CARTOGRAPHY

MAP

Representation of the earth's patterns as a whole or part pf it or the heavenly bodies a plain surface

Amount of information can be represented on a map depending on the following.

(i). Scale
(ii). Projection
(iii). Conventional signs & symbols
(iv). Skill of draughtmanship / cartographer
(v). Method of map making
(vi). Requirement of eh user

Large the scale more the info

Frame work of the map - depend on the latitude - longitude

Kid also knows as gratitude

There are various tase by which we can prepare a map

1. By actual survey – by using instructs like prismatic, compass chain, taps, teodialite, plane tabbet
2. By photographs – by manless flights (Gird photographs, Ariel photographs)
3. Free hand sketches and diagram – no accuracy
4. Computer maps by using (R.S.S.) remote sensing satelitel digital mapping, Global positioning system.

History of Maps

300 years before Egyptians were the fast to prepare acceptable maps. But the foundation for modern cartography by Greeks and unquestionable till 16th cen Greeks recognised earth as spheroids c pole, c equator, c tropics, divided the earth into climatic zones (heuxbtus) sys. Of graticules, had the idea of projections.

Contributors

i. Anaximander (5th cen B.C) Gnomen
ii. Aristotle (4th cen B.C)

iii. Eratosthenes (3rd cen B.C)

iv. Hipparchus (2nd cen B.C)

Projection is modified

Polyclone projected (1:1 million)

- It took 2222 sheets to complete the entire globe
- Topographical maps are also known as toposheets

c). Wall maps – 'class room maps'

- used in cater to large audience
- used to represent continent & whole ctry, hemisphere
- Smaller than topographical but larger than atlas maps

d). Atlas maps / Chorographical maps

- Very small maps
- give a generalized picture, specifics are deft out mainly b/o lack of space
- Only main topographical features are depicted
- Eg. 1:150 km, 1:15, million i.e. 1:15000000

e). Classification bused on purpose

a. Astronomical maps shoring heavenly bodies
b. Orgraphic maps
c. Geological maps
    - Rock, structural geo
    - Mode of occurrence
    - Period of Rock formation
d. Daily weather maps
e. Senical maps
f. Climatic maps
g. Vegetation maps
h. Soil maps
i. Cultural maps
j. Distribution maps (popln maps)

- Distribution of diff objects of definite value that are grouped together

Eg Rainfall, Temp, popln, industries

- Represented in various forms based on
- Colours ➔ chorochromatic
- Symbols ➔ choroschematic
- Dots
- Shading
- Bar diagram
- Circles, spheres

Propleth maps – Joing equal lines

Chlorolpeth maps prepared on the basis of avg. no, offer unit area ex density of POP / unit area

<u>Scale</u>

Indicates the proportion at c dist betn 2 pts of on a map bears to the dist betn corresponding points on ground

<u>Scale depends on the following</u>

1. size of the area to be mapped
2. the amt of details required
3. size of paper

scale can be represented in 3 ways

i. By a stmt (statement)

   Eg. 1 inch on the map represents 10 miles on the grd or 3 inches to the mile

ii. Graphical representation

   - St Line is divided into a no of equal parts
   - One advantage can enlarge / reduce the map

iii. Rrepresentative fraction

   Numergor and Demominator have same unit of length

   Advantage (Adv)

   Foreign map can be compaired

$$R.F. = \frac{\text{Map dist}}{\text{Ground dist}}$$

Find R.F. when scale is 1”: 5 mile

1: 63360 x 5 1 mile = 63360”

1: 316800

Find R.F. when scale is 1:2 km (1cm = 2km)

1: 2, 00,000 1 km = 1, 00,000 cm

R.F. of a map is 1:2 milloin

Scale in terms of miles to inch

1: 2,000000 / 63360

1” = 31.6 miles

Spl types of scales

1. **Vertical Interval**

   Interval in c contour lines are drawn

2. **Horizontal Equivalent (H.E)**

   - dist beln 2 successive condowrn
   - length of H.E. will vary depending on the degree of slope
   - sleeper the slope smaller the H.E

3. **Squre roof scale**

   Geographical maps showing certain quantities in circular graph or pie chart

4. **Cube roof scale**

   Sphere diagrams (of volume is gn)

5. **Scale of verticals**

   For Arial photography where vertical or top pictures / photographs are taken

6. **Perspective scale**

   - used in landscape drawing
   - eg block diagrams or filed sketches

- user from forged to a vanishing pt in the horizon

7. **Diagonal scale**
   - to measure precise length
   - divide shorter lines into equal parts
8. **Venire scale**

   Dividing fraction into equal parts

   Enlargement or Reduction of scales

1. **Sqr Method**

   Map can be dividing into any suitable w/ws of sqrs

   - applicable mare in a fairly large area
   - side of a sqr was 2 cms & psed to 8 cm then area will psed by 16 times

ii) Similar a method

used to reduce or enlarge a narrow area such as Road, Railway, River, Canal

In sqr. Map R.F = 1

40,000000 is converted into

1: 80,000000 ➔ area reduced by 4 times

➔ sides reduced by 2 times

Map c R.F. ➔ 1: 63360 has been enlarged by 4 times then new R.F. = 1:15840 (cenlarged)

iii). Instrumental Method

Instrument – proportional compasses, pantographs, camera lucida, Photostats, eidographs

A proportional compass has & bass clamped together by sliding screw and a pair of needle points used in sqr and similar & method

Pantographs - 4 tabular bass

- freely hinged together to form parellogram

- use for reduction of plans (top view)
- charts, map (not used far enlarged)

Eidograph - 3 graduated bass

- 2 lled and one central horizontal bar
- More precise and moro reliable than pantograph
- Principle is based on similar as

Camera Lucida

- Based on principle of optics and photography
- Suitable for reduction of large map especially wall maps
- The distance from the drawing paper to prism is less than the dist from the prism tot eh original map to enlarge and vice versa (i.e reduction)

Measurement of Distance

(Stmt 1.5" = I latitude concert it into R.F)

Gn 1 lati = 69 mile = 111 km

1.5" = 69 x 63360"

1" = 69 x 63360

1.5

= 4371840

15

= 29.14560 1: 29.14560

1. If the lines are too irregular, conveniently divide into st. line
2. A piece of thread or wise can be used
3. By using opismeter

Opisometer - Instrument used for measuring irregular line

- It has small toothed wheel as the wheel relates dist recorded

- Form of Rolometer
- Can be used in plain surfaces

Measurement of Area

'Planimeter' – Invented by amster (swiss mathematician) simpler planimeter – Hatcher planimeter

Sea level – Datum plane

In India Datum plane is taken to be the mean sea level at spring tide at Chennai formerly it was at Karachi

Relief

Indicates variation in the nature of the land surface – includes the broad features and relative heights of highlands and lawlands

Representation – 3 ways

1. Pictorial
2. Mathematical
3. 1 + 2

1. Pictorial

Hachure – presenting relief by mean of sets of finely drawn disconnected lines c will indicate the direction of flow of water

- Line are thicker and closely drawn on sheep slopes and thin wide apart on gentle slopes
- Draw back – doesn't indicate absolute heights only indicate rough feature

Hill shading

Shade is gn on the base of

a). Vertical illumination

- Sheeper slope darker shade
- Flat areas – lighter shade

b). Oblique illumination

- Illumination frm one comer

- Help in finding angle of slope
- Idea is to find out direction of the slope & will not give any idea on relative steepness

2. **Mathematical Methods**

i) Spot height – gives actual heights of places above sea level fixed by survey

- These are shown by dots followed by no
- c represents height
- ground height is given

ii). Bench – Marks

Marks placed on building indication height above sea level by actual survey

iii) Trigonometric stations

- paints on the surface of the earth
- used as station for triangulation survey

iv). Control method

- std method of representing relief
- Imaginecy lines on the ground joining places of same heights above sea level
- Pts are fixed by accurate survey
- Process is time consuming and costly (but present situation is not too much costly b/o global positioning sys)

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Satellite bases hard used computer system

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24 satellites

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Can be seen 4 at a time

(Stated in 1994)

- Contours are used as a basis for showing other relief

v). Form lines – Approximate contours

- Shown in broken lines
- Help to understand minor details of topography

  (c is not shown in contours maps)
- Normally done by eye sketching

Various contours features

Maintain – Height more than 300 feet above the surrounding landscape

Hill – less than 300 feet & greater than 500 feet slops & gradients

Slope

Uniform slopes – Contours are evenly spaced

Concave slopes – Contours are close together near the top of the hill and Further apart downwards

Convex slope - Contours are closest at any other point than the top

Undulating slope – spacing of contours are variatle

Gradient – Amt of veritical rise of a land in reln to horizontal equivalent

<u>Intervisibility</u>

- whether a distant pt is visible from another pt
- hidden area from line of sight is known as dead ground
- if 2 pts are on the same plains inervisibility depends on obstructer in betn
- if 2 pts are across a river valley - visible
- if 2 pts are either side of valley – visible
- if slope of the line joining 2 pts is concave – visible
- convex – not necessary intervisible

<u>Interpolation pf contour</u>

Drawing contour lines on a map when spot heights are gn

About contour

- contour line join adjacent places
- contours of diff elevation do not cross each other
- in case of diff, waterfall, inscarpent the contour seems to merge but it will cross
- contour lines of same elevation cannot merge & continue as same line
- spacing contour lines indicates nature of slope
- for a hill high contours are closely placed
- a depression low contours are closely placed
- contour line should close on itself on a map or it should begin at one edge and end at another
- it can either slop within the map nor end inside the map
- in case of ridge – contours either run ll^{el} to each other or they are enclosed at the top or vice-Aversa for valley

profiles

- created to analyse slope & relief
- the area study may be magined as cut into thin slicer at intervals and series of profiles of lled line may be drawn for clear understanding of platforms

Serial Profile

- a no of ll^{el} lines drawn on a map and series of profile are shown

Superimposed Profile

- if all the slopes are traced on a single frame then such profiles are knows as super imposed profile

Projected Profile

- careful superimposition
- position of each profile c comes below the succeeding one is left untraced

Composite profile

- it will show only ruggedness of skyline
- it is constructed to represent the surface as viewed in horizontal plain of summit levels from an infinite dist

Went worth method

General and random method far avg slope determination

Smith's Relative Relief method (Guy – Harold Smith)

Raisz and Henry improved on smith's relative method

Raisz – Co-efficient of landscape

A.H.Robinson – devised a method c quantitatively accurate relief maps showing slope variation was made

Slop Analysis - 2 x devices

1. Hypsographic – proportion of the area of surface at diff elevation above or below the datum lines
2. Altrimetric frequency Curves

   Involve the computation of frequency of occurrence of height above sea level and plotting on the paper

Block diagrams

- To show diff types of landforms and their evolution
- Given by G.K.Gilbert
- Perfected by W.M.Davis
- Diagrammatic & 3-D
- Advantage simple to understand

Topographical maps in India

- Survey started in late 1000
- Country is mapped on scale of 1, 2, 4 miles
- To an inch 1 mile to an inch

  1 mile to 2 inch

  1 mile to 4 inch
- Most map was 1: 10,00,000

- 2 series - i). India & adjacent countries series

  ii). International series of La carte

  International 'du-monde'

<u>India & adjacent series</u>

- Includes Afghan, Nepal Pak, Bhutan & adjacent countries
- These are 4' x 4' series

  Each block of 4' x 4; has been numbered
- For referring – sheet no is used known by dominant or important city (EG Srinagar sheet or no 83 sheet)
- Colours are determined

Letters	-	black
Wat	-	bluc
Contour	-	brown
Roads	-	red
Towns		

- These are 1: 1000,000 maps

  1" : 15.56 miles
- Each sheet is farther divided into 16 parts & named as A,B,C,D, ….. P

  i.e. Srinagar sheet having no 53 then each part of its division is represented as 53A, 53B, 53C, …. 53P

  Each small block is of 1 scale

  Block scale is 1" : 16 mils

  ¼ " : 1 mile

  They are known as 'Quarter inch maps"

1' - contours interval 250 feet

- A,B,C,D further divided into 16 parts 53A/1, 53A/2, ….53A/16

<u>Climogram / Climograph -</u> Griffith Taylor

- Temp & relative humidity is considered

- 12 sides – each side represent 1 month mean monthly temp relative humidity is taken
- Each corner is named
- Basically made to give an idea about Europeans who wanted to settle in far – off place
- If temp below 40^o F & relative humidity > 70%
- RAW ➔ Temp = 40^o F, R.H. > 70%
- SCORCHING ➔ Temp >60^o F, R.H.<40
- KEEN ➔ Temp <40, R.H.<40
- MUGAY ➔ Temp >60, R.H.<70

Climography – scale of habitability

Hot Desert – Scorching

Cold Desert – Keen

Hither Graph – 12sided fig

- Avg monthly temp & R.H
- To compare climatic characters of diff regions c affects the cultivation
- Stared during colonial period

Egograph

- Graphical Representation of statistical data to show reln ship bet n season, climate & crops
- Cycle of plant growth closely corresponds to season
- Diff season come c diff climate and crops
  - i). Annual crop
  - ii). Bimanual
- Show many variable

Band Graph

- Compound or Aggregate line graph
- Shows trends of values in % age / no/ quantity in both total or in parts by a series of line drawn on same frame

Compound pyramids d(or Popln pyramids

- Sex & Age structure
- Growth & occupational structure

Cartogram

- Representation of statistical data on map in a diagrammatic way by purposefully distorting the original shape or appearance of area

Rectangular Cartogram

Rectangle are made to follow outline of subdivision so that of there be need the outline of region c its subregions may marked easily.

PROJECTIONS

A globe cannot be presented accurately on a plain sheet blo converting 3Dpicture into 2D is difficult c involves 3 issues

1. **Shape**
2. **Area**
3. **Direction**

So on plain paper we can assure only 2 issues for this globe is useful

Problems c Globe

1. Otherside cannot be seen
2. Globe can be made on small scale only
3. Portability is not that much easy

A concept called developable surface and non developable surface c can or cannot fold into a small space.

Developable surface

- Can infold into a flat surface
- Cone and cylinders are developable
- Spheres are indevelopable while pasting definitely wrinkles should be there
- Our task in map-making is complicated b/o sphere c is underelopable

Types of Projection

A. On the basis of method of construction

i. Perspective Projection Src of light is used in the map making

ii. Non-perspective Projection

i). **Perspective Projection using light 3 types**

1. **Gnomonic – Light is in the centre**
2. **Stereographic - If light is placed opposite side of the place**
3. **Orthographic - Rays coming from infinity**

In perspective projection longitude & latitude & small division on a grid is known as Graticule

ii). **Non-Perspective**

- Light is not used
- Mathematical calculation are used for development

B. Based on the developable surface used

i. Conical

ii. Cylindrical (eg. Mercator's projection)

iii. Azimuthal / Zenitahl – developable surface is plane

iv. Connectional (mathematical projections)

- Uses a no of developable surface
- Border of cone touches on only one latitude other portions having some distortions
- The latitude along c cone touches known as std ll^{el} . We tried to have more std ll^{el} so it becomes a multiconical / conventional projection
  Eg of Conventional projection is
  Bonnes Projection, Multiconical Projectin.

C. Based on preserved qualities

i. Homolographic - ensure that area is not distorted
- Equal area projection.

ii. Orthomorphic - ensure that shape is maintained

- Also known as conformed / shape

iii. Azimuthal (or) Bearing

- ensure the direction

iv. Equidistant

- based on the concern of perfect distance preservation

D. Based on the position of the tangent surface

i. Equatorial or Normal Zenithal – sheet is placed vertical, touching the equator

ii. Oblique (at any angle)

(Developable surface we used is a sheet)

iii. Polar – sheet is placed on poles ll^{el} to equator

E. Based on the position of the light

i. Gnomonic

ii. Stereographic

iii. Orthographic

F. Based on the geometric shape of the final sheet

i. Rectangular

ii. Circular

iii. Elliptical

iv. Butterfly shaped

- Cylindrical Projections are suited for law latitudes (equatorial areas)
- Conical Projections – suited for middle latitudes
- Zenithal Projections – Polar regions

Both zenithal & cylindrical projections are variables of conical projections

If we se the angle of conical projection to 180

It will become zenithal & reduced to 0^{o} it will becomes cylindrical

1. Zenithal

- Direction is ensured
- Bearing is maintained

- 2 types

1. **Perspective**

3 types

2. Non perspective

1. Stereographic polar zenithal
2. Gnomonic polar – Z
3. Orthographic polar – Z

a. **Stereographic – Polar Zenithal projection**

- light is on one pole & sheet is on opposite pole
- meridians - Str lines
- latitudes – circular / concentric circles
- distance b/w motions towards equator
- length of latitude is towards equator

  (As we move away form centre)
- distorted view as shape will be there as we move away from the centre
- shape will be maintained for the small areas near the centre
- it is both azimuthal and conformed (slightly more than equator)
- commonly used for hemispherical maps

b. **Gnomonic Polar zenithal projection (light at centre)**

- Also known as great circle sailing chests
- The shape of meridians' and 11els enormously outward from the map centre
- Impossible to draw map on one hemisphere boos equates become infinite
- Suited for small areas around the pore
- Also used in air navigation – all great circles are str times and short list bet 2 pts can be directly seen (sheet no 3 fig 2011)
- Rhomb line – line along c dir is donaintained also known as loxodromes

C. **Orthographical polar zenithal (light from infinity dist)**

- Parallels or latitudes crowed together near the outer margins

- Largest possible piston of a globe c can be shown is a hemisphere
- Parallels or latitudes crowd together near the outer margins
- Give clear picture
- Very similes to the photograph of the globe
- In Books, Articles, Illustrations it is used because looks like a photograph
- Astronomical purposes

Normal zenithal projections

- Latitudes grand nears the post
- Meridians will be elliptical in shape
- Used in studying the astronomical maps
- Astronomers used to see the position of heavenly bodies every time on such a map

NON-PERSPECTIVE

a. polar – Zenithal exult – area projections

- Designed by lambent
- Dir is maintained in zenithal and we are trying to maintain area also
- 11es are concentric circles
- Meridians have true or prefect angular dist
- To maintain the area we are forcing to reduce the spacing

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Circles of latitudes become closes away from the poles to maintain area

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Equal – area projection or Lambert projection

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b. Polar – Zenithal equidistant projection

Azimuthal equidistant projection

- Dir or dist is maintained
- Meridian are equidistance

- Arbitrary projection
- Not a perspective projection
- In any case llel can never to be equidistant
- Near poles can be used for smaller areas around 30^{o} latitudinal extent (for Artic circle)

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Dist & dir are perfect

c. <u>Stereographic Normal Zenithal</u>

- Light, opposite side, sheet touching the equater
- Orthomorphic
- Central meridian and equator are to each other (st. lines) other ll^{el} and meridians are carved lines

CONICAL PROJECTION

a). Conical perspective

- Touch the globe on one std ll^{el}
- If std ll^{el} is the slope
- Meridians are st. lines radiating from common centre
- Scale can be preserved only along std ll^{el}
- If the std ll^{el} is 30^{o}, the shape of the map will be a semi-circle
- If the std ll^{el} is $<30^{o,}$ the shape of the map will be more than a semicircle
- If the std ll^{el} is $> 30^{o}$, the shape of the map will be less than a semicircle
- If con show more than a hemisphere
- Limited utility it has to be adjusted mathematically
- Suitable to that area having less than 20o latitudinal extent especially those countries ties in mid-latitudes
  (Baltic, States, Ireland etc)
- Used first time by Ptolemy

b). Modified conical perspective projection (non-perspective) c two std ll^{el}

- Neither the cone, touches the sphere nor cuts the sphere

- Instead tow circles of the cone corresponds to the two respective ll^{el} of the globe and form o ordinary cone independent of the globe
- Neither equal area nor orthomorphic (shape)
- Suitable for mid-latitude countries c small latitudinal extent. So that 2/3 rd of the N-S extent of the ctry should lie within the 2 ll^{el}
- Eg to show trans Siberian Railway

c. **Polycmic projection**

- Multiple std ll^{el}
- As many cones as the circle of latitude to c they correspond
- Latitudes are not concentric circle a in case of simple conic / Bonne's projection
- Neither conformal nor equal area
- The scale in true along the central meridian and all parallets
- Good for maps of Europe toposheets international maps
- Not suitable for more than 60^{o} latitudinal extent

d. Boonne's projection (non-perspective)

- All ll^{el} true to scale with one ll^{el} as std along c it can be drawn
- Equal area projection – LAMBRTS
- Projection (Shape) is conformal along central meridian
- All ll^{el} are equispaced and drawn as axcs of concentric circles from a common centre
- Modified version of simple conic projection
- Suitable for drawing single continent except Africa
- (For Africa, Sinusoidal prohjection is used c is a spl case of Banne's projection where equator is taken as std ll^{el})

c. Conical equal area projection c one std ll^{el} (or)

Lambert's conical equal area projection

- Parallels are arcs of concentric circles
- Meridians are radial st. lines at equal angular intervals

- ll^{el} intersect to meridians
- Scale along the std ll^{el} is correct
- ll^{el} are unequally spaced
- Scale along ll^{el} exaggerated
- Exaggeration away from std ll^{el}
- Scale along meridian is minimized
- Widely used in world aeronautical charts exp. USA coast and Geodetic survey
- ll^{el} are deliberately spaced to ensure conformal properties
- if we take std ll^{el} as 33^o a or 45^o then scale of error is only 0.5%

  (No need for any gnemonic projections in mainland USA)

CYLINDRICAL PROJECTIONS

i. Natural cylindrical projection or Gnomonic perspective

- Cylinder wrapped around the Globe touching the equator
- Meridinal and ll^{el} scales are exaggerated away from equator true only along equator
- Poles cannot be shown
- Not useful for any purpose

ii. Simple cylindrical projection (non perspective)

- Cylindrical equidistant are kept equidistant
- ll^{el} lines & RT angles
- Lngth of all ll^{el} are equal to equator
- All meridians are the length half that of equator
- Sale along equator is true
- Latitudinal length away from the equator
- Along meridians scale is true
- Exaggeration of area towards poles as well as great distortion of shape towards pole

- Neither orthomorphic nor homolographic

iii. Cylindrical equal area projection (Lambert's)

- Deceived by using ll^{el} light rays (orthographic)
- Longitudes & latitudes str lines for to each olier
- Areas are made equal at the cost of great obliteration in shape towards higher latitudes
- Meridians are equally
- All ll^{el} have same length
- Orthomorphic only near equator
- Used to show distribution of commodities
- Dist bet ll^{el} goes on towards the piles

iv. Mercator's Projection

- Cylindrical orthomorphic projection
- Shape is maintained
- Most popular for world map
- 1st map used fro navigation
- ll^{el} & meridians as to each other
- dist betn ll^{el} towards poles
- meridian are equidistant
- Scale is considerately towards poles
- Orthomorphic and azimuthal
- Greenland appears to be bigger than South American
- At 68 area is 4 times and 75^{o} area is 15 times 80^{o} → 33 times exaggerated
- Projection is used to show only upto 80^{o} ll^{el}
- Any line we draw it will cut equal c longitudes & latitudes – Rhomb lines – loxoderms
- Used for navigation

- Suitable for showing ocean currents wind system dirs, navigation routes, drainage pattern, political map
- ll^{el} & meridian c with same proposition

v. Homolosize – Goods projection

- Combination of sinusoidal & molleweide proj
- Equal area
- Molleweid's is homolographic for pole ward regions
- Sinusoidal is homolographic for equational regions

So towards pole – mollweide

Towards equator – sinusoidal

Eckert iv projection

- Equal area
- Meridian are ellipres
- ll^{el} equally cut by the meridians
- poles are shown as half the length of equator

v). **Samson Flamstend Projection (Sinusoidal) conventional**

- Used sine curves
- Mollification of cylindrical equidistant and Bonne's Proj
- Each ll^{el} is tree to scale and is divided in equal dist division by meridians
- Equator as std ll^{el}
- Std meridian as st line
- Equal area
- All ll^{el} and std meridian are str. Lines
- Great distortion along the margins of the globe
- Suitable for equatorial cries small E – W & N- S oxen distribution maps, Africa, South America

Mellweide's Projection (Elliptical Projection) conventional

- Equal area
- All ………………………………

- Spacing does towards poles
- Easily recognized by the ellipsoid boundaries
- All meridian except central at the 90^{th} one form ellif
- So called elliptical projected
- Used as distribution maps
- Distortion in shape towards the margins nut less as compare to sinusoidal

Gall's Projection – 45 ll^{el} true to scale

- Stereographic, cylindrical, Similar to Mercator's projection
- Dist betn ll^{el} towards the poles but not so much as in Mercator
- Net an equal more projection
- Cylinder thus halfway (i.e.45^{o} – N.S)
- Used in Gen. purpose world map.