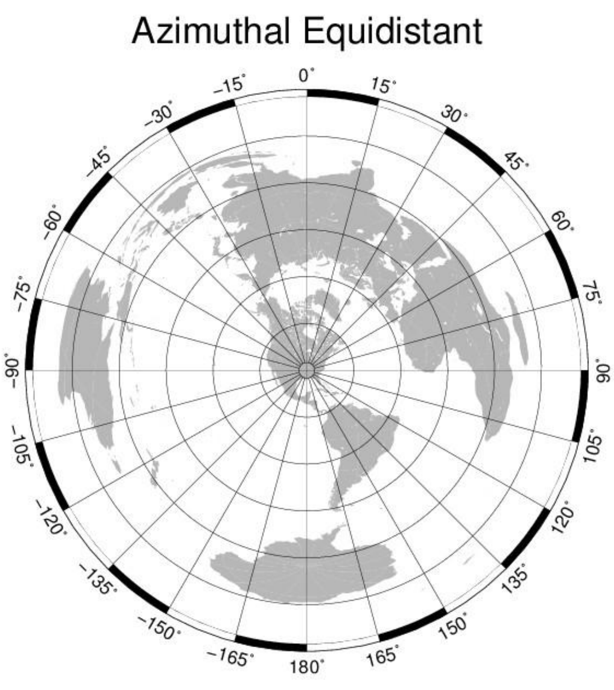
The orthographic projection is how the earth would appear if viewedfrom a distant planet. Since the light source is at an infinite distance from the generating globe, all rays are parallel. This projection appears to have been first used by astronomers in ancient Egypt, but it came into widespread use during World War II with the advent of the global perspective provided by the air age. It is even more popular in today's space age, often used to show land-cover and topography data obtained from remote sensing devices. The generating globe and half-globe illustrations in this book are orthographic projections, as is the map on the front cover of the book. The main drawback of the orthographic projection is that only a single hemisphere can be projected. Showing the entire earth requires two hemispherical maps. Northern and southern hemisphere maps are commonly made, but you may also see western and eastern hemisphere maps.

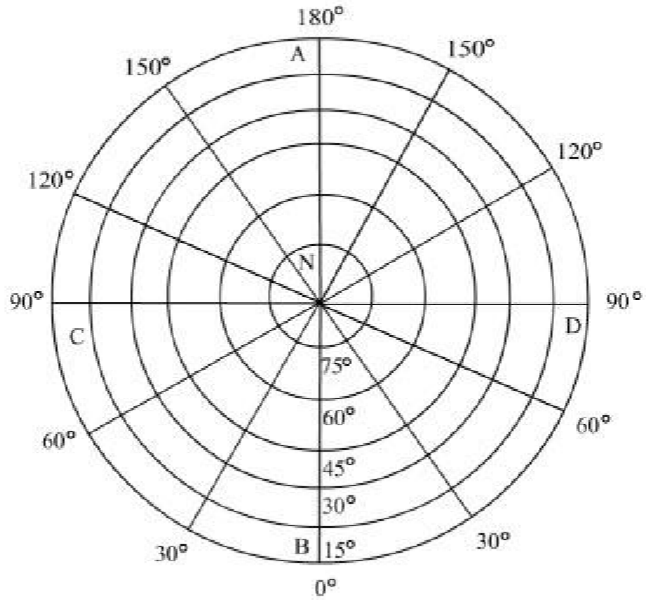




<u>The Azimuthal Equidistant Projection</u>:

The azimuthal equidistant projection is an [azimuthal map projection](). It has the useful properties that all points on the map are at proportionately correct distances from the center point, and that all points on the map are at the correct azimuth (direction) from the center point. A useful application for this type of projection is a polar projection which shows all meridians (lines of longitude) as straight, with distances from the pole represented correctly. The Nations contains an example of a polar azimuthal equidistant projection.



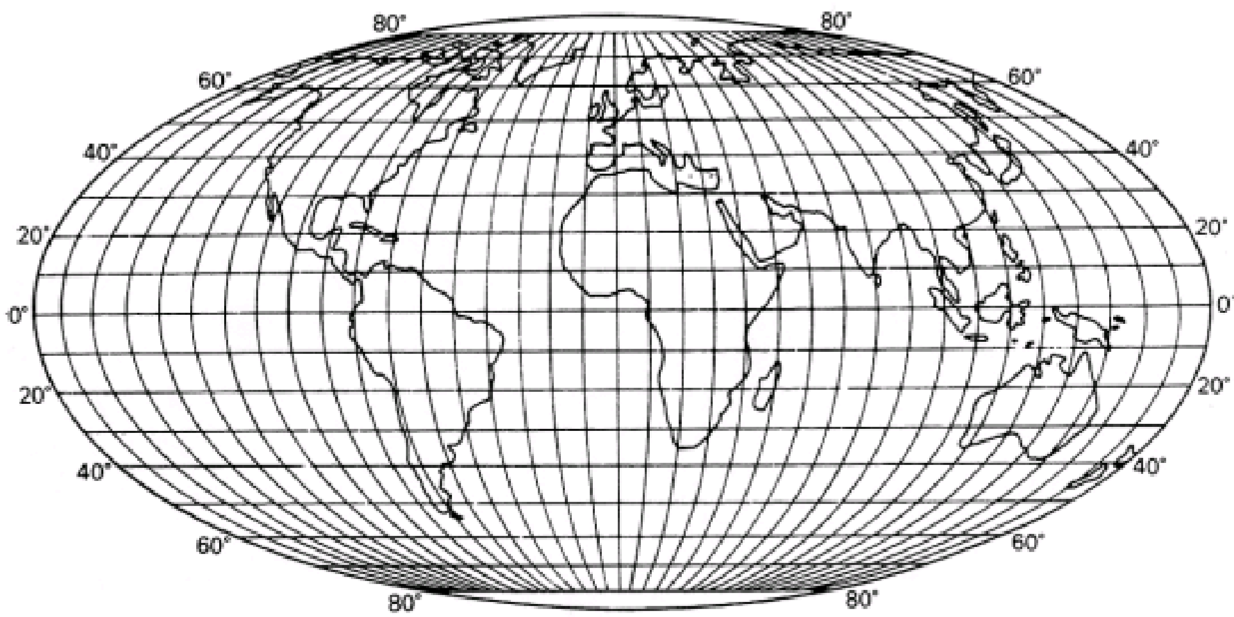


180°
150°
150°
A
120°
120°
N
90°
90°
C
D
75°
60°
60°
60°
45°
30°
30°
30°
B
15°
0°

1. **<u>Convectional Or Modified Projections:</u>**

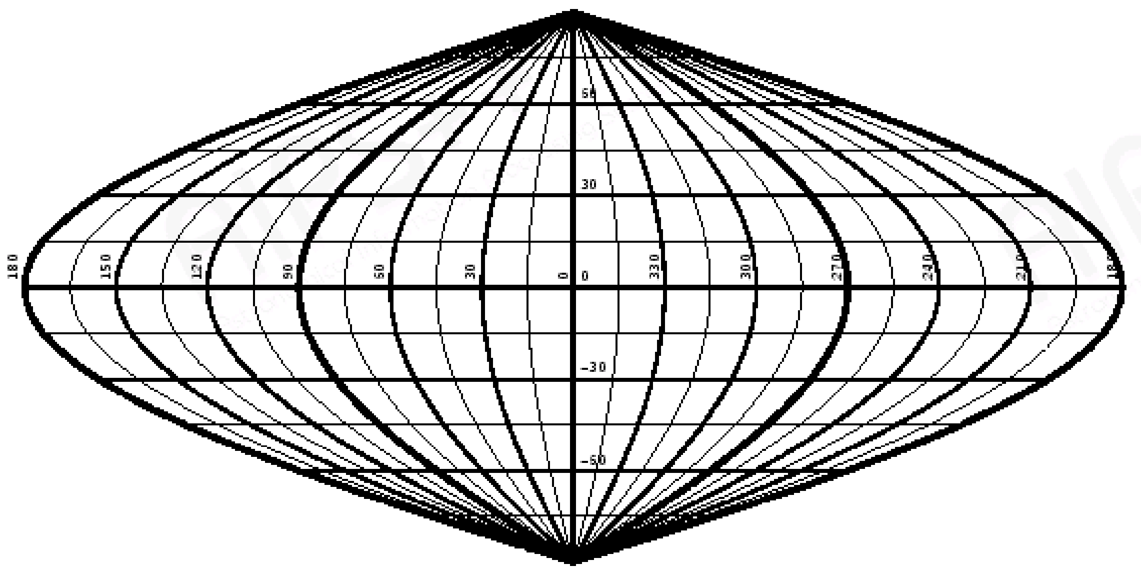
<u>Mollweide's projection:</u>

Mollweide Projection also known as the homolographic projection is a very commonly used example of a mathematical projection developed to correct some of the worst features of shape distortion in equal-area projections such as the cylindrical equal-area and sinusoidal projections. It is simply a mathematical response to the need for an equal-area projection formed within an elliptical frame in which the parallels are straight lines; the central meridian is one half the length of the equator. Although Mollweide's projection also suffers from the skewing of meridians as they are gathered together at the poles, it distributes shape distortions more evenly over the map and provides a more aesthetically pleasing map than does the plate carrée or sinusoidal projections. The Mollweide projection is widely used in atlases for mapping areal data and like the sinusoidal projection, Mollweide's often is presented in interrupted form to reduce overall shape distortion on single-sheet world maps. We might note here that cartographer J.P. Goode has developed a hybrid projection (the homolosine projection) formed by a sinusoidal projection from the equator to 40o and capped by Mollweide's projection in the higher latitude areas, thus retaining the best of both components and minimizing distortion overall.



The Sinusoidal projection:

The sinusoidal projection, also known as the Sanson-Flamsteed projection, is derived directly from the plate carrée by adjusting the equatorial length of parallels, and therefore the spacing of the 85 meridians, so that they are equal to their true values for the globe. The result is a rather aesthetically displeasing ellipsoidal outline pinched to a peak at both poles. Nevertheless, it has the virtue of a central region of minimal distortion rather than an equatorial strip as in the case of the plate carrée, for example. In fact, the sinusoidal projection retains the property of equivalence over the entire projection. This property follows from the theorem showing that parallelograms with similar bases drawn between the same parallel lines are equal in area regardless of shape. As an equal-area projection the sinusoidal projection is better than a cylindrical equal-area projection which has extreme shape distortion at high latitudes. A solution to the shape-distortion problem on the sinusoidal and certain other projections is to interrupt the graticule along selected meridians. Here several central meridians of low distortion are employed along with graticule breaks so that the overall shape distortion is reduced. But the result clearly is rather odd! Now we have a map which appears to have been torn into strips and furthermore it cannot be reformed to an uninterrupted version by cutting and pasting; adjoining sheets do not match well without boundary distortion. Nevertheless, if we are just interested in seeing well-shaped equal-area continental areas on the one projection, interruption can be confined to the oceans so that information loss and distortion is minimal. Certainly you will find examples of interrupted projections in most world atlases.



2. **Plain Table Survey:**

Plane Table Surveying is a graphical method of survey in which the field observations and plotting are done simultaneously. It is simple and cheaper than theodolite survey. It is most suitable for small scale maps.

Methods of Plane Table:

1. Radiation
2. Intersection
3. Traversing
4. Resection

Radiation:

This method is useful in surveying small areas which can be commanded from one station.From a station, the suitable is selected.Rays are drawn to various objects.The distance of the object from the station are measured and marked off on the ray.

Intersection:

In this method, the positions of the object on the plan are fixed by the intersection of rays drawn from two instrument stations.The line joining these instrument stations are called baseline.

Traversing:

This method is used for running survey lines for close or open traverse.This is the main method of plane table and is similar to compass or theodolite traversing.This method consists in running a traverse with a plane table; locating details by taking offsets in usual manner.

<u>Resection:</u>

This method is used for establishing instrument station on a plan with reference to two points already plotted on the plan.

9.2 The following accessories are required to carry out plane table survey:

1. Alidade

2. Plumbing fork with plumb bob.

3. Spirit level

4. Trough compass

5. Drawing sheets and accessories for drawing.

1. Alidade

It is a straight edge ruler having some form of sighting device. One edge of the ruler is bevelled and is graduated. Always this edge is used for drawing line of sight. Depending on the type of line of sight there are two types of alidade:

(a) Plain alidade

(b) Telescopic alidade

Plain Alidade: Figure 2 shows a typical plain alidade. A sight vane is provided at each end of the ruler. The vane with narrow slit serves as eye vane and the other with wide slit and having a thin wire at its centre serves as object vane. The two vanes are provided with hinges at the ends of ruler so that when not in use they can be folded on the ruler. Plain alidade is not suitable in surveying hilly areas as the inclination of line of sight in this case is limited.

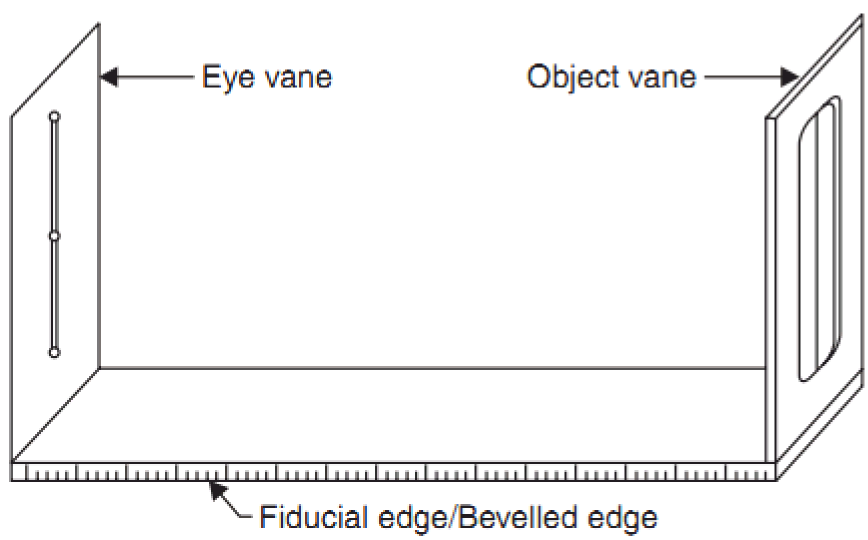


Fig: 2 – Plane Alidade

Telescopic Alidade: It consists of a telescope mounted on a column fixed to the ruler [Fig. 3]. The line of sight through the telescope is kept parallel to the bevelled edge of the ruler. The telescope is provided with a level tube and vertical graduation arc. If horizontal sight is required bubble in the level tube is kept at the centre. If inclined sights are required vertical graduation helps in noting the inclination of the line of sight. By providing telescope the range and the accuracy of line of sight is increased.

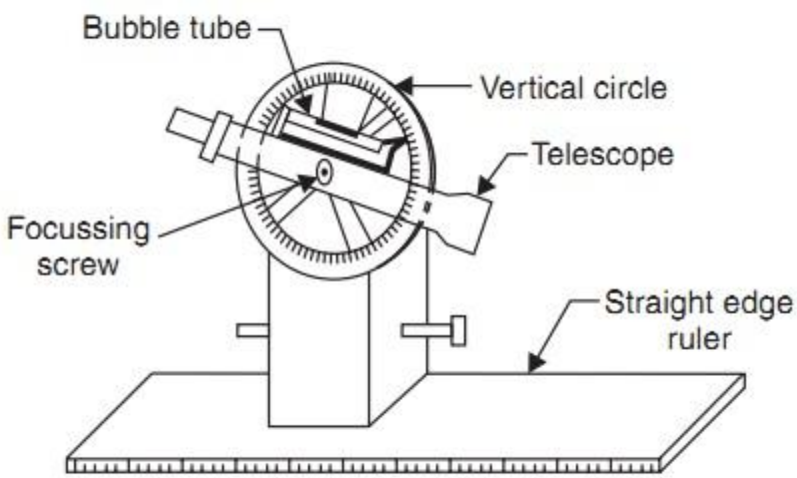


Fig. 3: Telescopic alidade

2. Plumbing Fork and Plumb Bob

Figure 4 shows a typical plumbing fork with a plum bob. Plumbing fork is a U-shaped metal frame with a upper horizontal arm and a lower inclined arm. The upper arm is provided with a pointer at the end while the lower arm is provided with a hook to suspend plumb bob. When the plumbing fork is kept on the plane table the vertical line (line of plumb bob) passes through the pointed edge of upper arm. The plumb bob helps in transferring the ground point to the drawing sheet and vice versa also.

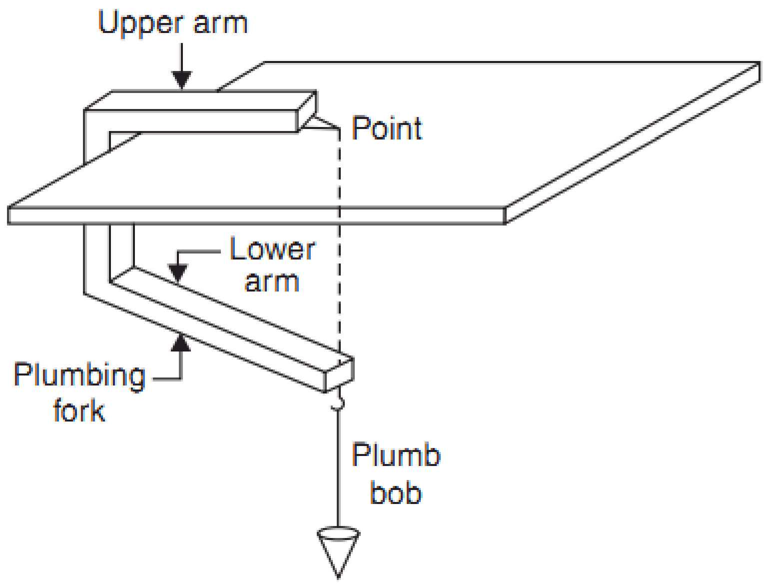


Fig. 4: Plumbing fork and plumb bob

3. Spirit Level

A flat based spirit level is used to level the plane table during surveying (Fig.5). To get perfect level, spirit level should show central position for bubble tube when checked with its positions in any two mutually perpendicular directions.

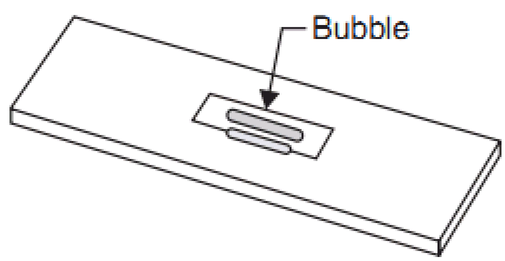


Fig. 5: Spirit level

4. Trough Compass

It consists of a 80 to 150 mm long and 30 mm wide box carrying a freely suspended needle at its centre (Ref. Fig. 6). At the ends of the needle graduations are marked on the box to indicate zero to five degrees on either side of the centre. The box is provided with glass top to prevent oscillation of the needle by wind. When needle is centred (reading 0–0), the line of needle is parallel to the edge of the box. Hence marking on the edges in this state indicates magnetic north–south direction.

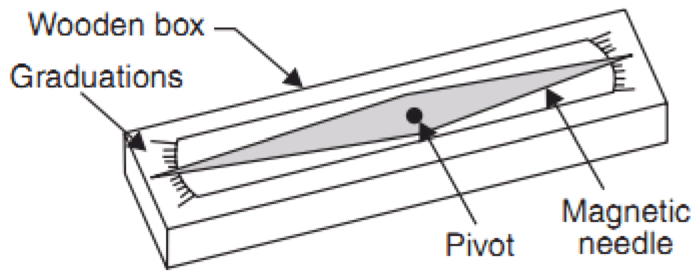


Fig. 6: Trough compass

5. Drawing Sheet and Accessories for Drawing

A good quality, seasoned drawing sheet should be used for plane table surveying. The drawing sheet may be rolled when not in use, but should never is folded. For important works fibre glass sheets or paper backed with thin aluminum sheets are used. Clips clamps, adhesive tapes may be used for fixing drawing sheet to the plane table. Sharp hard pencil, good quality eraser, pencil cutter and sand paper to keep pencil point sharp are other accessories required for the drawing work. If necessary, plastic sheet should be carried to cover the drawing sheet from rain and dust.