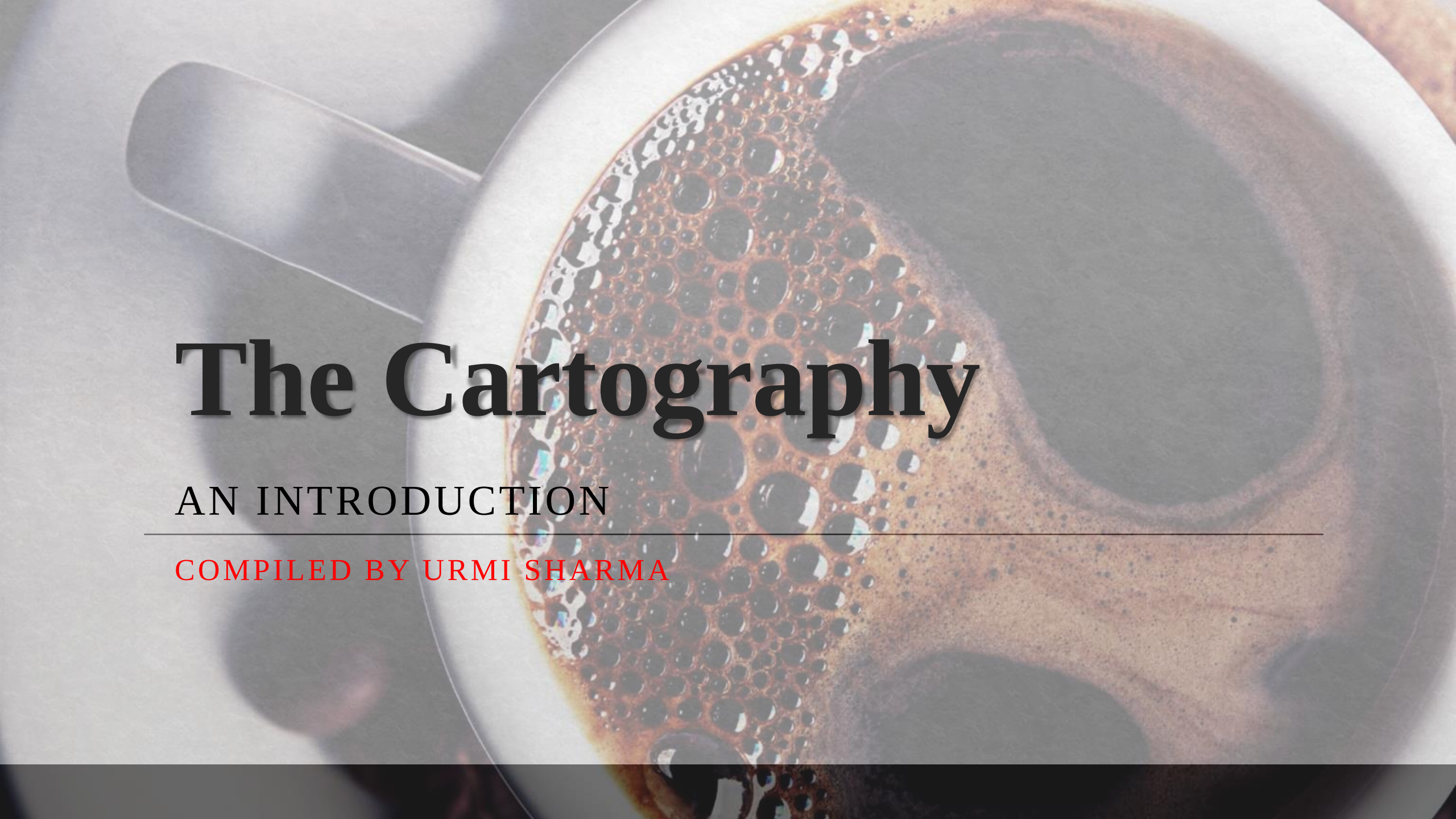


The Cartography

AN INTRODUCTION

COMPILED BY URMI SHARMA

1. Do you use **Google maps**?
2. Have you ever explored **Google Earth**?
3. Have you seen any **toposheet**?

Introduction

- **Cartography, the art and science of graphically representing a geographical area.**
- Map making involves the application of both **scientific** and **artistic** elements, combining graphic talents and specialized **knowledge** of compilation and design **principles**.
- **Maps function as visualization tools for spatial data.**
- **Spatial data** is stored in a **database** and extracted for a variety of purposes.
- The **traditional analog methods of map making have been replaced by digital systems** capable of producing dynamic interactive maps that can be manipulated digitally.

(The world of GIS – Geographical Information System)

Introduction…

- Modern Cartography like many other fields of "information technology" has undergone rapid changes in the last decade.
- **Rather than merely drawing maps** the cartographic process is concerned with **data manipulation, data capture, image processing and visual display**.
- Cartographic representations may appear in **printed form** or as **dynamic images** generated on a computer display screen.
- Computer assisted mapping systems have added a new and exciting dimension to cartographic techniques and traditional methodologies have to be augmented with new skills.
- The **fundamental nature of cartography has changed with the evolving technologies**, providing cartographers with **new methods for visualization and communication of spatial information**.
- Combining **science, aesthetics, and technique, cartography** builds on the premise that reality (or an imagined reality) can be modeled in ways that communicate spatial information effectively.

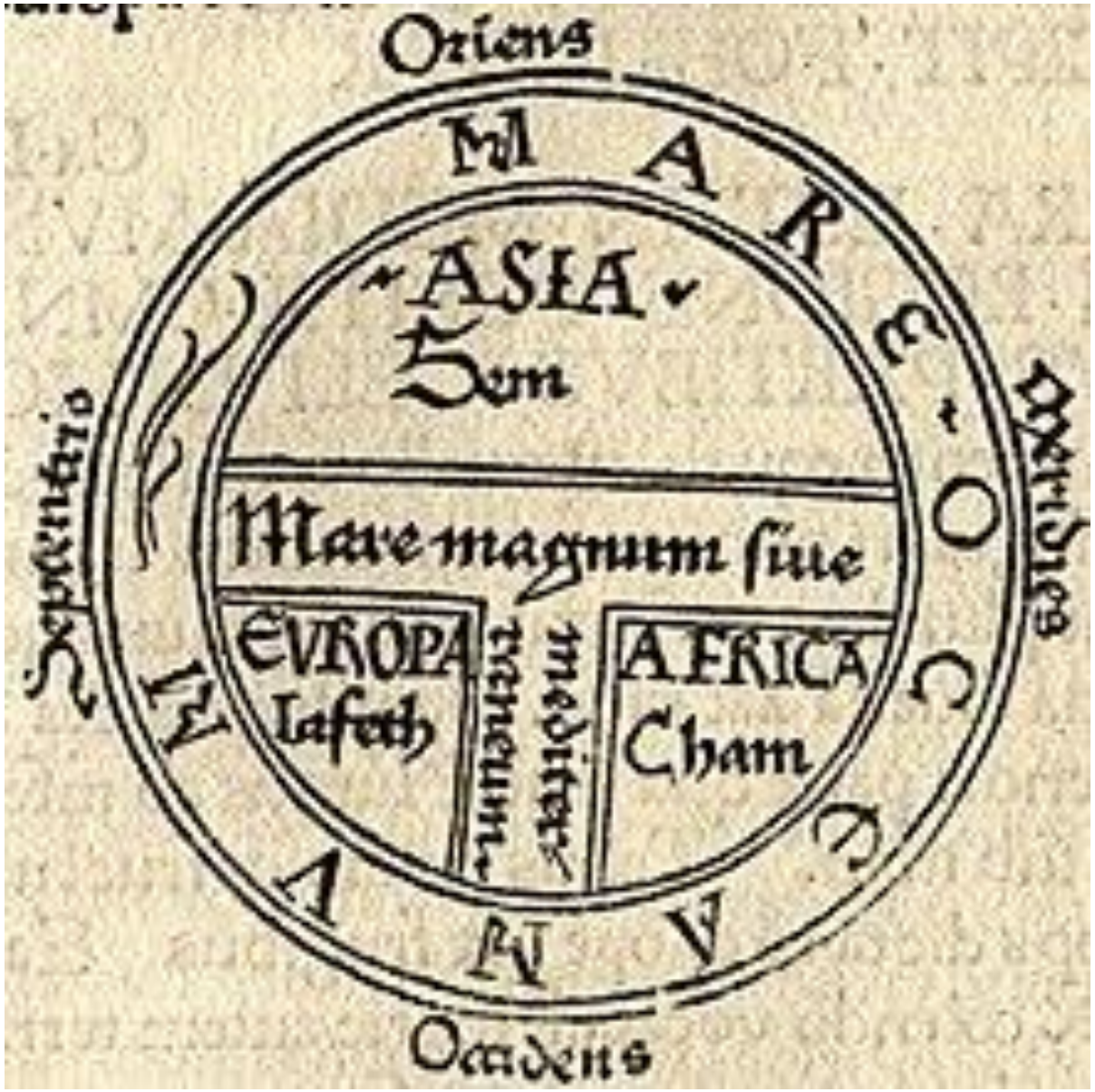
Ptolemy's map of the world

Nautical chart by Pedro Reinel (c. 1504) is one of the first based on astronomical observations and to depict a scale of latitudes

A 1730 world map as drawn by Stoopendaal for publication in the Keur Bible

History of Cartography

- Cartography is an **ancient discipline** that dates from the prehistoric depiction of hunting and fishing territories.
- The **Babylonians mapped the world in a flattened, disk-shaped form.**
- Claudius Ptolemaeus (**Ptolemy**) in the **2nd century** CE showed a **spherical Earth.**
- Maps produced during the Middle Ages followed Ptolemy's guide
- **Those representations are often called T-maps because they show only three continents (Europe, Asia, and Africa), separated by the "T" formed by the Mediterranean Sea and the Nile River.**
- More accurate geographical representation began in the 14th century when portolan (seamen's) charts were compiled for navigation.



Mappa Mundi (Map of the world)

T in O map

During these **Dark Ages in Europe**, **Arab scholars kept scientific cartography** alive.

They preserved the works of Ptolemy and translated them to Arabic. Arab cartographers produced the first reliable globe of the Western world.

- In the 15th century, cartography in Europe improved.
- The development of **printing** and **engraving** meant maps that had previously been painted by hand could be copied more quickly.
- **Around the same time, sailors began traveling farther on the oceans.**
- **They added newly discovered lands and more detailed coastlines to their maps.**
- **Explorers brought back descriptions of the interiors, as well as the coastlines, of continents.**
- The **discovery of the New World by Europeans** led to the need for new techniques in cartography, particularly for the systematic representation on a flat surface of the features of a curved surface—generally referred to as a projection (e.g., Mercator projection, cylindrical projection, and Lambert conformal projection).
- During the **17th and 18th centuries** there was a vast outpouring of **printed maps** of **ever-increasing accuracy and sophistication**.
- **Systematic surveys** were undertaken involving **triangulation** that greatly **improved map reliability and precision.**
- Noteworthy among the scientific methods introduced later was the **use of the telescope for determining the length of a degree of longitude.**

Modern cartography

- Modern cartography largely involves the use of **aerial** and, increasingly, **satellite photographs** as a base for any desired map or chart.
- The procedures for **translating photographic data into maps are governed by the principles of photogrammetry** and yield a degree of accuracy previously unattainable.
- The remarkable improvements in **satellite photography since the late 20th century** and the general availability on the internet of satellite images have made possible the creation of Google Earth and other databases that are widely available online.
- **Satellite photography** has also been used to create highly detailed maps of features of the **Moon** and of several **planets in our solar system and their satellites**.
- In addition, the **use of geographic information systems (GIS)** has been indispensable in expanding the scope of cartographic subjects.

Map

Graphical representation of the earth surface on a plane surface drawn to some scale is known as MAP.

- Tools of geographers
  - Scale
  - Projection
  - Legend/ Index
  - Directional Element: North Arrow
  - Title

Map Elements

TITLE

- The title of your map should tell basic information about the map, such as the area represented.
- "***What? Where? When?***"
- Basic information about the map: Date, Area,

LEGEND

- also known as the key
- it explains what symbols that are used on that particular map represent, such as symbols for major landmarks.

Map Elements

GRID/ PROJECTION

- Most commonly represents the geographic grid system, or **latitude** and **longitude** marks used to precisely locate specific locations.

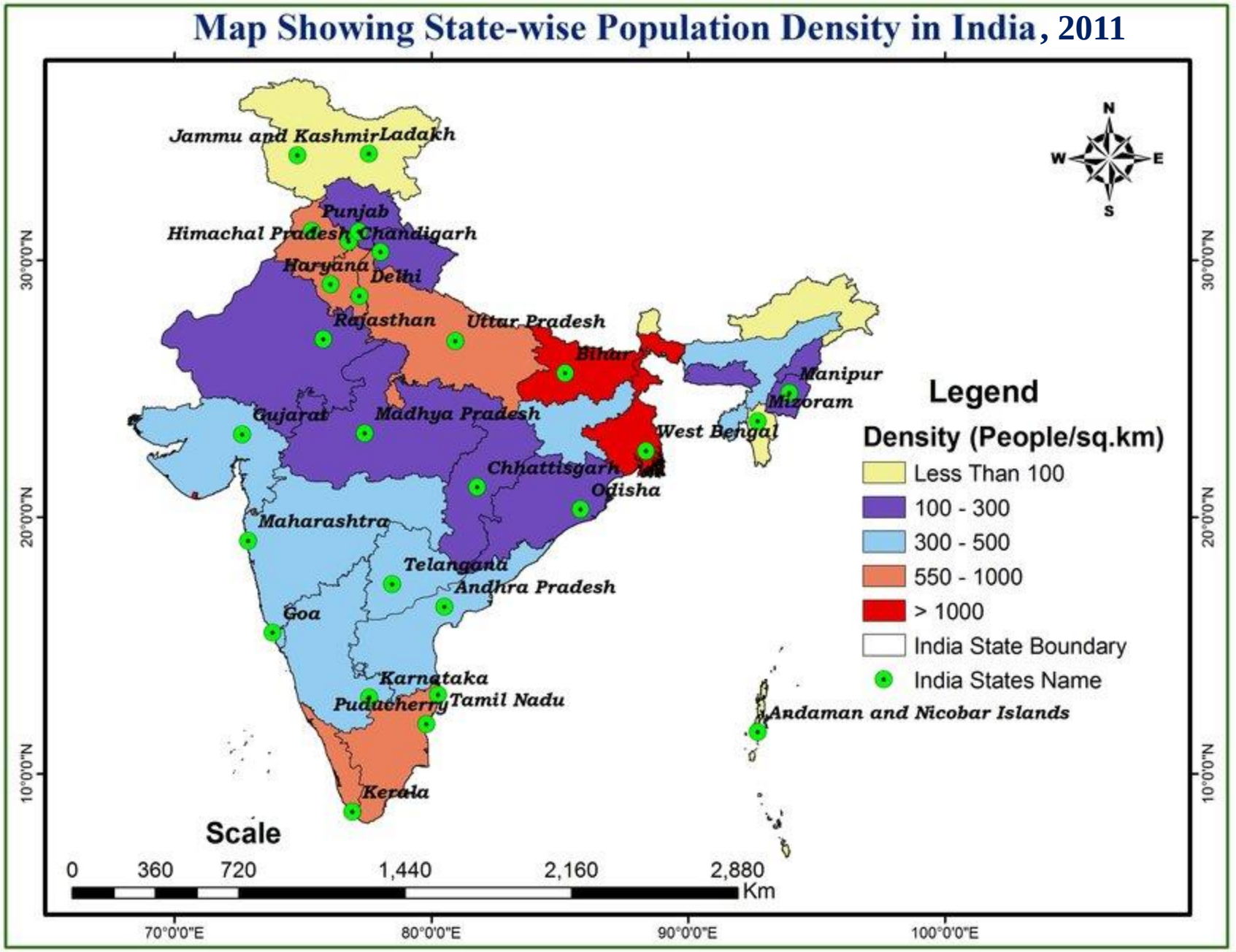
DIRECTION

- A compass rose or some other symbol, is usually going to be present on the map to indicate the cardinal directions of **north, south, east, and west**.

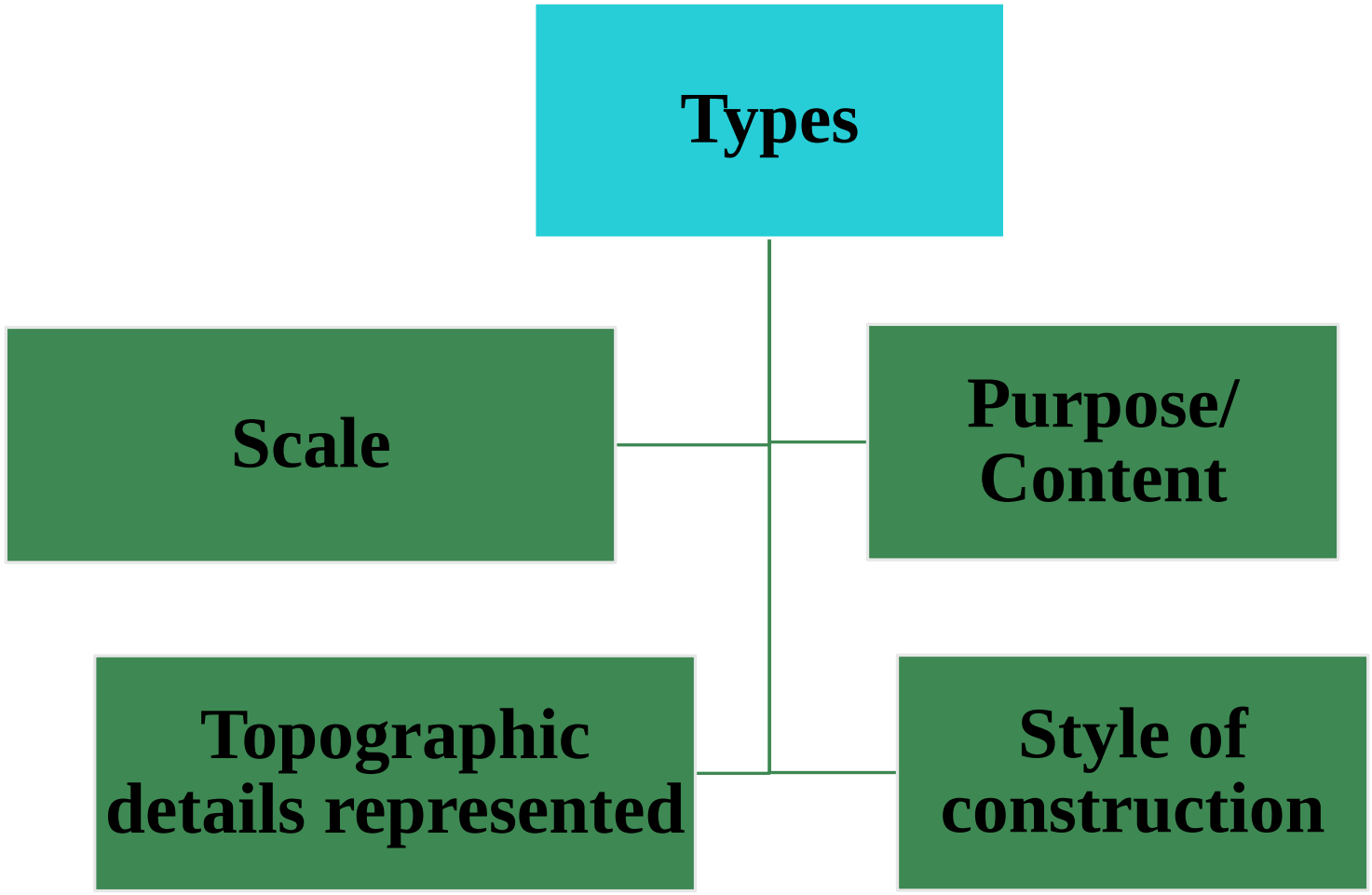
SCALE

- A scale shows the relation between a certain distance on the map and the actual distance in real life.
- A scale is just going to tell you what the measurement that you can do on map, in centimeters or inches, is going to be equal to in terms of real life measurements of feet or yards or miles depending on how large of an area your map is representing.

So the five elements that you should see on any map and be able to identify, are the title, legend, grid, directions, and scale


Map Showing State-wise Population Density in India, 2011
Jammu and Kashmir
Ladakh
Punjab
Himachal Pradesh
Chandigarh
Haryana
Delhi
Rajasthan
Uttar Pradesh
Bihar
Manipur
Mizoram
Gujarat
Madhya Pradesh
West Bengal
Chhattisgarh
Odisha
Maharashtra
Telangana
Andhra Pradesh
Goa
Karnataka
Puducherry
Tamil Nadu
Andaman and Nicobar Islands
Kerala
Legend
Density (People/sq.km)
Less Than 100
100 - 300
300 - 500
550 - 1000
> 1000
India State Boundary
India States Name
Scale
0 360 720 1,440 2,160 2,880
Km
N
W
E
S
30°0'0"N
20°0'0"N
10°0'0"N
70°0'0"E
80°0'0"E
90°0'0"E
100°0'0"E

Classification of Maps



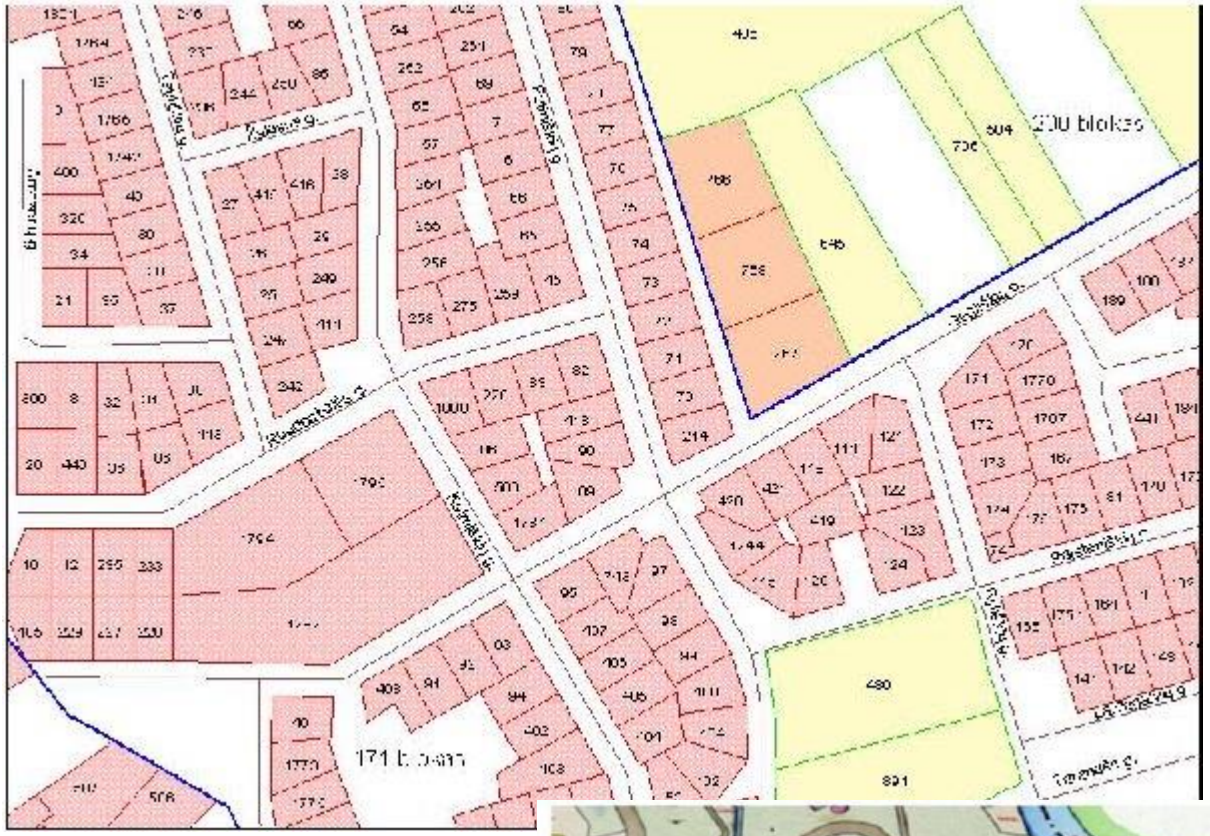
Scale

1. **Cadastral Maps: (1: 1000) पटवार मानचित्र**

   Topographic Maps:

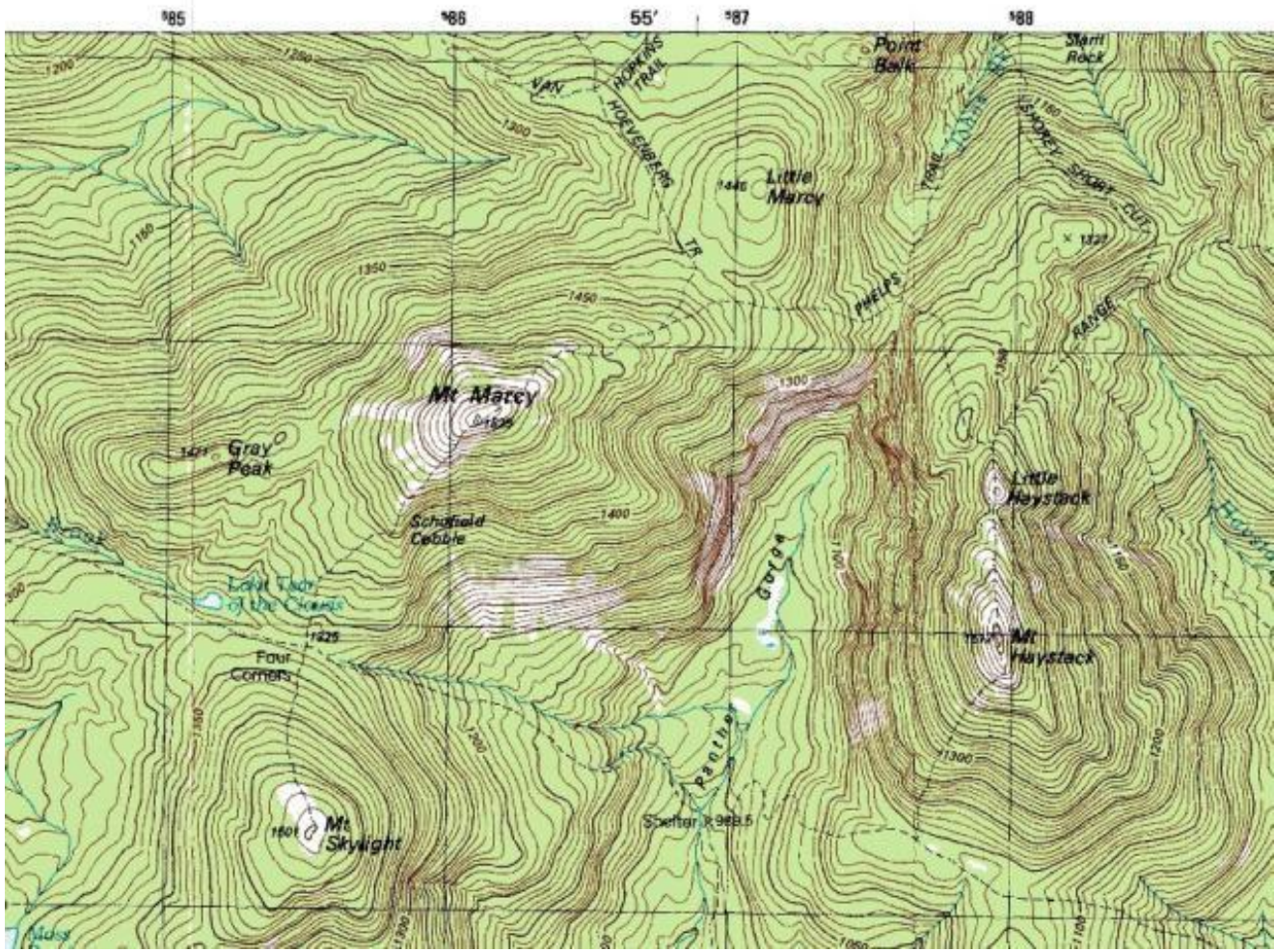
2. Wall Maps: As wall hangings

3. Atlas Maps: For atlas use



Scale

1. Cadastral Maps:
2. **Topographic Maps: Toposheets (1: 50,000)**
3. Wall Maps: As wall hangings
4. Atlas Maps: For atlas use

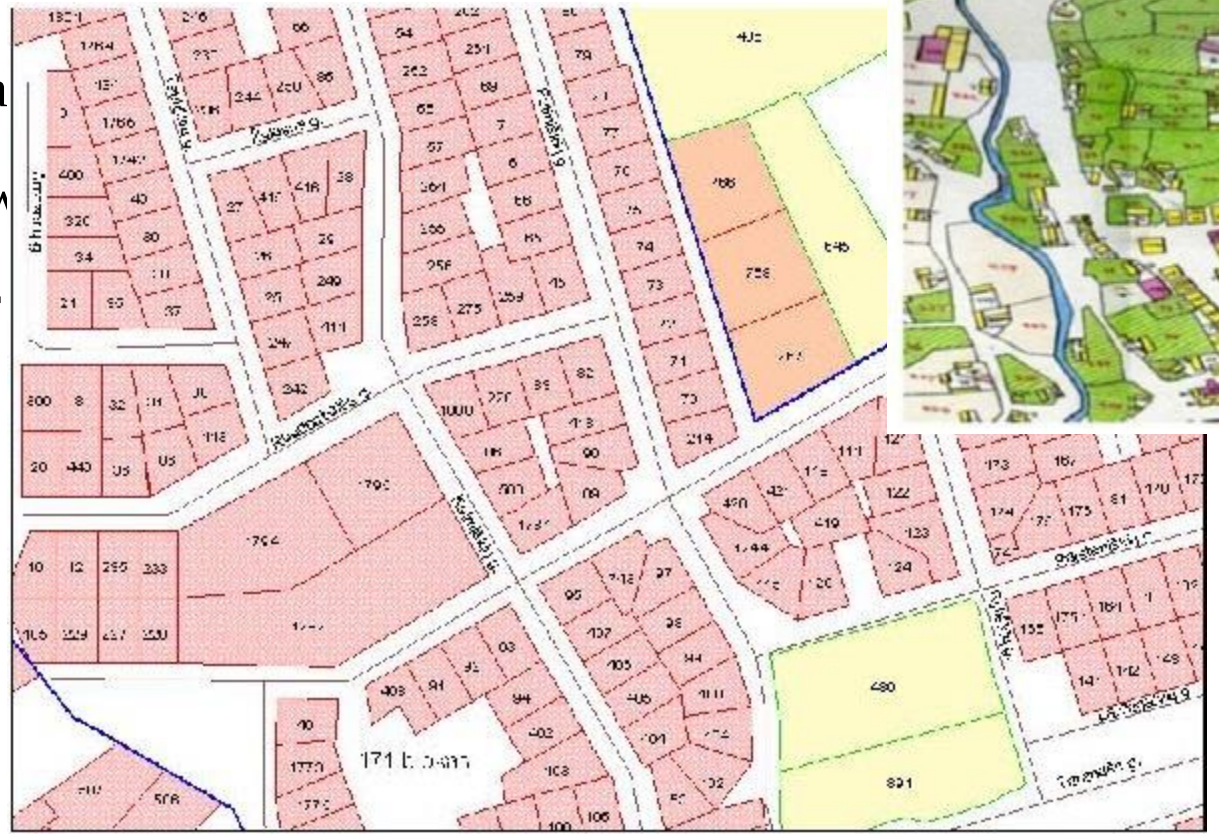


Scale

1. Cadastral Maps:
2. Topographic Maps: Toposheets
3. **Wall Maps: As wall hangings (1:25 M)**
4. **Atlas Maps: For atlas use (1: 150 Million)**

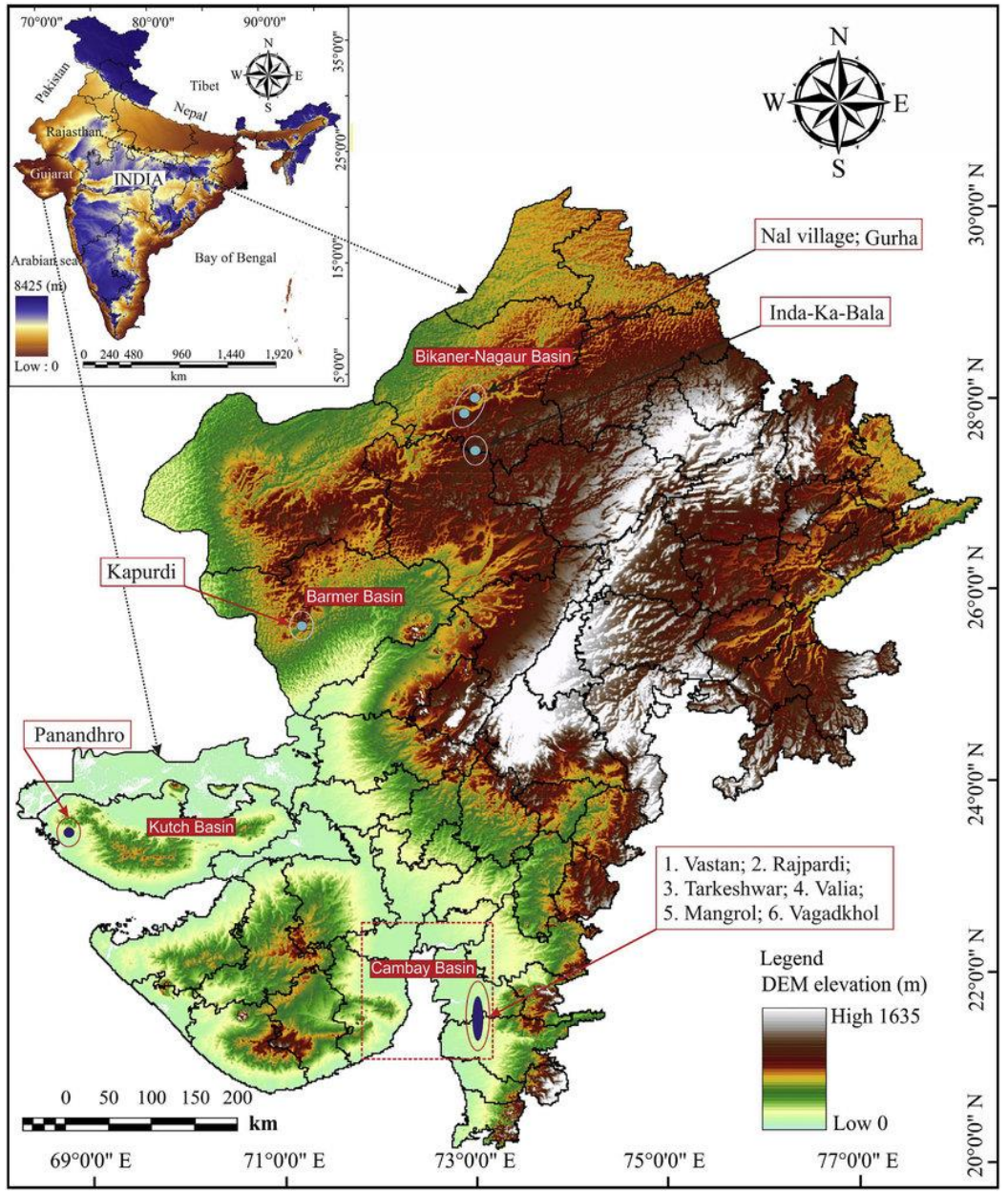
Scale

1. Cadastral Maps:
2. Topographic Ma
3. Wall Maps: As w
4. Atlas Maps: For



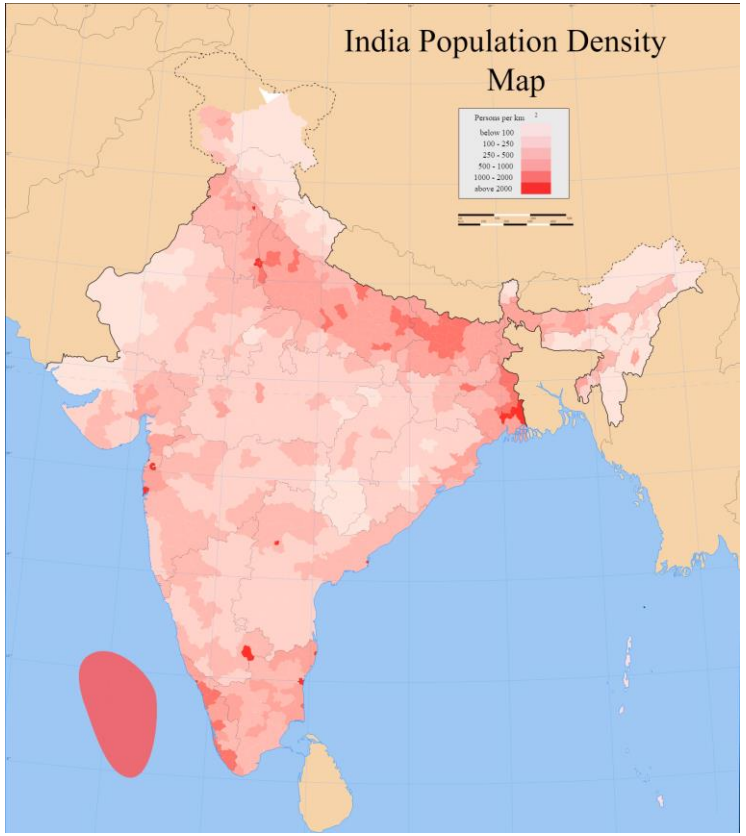
Topographic details represented

1. **Hypsometric map**: Topographical (Physical details) RELIEF
2. **Planimetric maps**: Cultural and socio-economic details



Purpose/ Content

1. Physical maps
2. Populations maps
3. Socio-cultural maps
4. Climate maps
5. Weather maps



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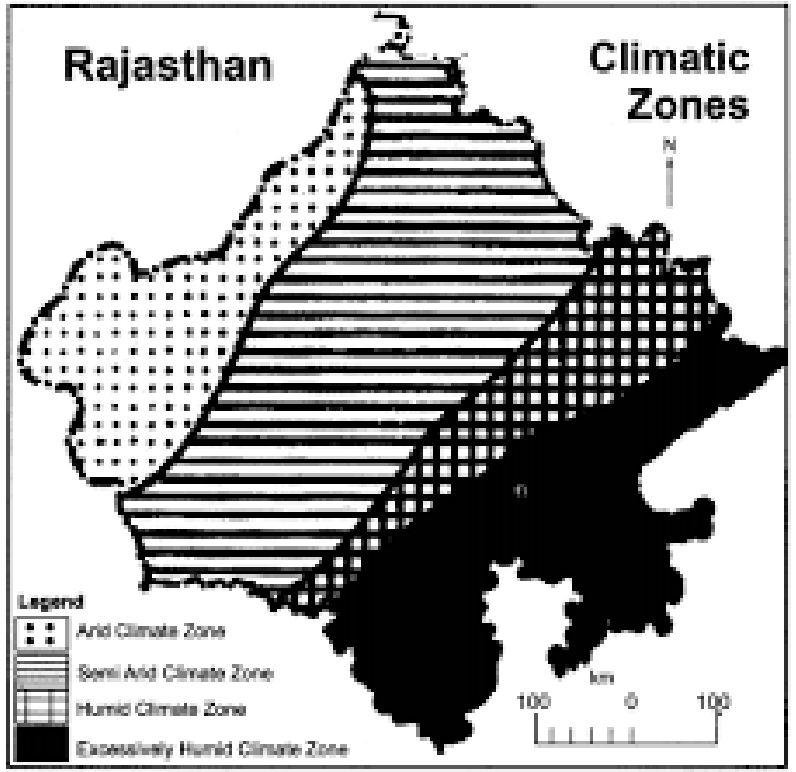
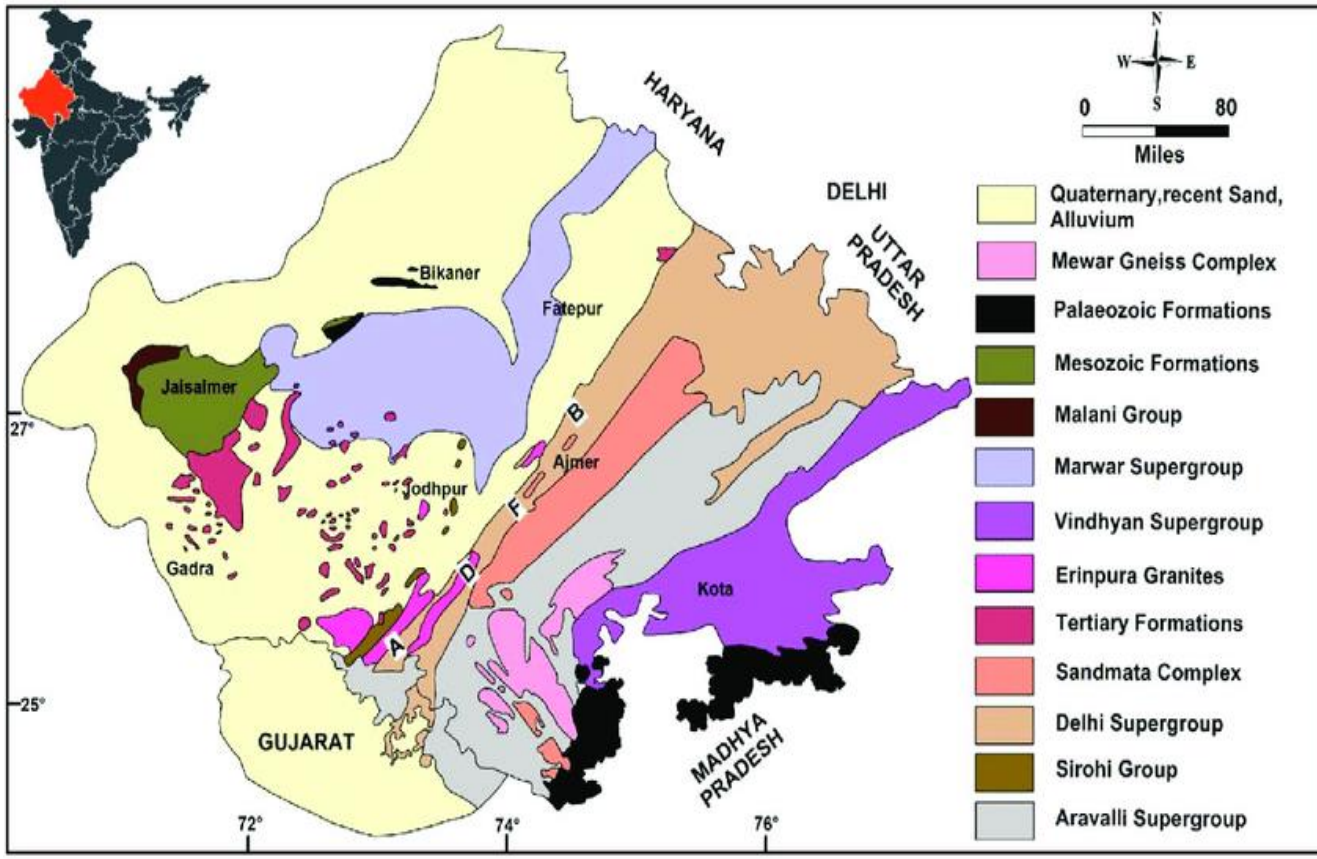
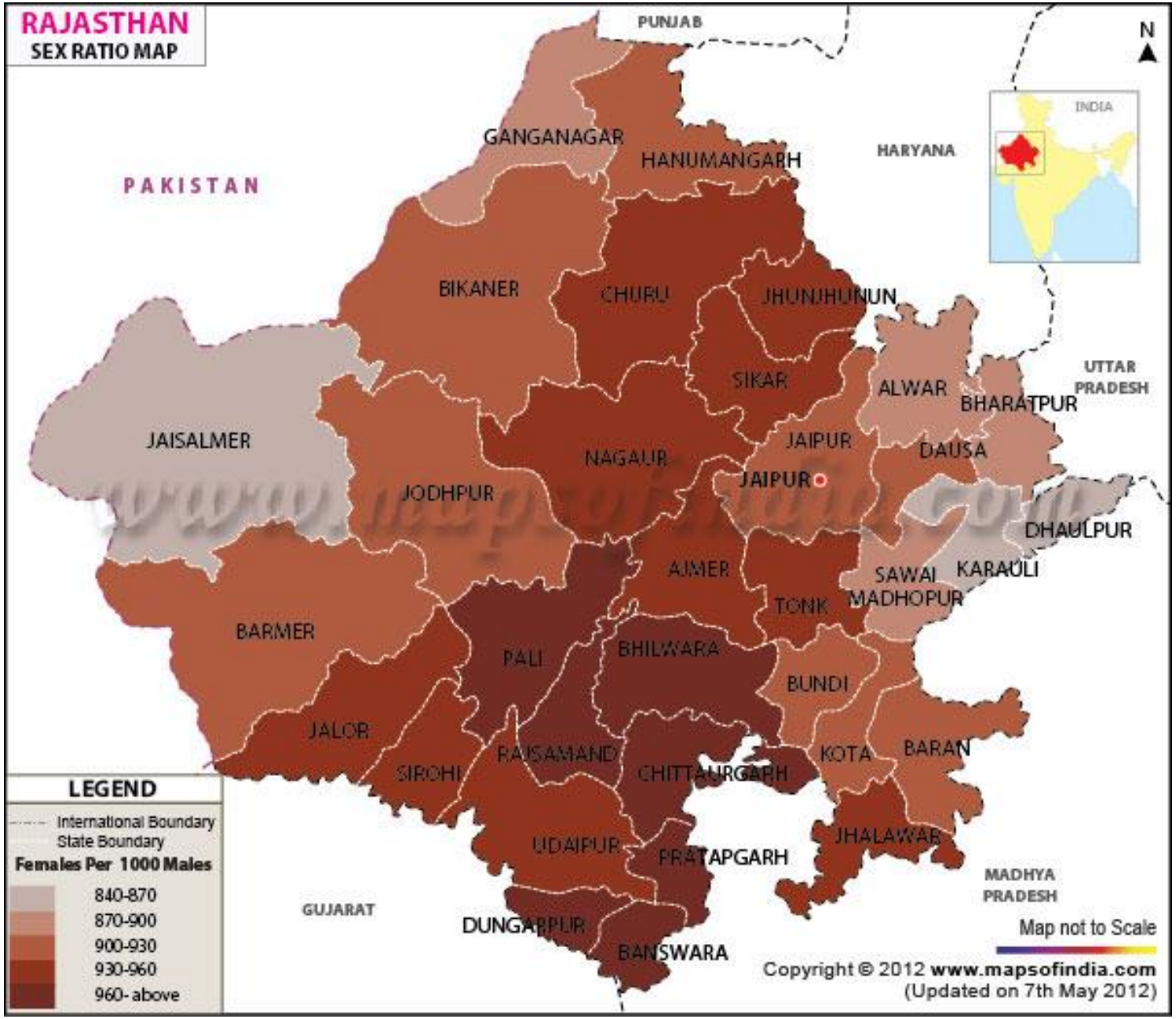


Style of construction

- **Qualitative**: Types of houses, Types of schools, types of rocks
- **Quantitative**: Literacy rate of districts on Rajasthan for year 2011,
- Annual average rainfall in India (1980 - 2010)





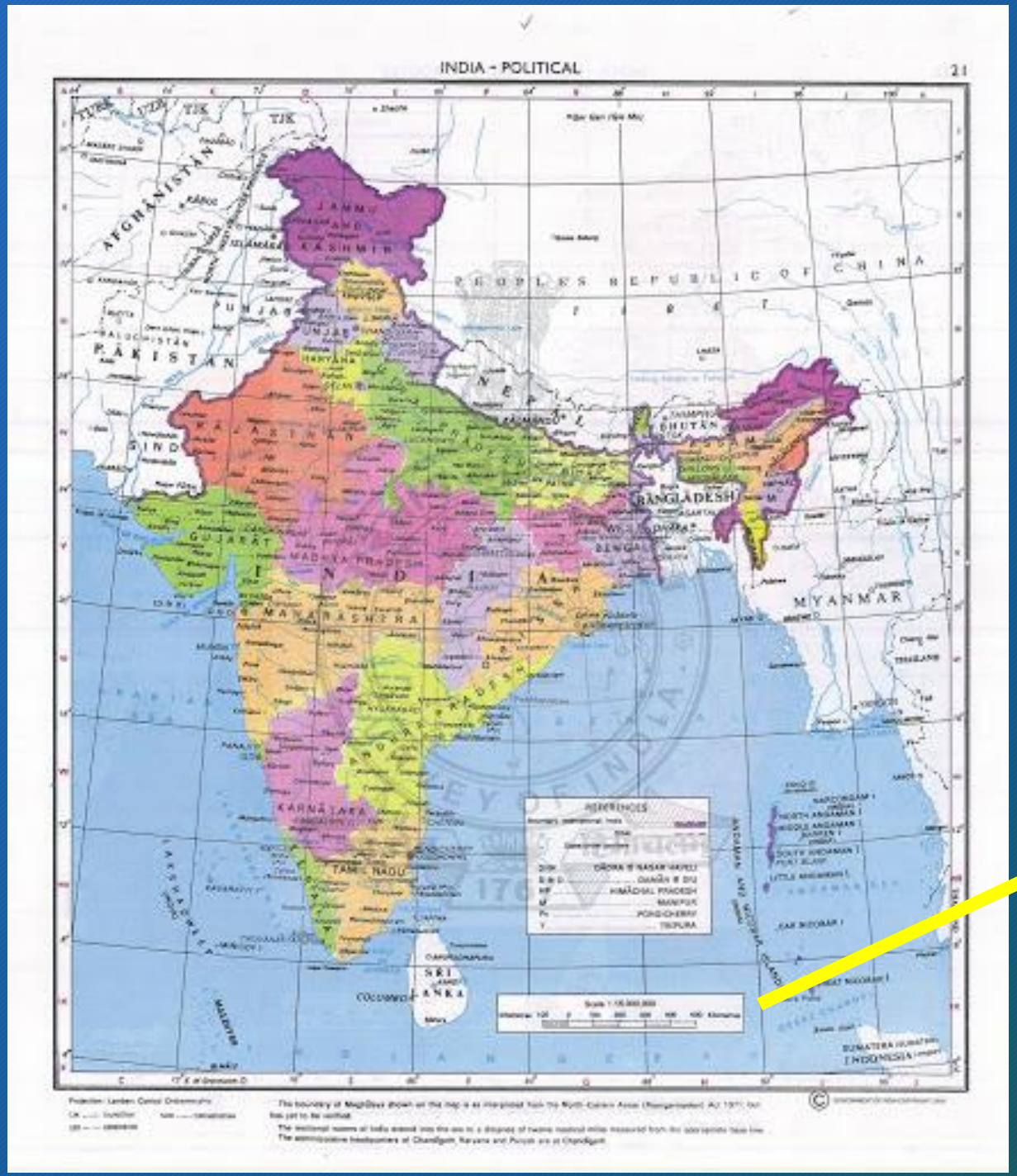
Quantitative Map

District wise Sex ratio in Rajasthan (2011)

Scales

मापनी

Compiled by Urmi Sharma


INDIA - POLITICAL
21
AFGHANISTAN
PAKISTAN
PEOPLES REPUBLIC OF CHINA
NEPAL
BHUTAN
BANGLADESH
MYANMAR
SRI LANKA
TAMIL NADU
KARNATAKA
MAHARASHTRA
GUJARAT
MADHYA PRADESH
JAMMU AND KASHMIR
PUNJAB
HARYANA
RAJASTHAN
UTTAR PRADESH
BIHAR
WEST BENGAL
ORISSA
ANDHRA PRADESH
GOA
KERALA
HIMACHAL PRADESH
MANIPUR
PONDICHERRY
TRIPURA
DAMAN & DIU
DADRA & NAGAR HAVELI
CHANDIGARH
NORTH ANDAMAN I
MIDDLE ANDAMAN I
SOUTH ANDAMAN I
LITTLE ANDAMAN I
CAR NICOBAR I
GREAT NICOBAR I
SUMATERA
INDONESIA
MALDIVES
COLOMBO
REFERENCES


TAMIL NADU
SRI LANKA
COLOMBO
HIMACHAL PRADESH
MANIPUR
PONDICHERRY
TRIPURA

Introduction

- वास्तविकता और उसके निरूपण के बीच का अनुपात को मापनी कहते हैं।
- इसकी इकाई नहीं होती । It does not have any UNIT
- यह भिन्न अथवा गुणक के रूप में व्यक्त किया जाता है। It can be represented as fraction or ratio
- **मापक धरातल के किन्ही दो बिदुओं के बीच की वास्तविक दूरी तथा मानचित्र पर दर्शित उन्हीं दो बिन्दुओं के बीच की दूरी का अनुपात है।**
- सरल शब्दों मे कहा जा सकता है कि धरातल व मानचित्र कि दूरि के अनुपात RATIO को मापक कहते है।

- **The scale of a map is the ratio of a distance on the map to the corresponding distance on the ground.**
- This simple concept is complicated by the curvature of the Earth's surface, which forces scale to vary across a map.
- Scale can be defined as the RATIO of distance between any two points on MAP to the distance between same (actual) two points on GROUND/ EARTH SURFACE

$$\text{Scale} = \frac{\text{distance between two points ('a' \& 'b') on MAP}}{\text{distance between two points ('A' \& 'B') on GROUND}}$$

Illustration

- Distance between two points on MAP = 2 cm
- Distance between those two points (actually) on GROUND = 1 km
- Then the scale of the given map is 2 cm: 1 km or
- 2 cm = 1 x 1,00,000 cm (1 km = 100000 cm)
- **1:50,000**

Types of Scales

(i) कथनात्मक मापनी (Statement Scale)

(ii) प्रदर्शक भिन्न/ निरूपक भिन्न मापनी (Representative Fraction or R.F.)

(iii) आलेखी या रैखिक मापनी (Graphical Scale)

Statement scale कथनात्मक मापनी

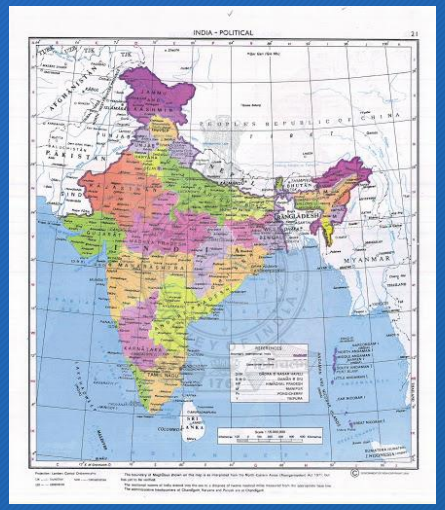
- The scale may be indicated in the form of a written statement or verbally.
- For example **1 cm on the map represents 1 km on the ground**
- The scale is written as 1 cm = 1 km
- 1 inch = 1 mile
- 1 inch = 1 yard
- Involves **UNIT**
- Knowledge of **measurement units** is required to understand this kind of scale

निरूपक भिन्न मापनी
Representative Fraction or R.F.

- Scale is represented as FRACTION भिन्न
- It **avoids the use of units**
- Scale is ***1: 50,000***

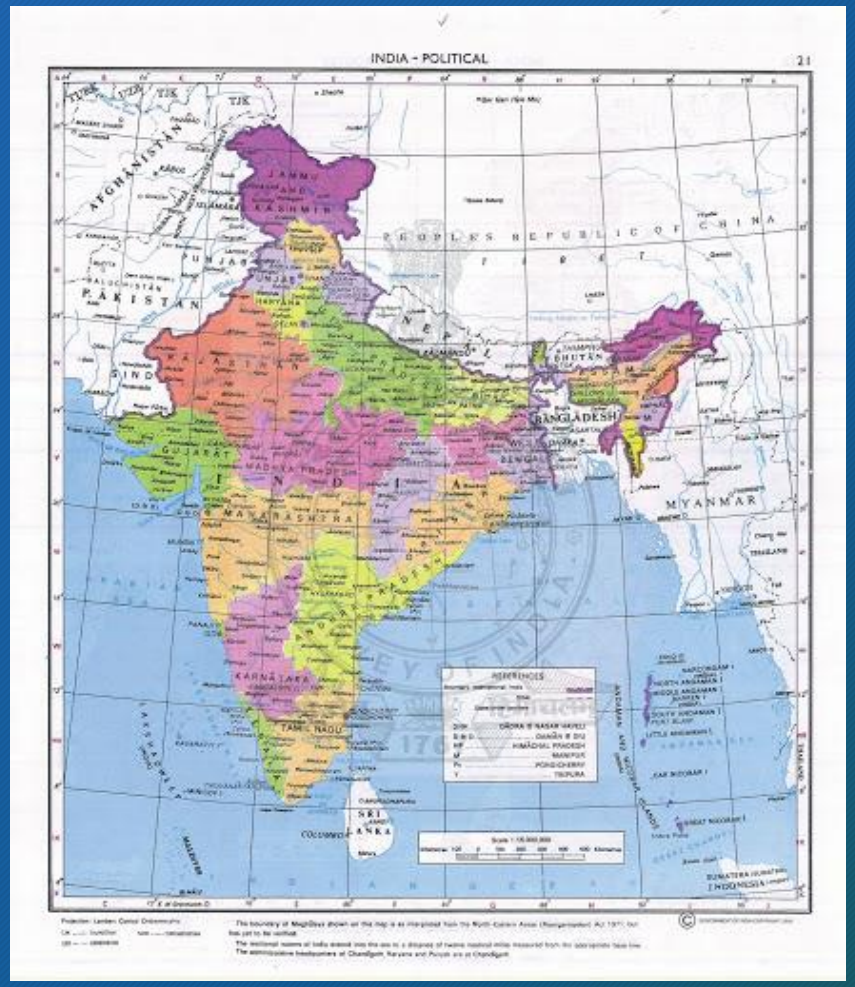
1 cm (map) = 50,000 cm (ground)

1 inch (map) = 50,000 inch (ground)

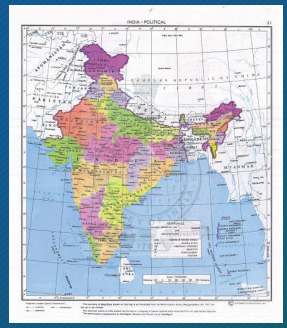


Original map

R.F. of the original map changes when one goes for Enlargement or reduction in map size



Enlarged map



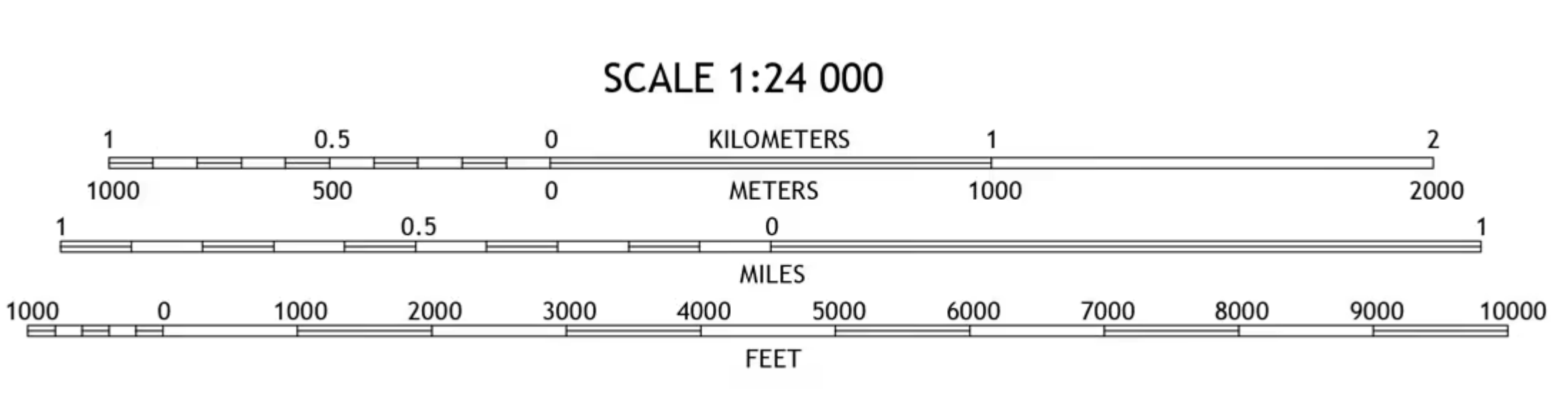
Reduced map

Exercise:

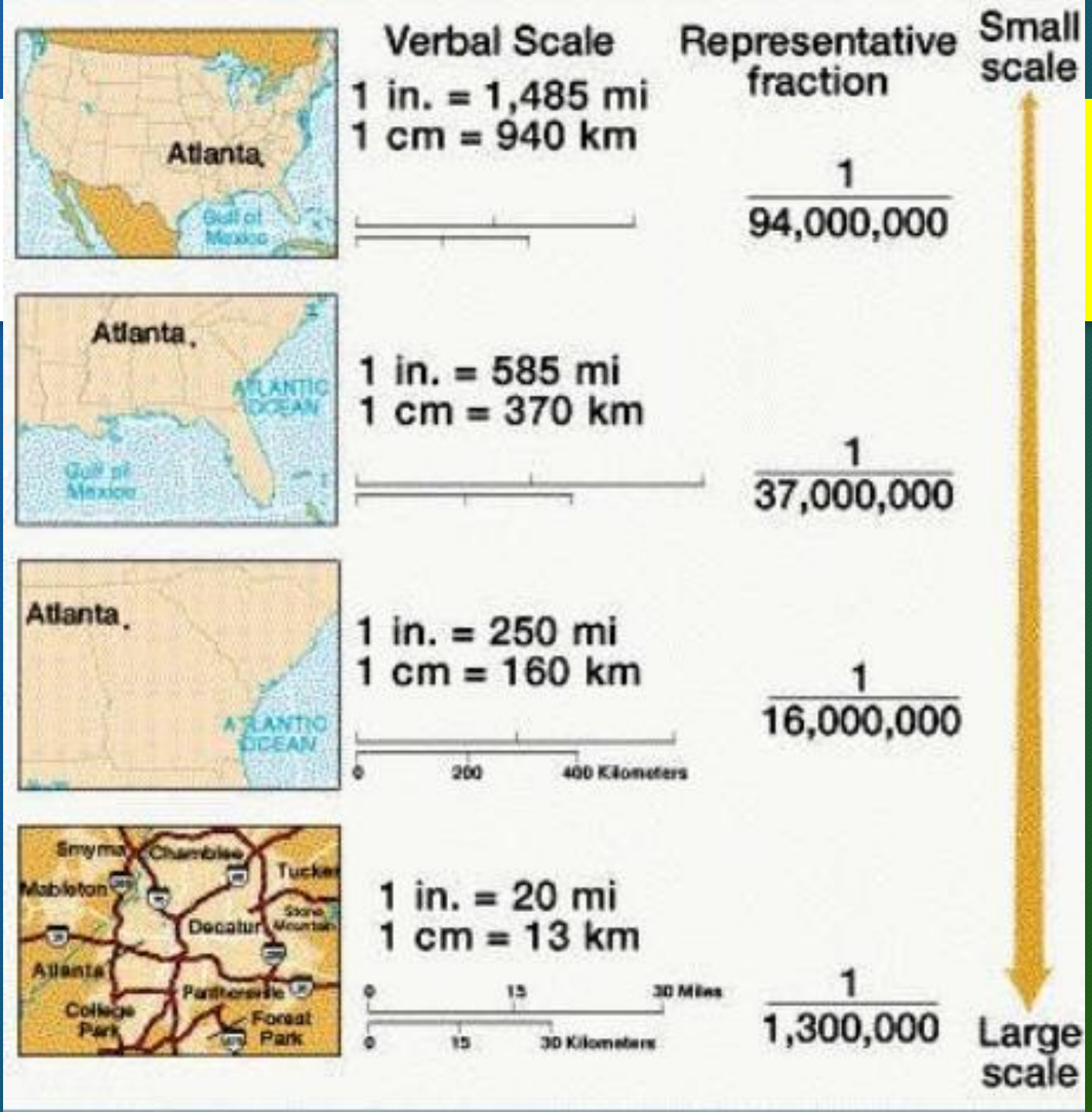
- 1: 1,00,000 1 cm on map represents 1 km on ground
- 1: 100
- 1: 50,000
- 1: 31680 Mile system of unit
- 1: 63,360 1 inch on map represents 63360 inches on ground
- 1 inch on map represents 1 mile on ground
- 1: 12

आलेखी मापनी (Graphical Scale)

- Scale representation in the form of GRAPH आलेख



The Relation

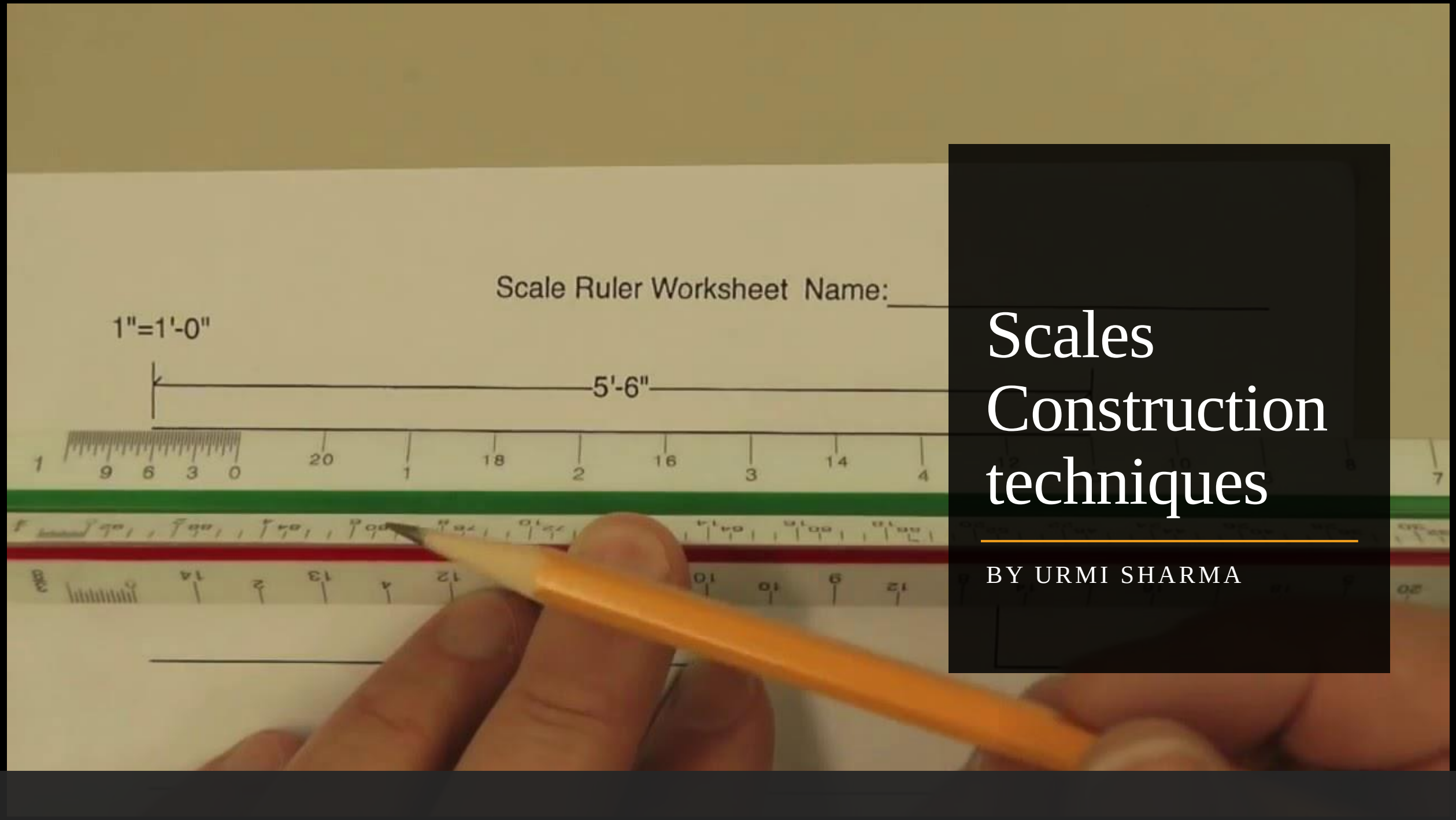


Mile system conversion table

CONVERSION	Inch (”) 1” =	Feet (ft) 1 ft =	Yard 1 yard =	Furlong 1 furlong =	Mile 1 mile =
In ***inch***	1”	12”	36”		63,360”
In feet		1 foot	3 feet		
In yards			1 yard	220 yards	1,760 yards
In Furlong				1	8 furlong

Metric system conversion table

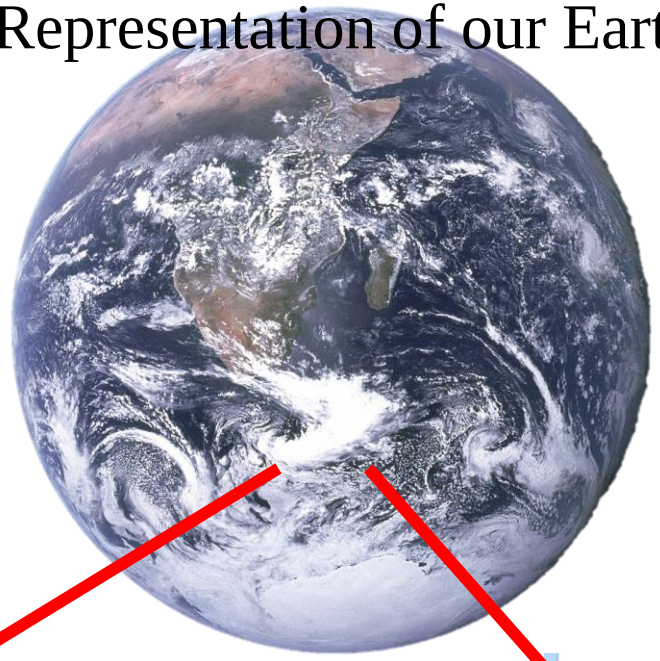
CONVERSION	Centimeter (cm) 1 cm =	Decimeter (dm) 1 dm =	Meter (m) 1 m =	Deca Meter (dam) 1 dam =	Hecto Meter (hm) 1 hm =	Kilo Meter (km) 1 km =
In ***meters***	0.01 m	0.1 m	1 m	10 m	100 m	1,000 m
In ***centimeters***	1 cm	10 cm	100 cm	1,000 cm	10,000 cm	1,00,000 cm



Scales Construction techniques

BY URMI SHARMA

Representation of our Earth



Globe

Map

Types of GRAPHICAL Scales

1. **Plain scale/ Linear scale** सरल मापनी
2. **Comparative scale** तुलनात्मक मापनी
3. **Diagonal scale** विकर्ण मापनी
4. **Time scale** समय मापनी
5. **Vernier scale** वर्नियर मापनी

Construction of Plain scale

- To construct the scale the data required is
  1. The **R.F** of the scale मापनी का निरूपक भिन्न
  2. The **units** which it has to represent i.e. millimeters or centimeters or meters or kilometers or in inches or feet or yards or miles प्रदर्शन की इकाई
  3. The maximum length which the scale should measure. अधिकतम लंबाई जो मपक को मापनी है।
- If the maximum length is not given, some suitable length can be assumed. **This should be generally of 12 to 15 cm in length.**
- The maximum length of the scale to be constructed on the drawing sheet = R.F x maximum length the scale should measure.

Mile system conversion table

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Metric system conversion table

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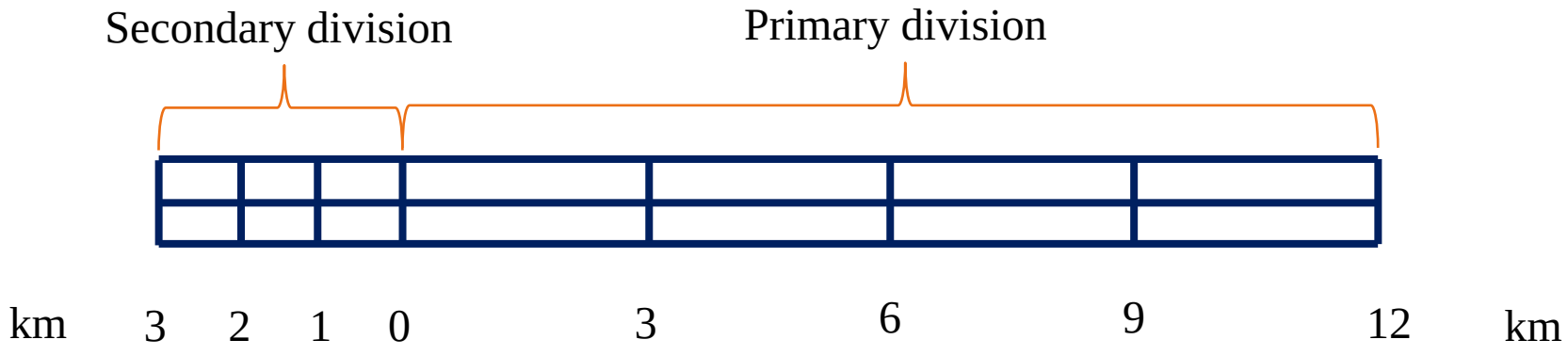
In ***meters***	0.01 m	0.1 m	1 m	10 m	100 m	1,000 m
In ***centimeters***	1 cm	10 cm	100 cm	1,000 cm	10,000 cm	1,00,000 cm
In hectometers					1 hm	10 hm

Plain scale

- In the form of a **simple line**
- They read or measure up to **two** units or **a unit** and **its sub-division.**
- ***For example centimeters (cm) and millimeters (mm). Inches or feet, Furlong or Miles***
- It consists of a **line divided into number of equal parts**
- TheR.F.should be mentioned below the scale

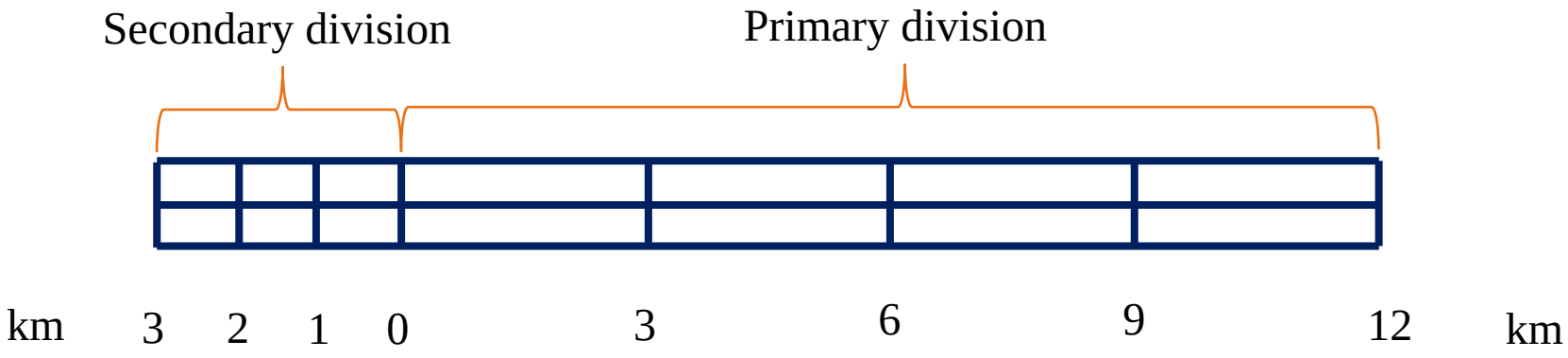
Plain scale

- ✓ Primary on the right side of the scale
- ✓ Sub divisions (secondary divisions) on the left side
- ✓ Labeling of ‘0’
- ✓ Scale should be utilized fully. Labelling plays a major role here



Plain scale problems

1. Construct a plain scale in which a distance of 15 km on ground can be measured. The given R.F. is 1: 1,00,000



Steps to follow

1. Draw a scale of **15 cm** on your sheet
2. According to R.F. (1/1,00,000) =

   1 cm on map represents 1,00,000 cm on ground

   Or

   1 cm on map represents 1 km on ground **(as 1 km = 1,00,000 cm)**

   15 cm on map will represent **15 km on ground**

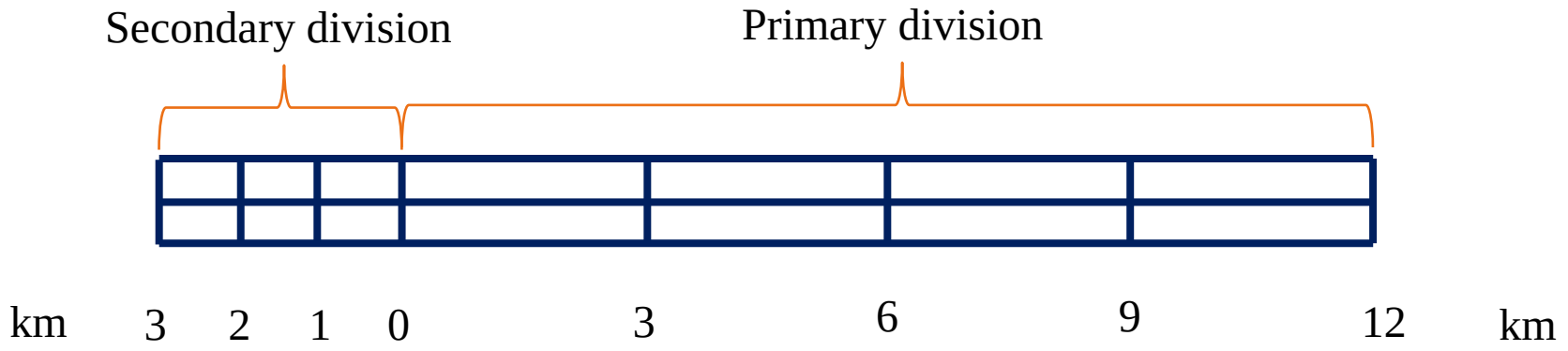
   (Now you got this why we drew 15 cm line in the starting)

Steps…

3. Divide the line (15 cm) into 5 equal parts
4. Therefore each division will be of 3 cm (5 x 3 = 15 cm)

---

5. Now 3 cm on map represents 3 km on ground. Label the scale in this way where each part of 3 cm = 3 km
6. Label 0 at the first main part
7. Divide the secondary part of the scale into again 3 equal parts



Task

Q1. Construct a plain scale on R.F. 1: 2,00,000. Read the following distances on it

10 km , 5 km, 14 km, 16 km

Q2. Construct a plain scale on R.F. 1: 5,00,000. Read the following distances on it

35 km, 15 km, 40 km, 75 km

Q3. Construct a plain scale on R.F. 1: 50,000 on which measurements in km and hectometer can be read. Read the following distances on it

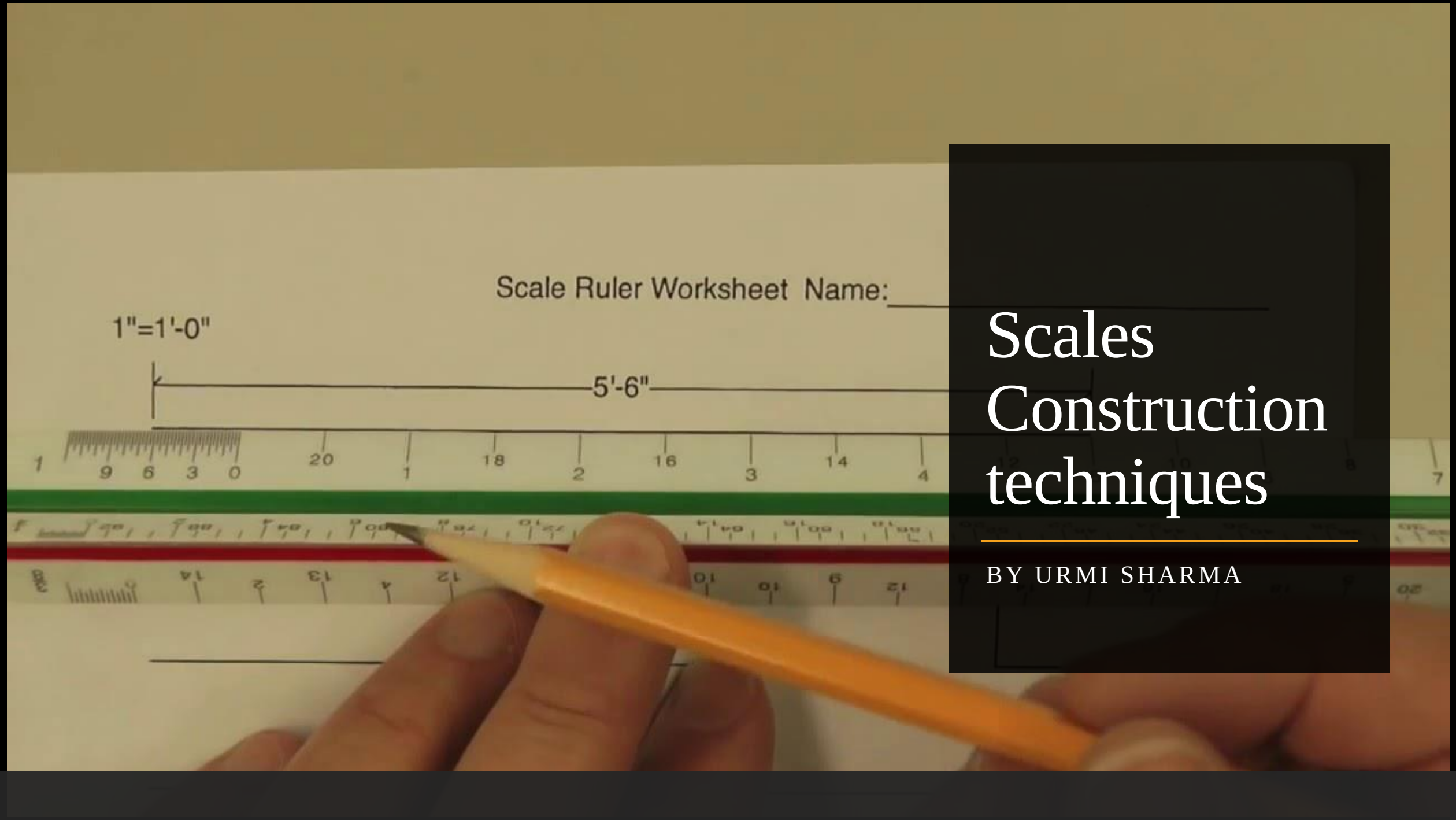
3 km, 4 km 6 hm, 3 km 3 hm, 5 km 8 hm

Hints

1. 1 cm = 2 km (draw a scale of 12 cm) (6 divisions of 4 cm each)

12 cm = 24 km (2 * 12 = 24) (12* 2; 8 * 3; 6* 4; 4*6; 3*8; 2*12)

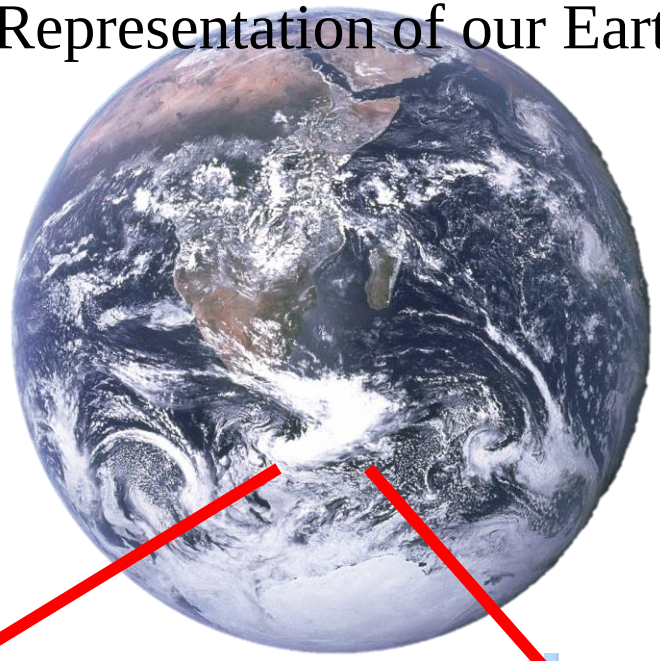
1. 1 cm = 5 km (draw a scale of 15 cm) (5 divisions of 3 cm each)
2. 1 cm = 0.5 km…… 2 cm = 1 km (draw a scale of 12 cm) (6 divisions of 2 cm each)



Scales Construction techniques

BY URMI SHARMA

Representation of our Earth



Globe

Map

Types of GRAPHICAL Scales

1. **Plain scale/ Linear scale** सरल मापनी
2. **Comparative scale** तुलनात्मक मापनी
3. **Diagonal scale** विकर्ण मापनी
4. **Time scale** समय मापनी
5. **Vernier scale** वर्नियर मापनी

Construction of Plain scale

- To construct the scale the data required is
  1. The **R.F** of the scale मापनी का निरूपक भिन्न
  2. The **units** which it has to represent i.e. millimeters or centimeters or meters or kilometers or in inches or feet or yards or miles प्रदर्शन की इकाई
  3. The maximum length which the scale should measure. अधिकतम लंबाई जो मपक को मापनी है।
- If the maximum length is not given, some suitable length can be assumed. **This should be generally of 12 to 15 cm in length.**
- The maximum length of the scale to be constructed on the drawing sheet = R.F x maximum length the scale should measure.

Mile system conversion table

CONVERSION	Inch (”) 1"" =	Feet (ft) 1 ft =	Yard 1 yard =	Furlong 1 furlong =	Mile 1 mile =
In ***inch***	1”	12”	36"		63,360"
In feet		1 foot	3 feet		
In yards			1 yard	220 yards	1,760 yards
In Furlong				1	8 furlong

Metric system conversion table

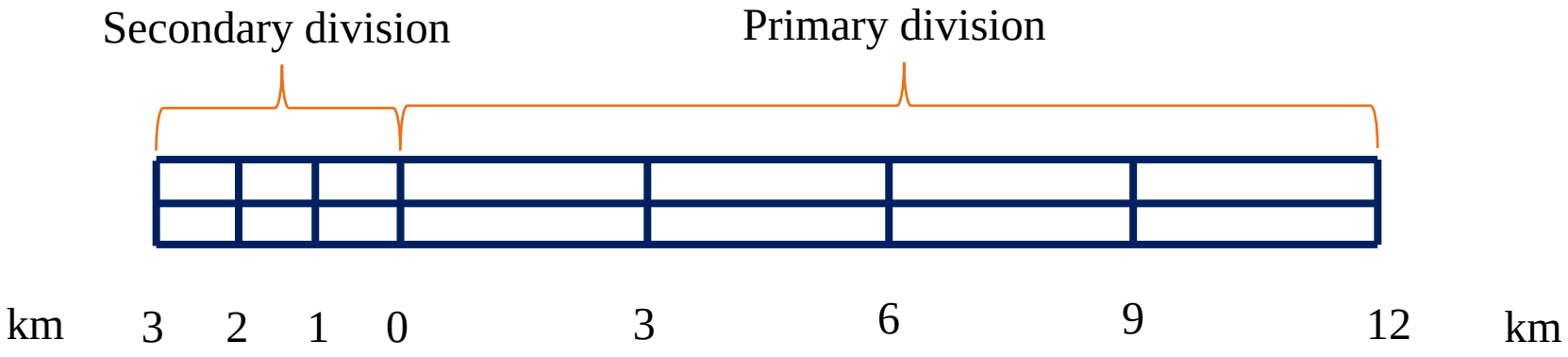
CONVERSION	Centimeter (cm) 1 cm =	Decimeter (dm) 1 dm =	Meter (m) 1 m =	Deca Meter (dam) 1 dam =	Hecto Meter (hm) 1 hm =	Kilo Meter (km) 1 km =
In ***meters***	0.01 m	0.1 m	1 m	10 m	100 m	1,000 m
In ***centimeters***	1 cm	10 cm	100 cm	1,000 cm	10,000 cm	1,00,000 cm
In hectometers					1 hm	10 hm

Plain scale

- In the form of a **simple line**
- They read or measure up to **two** units or **a unit** and **its sub-division.**
- ***For example centimeters (cm) and millimeters (mm). Inches or feet, Furlong or Miles***
- It consists of a **line divided into number of equal parts**
- TheR.F.should be mentioned below the scale

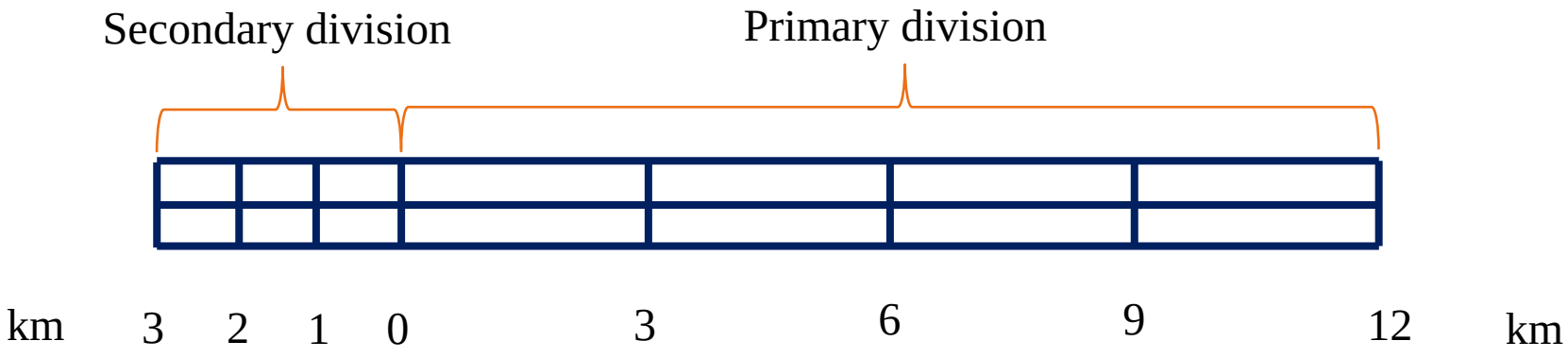
Plain scale

- ✓ Primary on the right side of the scale
- ✓ Sub divisions (secondary divisions) on the left side
- ✓ Labeling of "0"
- ✓ Scale should be utilized fully. Labelling plays a major role here



Plain scale problems

1. Construct a plain scale in which a distance of 15 km on ground can be measured. The given R.F. is 1: 1,00,000



Steps to follow

1. Draw a scale of **15 cm** on your sheet
2. According to R.F. (1/1,00,000) =

   1 cm on map represents 1,00,000 cm on ground

   Or

   1 cm on map represents 1 km on ground **(as 1 km = 1,00,000 cm)**

   15 cm on map will represent **15 km on ground**

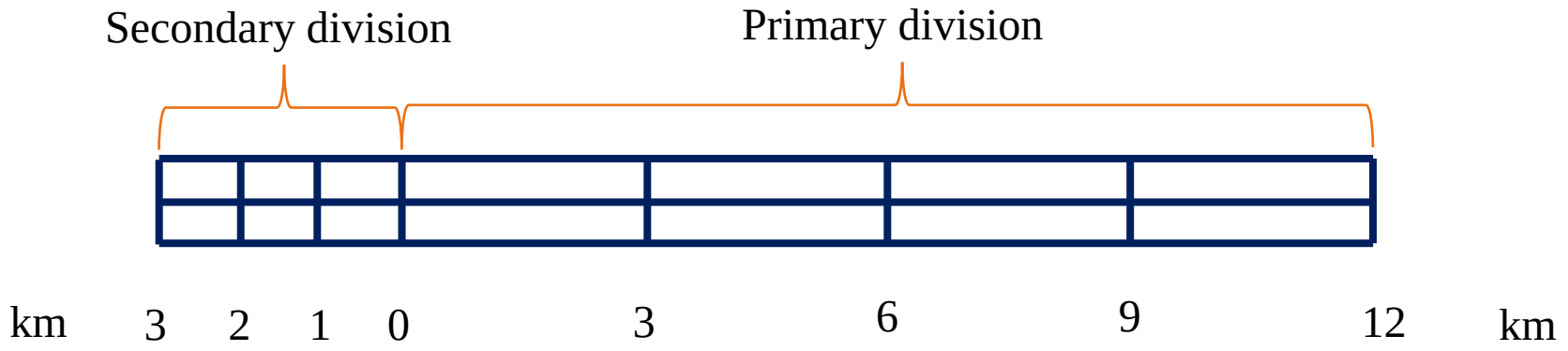
   (Now you got this why we drew 15 cm line in the starting)

Steps…

3. Divide the line (15 cm) into 5 equal parts
4. Therefore each division will be of 3 cm (5 x 3 = 15 cm)

---

5. Now 3 cm on map represents 3 km on ground. Label the scale in this way where each part of 3 cm = 3 km
6. Label 0 at the first main part
7. Divide the secondary part of the scale into again 3 equal parts



Task (cm – km problems)

Q1. Construct a plain scale on R.F. 1: 2,00,000. Read the following distances on it

10 km , 5 km, 14 km, 16 km

Q2. Construct a plain scale on R.F. 1: 5,00,000. Read the following distances on it

35 km, 15 km, 40 km, 75 km

Q3. Construct a plain scale on R.F. 1: 50,000 on which measurements in km and hectometer can be read. Read the following distances on it

3 km, 4 km 6 hm, 3 km 3 hm, 5 km 8 hm

1: 500000

1 cm = 500000 cm

1 cm = 5 km

Draw a scale of 15 cm

Divide the scale into 5 equal parts

3 cm each part

1 cm = 5 km

3 cm = 5 x 3 = 15 km

1 part = 15 km on ground

15 cm = 5 x 15 =75 km

1: 50000

1 cm = 50000 cm

1 cm = ½ km

2 cm = 1 km

Draw a 12 cm scale

6 divisions

Each part = 2 cm

2 cm = 1 km

1 km = 10 hectometers

Hints

1. **1 cm = 2 km (draw a scale of 12 cm) (6 divisions of 2 cm each)**

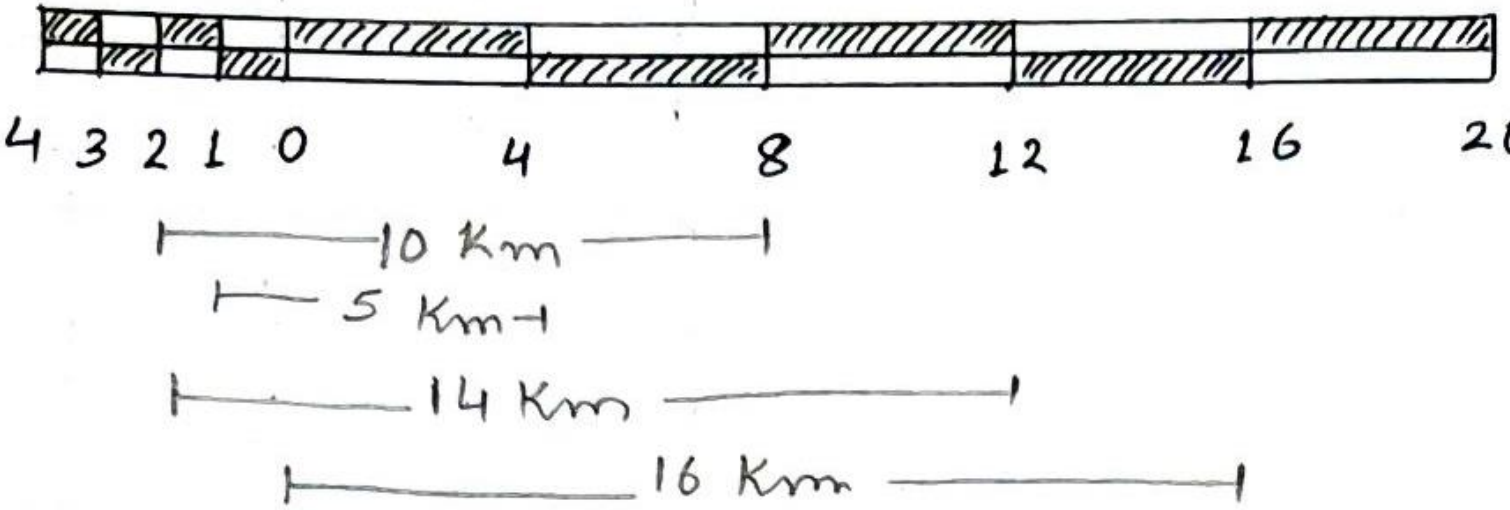
   12 cm = 24 km (2 * 12 = 24) (12* 2; 8 * 3; 6* 4; 4*6; 3*8; 2*12)

2. **1 cm = 5 km (draw a scale of 15 cm) (5 divisions of 3 cm each)**

3. **1 cm = 0.5 km…… 2 cm = 1 km (draw a scale of 12 cm) (6 divisions of 2 cm each)**

Q1.

R.F = 1 : 200,000



Q2. R.F = 1 : 5,00,000

KILOMETRE 15 10 5 0 15 30 45 60 KILOMETR

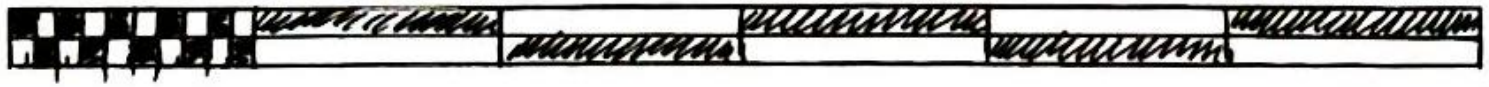
35 Km

15 Km

30 Km

75 Km

Q3. R.F. = 1 : 50,000



10 8 6 4 2 0 1 2 3 4 5 KILOMETRE

3 Km

4 Km 6 Hm

3 Km 3 Hm

5 Km 8 Hm

Task (Inch-mile problems)

Q1. Construct a plain scale on R.F. 1: 63,360. Read the following distances on it

4 miles, 3 miles 2 furlong, 5 miles 8 furlong, 4 miles 4 furlong

Q2. Construct a plain scale on R.F. 1: 316,800. Read the following distances on it

15 miles, 22 miles, 25 miles, 14 miles

Q3. Construct a plain scale on R.F. 1: 7920 on which measurements in furlong and yards can be read. Read the following distances on it

3 furlong, 4 furlong 66 yards, 2 furlong 132 yards, 5 furlongs 220 yards

1: 7920

220 yards = 1 furlong

7920/220 = 36

1 inch = 7920 inches

1 inch = 36 x 220 inches

1 inch =1 yard x 220

1 inch = 220 yards

1 inch = 1 furlong

Draw a scale of 6 inch

6 divisions

1 division = 1 furlong

Hints

1. **1 inch = 63360 inch or**

- 1 inch = 1 mile
- 6 inch = 6 miles (Draw a scale of 6 inches and divide the line into 6 equal parts)
- To read the measurements in furlong divide the secondary part of scale in 8 parts (1 mile = 8 furlongs)

2. **1" = 316800 inch**

- **316800/63360 = 5**
- 1" = 5 x 63360 inch
- 1" = 5 mile
- 6" = 5 x 6 = 30 miles
- Draw a scale of 6 inches and divide the scale into 6 parts (5" each)
- Divide the secondary part of scale into 5 parts each

3. **1" = 7920 inch**

- **7920/220 = 36**
- 1" = 36 x 220 inch
- 1" = 1 yard x 220
- 1 " = 220 yards = 1 furlong
- 6" = 6 furlong
- Draw a scale of 6 inches and divide the scale into 6 parts (5" each)
- Divide the secondary part of scale into 10 parts

Q1

R.F. = 1:63360

FURLONGS 8 6 4 2 0 1 2 3 4 5 MILES

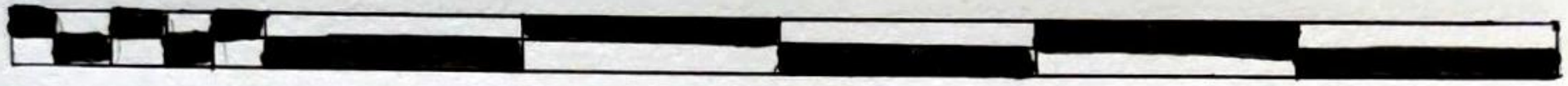
4 miles

3 miles 2 Furlong

5 miles 8 Furlong

4 miles 4 furlong

Q2. R.F. = 1 : 316800



MILES 5 4 3 2 1 0 5 10 15 20 25 MILES

15 miles

22 Miles

25 Miles

14 Miles

Q3 R.F. = 1 : 7920

3 Furlong

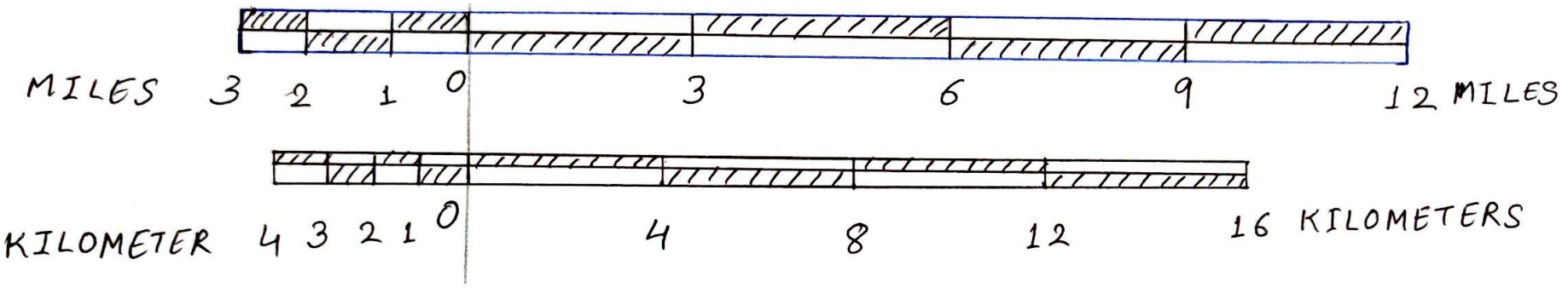
4 Furlong 66 Yards

2 Furlong 132 Yards

5 Furlong 220 Yards

Comparative Scale तुलनात्मक मापनी

- It is used to represent measurements in two different unit systems
- Eg. **Mile and Kilometer**, **Meter and Yard**, **Foot and Meter**
- It is a type of **plain scale**



Construction of Comparative scale

- **Two plain scales** are constructed.
- There is only **one R.F**. of both the scales
- The ‘**0’ in both the scales are placed in such a way that they align in one straight** line.

1. First construct plain scale of one unit.
2. Calculate the length of this scale (in cm or inch).
3. If the **GROUND measurement of the scale** is coming in *decimal values* try to round it off .
4. Again calculate the final length of the scale to be drawn on the sheet.
5. Suitably divide the secondary parts also.
6. Repeat the process for second plain scale of another unit

Comparative Scale: Problems

1. **Construct a comparative scale on R.F. 1/150,000 on which measurements in mile and kilometer can be read.**

- First we will draw a scale for **mile-inch measurement.**
- Therefore, according to R.F. 1: 150000
- 1 inch (map) = 150000 inches (ground)
- Now we will convert the ground value into mile. [For that we will divide this value (150000) by 63360 as 1 mile = 63,360 inches]
- 150000/63360 = 2.367 miles
- A scale of **6" will represent how much on ground**
- Therefore, **6" (map) = 2.37 x 6 miles (ground)**

=14.22 miles

- Take its round off = 15 miles
- **Now 15 miles** will be represented by

$$= \frac{6\ x\ 15}{14.22}\ \text{inches}$$

= 6.23"

Solution

- Now finally draw a scale of **6.23 inches**
- Therefore, **6.23” (map) = 15 miles (ground)**
- Divide the scale into 5 equal parts **(Why 5?)**

[15 miles of Scale]

- 1.26” each part representing 3 miles
- Divide the secondary part of the scale into 3 equal parts representing 1 mile each)

Part II: Kilometer – cm construction

- According to R.F. 1: 150000
- 1 cm (map) = 150000 cm (ground)
- Or 1 cm = 1.5 km
- For a scale of 15 cm
- Representing distance of 15 x 1.5 km on ground = 22.5 km
- **Round off it = 20 km**
- **(Take nearest multiple of 5 in this case)**

Solution

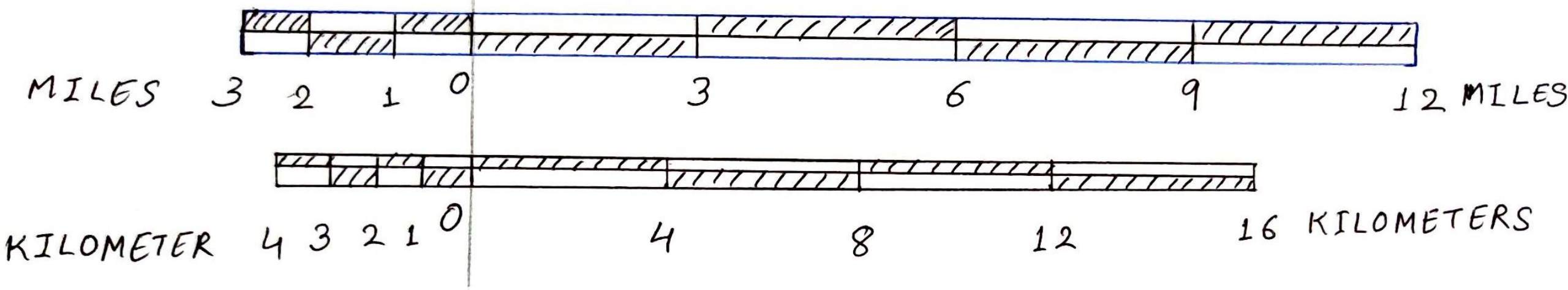
- Now 20 km on ground will be represented by

$$= \frac{15\ x\ 20}{22.5}\ \text{cm}$$

=13.33 cm

- Draw a scale of 13.33 cm (Remember to align ‘0’ of both scales in one line)
- Divide the scale into 5 equal parts (**Why 5?)** *[20km of scale]*
- Each part of 13.33/5 = 2.6 cm representing 4 km on ground
- Divide the secondary part of scale into 4 equal parts (each representing 1 km)

Q1 R.F = 1:150 000



Problems

2. **Construct a comparative scale on R.F. 1/31680 on which measurements in mile and kilometer can be read.**

Solution

- First we will draw a scale for **mile-inch measurement.**
- Therefore, according to R.F. 1: 31680
- 1 inch (map) = 31680 inches (ground)
- Now we will convert the ground value into mile. [For that we will divide this value (31680) by 63360 as 1 mile = 63,360 inches]
- 31680/63360 = 0.5 miles

- **Or say 2” (map) = 1 mile (ground)**
- A scale of **6” will represent how much on ground**
- Therefore, **6” (map) = 3 miles (ground)**

Solution

- Divide the scale into 3 equal parts (1 mile each)
- **Secondary parts in furlong unit (8 parts)**

Part II: Kilometer – cm construction

- According to R.F. 1: 31680
- 1 cm (map) = 31680 cm (ground)
- Or 1 cm = 0.3168 km = 0.317 km
- For a scale of 15 cm
- Representing distance of 15 x 0.317 km on ground = 4.752 km
- **Round off it = 5 km**

Solution

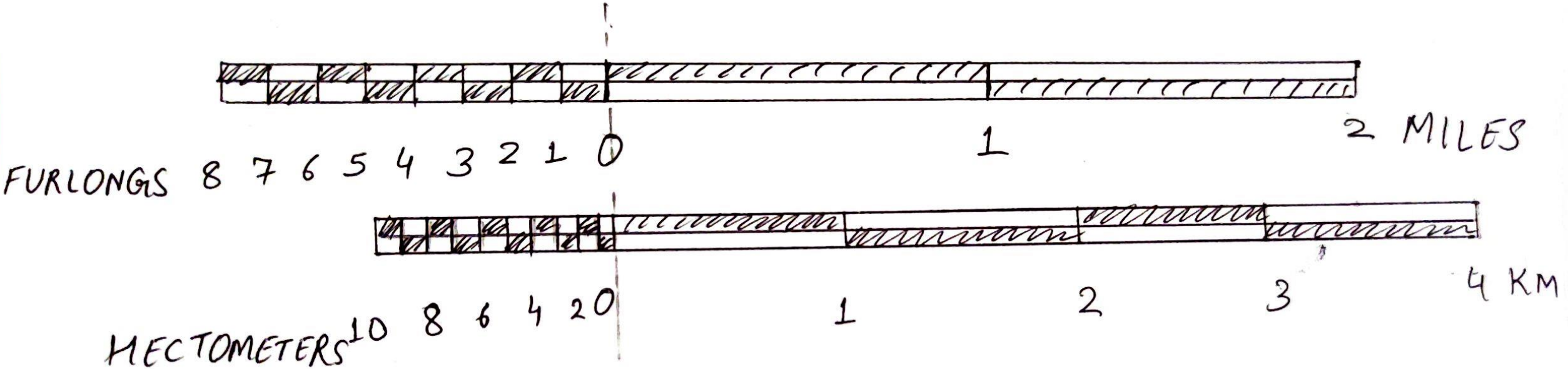
- Now 5 km on ground will be represented by

$$= \frac{15\ x\ 5}{4.75}\ \text{cm}$$

=15.78 cm or 15.8 cm

- Draw a scale of 15.8 cm (Remember to align ‘0’ of both scales in one line)
- Divide the scale into 5 equal parts
- Each part of 15.8/5= 3.16 cm representing 1 km on ground
- Divide the secondary part of scale into 10 equal parts (each representing 1 Hectometer)

Q2. R.F. = 1 : 31680

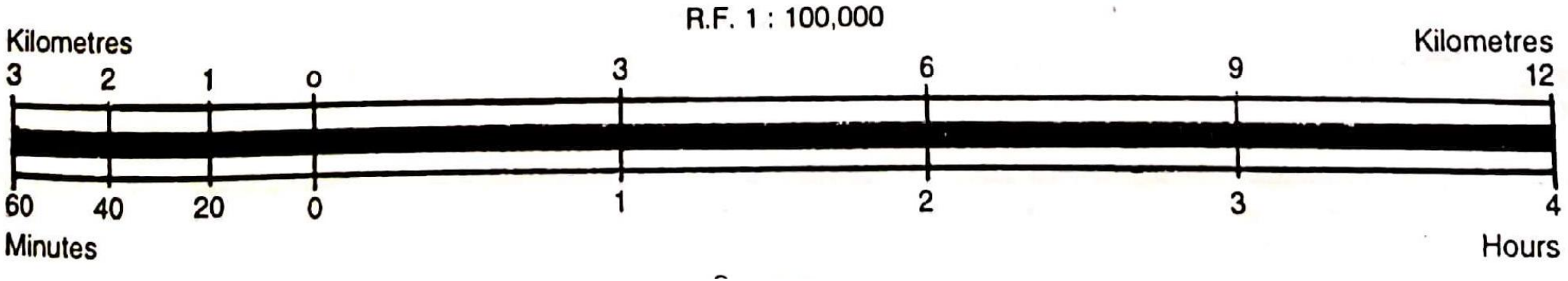


Homework Problems

3. **Construct a comparative scale on R.F. 1/100000 on which measurements in mile and kilometer can be read.**
4. **Construct a comparative scale on R.F. 1/253440 on which measurements in mile and kilometer can be read.**

Time Scale

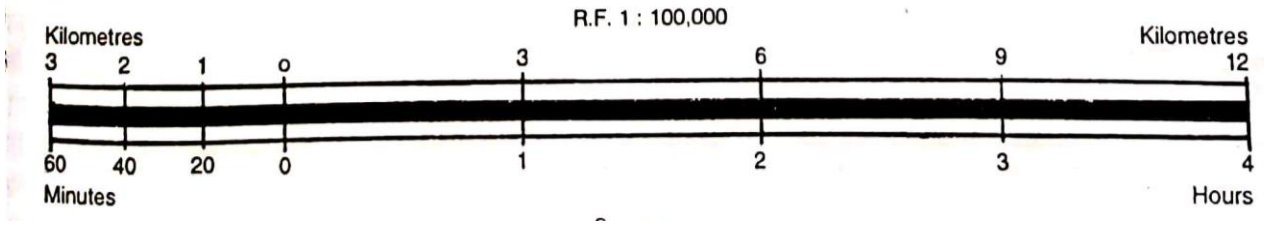
- A kind of comparative scale
- Used to represent **DISTANCE** and **TIME** simultaneously.
- Using this we can also calculate **SPEED** as (Distance/ Time = SPEED)



Steps to construct TIME scale

(1) विभिन्न मात्रकों में दूरी प्रदर्शित करने वाली तुलनात्मक मापनी के विपरीत समय मापनी में समय तथा दूरी की माप प्रदर्शित करने वाले प्राथमिक तथा गौण भागों की संख्या एक समान होती है। अतः समय मापनी के प्राथमिक तथा गौण भागों की संख्या निश्चित करते समय इस बात का विशेष ध्यान रखा जाता है कि मापनी के प्रत्येक प्राथमिक तथा गौण भाग द्वारा प्रदर्शित दूरी को तय करने का समय भी पूर्णांकों में लिखा जा सके। अतः यह आवश्यक है कि मापनी की कुल लम्बाई समय एवं दूरी दोनों को पूर्णांकों में प्रदर्शित करने वाली होनी चाहिए।

(2) अन्य तुलनात्मक मापनियों के विपरीत समय मापनी में भिन्न-भिन्न मापनियाँ नहीं बनाई जातीं अपितु एक ही आलेखी मापनी में समय तथा दूरी दोनों का प्रदर्शन कर दिया जाता है।



Questions

उदाहरण (19) 1 मील प्रति घण्टा की गति से चल रही किसी स्काउट टोली के लिये समय तथा दूरी की तुलनात्मक मापनी बनाइये जबकि मानचित्र की निरूपक भिन्न 1/63,360 है। मापनी में स्काउट टोली के द्वारा 4 घण्टे 15 मिनट में तय की जाने वाली दूरी प्रदर्शित कीजिये।

हल—

∵ 1 इन्च प्रकट करता है = 63,360 इन्च = 1 मील

∴ 6 इन्च प्रकट करेंगे = 6 मील

अब, ∵ 1 मील की दूरी तय होती है

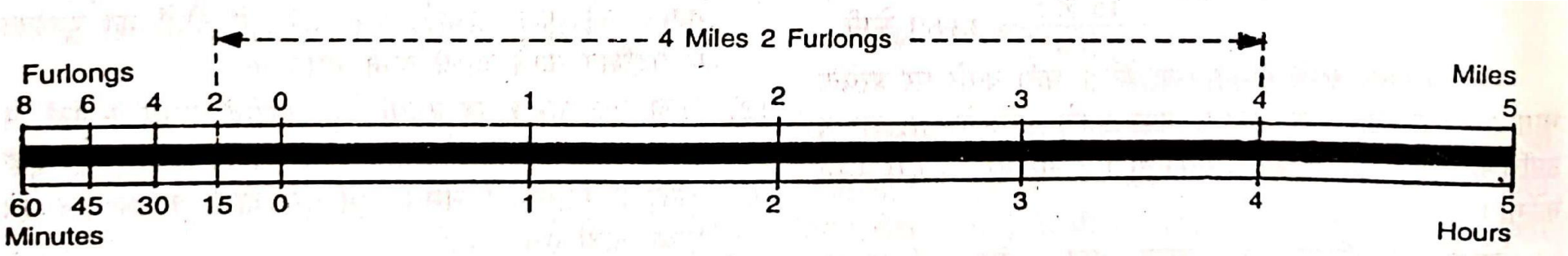
= 1 घण्टे में

∴ 6 मील की दूरी तय होगी

= 6 घण्टे में

अतः 6 इन्च लम्बी रेखा 6 मील की दूरी अथवा 6 घण्टे का समय प्रकट करेगी। इस रेखा के 6 भाग करने पर प्रत्येक भाग 1 मील अथवा एक घण्टे का समय प्रकट करेगा। प्रथम भाग के चार उपविभाग करने पर प्रत्येक गौण भाग 2 फर्लांग की दूरी अथवा 15 मिनट का समय प्रदर्शित करेगा। चित्र 4.18 के अनुसार मापनी में 4 घण्टे तथा 15 मिनट के समय दिखलाने वाले भागों के मध्य सरल रेखा खींचिये तथा इस रेखा द्वारा प्रदर्शित दूरी को इस पर लिखिये।

R.F. 1 : 63,360



Solutions

- Speed 1mile per hour
- Given R.F. = 1:63360
- Show = distance travelled in 4 hours and 15 minutes

- 1inch = 63360 inches on ground
- 1 inch = 1 mile
- 6 inch = 6 miles (ground)
- 1 mile – 1 hour
- 6 mile – 6 hours

Questions

उदाहरण (20) 30 किमी प्रति घण्टा की रफ्तार से जाने वाले किसी स्कूटर चालक के लिये एक समय मापनी की रचना कीजिये जबकि मानचित्र की निरूपक भिन्न 1/5,000,000 है। स्कूटर चालक द्वारा 18 घण्टे में तय की जाने वाली दूरी मापनी में प्रदर्शित कीजिये।

हल— निरूपक भिन्न के अनुसार,

∵ 1 सेमी की दूरी प्रकट करती है

=5,000,000 सेमी अर्थात् 50 किमी

∴ 15 सेमी की दूरी प्रकट करेगी

= 15 × 50 = 750 किमी

अब, ∵ 30 किमी स्कूटर चालक जाता है

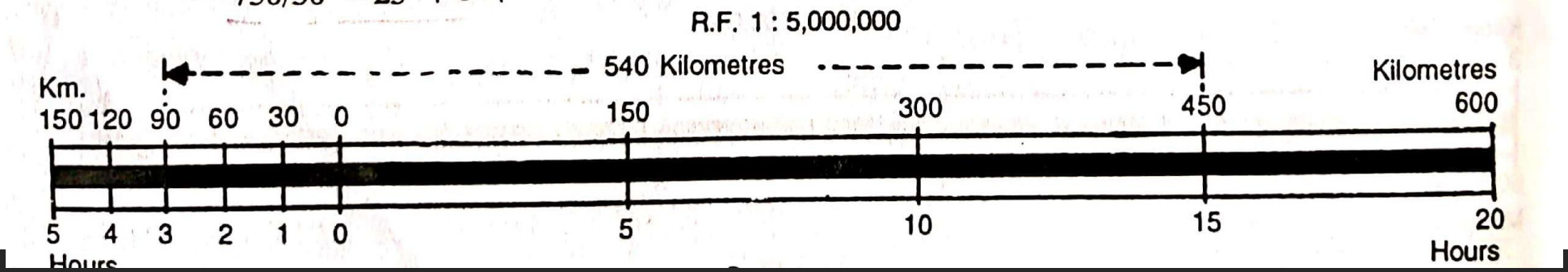
= 1 घण्टे में

∴ 750 किमी स्कूटर चालक जायेगा

= 750/30 =25 घण्टे में

अब 15 सेमी लम्बी रेखा खींचिये जो 750 किमी की दूरी अथवा 25 घण्टे का समय प्रदर्शित करेगी। इस रेखा के 5 भाग करने पर प्रत्येक भाग 150 किमी की दूरी अथवा 5 घण्टे का समय प्रदर्शित करेगा। बायीं ओर के प्रथम भाग को 5 उपविभागों में बाँटने पर प्रत्येक उपविभाग 30 किमी की दूरी अथवा 1 घण्टे का समय प्रदर्शित करेगा। चित्र 4.19 के अनुसार 18 घण्टे में तय की जाने वाली दूरी को सरल रेखा खींचकर प्रदर्शित कीजिये।

उपरोक्त उदाहरणों में दी हुई निरूपक भिन्नों के अनुसार 6 इन्च अथवा 15 सेमी द्वारा प्रकट होने वाली किलोमीटरों अथवा मीलों की दूरियाँ प्रति घण्टे तय होने वाली दूरियों से पूरी-पूरी विभाजित हो गयी थीं अतः 15 सेमी या 6 इन्च लम्बी रेखा को छोटा या बड़ा करने की आवश्यकता नहीं हुई थी। परन्तु कभी-कभी निरूपक भिन्न के अनुसार 6 इन्च अथवा 15



Questions

उदाहरण (21) 50 किमी प्रति घण्टा की गति से दौड़ती हुई किसी मोटरकार के लिये एक समय मापनी की रचना कीजिये जबकि मानचित्र की निरूपक भिन्न 1/2,200,000 है।

हल— निरूपक भिन्न के अनुसार,

∵ 1 सेमी की दूरी प्रकट करती है

$= 2{,}200{,}000$ सेमी अर्थात् 22 किमी

∴ 15 सेमी की दूरी प्रकट करेगी

$= 22 \times 15 = 330$ किमी

330 ऐसी संख्या है जो प्रति घण्टा तय की जाने वाली दूरी अर्थात् 50 किमी से पूरी-पूरी विभाजित नहीं होती। 330 के निकट की 300 ऐसी संख्या है जो 50 से पूरी-पूरी विभाजित हो जाती है अतः 300 किमी को प्रकट करने वाली मापनी की लम्बाई ज्ञात की जायेगी।

∵ 330 किमी प्रकट होते हैं $= 15$ सेमी से

∴ 300 किमी प्रकट होंगे

$= (15 \times 300)/330 = 13.63$ सेमी से

अब, ∵ 50 किमी मोटरकार जाती है $= 1$ घण्टे में

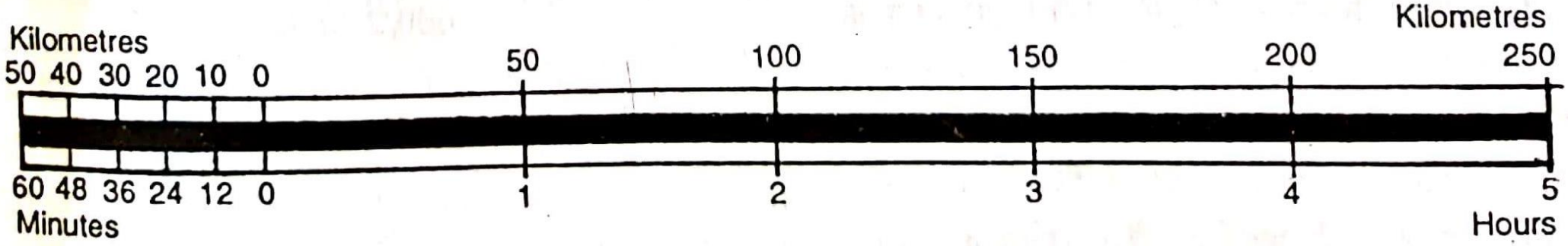
∴ 300 किमी मोटरकार जायेगी

$= 300/50 = 6$ घण्टे में

अब 13.63 सेमी लम्बी रेखा खींचिये जो 300 किमी की दूरी अथवा 6 घण्टे के समय को प्रदर्शित करेगी।

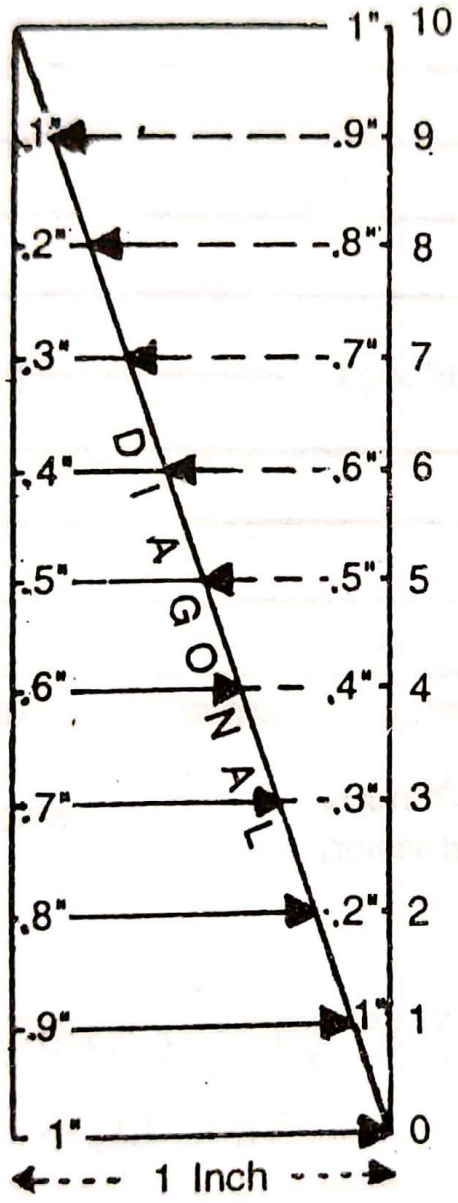
इस रेखा के 6 भाग करने पर प्रत्येक भाग 50 किमी अथवा 1 घण्टे का समय प्रदर्शित करेगा। बायीं ओर के प्रथम भाग को 5 गौण भागों में बाँटने पर प्रत्येक गौण भाग 10 किमी की दूरी अथवा 12 मिनट का समय प्रदर्शित करेगा (चित्र 4.20)।

R.F. 1 : 2,200,000



Diagonal Scale

- First half of the construction is similar to that of Plain scale.
- In second half diagonal is made.
- **The scale is used to measure distances upto three units**. For eg. 3km 5 hectometer 20 decameter; or 1 mile 5 furlong 220 yards
- To **sub-divide the secondary part o**f the scale we use diagonal scales.



Properties of the Diagonal

- Draw any measurement. Say 1 inch
- How many divisions we have to do for it? Say 10 equal parts
- Draw two perpendiculars on each end of it.
- Using compass or scale mark 10 equal distances on both these perpendiculars.
- Join these points in a way that they are parallel to the base line of 1 inch.
- Now draw a DIAGONAL across these lines from 1st to 10th division.
- The diagonal on each horizontal line will divide the it into fractions. For eg. Line 4 form the bottom will be divide as 4/10 and 6/10 part. Or in ratio it will be 4:6
- Similarly for line 3 it will be 3:7

Steps to construct diagonal scale

विकर्ण मापनी की रचना निम्नलिखित नियमों के अनुसार की जाती है :

(1) मापनी को प्राथमिक तथा गौण भागों में विभाजित करने वाले प्रत्येक बिन्दु पर समान लम्बाई वाली लम्ब रेखाएँ बनाई जाती हैं। इन लम्ब रेखाओं की लम्बाई प्रायः 3 से 4 सेन्टीमीटर तक रखते हैं। कभी-कभी मापनी को गौण भागों में विभाजित करने वाले बिन्दुओं पर रचना-सम्बन्धी सरलता के लिये लम्ब नहीं बनाये जाते।

After constructing Plain scale…….Draw perpendiculars

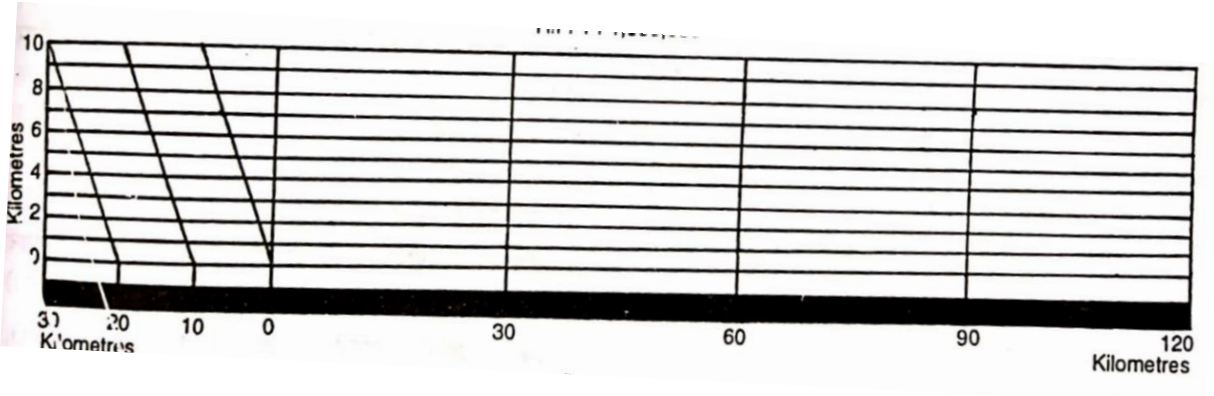
(2) मापनी के बायें सिरे पर बनाये गये लम्ब को आवश्यकतानुसार संख्या में समान दूरी के अन्तर पर विभाजित करते हैं तथा इन विभाजक-बिन्दुओं के मान नीचे से ऊपर की ओर को लिखे जाते हैं।

(3) लम्ब रेखा को समान भागों में बाँटने वाले इन बिन्दुओं से मापनी की पूरी लम्बाई में समान्तर रेखाएँ खींची जाती हैं जो मापनी की प्रत्येक लम्ब रेखा को समान भागों में विभाजित करती हैं।

Draw parallels

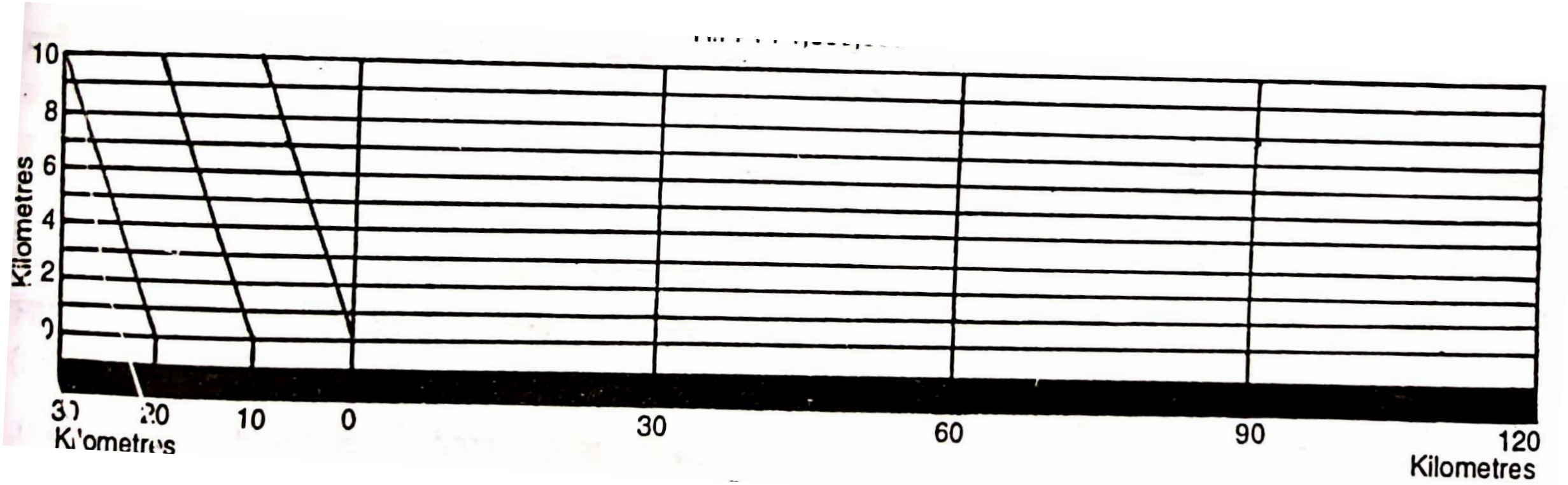
Steps to construct diagonal scale

(4) मापनी के गौण भागों पर इस प्रकार बने आयतों में परस्पर समान्तर विकर्ण बनाये जाते हैं। प्राथमिक भागों पर बने आयतों में विकर्ण बनाने की आवश्यकता नहीं होती। विकर्ण बनाने के लिये सदैव आयत के ऊपरी बायें कोने से निचले दायें कोने को मिलाती हुई सरल रेखा खींची जाती है। यदि मापनी के गौण भागों पर आयत नहीं बनाये गये हैं तो जिस प्रकार मापनी की निचली रेखा पर शून्य से बायीं ओर को गौण भागों के 1, 2, 3, 4, आदि मान लिखे जाते हैं उसी प्रकार मापनी की ऊपरी रेखा पर शून्य से बायीं ओर को गौण भागों के 1, 2, 3, 4, आदि मान लिख देते हैं और तत्पश्चात् निचली रेखा पर अंकित 0, 1, 2, तथा 3 के मान वाले बिन्दुओं की ऊपरी रेखा पर अंकित क्रमशः 1, 2, 3, तथा 4, मान वाले बिन्दुओं से



(5) विकर्ण मापनी पर कोई दूरी पढ़ने के लिए सम्बन्धित समान्तर रेखा पर शून्य के दायीं ओर किसी प्राथमिक भाग के लम्ब पर तथा शून्य के बायीं ओर उस समान्तर रेखा तथा सम्बन्धित विकर्ण के छेदन बिन्दु पर गुणा (×) या तीर के चिह्न लगाये जाते हैं तथा इन चिह्नों के मध्य गहरी स्याही से रेखा खींचकर दूरी लिख देते हैं। उदाहरणार्थ,

(6) प्राथमिक तथा गौण भागों द्वारा प्रदर्शित दूरियों को लिखने की तथा मापनी की लम्बाई आदि ज्ञात करने की विधि वही होती है जो सरल मापनी की होती है। गौण भाग की छोटी दूरियों को मापनी के बायें सिरे पर बनाये गये लम्ब पर नीचे से ऊपर की ओर को सम्बन्धित समान्तर रेखा के सामने लिखते हैं।



Mile system conversion table

CONVERSION	Inch (”) 1"" =	Feet (ft) 1 ft =	Yard 1 yard =	Furlong 1 furlong =	Mile 1 mile =
In ***inch***	1”	12”	36"		63,360"
In feet		1 foot	3 feet		
In yards			1 yard	220 yards	1,760 yards
In Furlong				1	8 furlong

Metric system conversion table

CONVERSION	Centimeter (cm) 1 cm =	Decimeter (dm) 1 dm =	Meter (m) 1 m =	Deca Meter (dam) 1 dam =	Hecto Meter (hm) 1 hm =	Kilo Meter (km) 1 km =
In ***meters***	0.01 m	0.1 m	1 m	10 m	100 m	1,000 m
In ***centimeters***	1 cm	10 cm	100 cm	1,000 cm	10,000 cm	1,00,000 cm
In hectometers					1 hm	10 hm

Questions

उदाहरण (24) 1/50 निरूपक भिन्न पर बने किसी मकान के प्लान के लिये एक विकर्ण मापनी की रचना कीजिये जिसमें 1 सेमी तक की दूरी पढ़ी जा सके।

हल— निरूपक भिन्न के अनुसार,

∵ 1 सेमी की दूरी प्रकट करती है

= 50 सेमी

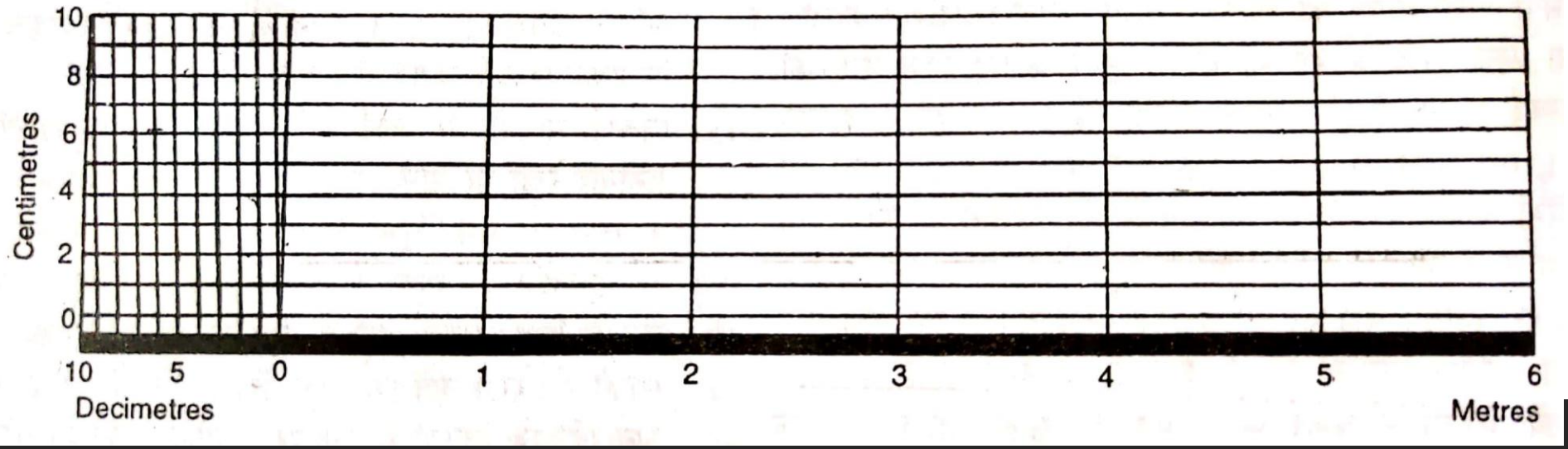
∴ 14 सेमी की दूरी प्रकट करेगी

= 50 × 14 सेमी अर्थात् 7 मीटर

अब 14 सेमी लम्बी कोई सरल रेखा खींचिये जो 7 मीटर की दूरी प्रकट करेगी। इस रेखा को 7 समान भागों में बाँटिये तथा विभाजक बिन्दुओं पर लम्ब खींचिये। इस प्रकार बना प्रत्येक भाग 1 मीटर की दूरी प्रदर्शित करेगा। बायीं ओर के भाग को पुनः 10 उपविभागों में बाँटिये जिससे प्रत्येक उपविभाग के द्वारा 1 डेसी (अर्थात् 10 सेमी) की दूरी प्रकट होगी। बायें सिरे पर बनाये गये लम्ब पर कोई दूरी लेकर 10 चिह्न लगाइये तथा इन चिह्नों से मापनी की पूरी लम्बाई में समान्तर रेखाएँ खींचिये। इन रेखाओं पर 1 से 10 सेमी तक की संख्याएँ लिखिये। चित्र 4.25 के अनुसार गौण भागों पर विकर्ण बनाइये।

1 m = 10 decimeter
1 dm = 10 cm

R.F. 1 : 50



उदाहरण (25) 1/63,360 निरूपक भिन्न पर बने मानचित्र के लिये एक विकर्ण मापनी की रचना कीजिए तथा मापनी में 3 मील 3 फर्लांग 132 गज की दूरी प्रदर्शित कीजिये।

हल—निरूपक भिन्न के अनुसार,

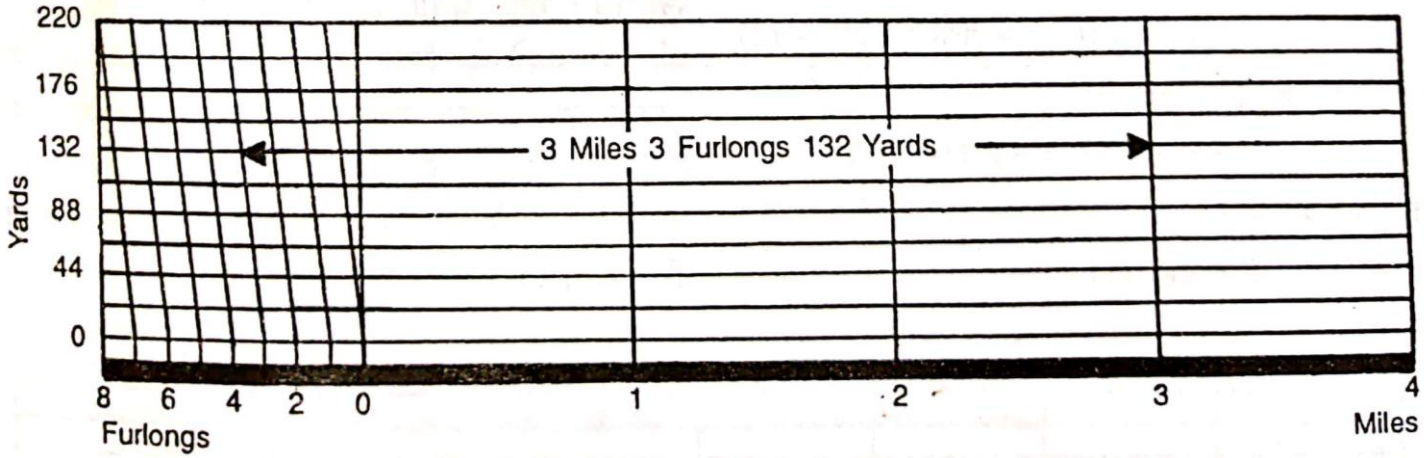
∵ 1 इन्च की दूरी प्रकट करती है

= 63,360 इन्च अर्थात् 1 मील

∴ 5 इन्च की दूरी प्रकट करेगी = 5 मील

अब 5 इन्च लम्बी कोई सरल रेखा खींचिये जो 5 मील की दूरी प्रकट करेगी। इस रेखा के 5 समान भाग कीजिये जिससे प्रत्येक भाग 1 मील की दूरी प्रदर्शित करेगा। विभाजक बिन्दुओं पर लम्ब उठाइये। फर्लांग दिखलाने के लिये बायीं ओर के पहले भाग को आठ समान भागों में विभाजित कीजिये। मापनी के बायें सिरे पर बनाये गये लम्ब पर कोई दूरी लेकर समान अन्तर पर 10 चिह्न लगाइये तथा इन चिह्नों से मापनी की आधार रेखा के समान्तर रेखाएँ खींचिये। चित्र 4.26 के अनुसार गौण भागों पर विकर्ण खींचिये। मापनी में 3 मील 3 फर्लांग 132 गज की दूरी प्रदर्शित करने के लिये शून्य से बायीं ओर की चौथी विकर्ण रेखा तथा छठी समान्तर रेखा के छेदन-बिन्दु पर तीर का चिह्न लगाइये तथा दूसरा चिह्न इस समान्तर रेखा तथा 3 मील प्रदर्शित करने वाली लम्ब रेखा के छेदन-बिन्दु पर अंकित किया जायेगा।

R.F. 1 : 63, 360



1 furlong = 220 yards

उदाहरण (26) 1/40,000 निरूपक भिन्न पर बने किसी मानचित्र के लिये विकर्ण मापनी की रचना कीजिये जिसमें 1 डेमी तक की दूरी पढ़ी जा सके।

हल– निरूपक भिन्न के अनुसार,

∵ 1 सेमी की दूरी प्रकट करती है

$= 40{,}000$ सेमी

∴ 12 सेमी की दूरी प्रकट करेगी

$= 12 \times 40{,}000$ सेमी अथवा 4.8 किमी

चूँकि 4.8 की निकटतम पूर्णांक संख्या 5 है, अतः

∵ 4.8 किमी प्रकट होते हैं

$= 12$ सेमी से

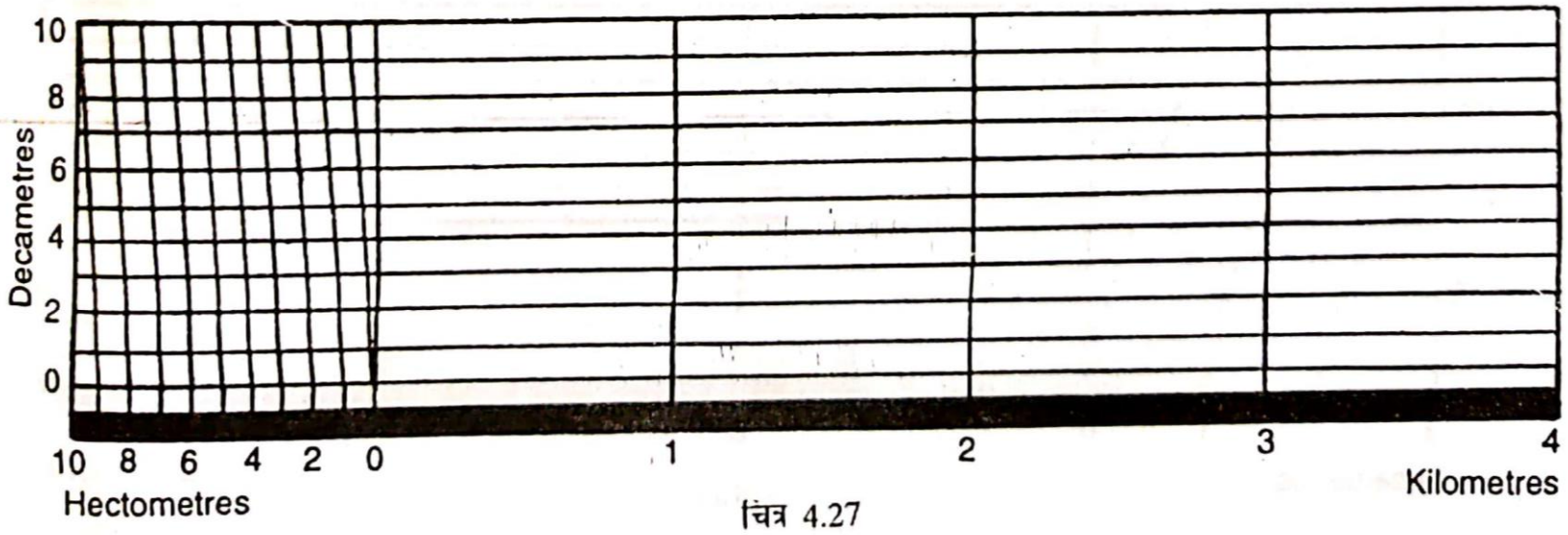
∴ 5 किमी प्रकट होंगे

$$= \frac{12 \times 5}{4.8} = 12.5 \text{ सेमी से}$$

अब 12.5 सेमी लम्बी रेखा को 5 भागों में विभाजित कीजिये जिससे प्रत्येक भाग 1 किमी की दूरी प्रदर्शित करेगा।

R.F. 1 : 40,000

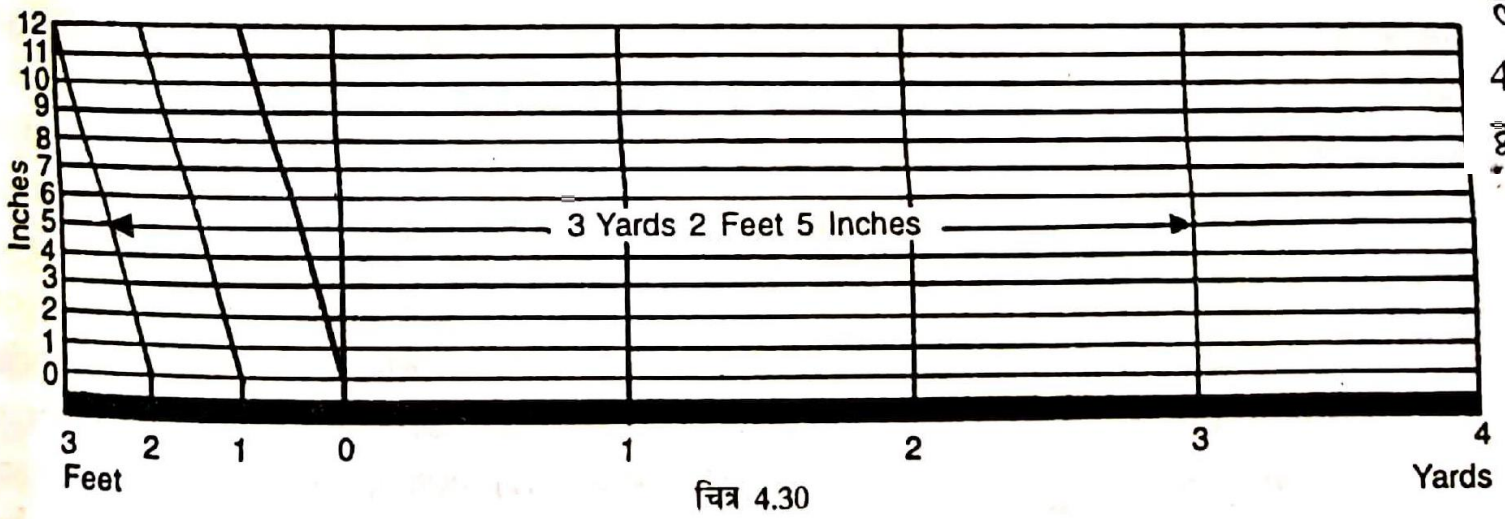
1 km = 10 hm
1 hm = 10 Deca m



चित्र 4.27

उदाहरण (29) 1/36 निरूपक भिन्न पर बने मानचित्र के लिये एक विकर्ण मापनी बनाइये तथा मापनी में 3 गज 2 फीट 5 इन्च की दूरी अंकित कीजिये।

R.F. 1 : 36



चित्र 4.30

हल— निरूपक भिन्न के अनुसार,

∵ 1 इन्च की दूरी प्रकट करती है

= 36 इन्च अर्थात् 1 गज

∴ 5 इन्च की दूरी प्रकट करेगी

= 5 गज

अब 5 इन्च लम्बी रेखा के 5 भाग करने पर प्रत्येक भाग 1 गज की दूरी प्रकट करेगा। बायीं ओर के भाग को तीन उपविभागों में बाँटने पर प्रत्येक उपविभाग 1 फुट की दूरी प्रकट करेगा। चूंकि 1 फुट में 12 इन्च होते हैं अतः बायीं ओर के लम्ब पर 12 चिह्न लगाकर समान्तर रेखाएँ खींची जायेंगी। चित्र 4.30 के अनुसार मापनी में विकर्ण खींचिये तथा तीर के चिह्नों द्वारा 3 गज 2 फीट 5 इन्च की दूरी प्रदर्शित कीजिये।

1 yard = 3 feet
1 foot = 12 inch

उदाहरण (30) 1/1,000,000 निरूपक भिन्न पर बने मानचित्र के लिये एक विकर्ण मापनी बनाइये जिसमें 1 किमी तक की दूरी पढ़ी जा सके।

हल—निरूपक भिन्न के अनुसार,

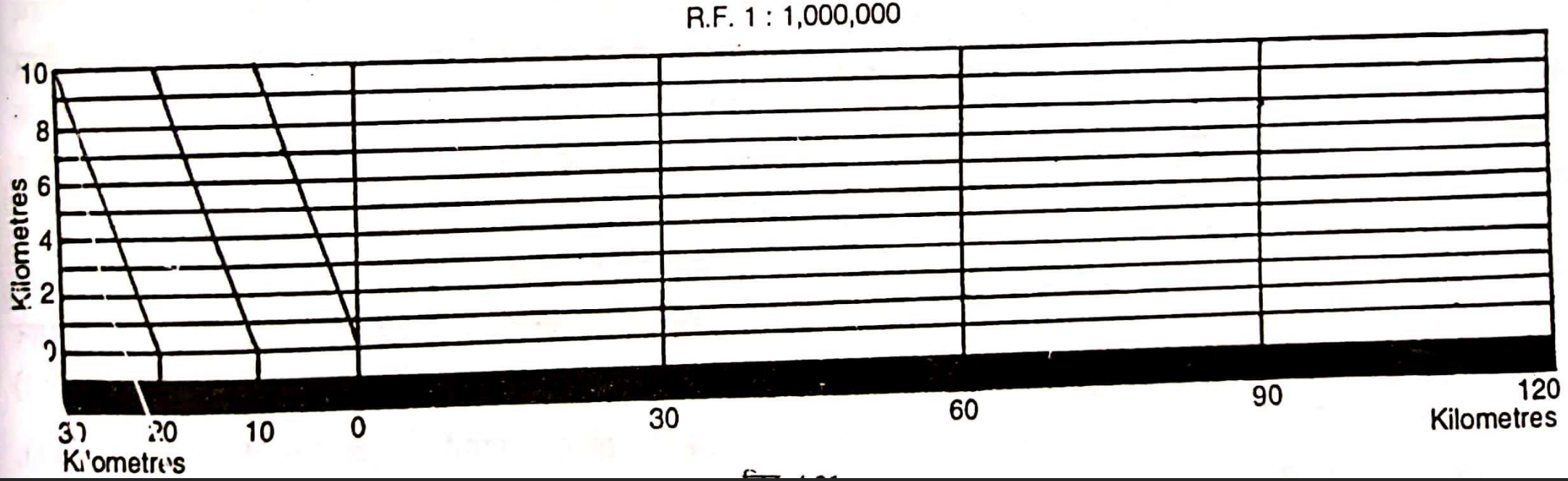
∵ 1 सेमी की दूरी प्रकट करती है

= 1,000,000 सेमी या 10 किमी

∴ 15 सेमी की दूरी प्रकट करेगी

= 10 × 15 = 150 किमी

अब 15 सेमी लम्बी रेखा के 5 भाग करने पर प्रत्येक भाग 30 किमी की दूरी प्रदर्शित करेगा। प्रथम भाग को 3 उपविभागों में बाँटने पर प्रत्येक उपविभाग 10 किमी की दूरी प्रकट करेगा। बायें सिरे के लम्ब पर समान अन्तर पर 10 चिह्न लगाकर उन चिह्नों से होती हुई समान्तर रेखाएँ खींचिये तथा विकर्ण बनाकर मापनी के भागों पर चित्र 4.31 अनुसार दूरियाँ लिखिये।



Enlargement, Reduction & Combination of *Maps*

COMPILED BY URMI SHARMA

Enlargement and reduction of maps

- In the process of compiling maps cartographers are often required to either reduce or enlarge maps.
- Reduction or enlargement involves change in the size of the MAP.
- **An enlargement provides the same map but proportionally larger than the original.**
- **A reduction gives the same map that is proportionally smaller than the original.**
- **The concept can better be understood through RATIO.**
- **Here we will use the ratio of**

The change in scale

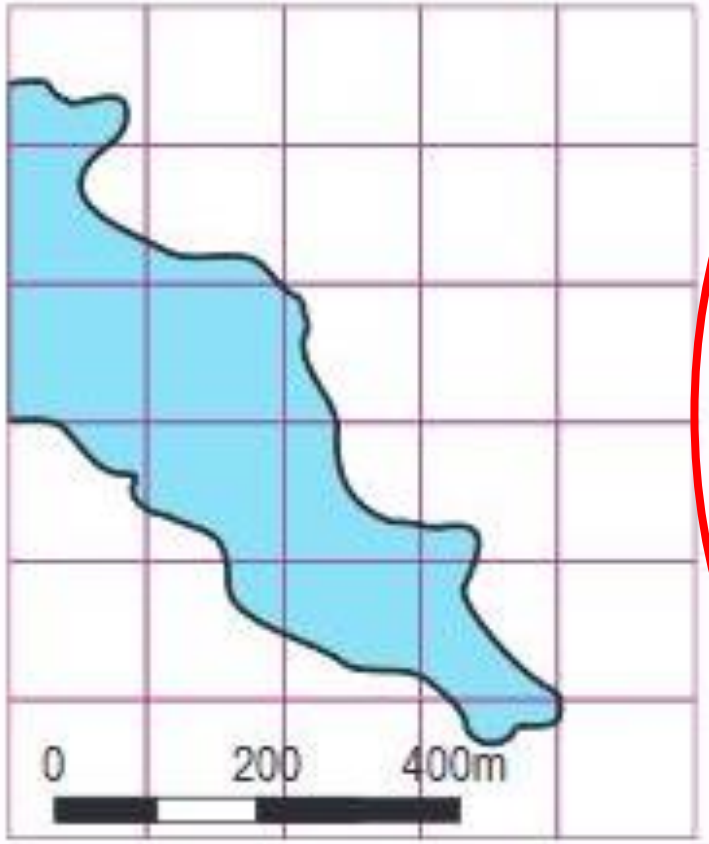
Enlargement

- **1:1,00,000 (Original map R.F.)**
- **1:50,000 (New enlarged Map R.F.)**
- **1:25,000**
- **1:20,000**
- **1:2500**
- **1:1000**
- **1:100**

Reduction

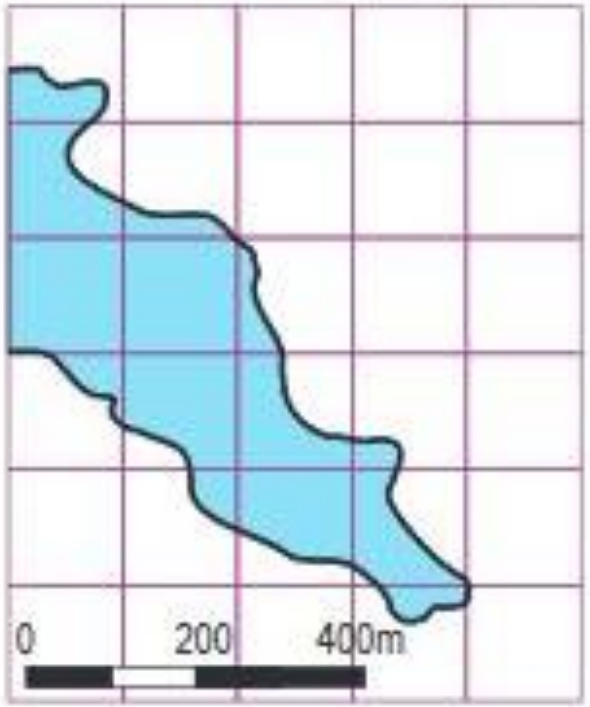
- **1:1,00,000 (Original map R.F.)**
- **1:1,50,000 (New reduced Map R.F.)**
- **1: 2,00,000**
- **1:15,00,000**
- **1:3,000,000**

AFTER ENLARGEMENT



A

ORIGINAL SIZE



B

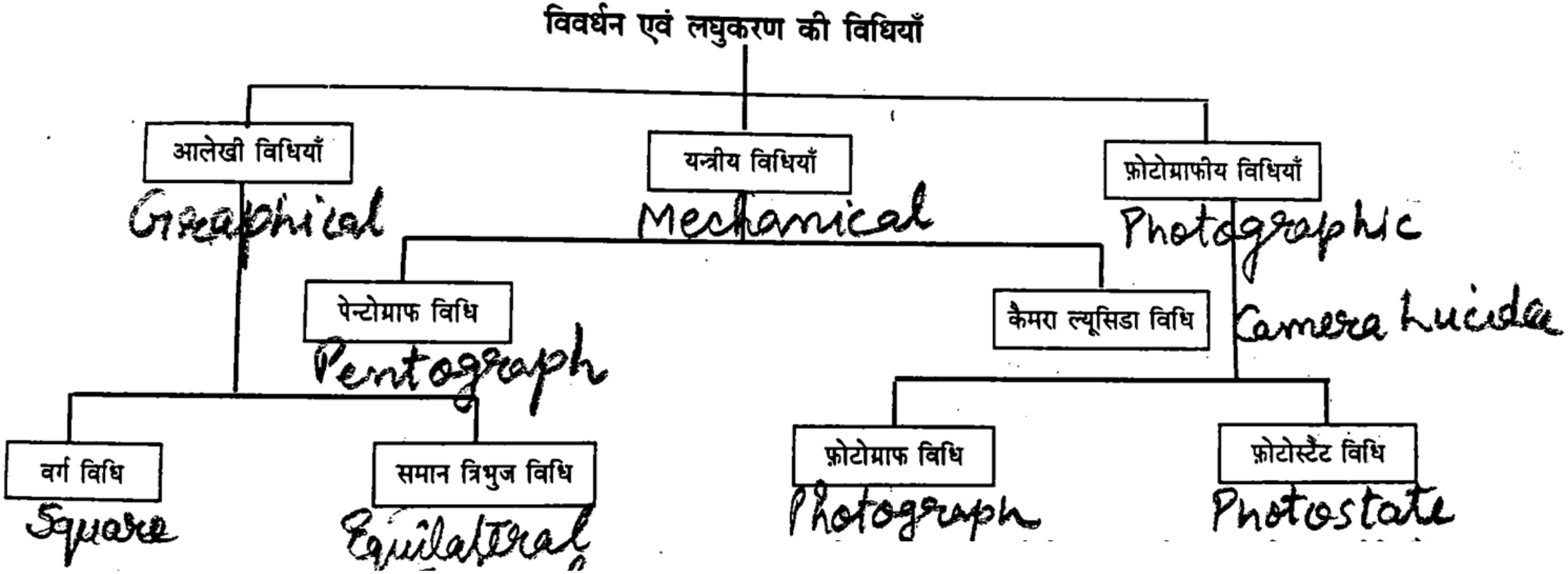
AFTER REDUCTION

C

Enlargement and reduction of maps

- The amount that an original image has been enlarged or reduced is called a **scale factor**, or an **enlargement or reduction factor.**
- **It is the constant factor by which all dimensions of an object are enlarged or reduced in a map.**
- If shapes have been **reduced by half, the scale factor is ½.**

Methods of Enlargement / Reduction



Square Method (*Graphical method type)*

- The square method is the most common and simplest method for enlargement and reduction of maps.
- In order to enlarge a map, cover the original map with a set of squares of equal sides.
- The side of the squares has to be enlarged proportionally to that the original map.
- The side of the square of the new map has to be determined using the formula.

$$\text{Scale of the new map} = \frac{\text{New scale}}{\text{Old scale}} \times \text{Side of the square of the original map}$$

Q1. This is a map of Rajasthan drawn on a scale of 1/16,000,000 and is to be enlarged on the scale of 1/8,000,000

- ***Step 1***: Draw a network of squares on the original map, each side being **1 cm. in length.**
- ***Step 2*****:** Calculation
- When the scale is 1/16,000,000 the side of the small square is 1 cm.
- Therefore, If scale is to be 1/8,000,000 side of the small square of new map = x

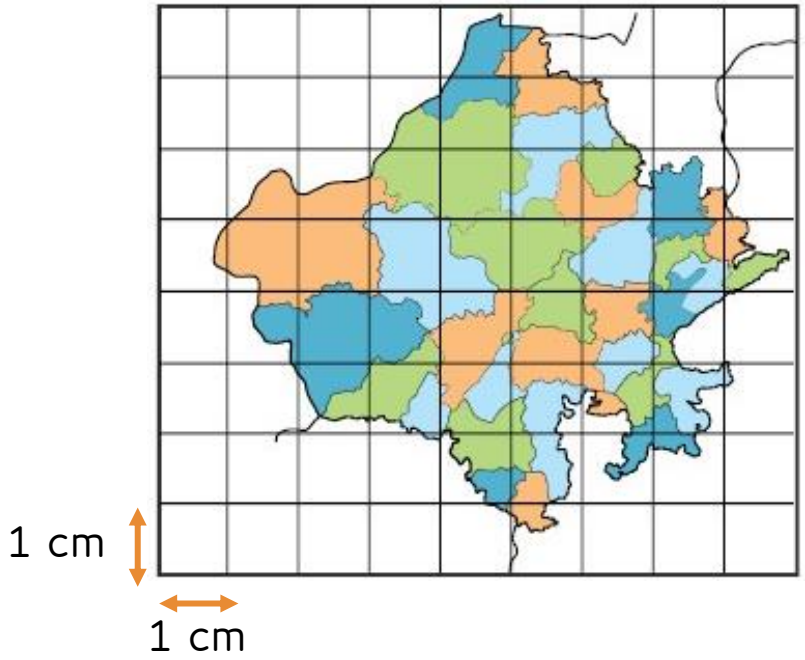
$$X = \frac{1/8,000,000}{1/16,000,000} \text{ x } 1 \text{ cm}$$

$$X = \frac{1 \text{ x } 16,000,000}{1 \text{ x } 8,000,000} = 2\text{cm}$$

Ans. 2 cm

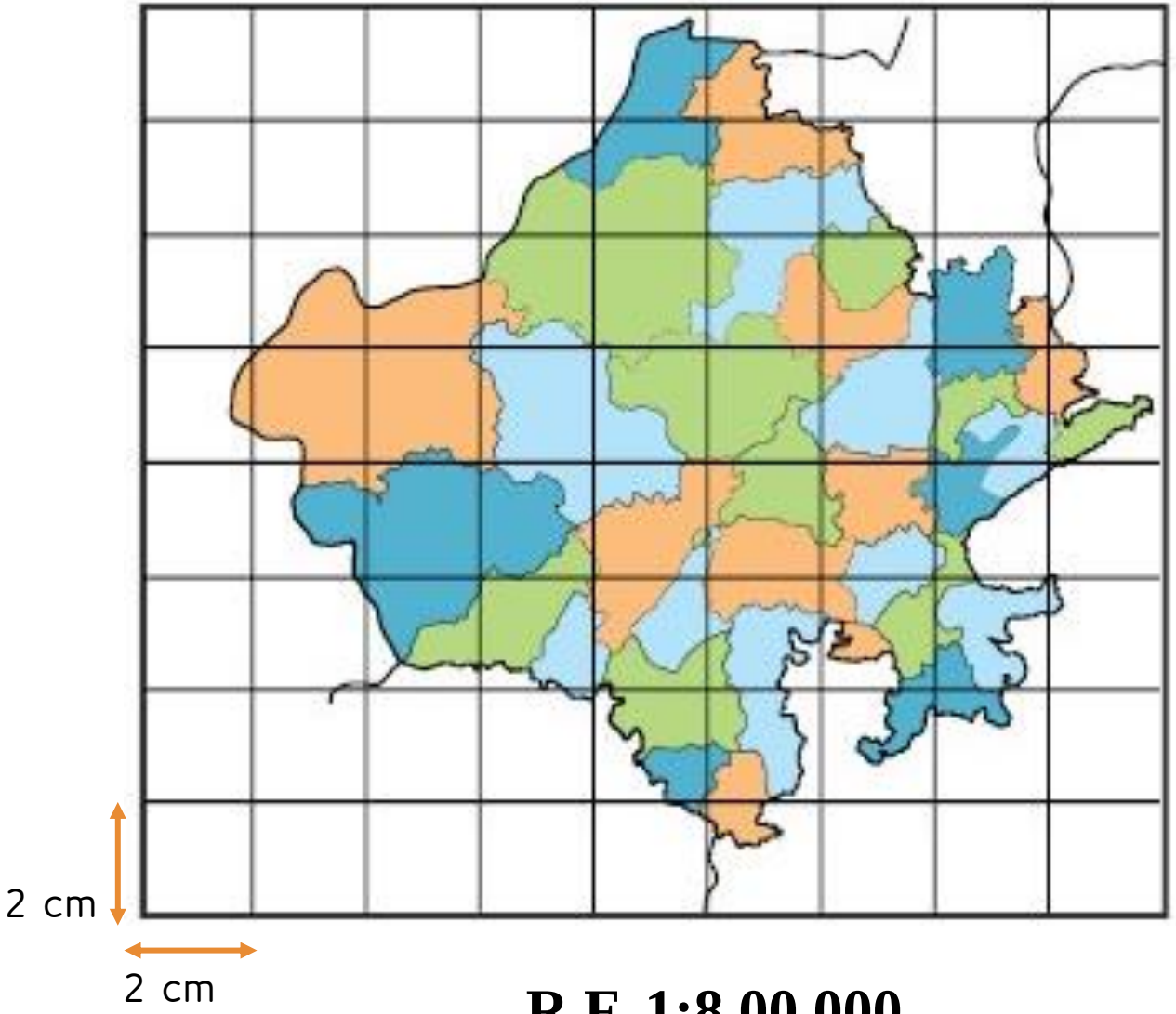
- When the scale is 1/8,000,000 the side of the small square will be 2cm.
- Now draw a network of squares, each side measuring 2 cm.
- The number of squares will be the same as on the original map.
- Now transfer the outline of original map on the enlarged map square by square.

Original Map



R.F. 1:16,00,000

Enlarged Map



R.F. 1:8,00,000

Q2. A map is drawn on a scale of 1/70,000,000. It is to be enlarged on the scale of 1/35,000,000 using square method.

- ***Step 1***: Draw a network of squares on the original map, each side being **1 cm. in length.**

Q3. A map is drawn on a scale of 1/40,000. It is to be enlarged on the scale of 1/30,000 using square method.

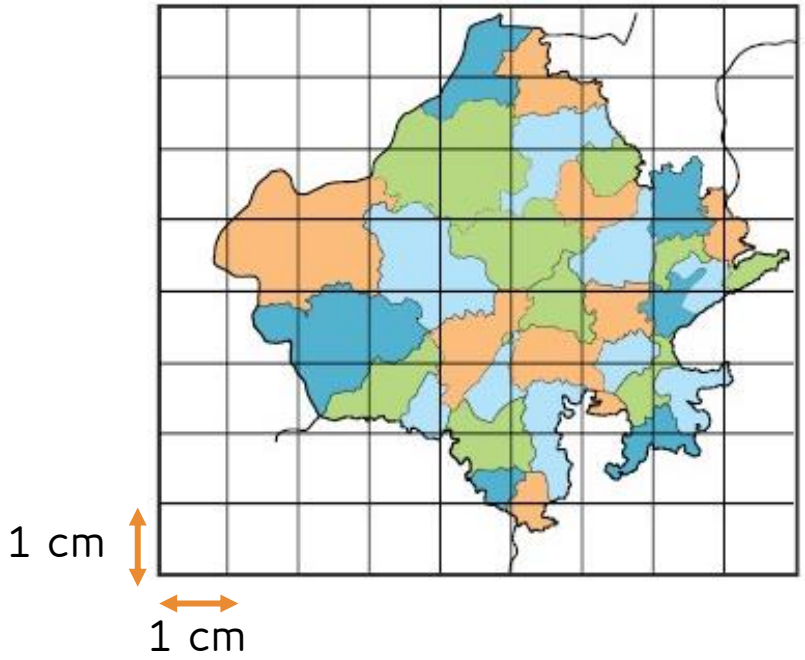
- ***Step 1***: Draw a network of squares on the original map, each side being **1 cm. in length.**

Q4. A map is drawn on a scale of 1/50,000. It is to be reduced on the scale of 1/100,000 using square method.

- ***Step 1***: Draw a network of squares on the original map, each side being **1 cm. in length.**
- ***Step 2*****:** Calculation
- When the scale is 1/50,000 the side of the small square is 1 cm.
- Therefore, If scale is to be 1/1, 00,000 side of the small square of new map = x
- $x = \frac{1/100000}{1/50000}$ x 1 cm

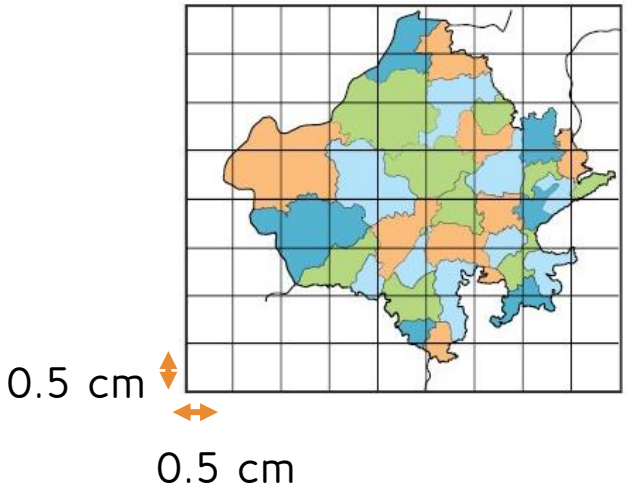
$$x = 0.5 \text{ cm}$$

Original Map

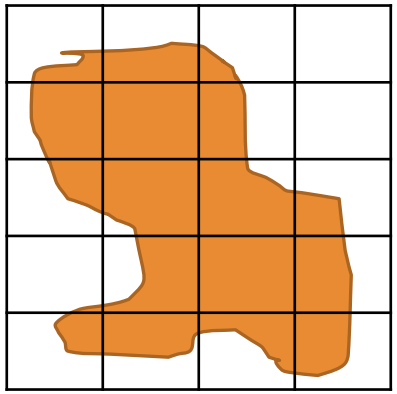


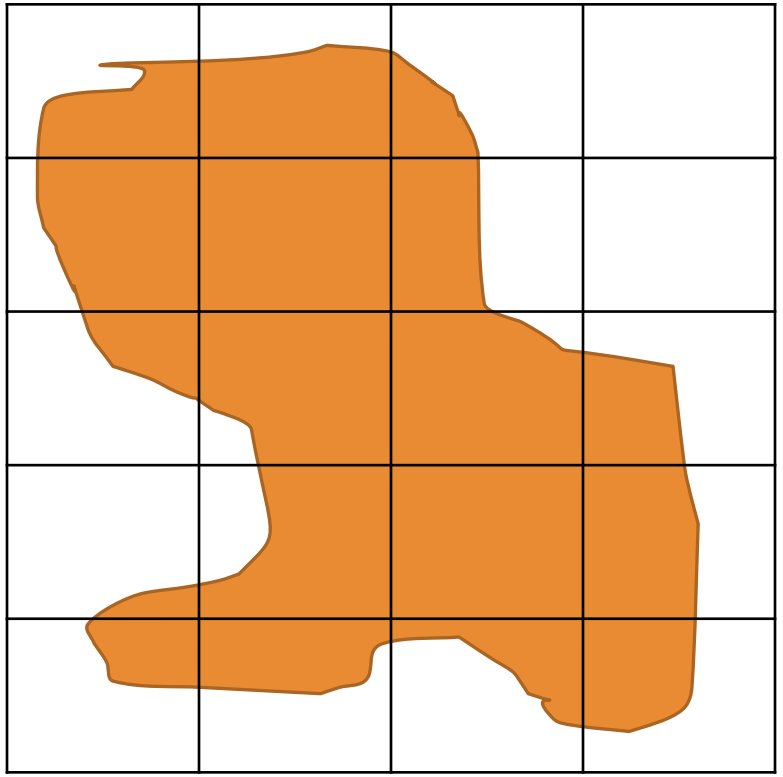
R.F. 1:50,000

Reduced Map



R.F. 1:1,00,000





Enlargement & Reduction of Maps (For Sheet)

Q. A map of Rajasthan is drawn on a scale of 1: 100,000. Enlarge the given map on scale of 1: 50,000 and similarly reduce the map on scale 1: 1,50,000 using square method.

- *Side of squares to be drawn for Enlarged map = 100000/50000 = 2 cm*
- *Side of squares to be drawn for Reduced map = 100000/150000 = 0.67 cm*

Combination of Maps

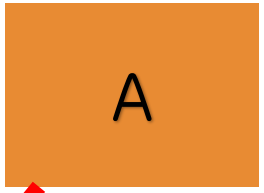
- To join different maps drawn on different scales.
- To join maps of an area drawn in parts.
- For this we use square method of enlargement and reduction of maps.

Things to remember

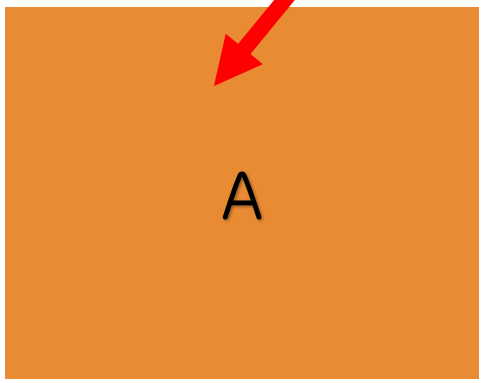
- There exist a common boundary in grid drawn for two maps.
- Start drawing squares/ grid from this common boundary

The process

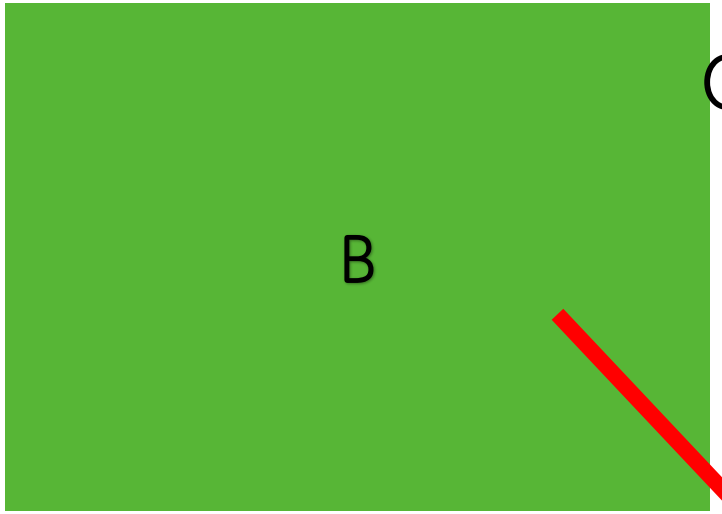
Original Map 1



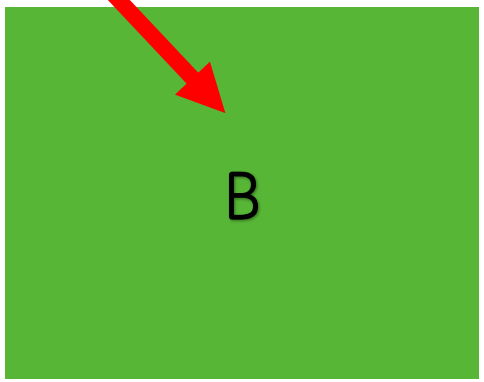
Enlargement



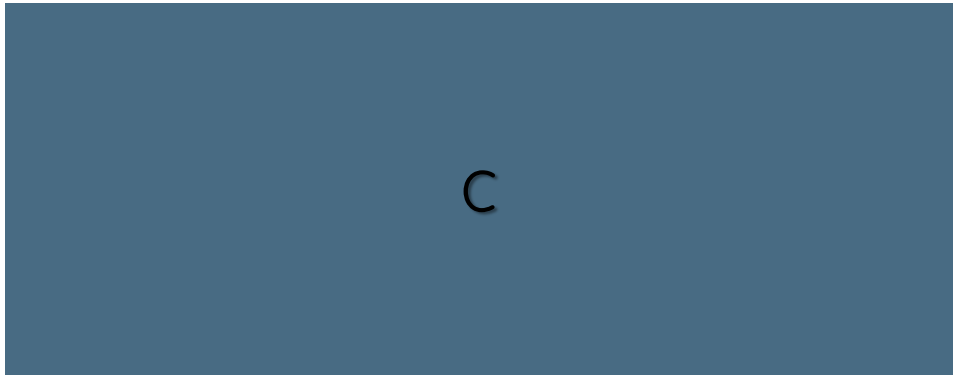
Original Map 2



Reduction

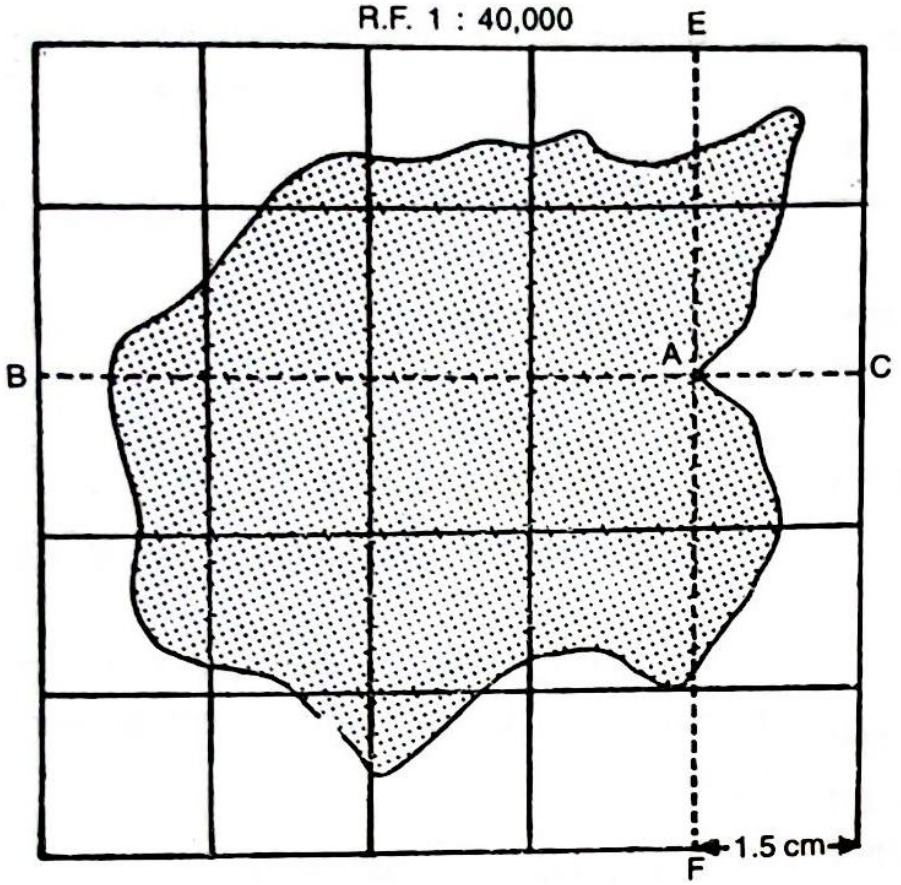


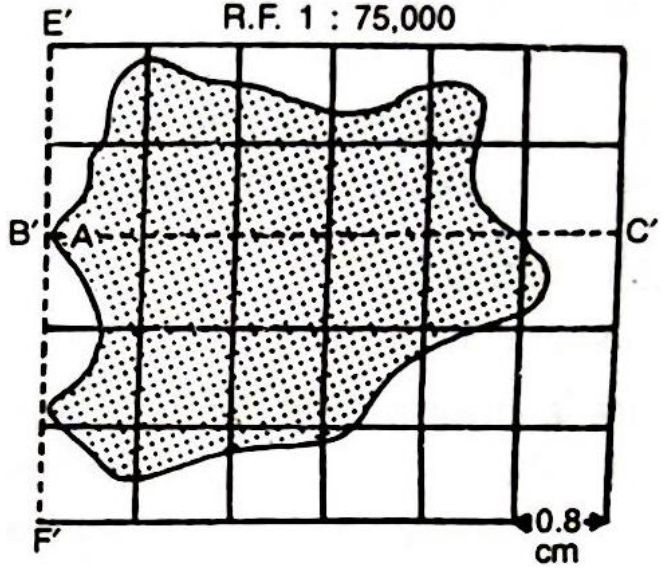
New Map

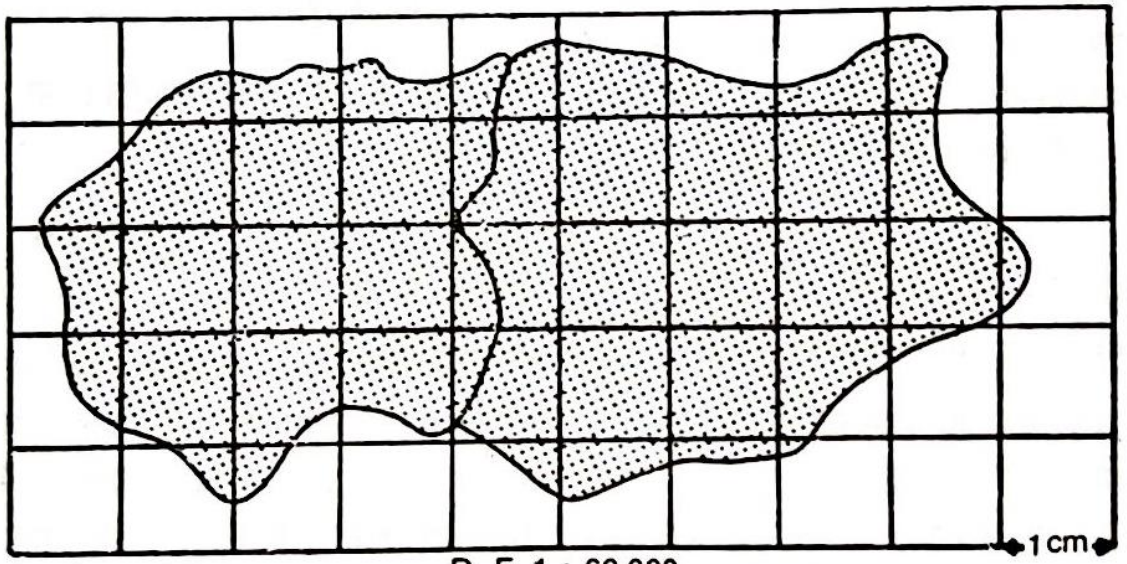


Combine two maps drawn on 1:40,000 & 1: 75,000 scales respectively to new R.F. on 1:60,000.

- Assuming that the squares drawn on **combined map is having a length of 1 cm**. *(Remember it is a **reverse process** of what we have learnt in **previous section of enlargement and reduction of maps**.)*
- **So we have to calculate the length of the side of the squares to be drawn on maps of 1: 40,000 and 1: 75,000**

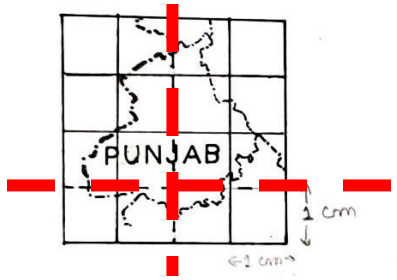

R.F. 1 : 40,000
E
B
A
C
F
1.5 cm

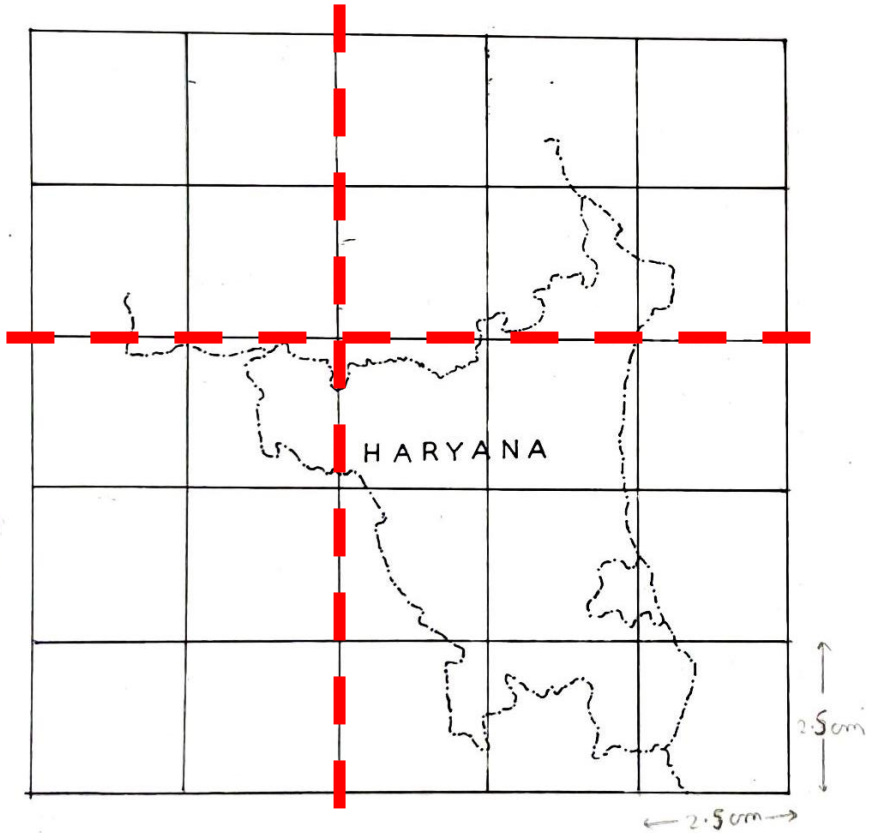

E′
R.F. 1 : 75,000
B′
A
C′
F′
0.8
cm


1 cm
R. F. 1 : 60.000

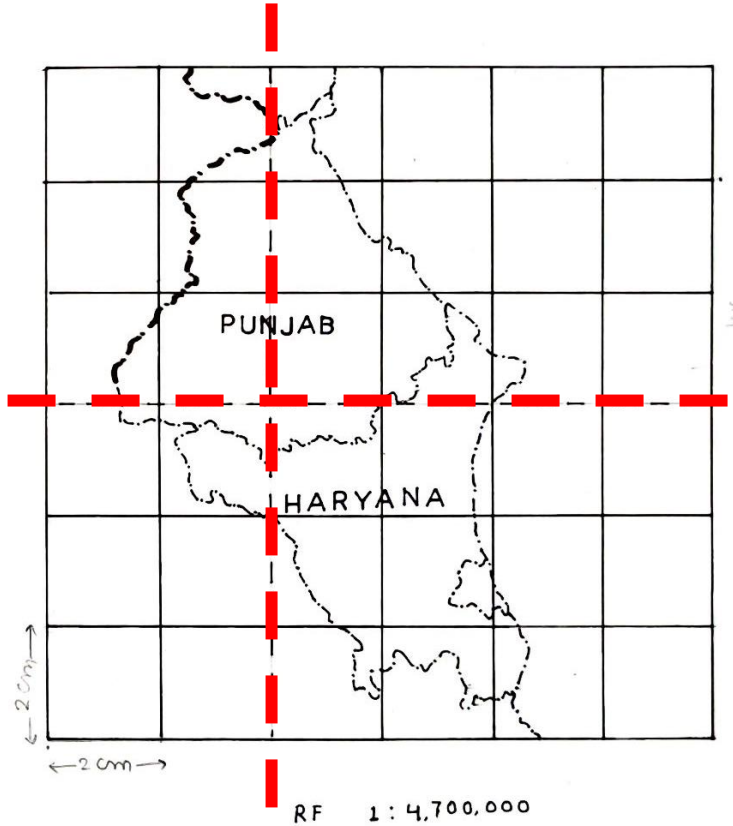
Combination of Maps

R.F. 1: 9,400,000





RF 1: 3,760,000



RF 1 : 4,700,000

20.2.20

Methods of representation of relief

Hachure,

Form Line,

Contour and

Layer Tint Methods

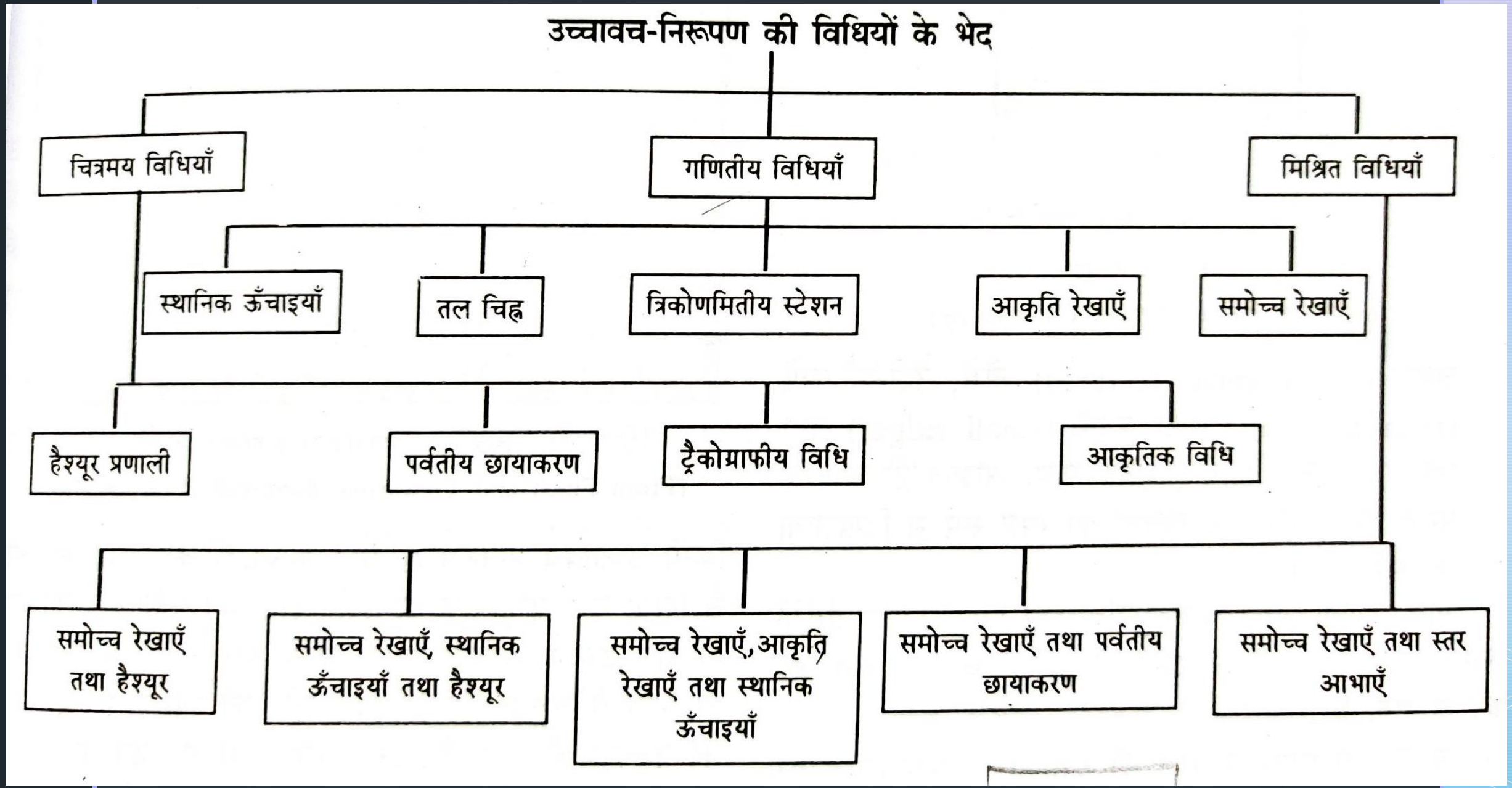
Relief

- Relief of a landscape is basically the physical configuration or appearance of such a landscape taking into account
- the elevations,
- slopes, and
- shape of natural features found in it.
- On maps, cartographers usually use several methods to portray the relief of the terrain.
- These include; contouring, layer tinting, relief shading, hachuring, benchmarks, trigonometric points, and spot heights.
- Which method is used on a certain map is usually the choice of the cartographer and a single map can contain more than one of these methods.

Topography

- Topography means the configuration of the land. A map of any part of the Earth surface, which is represented on a plane sheet of paper to a certain reduced scale is known as topographic map. The topographic features can be divided features can be broadly classified into three groups.
- **Relief :** Comprising hill, valley, escarpment, spur, saddle, plateau, plain, etc.
- **Drainage :** Comprising of sea, lake river, pond, canal, swaps, etc.
- **Culture :** Comprising town, railway, road, road, embankment, boundary and other works of man.

उच्चावच-निरूपण की विधियों के भेद



Methods of representation

- Different methods have been used to show the land surface on topographic maps which maybe grouped under three heads:

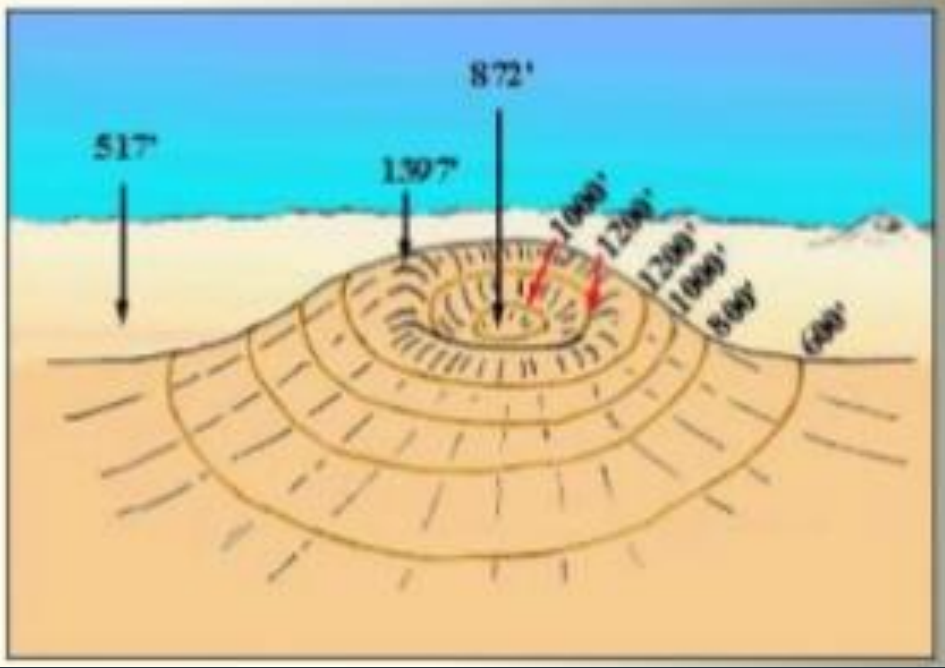
1. Pictorial method
2. Mathematical method
3. Combination of different methods

1. Pictorial method

- The pictorial method gives more or less true visual pictures of the terrain. This method is represented in two ways:

I. Hachures

II. Hill shading



- **Hachure lines**

Hachures

- Hachures are sets of finely **drawn disconnected lines**.
- **It indicate the direction to which water would flow from highland to lowland.**
  - ✓ The ***lines are thicker and closely*** drawn on ***steep slopes*** and
  - ✓ are ***thin and wide apart*** on ***gentle ones***.
- Hachures doesn't indicate absolute height but shows the general configuration of ground. Therefore, they are **non-numeric**.
- Being non-numeric, they are less useful to a scientific survey than contours, but can successfully communicate quite specific shapes of terrain.
- Flat areas whether on mountain tops or in lowlands are left blank.

Demerits

- Hachuring doesn't indicate the absolute heights, thus regions, say two hills or plateaux can have almost same pattern of hachuring and yet their actual altitudes may vary much different.
- In hilly country close hachures obscure other details of topography.
- Theses takes long time to be drawn and are thus costly.

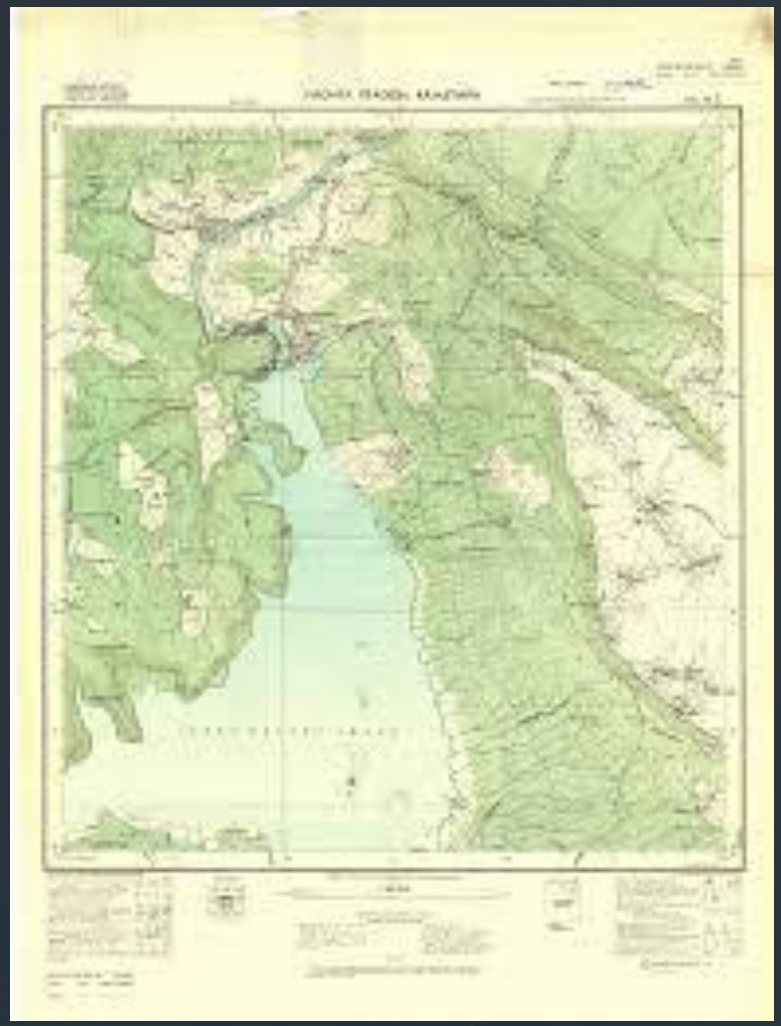
Mathematical Methods

1. Spot height
2. Bench marks
3. Triangulation survey
4. Layer Tint method
5. Contouring

Contour lines

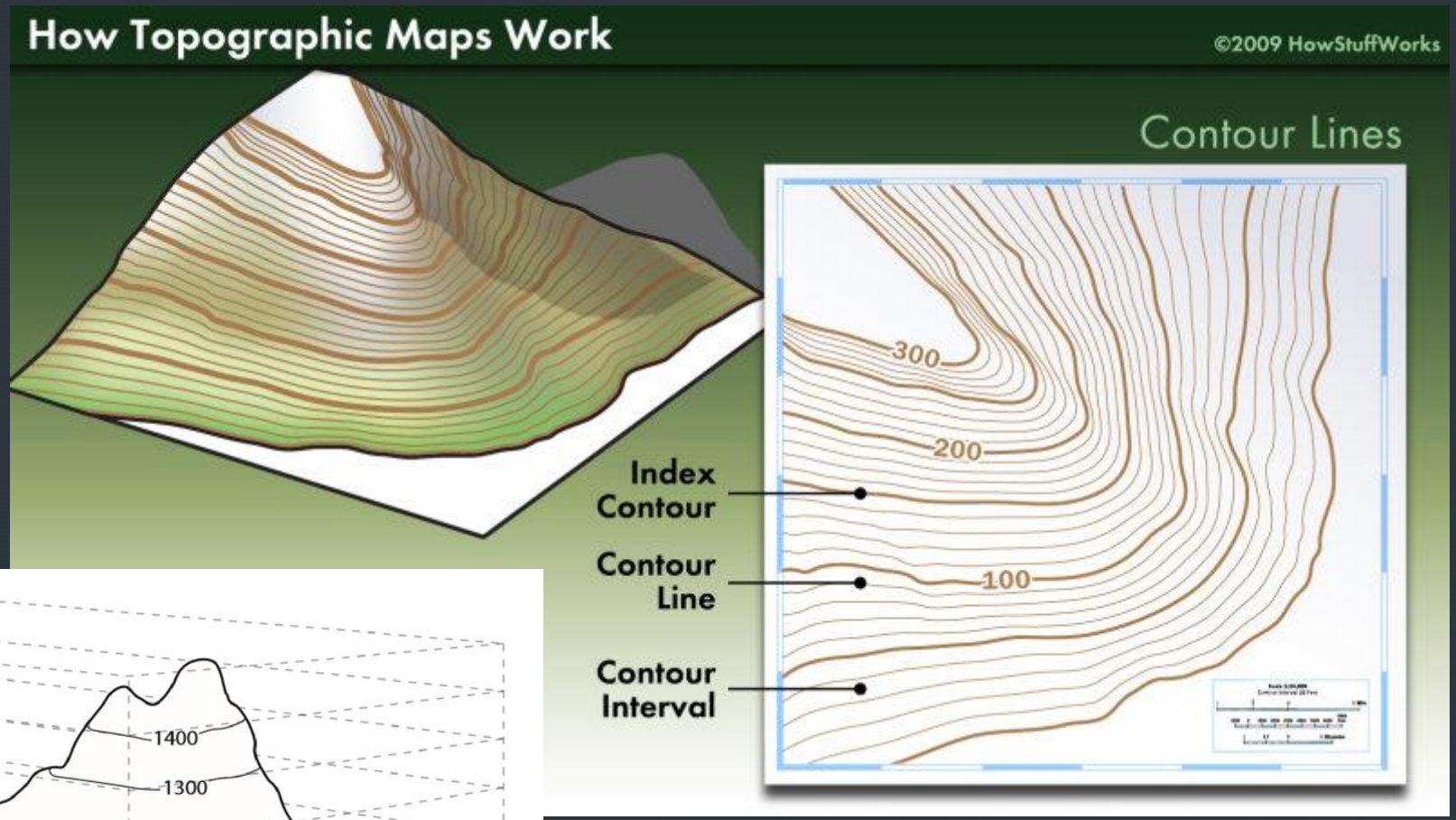
= Imaginary Line + joining places of equal/same elevation + from MSL

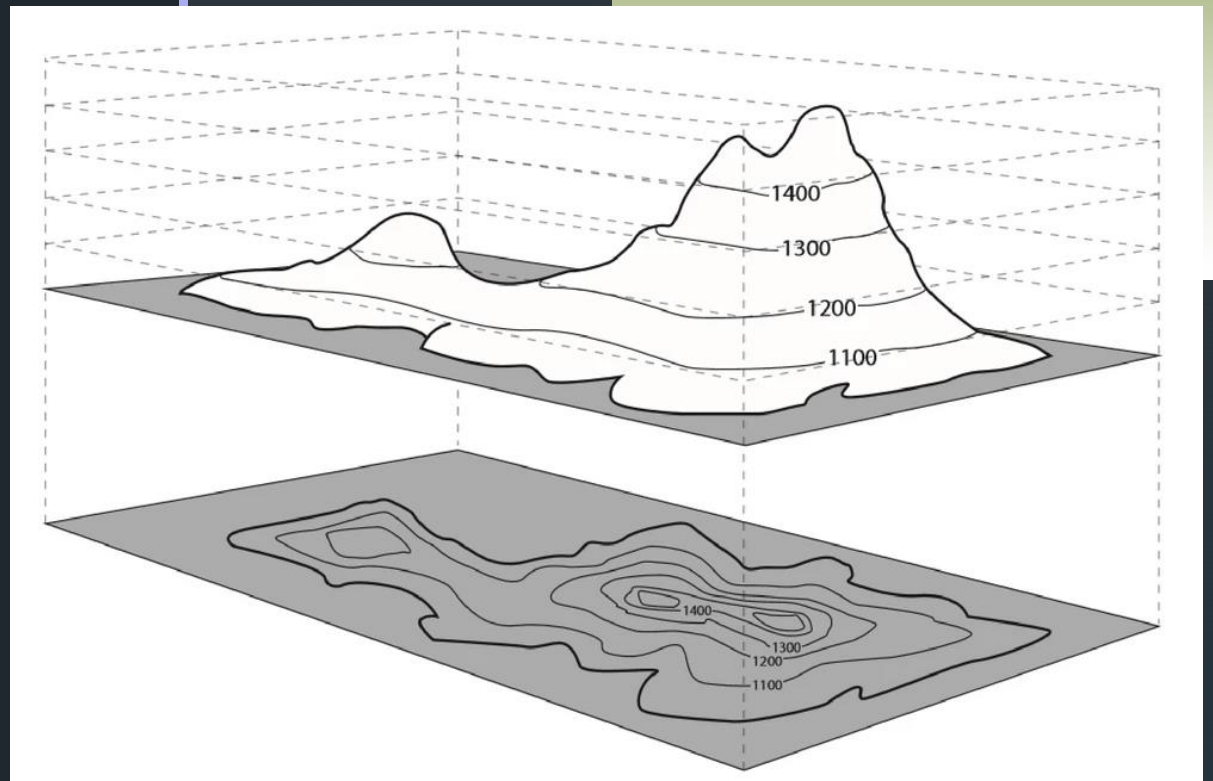
Sample toposheets representing contours



Contour lines

- Contour lines are an effective device for representing relief on topographic maps.
- They can be defined as an imaginary line connecting points of equal elevation on the ground surface.
- They are usually drawn in brown color.
- Each topographic map uses a contour interval, or equidistance, (the distance in elevation between contour lines) appropriate for that area.
- When contour lines are close together, they represent a steep slope, whereas when lines are far from each other, they represent a gradual slope.
- While flat areas may be mapped with a 5 meter contour interval, stepped terrain may have a 20 meter or more contour interval.
- This is why the contour interval is specified on the topographic map legend.


How Topographic Maps Work
©2009 HowStuffWorks
Contour Lines
300
200
100
Index Contour
Contour Line
Contour Interval


1400
1300
1200
1100
1400
1300
1200
1100

Characteristics of contour lines

1. Connect point of equal elevation from the Mean Sea Level (MSL).
2. Always connects close contour lines. This is not always visible on the map.
3. They never cross, split or intersect – at a **cliff** they might merge.
4. Evenly spaced contour lines indicate a **uniform slope**.
5. Closely spaced contour lines show a **steep slope**.
6. Widely spaced contour lines show **gentle slope**.
7. Uneven spacing – irregular or variable slope.
9. Closed contours with arrow in the centre represent depressions.

- Uniform slopes have uniformly spaced lines.
- *Along plane surfaces, contour lines are straight and parallel.*
- *For summits or depressions, contour lines most close upon themselves.*

There are some basic rules for contour lines:

1. A contour line must never split or divide.

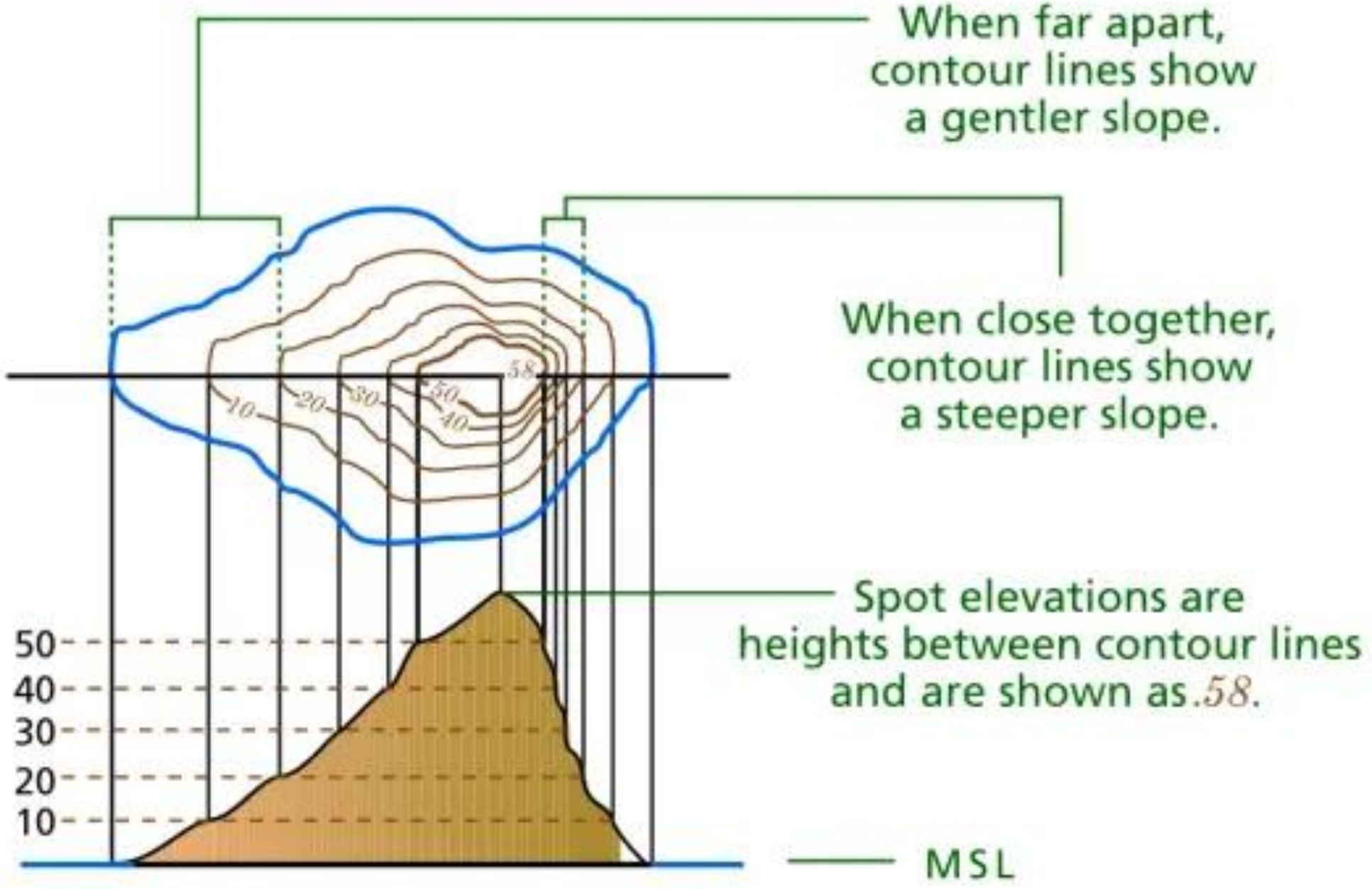
2. A contour line must never simply end, except at the edge of the map.

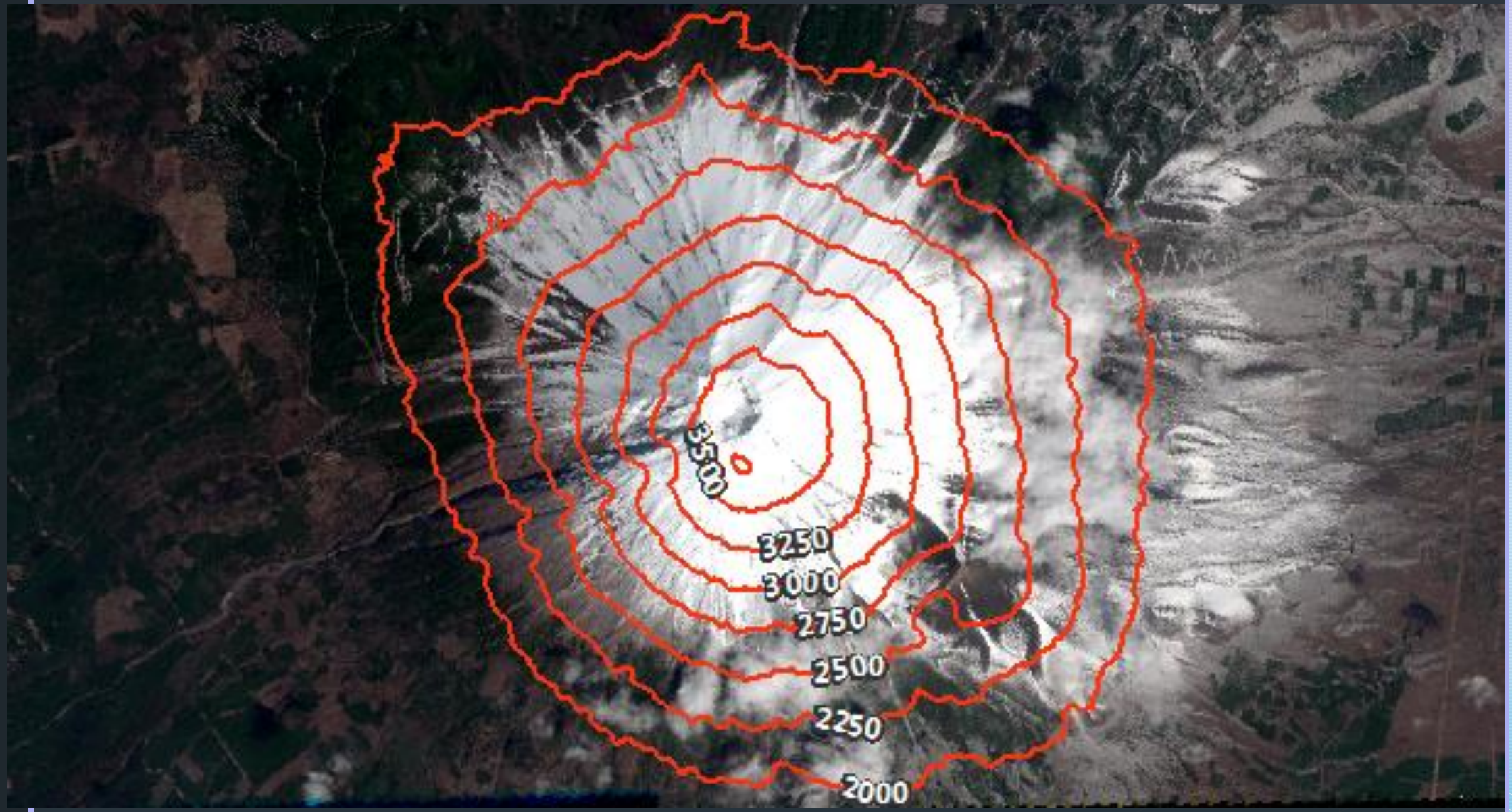
3. A contour line must represent one and only one elevation.

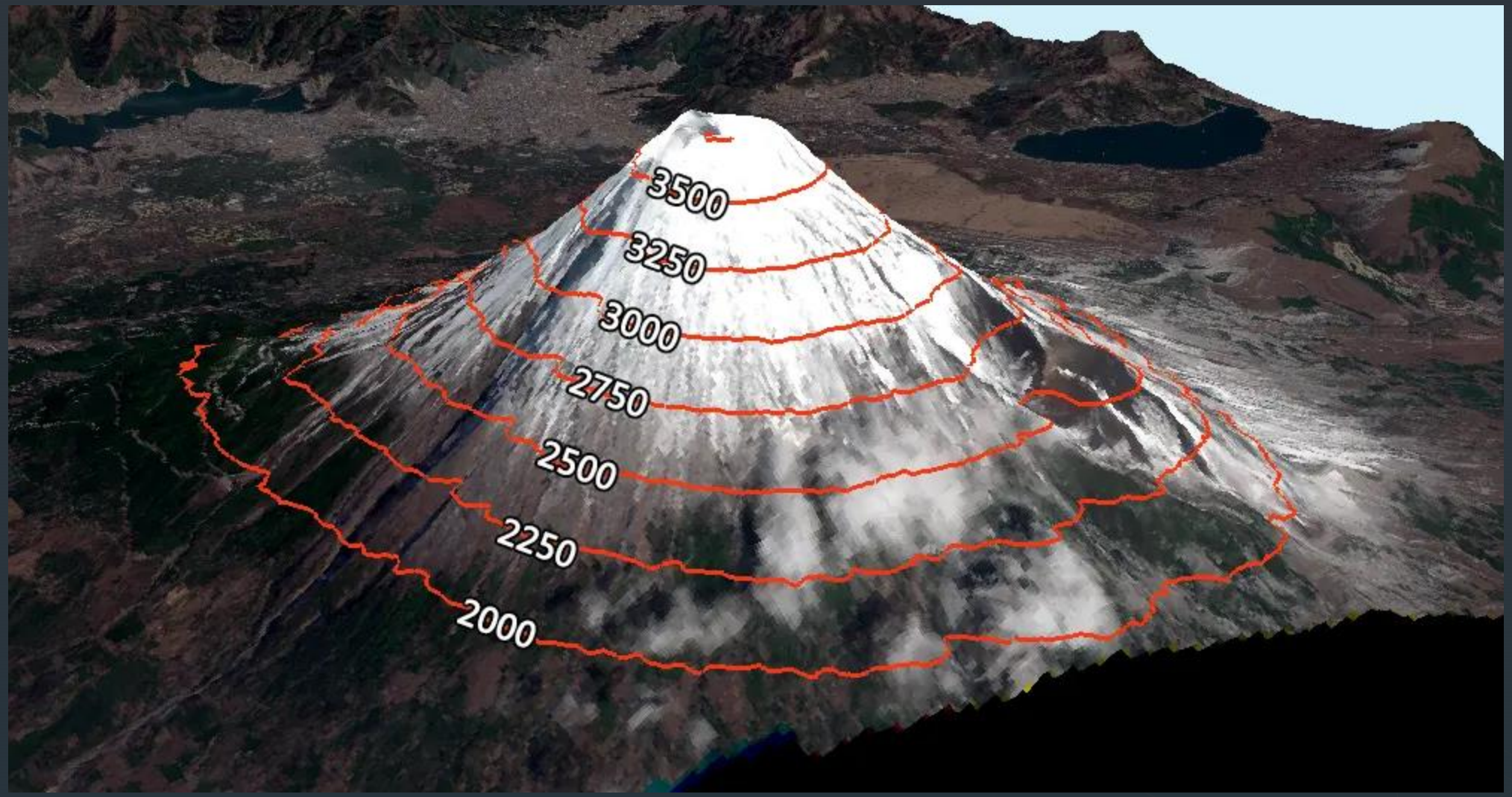
4. **A contour line may never intersect other contour lines. Except for cliffs.**

5. **Concentric circles of contour lines** indicate a hilltop or mountain peak.

6. **Concentric circles of hatched contour lines indicate a closed depression.**

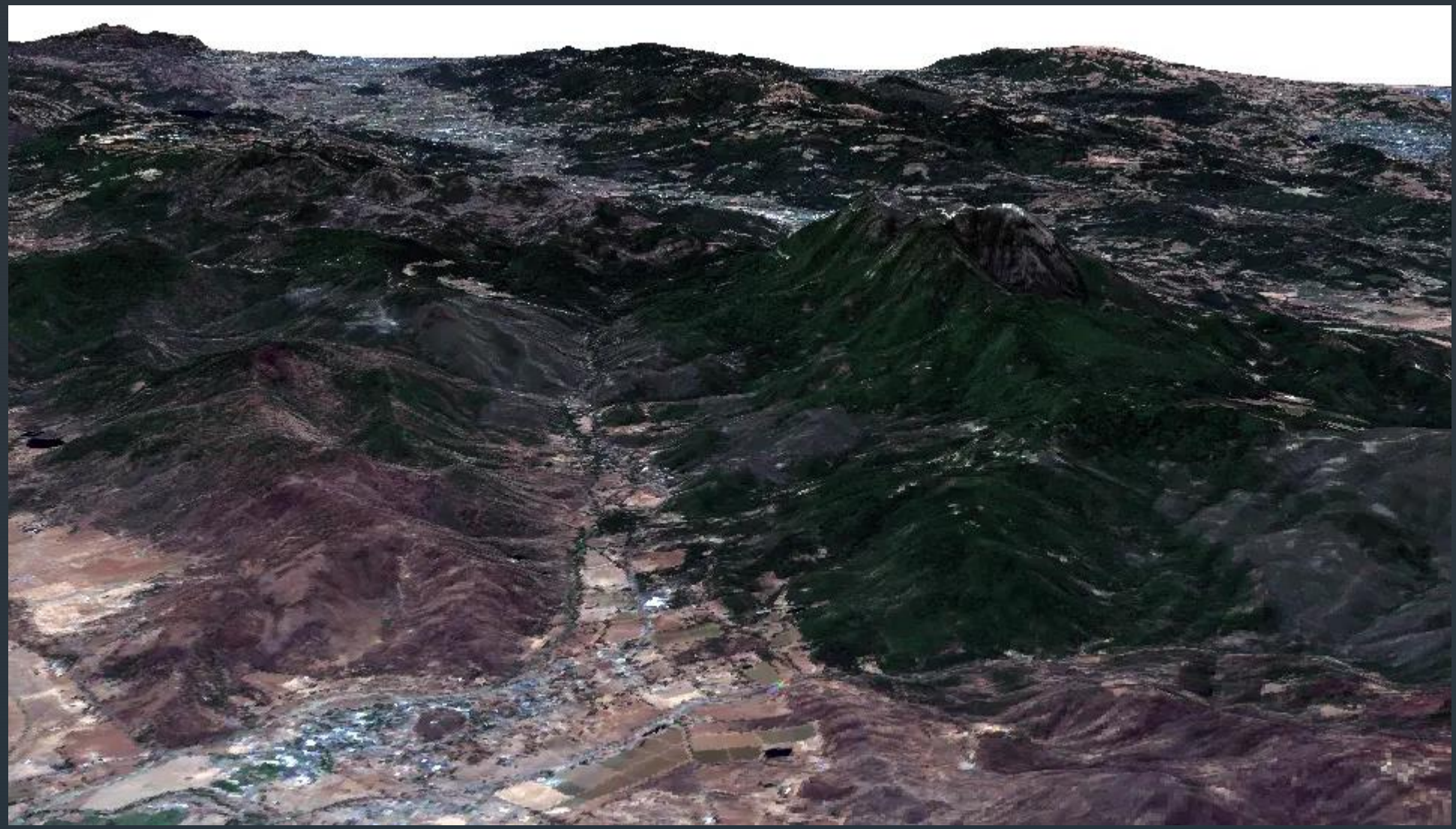

When far apart, contour lines show a gentler slope.
When close together, contour lines show a steeper slope.
Spot elevations are heights between contour lines and are shown as .58.
MSL
10
20
30
40
50
58
50
40
30
20
10


3500
3250
3000
2750
2500
2250
2000


3500
3250
3000
2750
2500
2250
2000

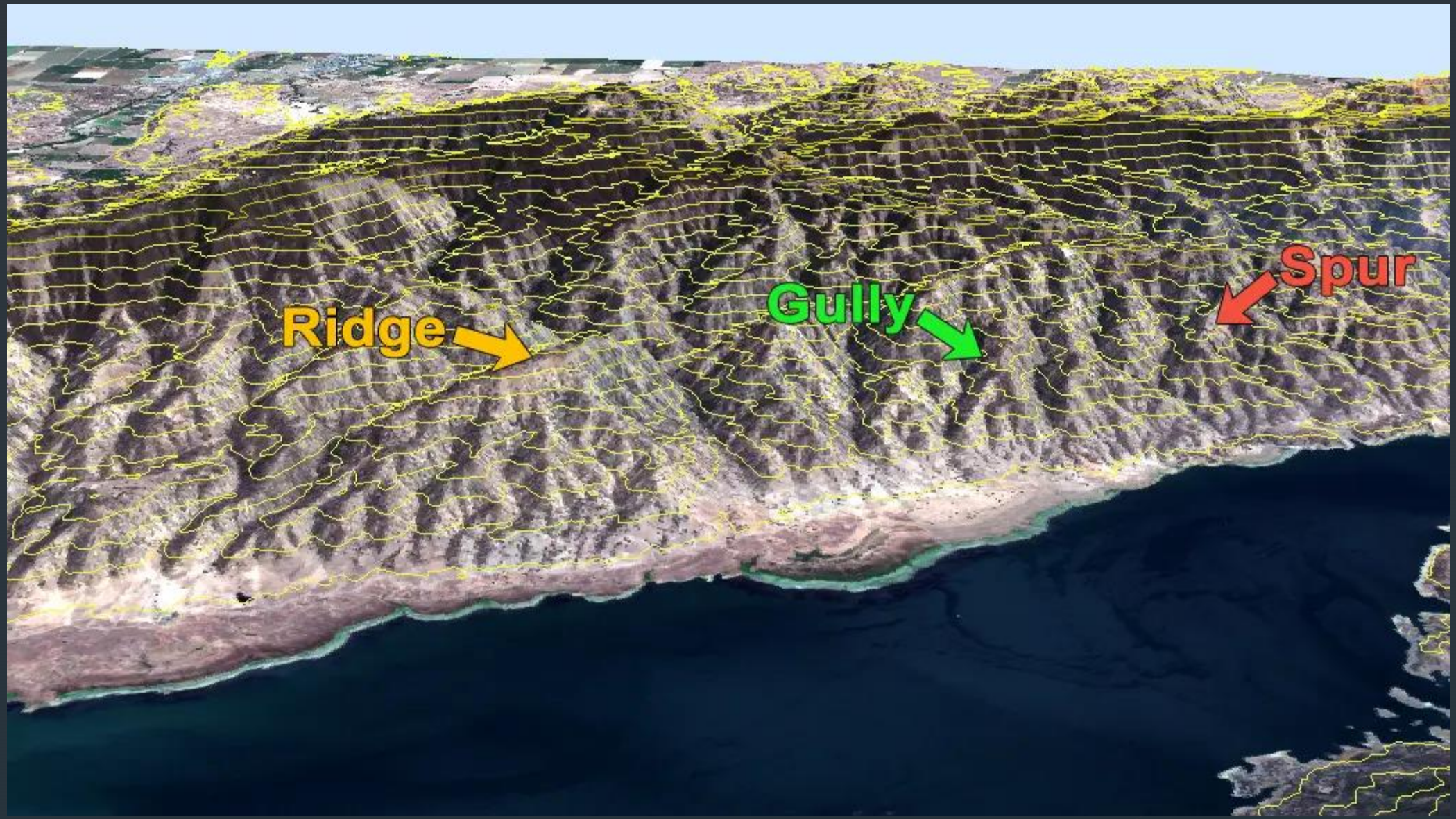

Cliff


Cliff

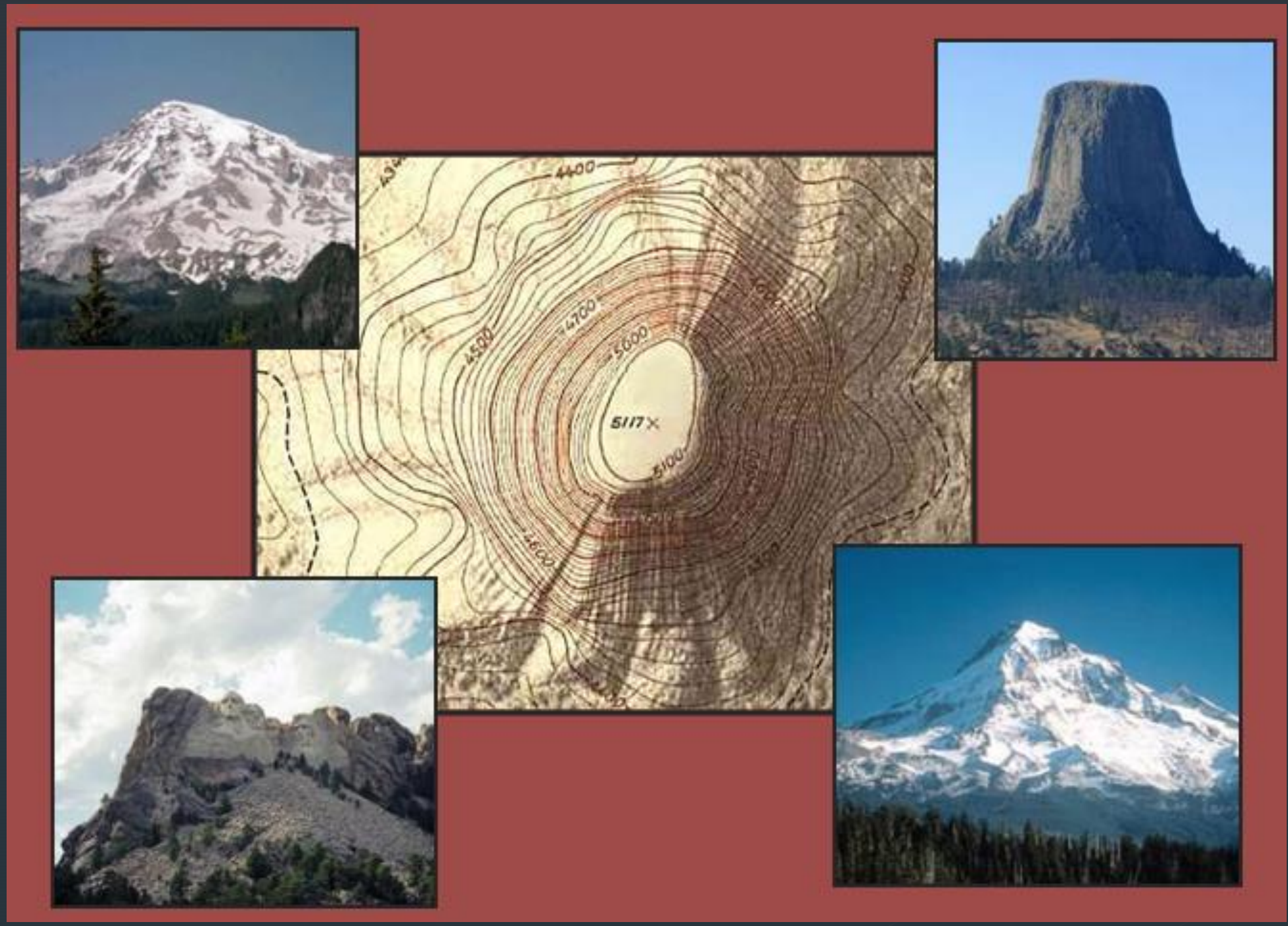



700
500
Steep Slope
1000
500
Flow
700
1200
600
600
1100
600
900
700
800
Flow
700
400
600
500
Gentle Slope
400


Ridge
Gully
Spur

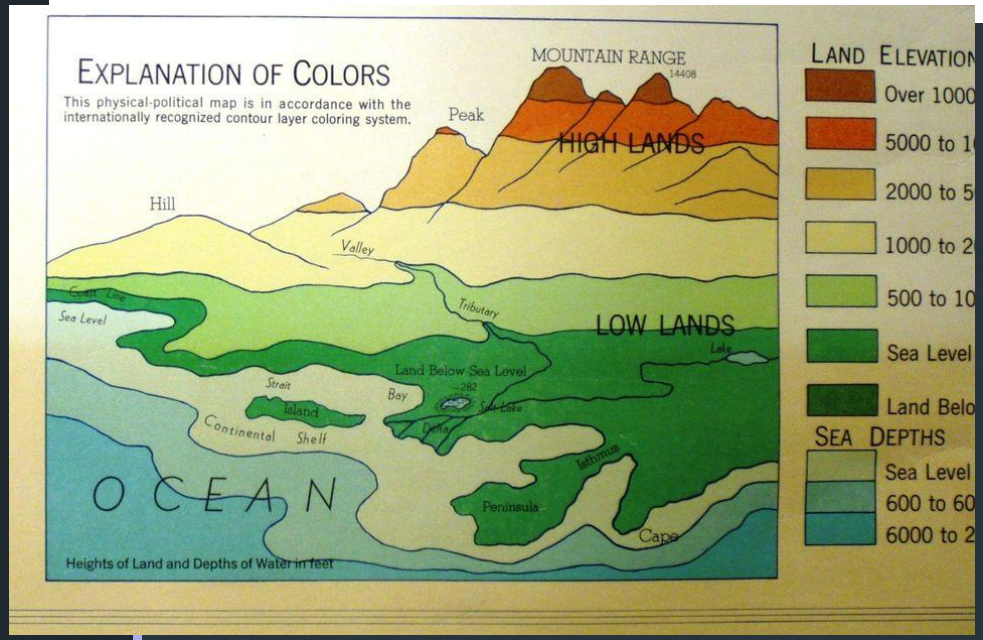

Ridge
Gully
Spur


Ridge
Gully
Spur

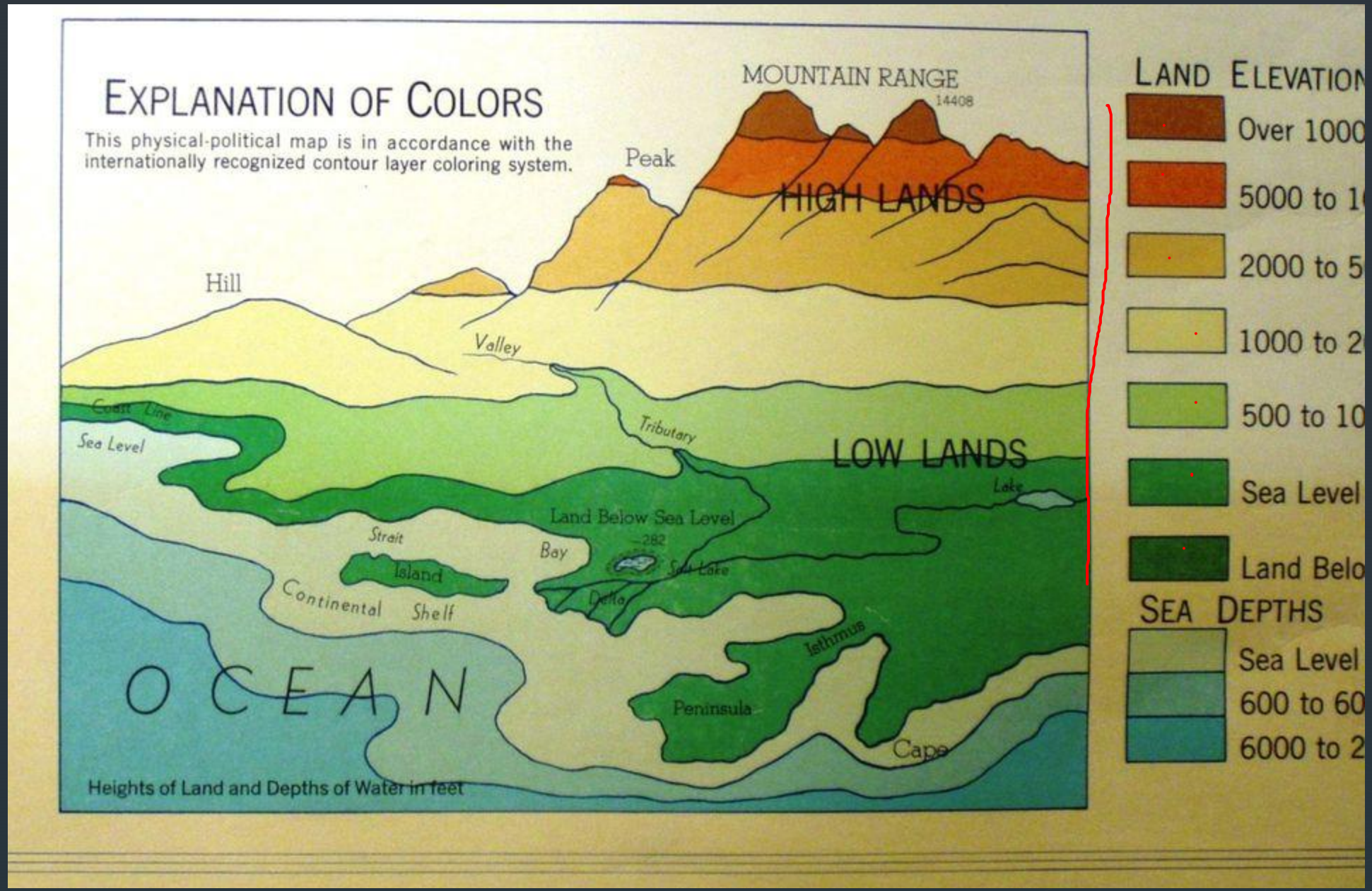

4400
4500
4700
5000
5117
5100
4600

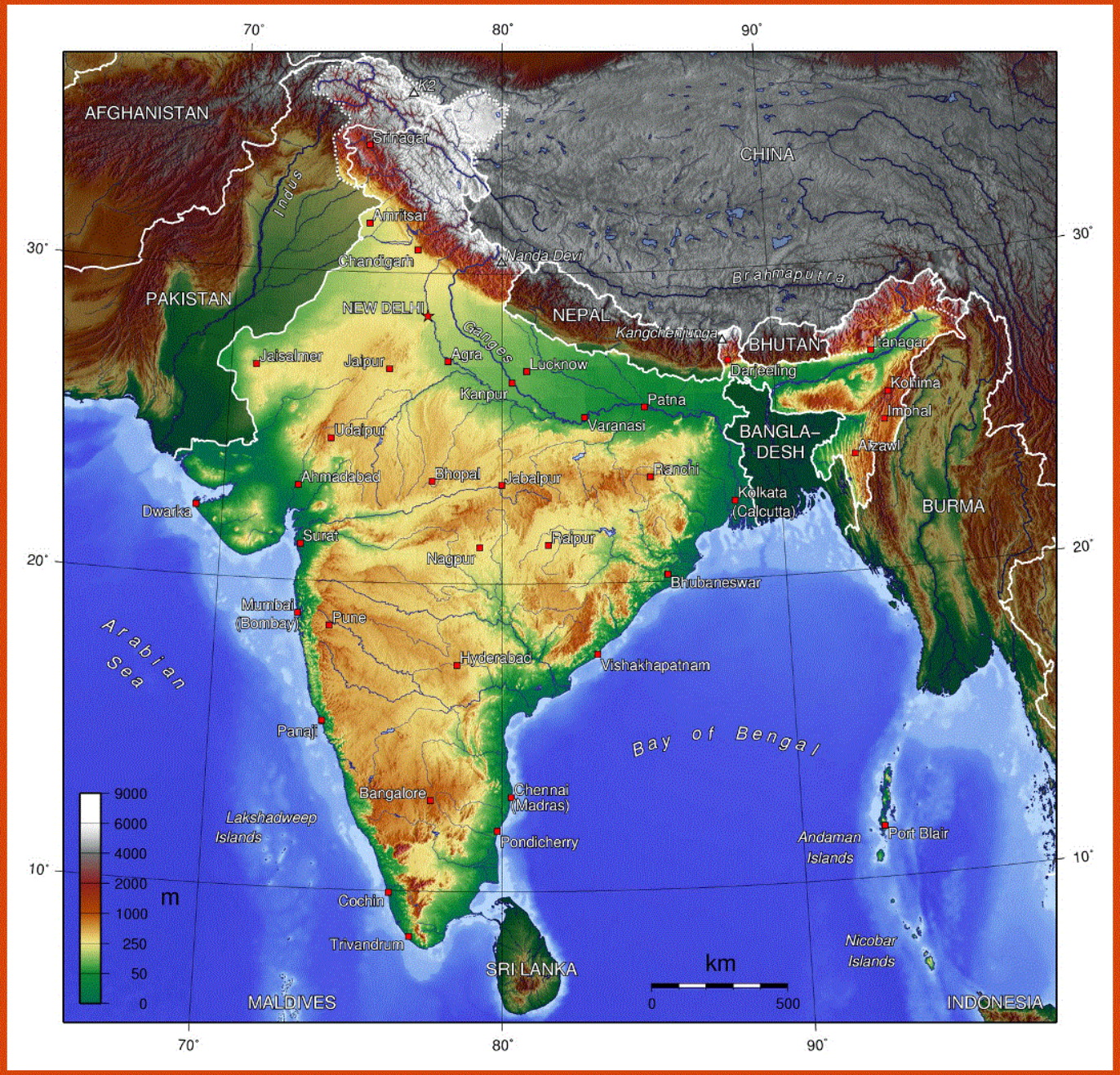
Layer Tint or Altitude Tint

* Layer tinting uses different colors (or shades) to represent different heights.
* A different color is used for each band of elevation.
* Each shade of color or band represent a definite elevation range.



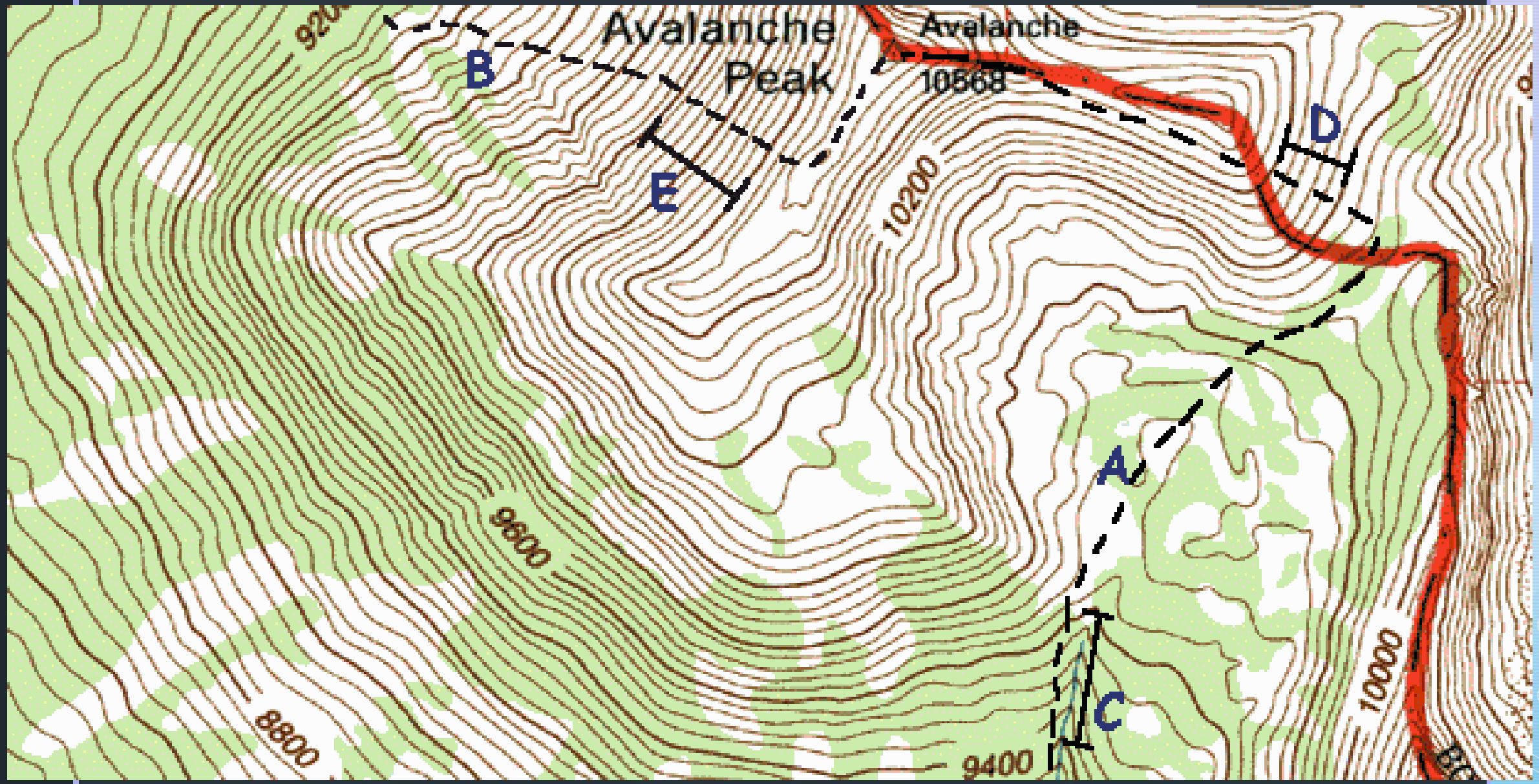
* A legend is printed in map to indicate the elevation range represented by color.
* However, this method does not allow the map user to determine the exact elevation of a specific point-only the range.


EXPLANATION OF COLORS
This physical-political map is in accordance with the internationally recognized contour layer coloring system.
MOUNTAIN RANGE
14408
Peak
HIGH LANDS
Hill
Valley
Coast Line
Sea Level
Tributary
LOW LANDS
Lake
Land Below Sea Level
-282
Strait
Bay
Island
Salt Lake
Delta
Continental Shelf
OCEAN
Isthmus
Peninsula
Cape
Heights of Land and Depths of Water in feet
LAND ELEVATION
Over 1000
5000 to 1
2000 to 5
1000 to 2
500 to 10
Sea Level
Land Belo
SEA DEPTHS
Sea Level
600 to 60
6000 to 2

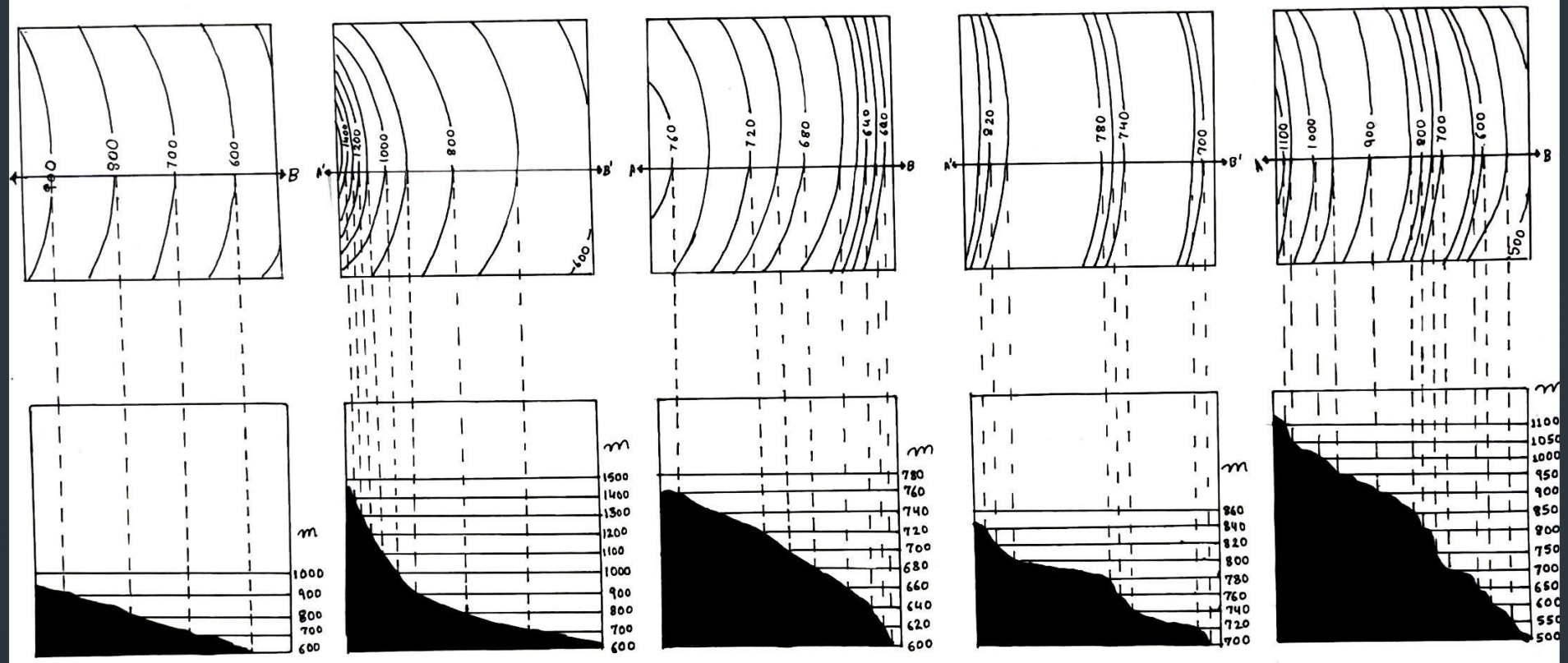

70°
80°
90°
30°
20°
10°
AFGHANISTAN
PAKISTAN
CHINA
NEPAL
BHUTAN
BANGLA–
DESH
BURMA
SRI LANKA
MALDIVES
INDONESIA
K2
Srinagar
Amritsar
Chandigarh
Nanda Devi
Kangchenjunga
Brahmaputra
Indus
Ganges
NEW DELHI
Jaisalmer
Jaipur
Agra
Lucknow
Kanpur
Patna
Varanasi
Darjeeling
Tanagar
Kohima
Imphal
Aizawl
Udaipur
Ahmadabad
Bhopal
Jabalpur
Ranchi
Kolkata
(Calcutta)
Dwarka
Surat
Nagpur
Raipur
Bhubaneswar
Mumbai
(Bombay)
Pune
Hyderabad
Vishakhapatnam
Panaji
Bangalore
Chennai
(Madras)
Pondicherry
Cochin
Trivandrum
Port Blair
Andaman
Islands
Nicobar
Islands
Lakshadweep
Islands
Arabian
Sea
Bay of Bengal
9000
6000
4000
2000
1000
250
50
0
m
km
0
500

Form Lines

- An approximation of a contour line without a definite elevation value, as one derived by visual observation,
- It is sometimes supplemented by measured elevations but not in sufficient quantity to produce accurate results.
- It is used **principally to indicate the appearance of terrain which has not been accurately surveyed.**
- These are drawn as **BROKEN LINES**.
- **This method is used in association with contours to show the hilly or mountainous areas.**
- They are **drawn without any precise measurements**.
- **They indicate minor details which are not shown by contours.**


Avalanche
Peak
Avalanche
10568
B
E
D
A
C
10200
9600
8800
9400
10000

Contours- Types of Slope



GENTLE SLOPE

CONCAVE SLOPE

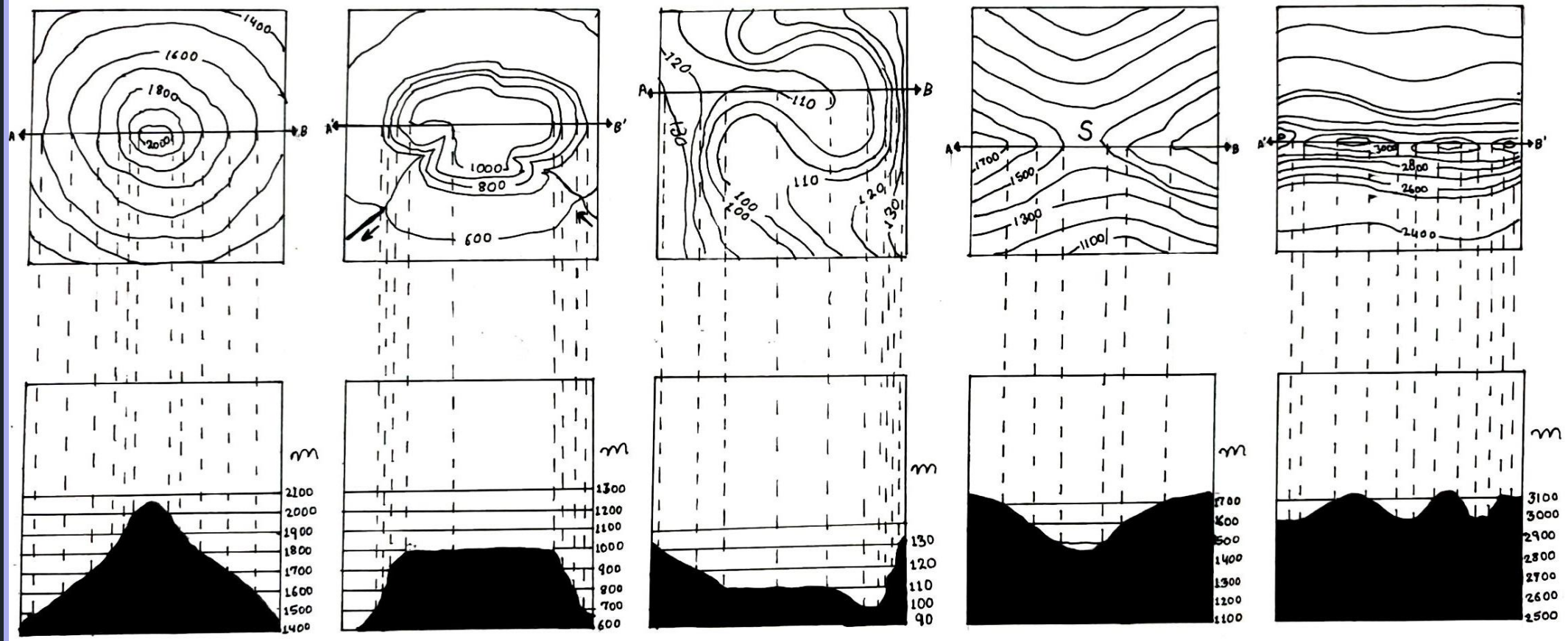
CONVEX SLOPE

TERRACED SLOPE

UNDULATED SLOPE

20.12.2010

Contours- Relief Features



CONICAL HILL

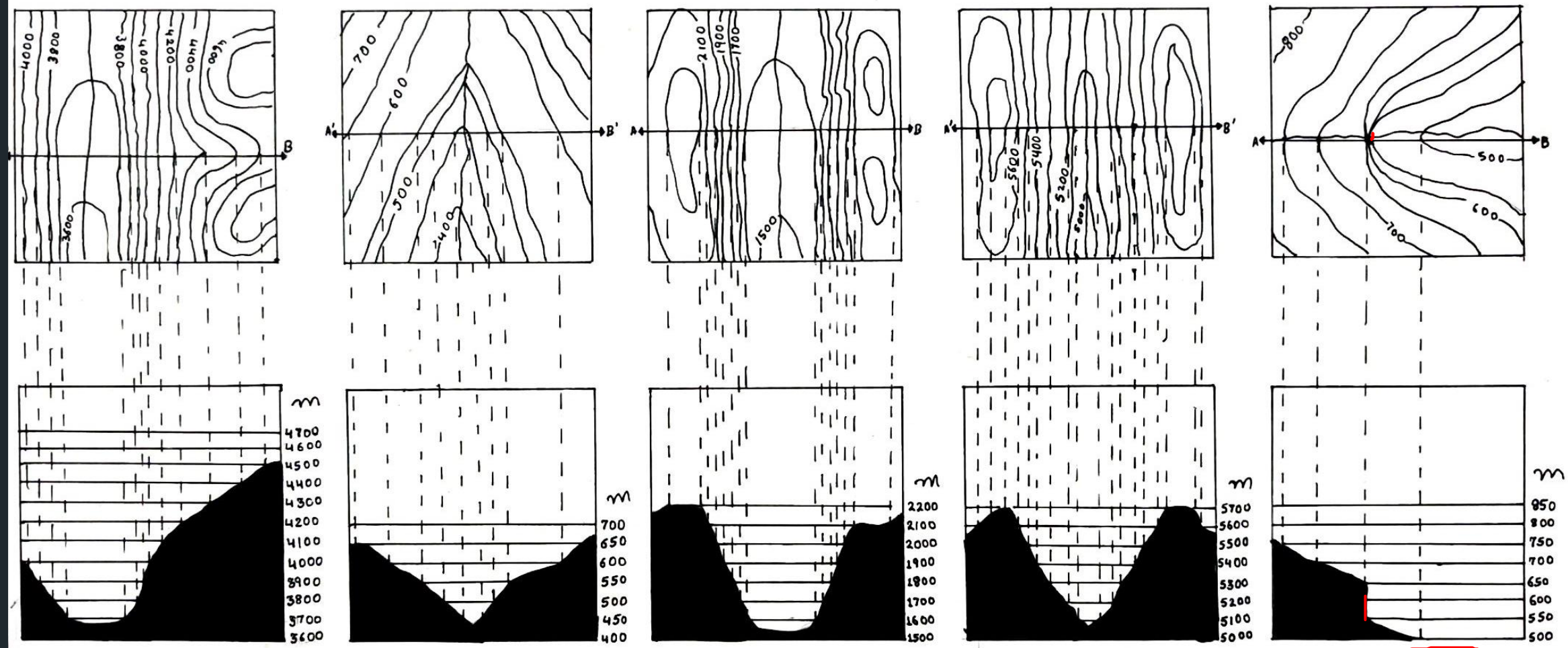
PLATEAU

MEANDER

SADDLE

RIDGE

20.2.2010



HANGING VALLEY

V-SHAPED VALLEY

Fluvial

U-SHAPED VALLEY

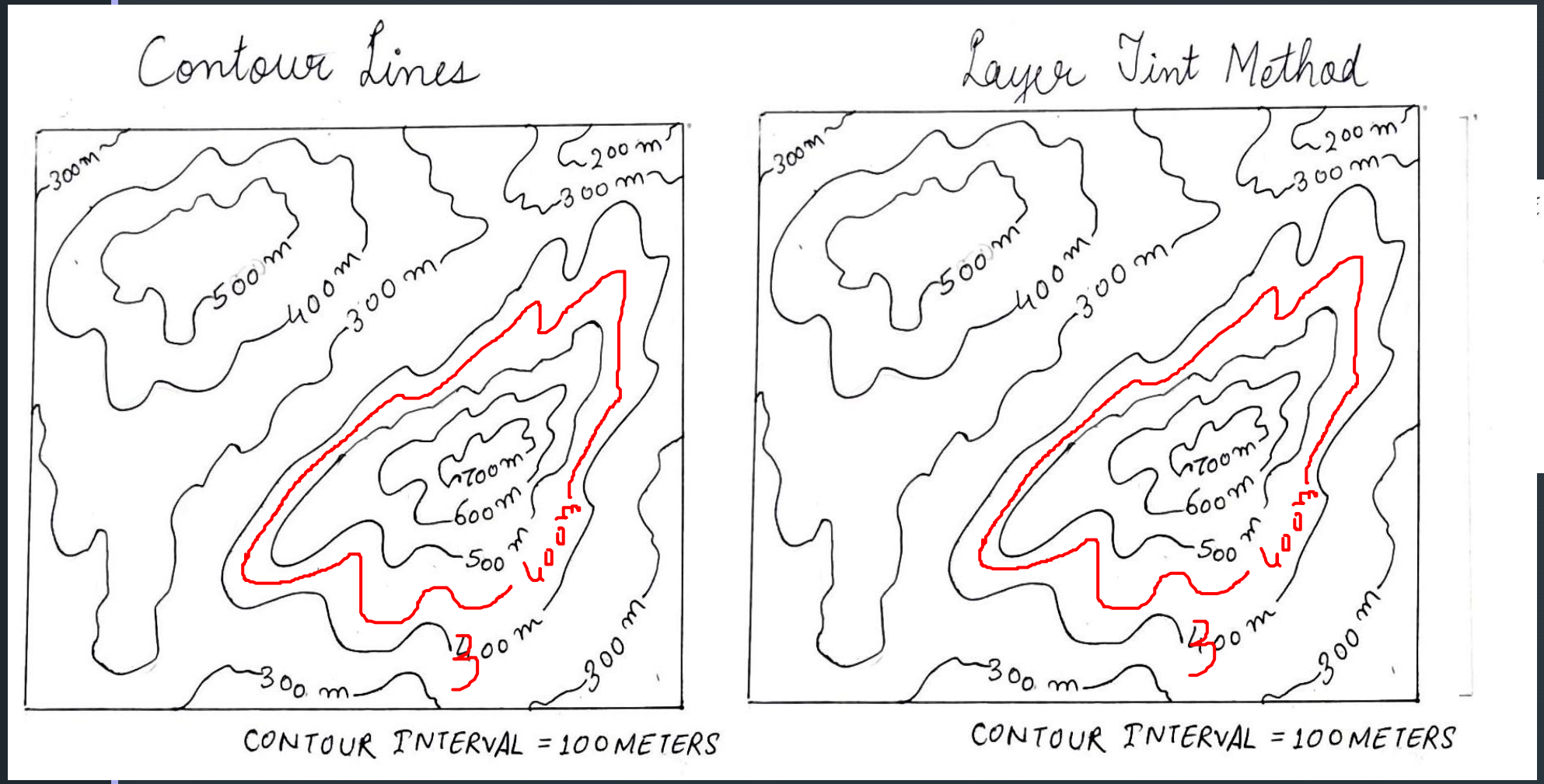
Glacial

GORGE

WATER-FALL

20.2.2018

Sheet 2: 2 Exercise



Profiles परिच्छेदिका

Drawing of profiles: serial (at least four), composite, superimposed and projected. (4 exercises on two sheets)

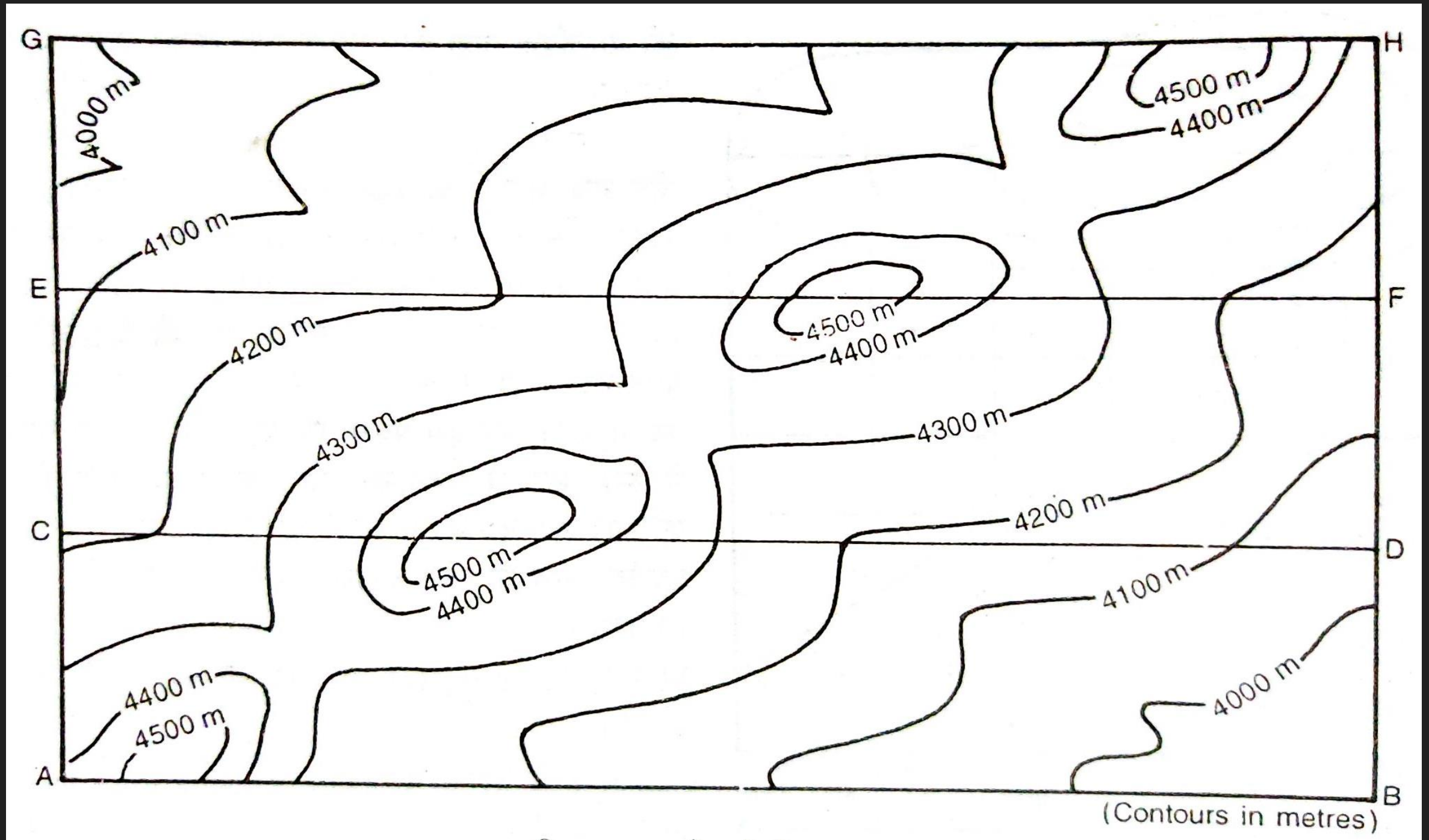
Profiles

- A profile or topographic cut is a **representation of the relief of the terrain** that is obtained by cutting transversely the lines of a topographic map.

- A series of parallel profiles, taken at regular intervals on a map, can be combined to provide a more complete three-dimensional view of the area that appears on the topographic map.

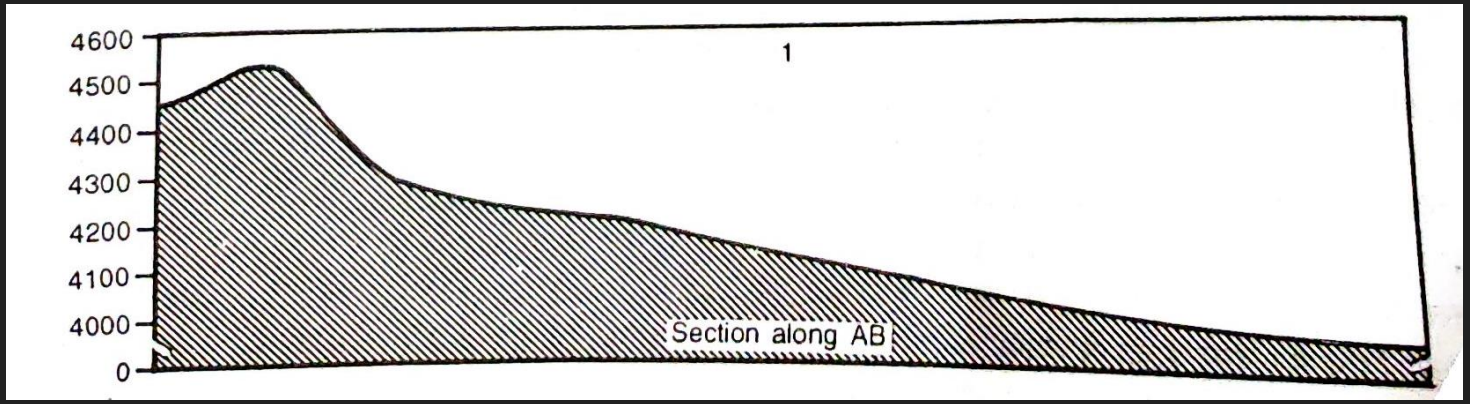
Types of Profiles

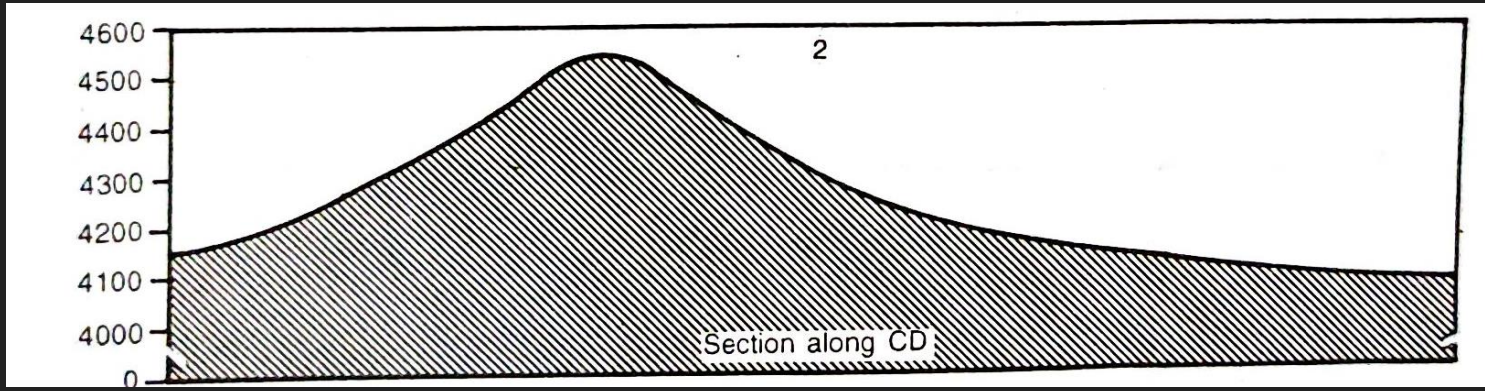
1. Serial profile संक्रम परिच्छेदिका
2. Superimposed profile अध्यारोपित परिच्छेदिका
3. Projected Profile प्रक्षिप्त परिच्छेदिका
4. Compound Profile मिश्र परिच्छेदिका

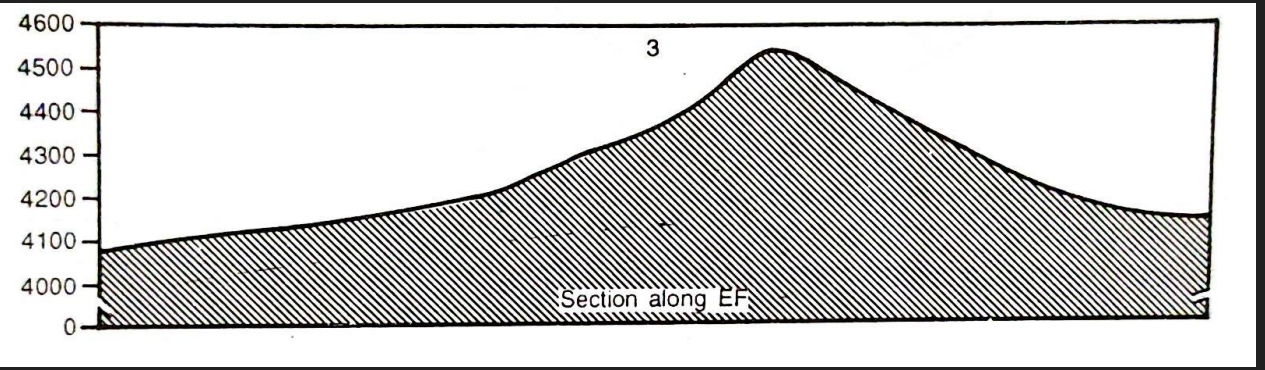

G
H
E
F
C
D
A
B
4000 m
4100 m
4200 m
4300 m
4400 m
4500 m
(Contours in metres)

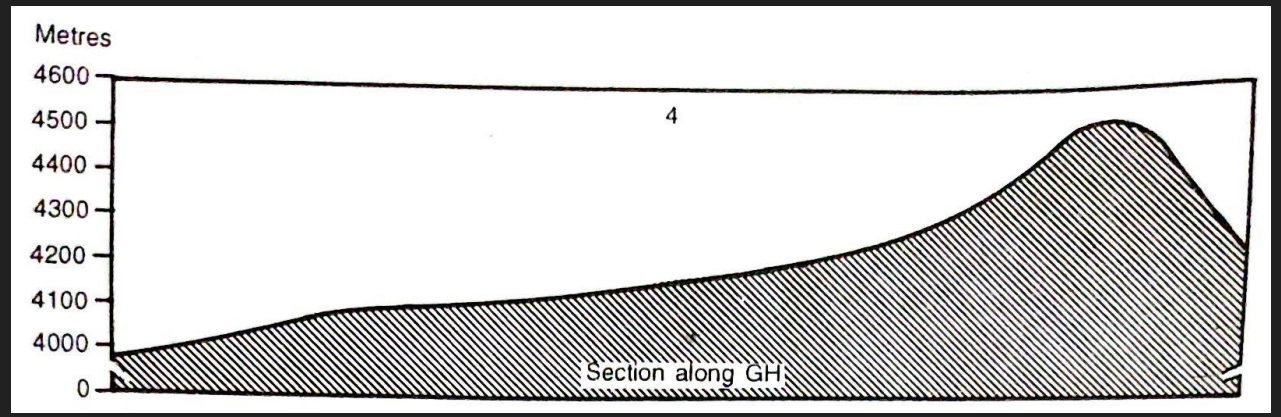
Serial Profiles

- A series of profiles drawn on a cross section lines on a given contour map.



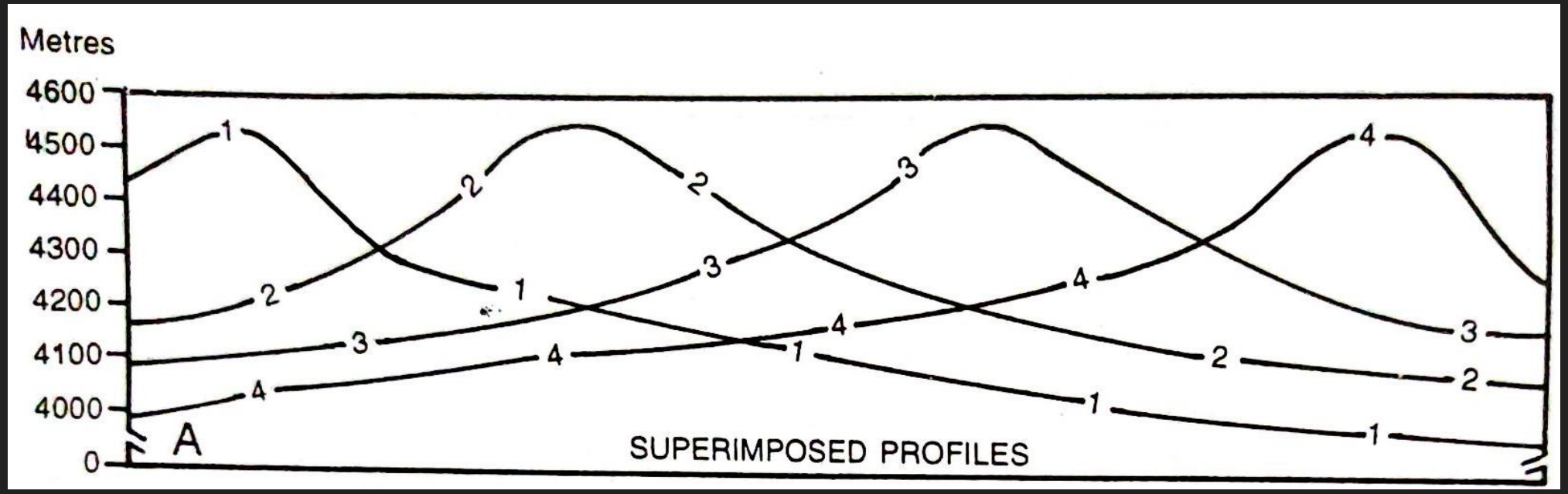






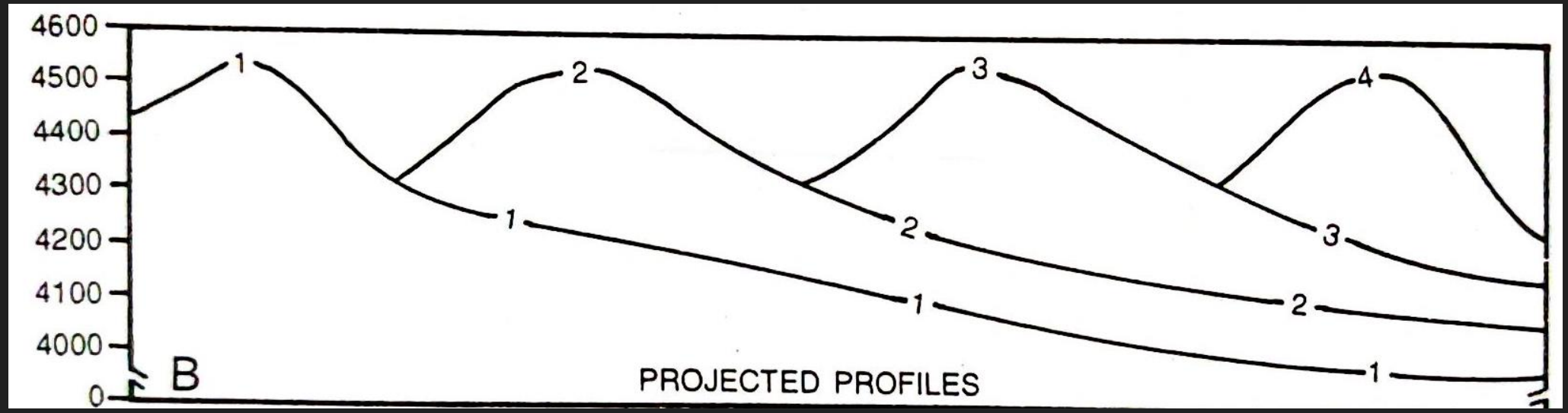
Superimposed Profiles

- When all serial profiles of a region are drawn in a single box .



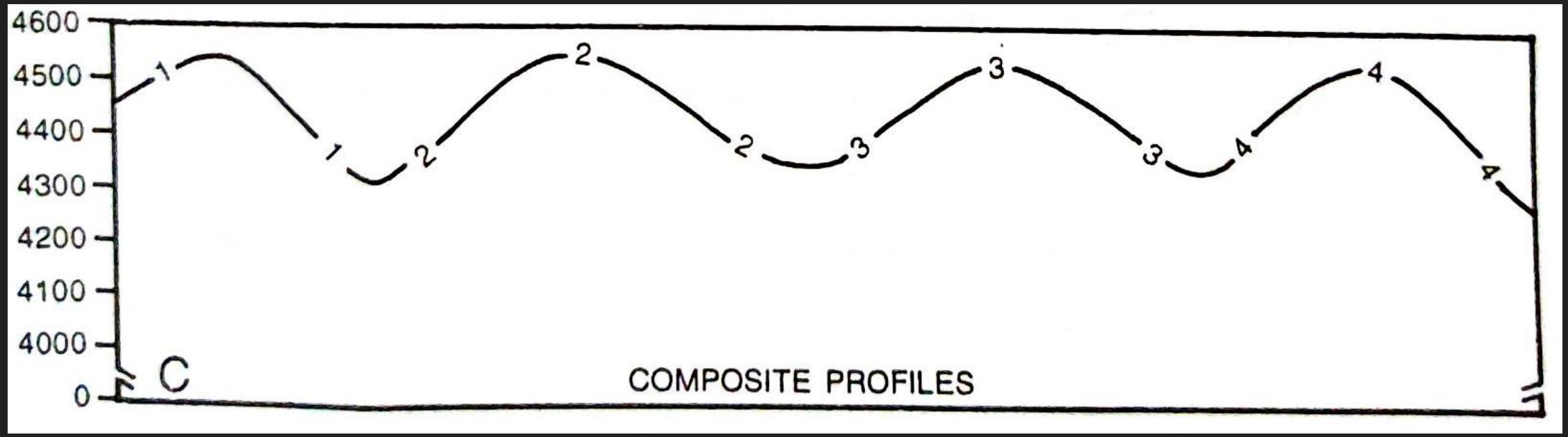
Projected Profiles

- When superimposed profiles of a region are drawn in such a way that the parts which are lying behind a profile and are not visible due to their comparatively lower elevation are removed from the project profile. .

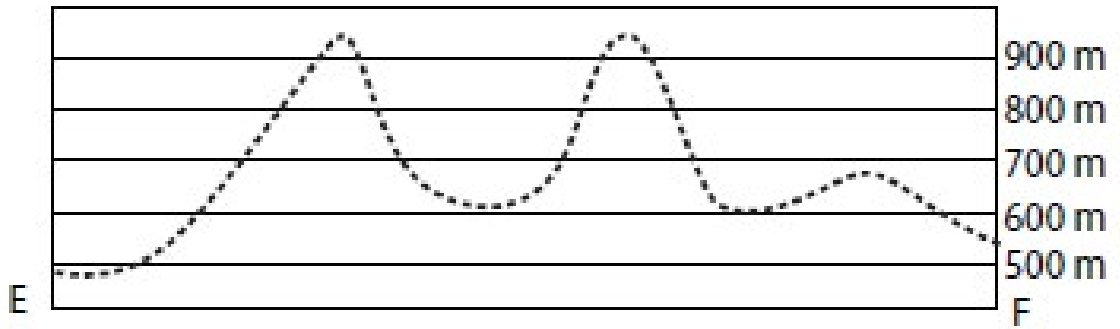


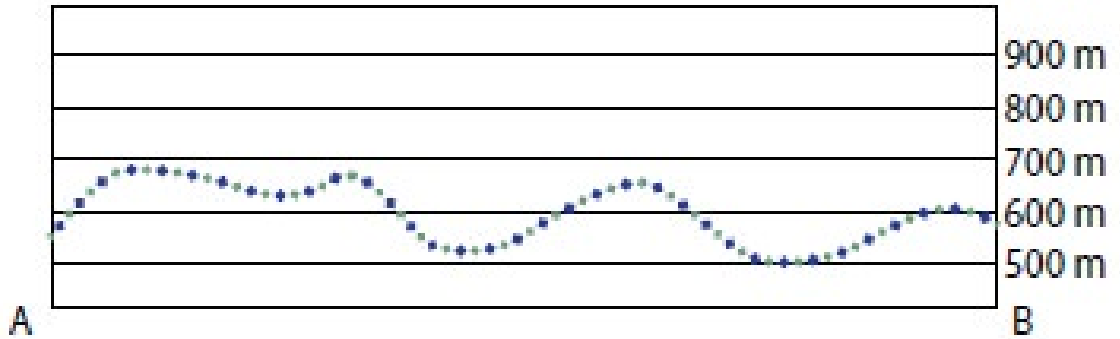
Composite Profiles

- When only the **SKYLINE** are drawn out of projected profiles, a **composite profile** results.

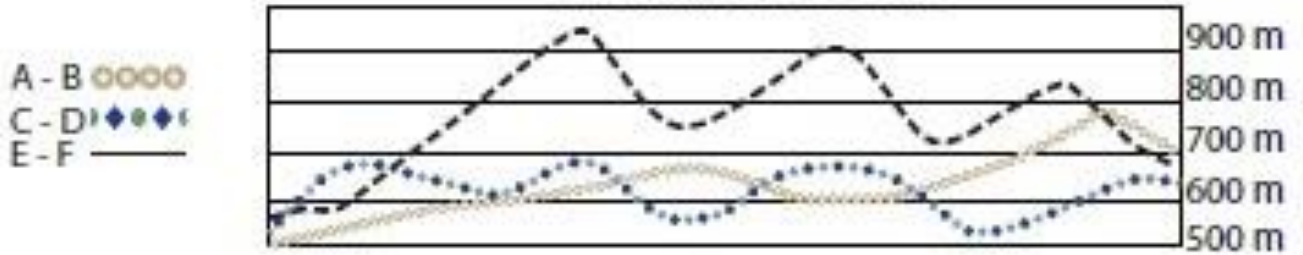


SERIAL PROFILE

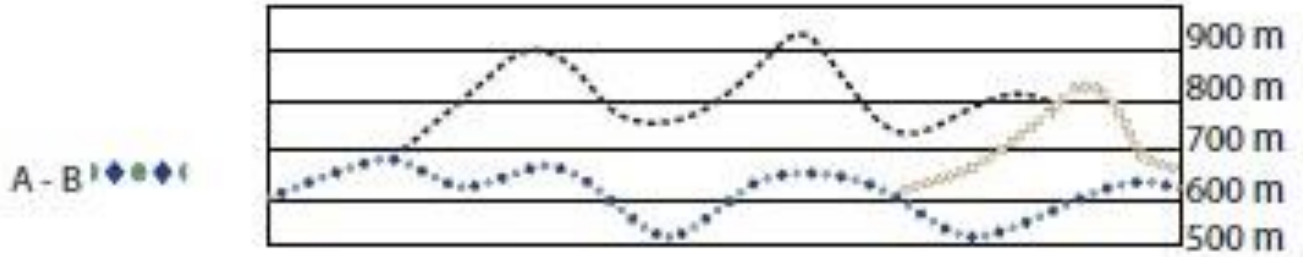




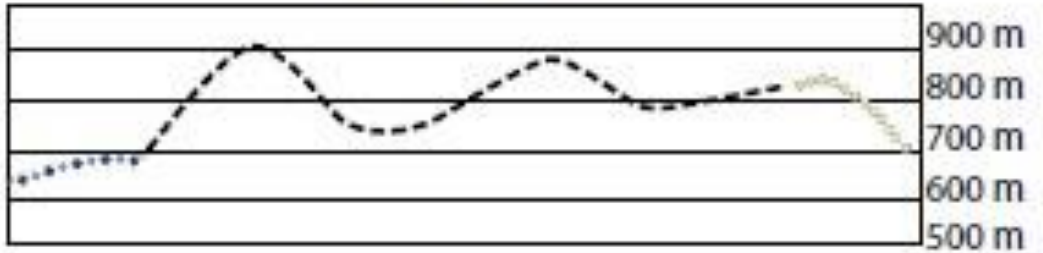
SUPER IMPOSED PROFILE



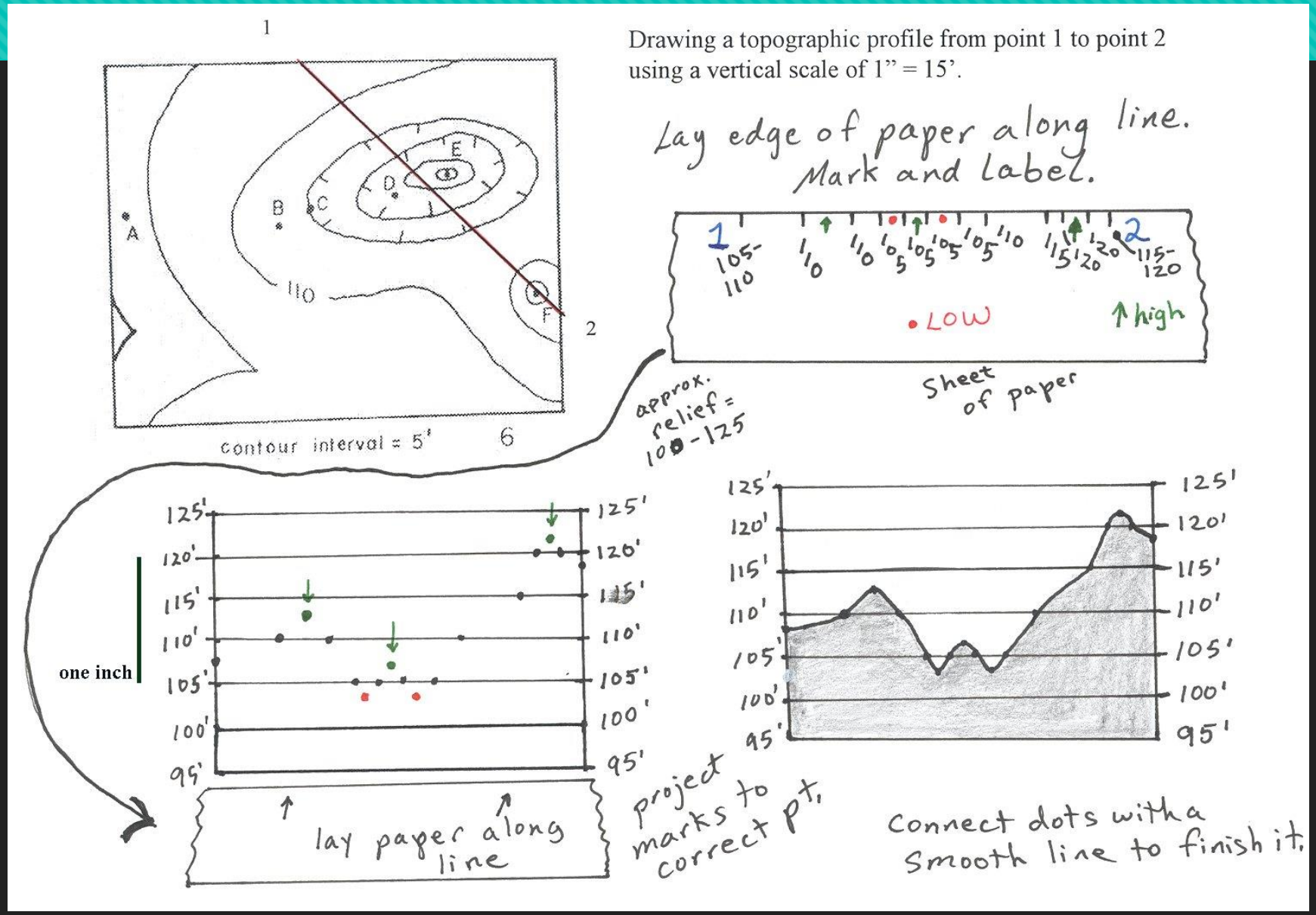
PROJECTED PROFILE



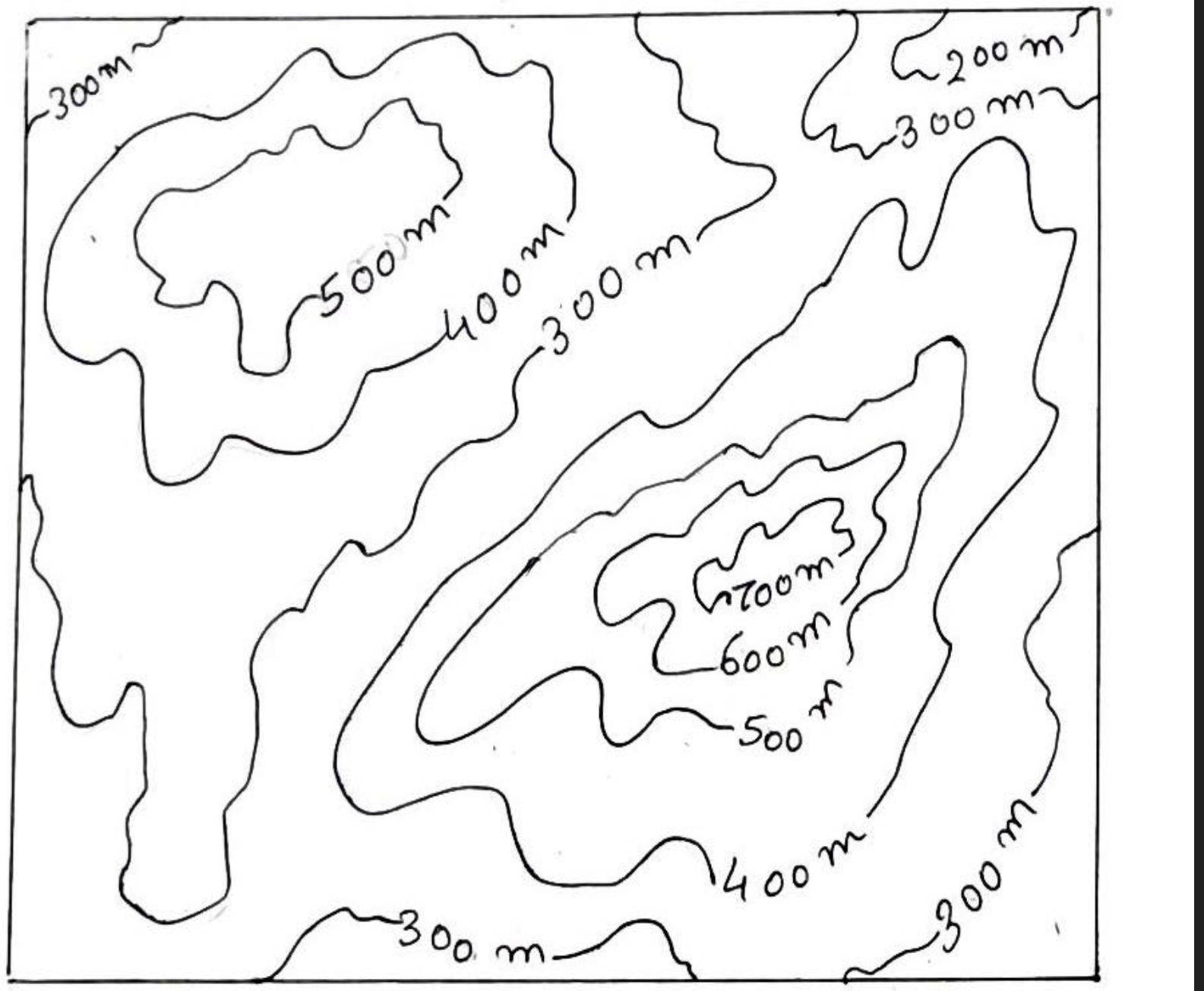
COMPOSITE PROFILE



Steps to draw Profiles

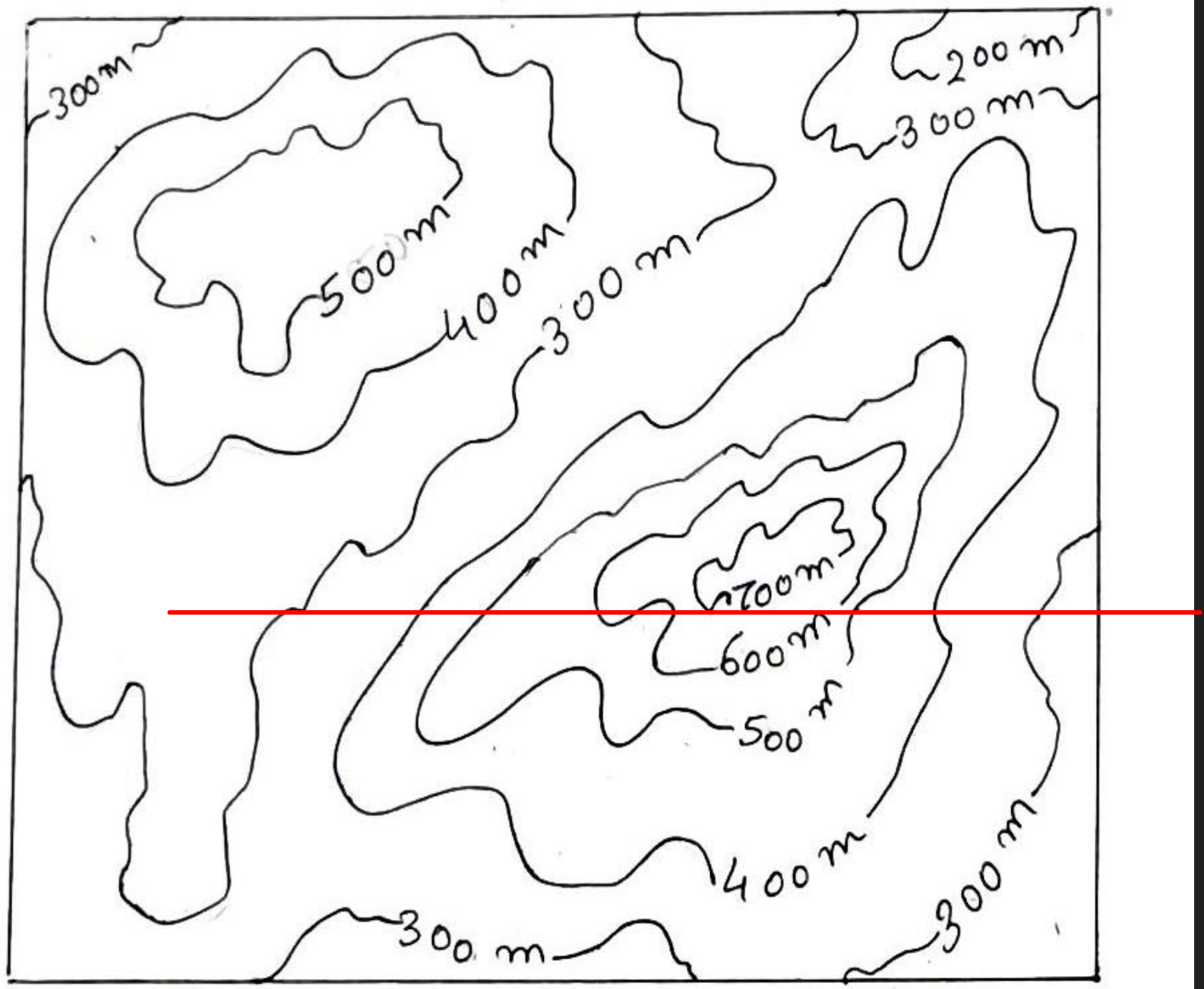


Profiles

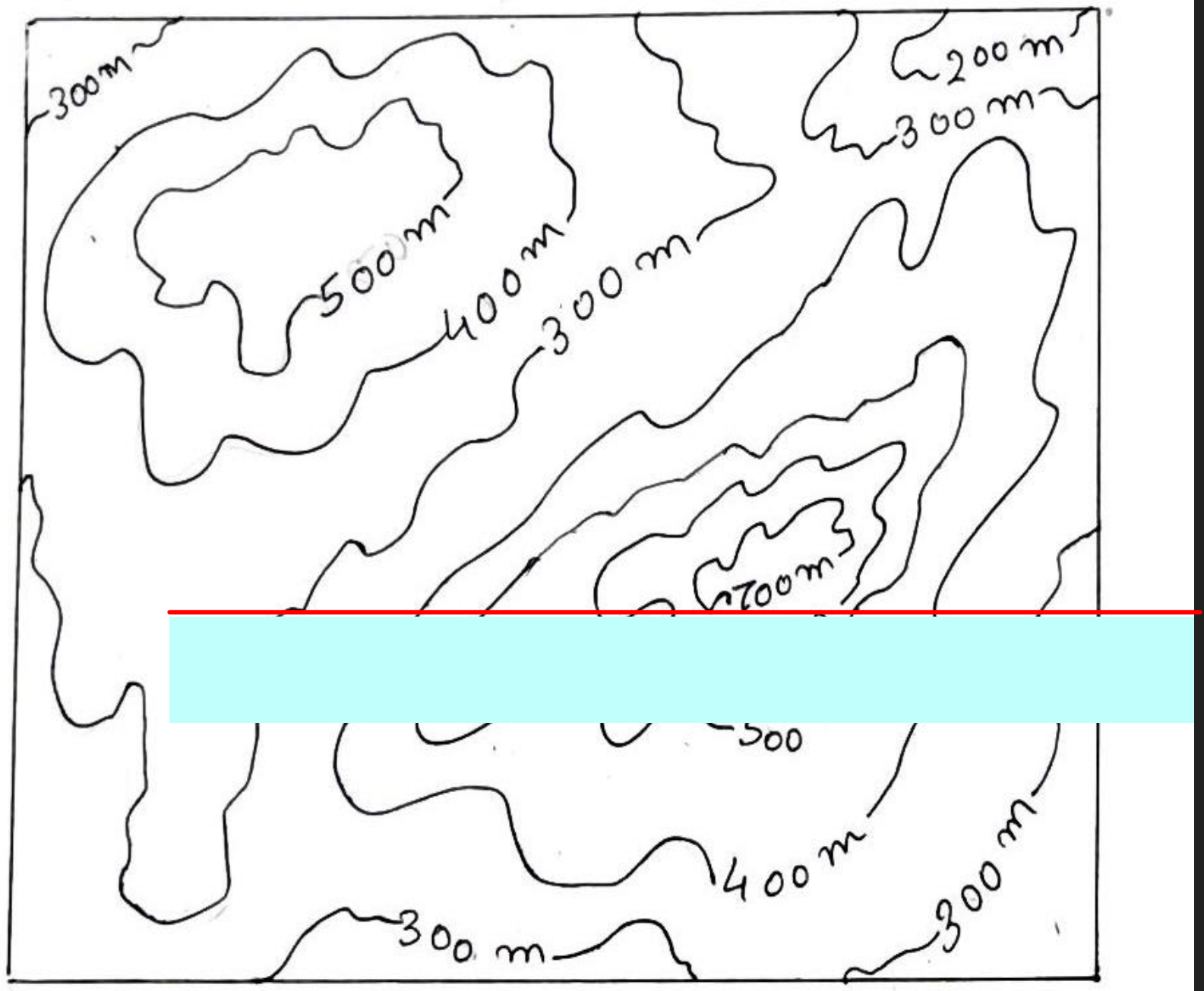


CONTOUR INTERVAL = 100 METERS

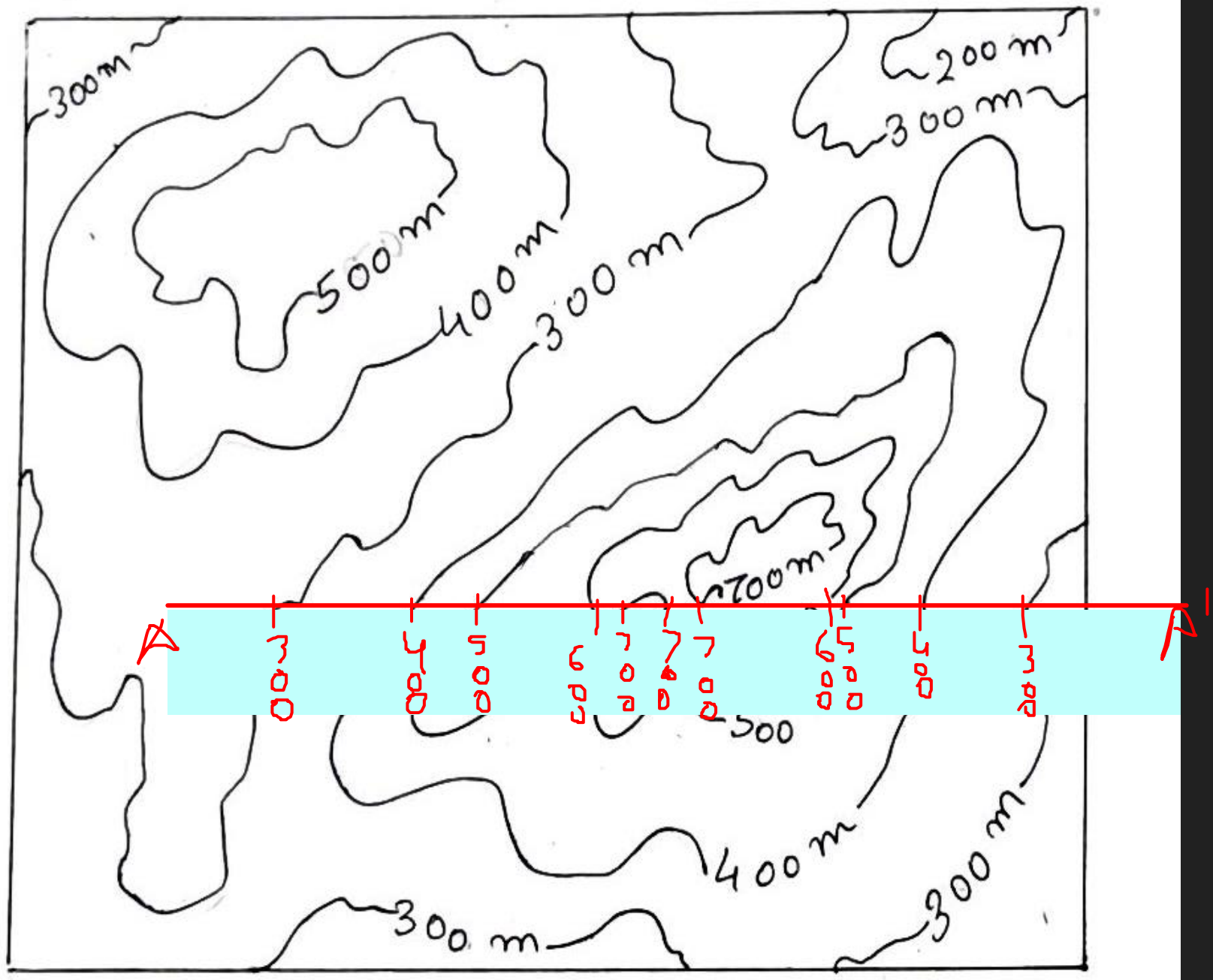
Profiles


300m
200m
300m
500m
400m
300m
700m
600m
500m
400m
300m
300m
CONTOUR INTERVAL = 100 METERS

Profiles


300m
200m
300m
500m
400m
300m
700m
500
400m
300m
300m
CONTOUR INTERVAL = 100 METERS

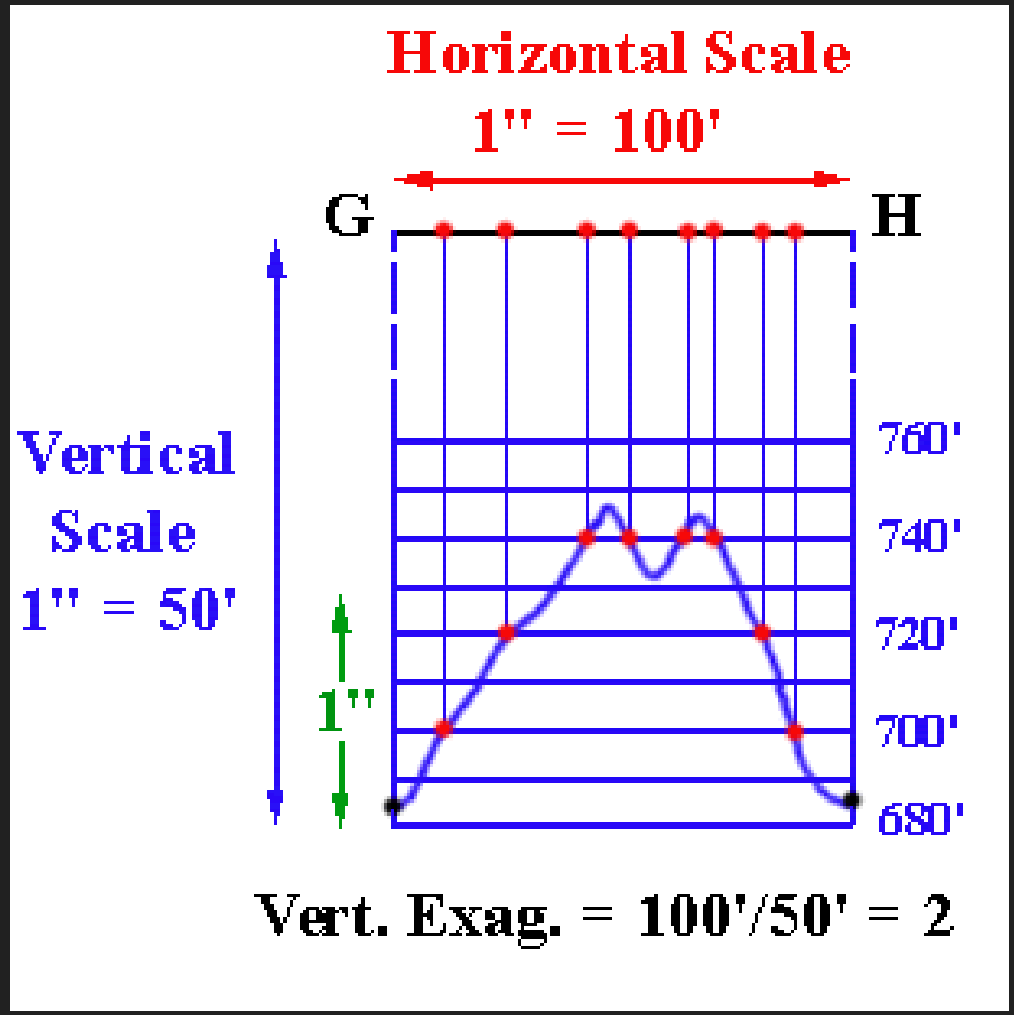
Profiles

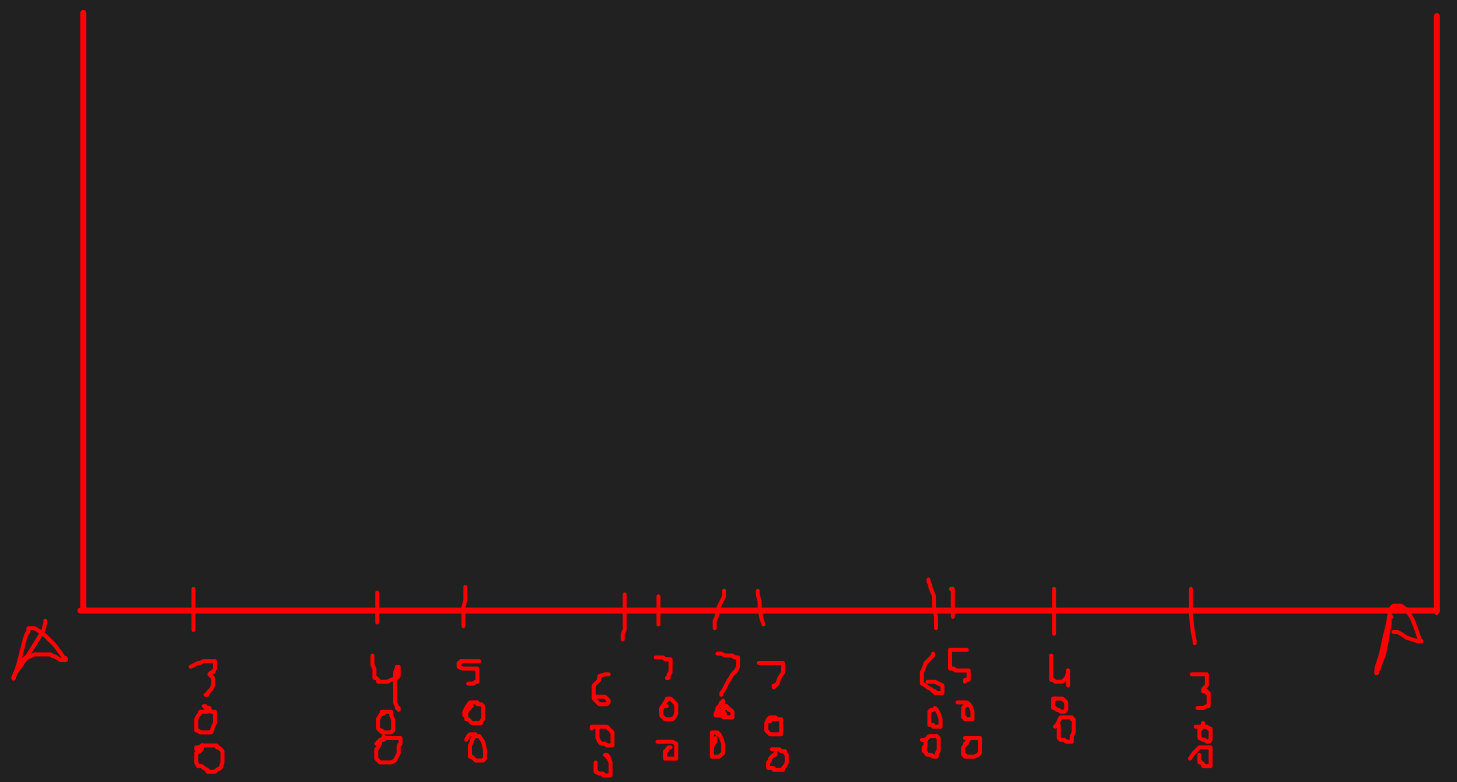


CONTOUR INTERVAL = 100 METERS

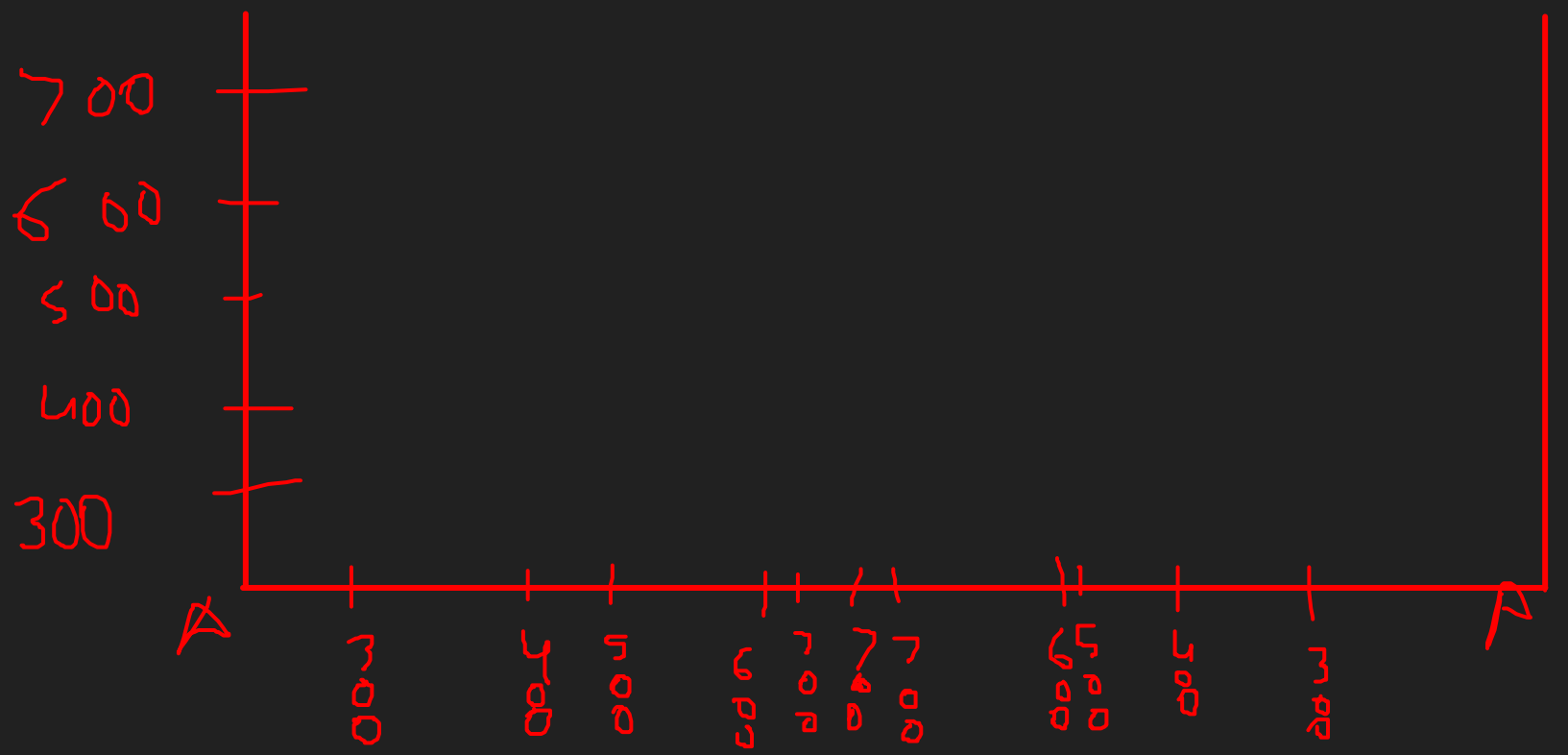
$$\text{Vertical Exaggeration} = \frac{\text{Vertical Scale}}{\text{Horizontal Scale}}$$

Vertical exaggeration is a scale that is used in raised-relief maps in order to emphasize vertical features, which might be too small to identify relative to the horizontal scale.

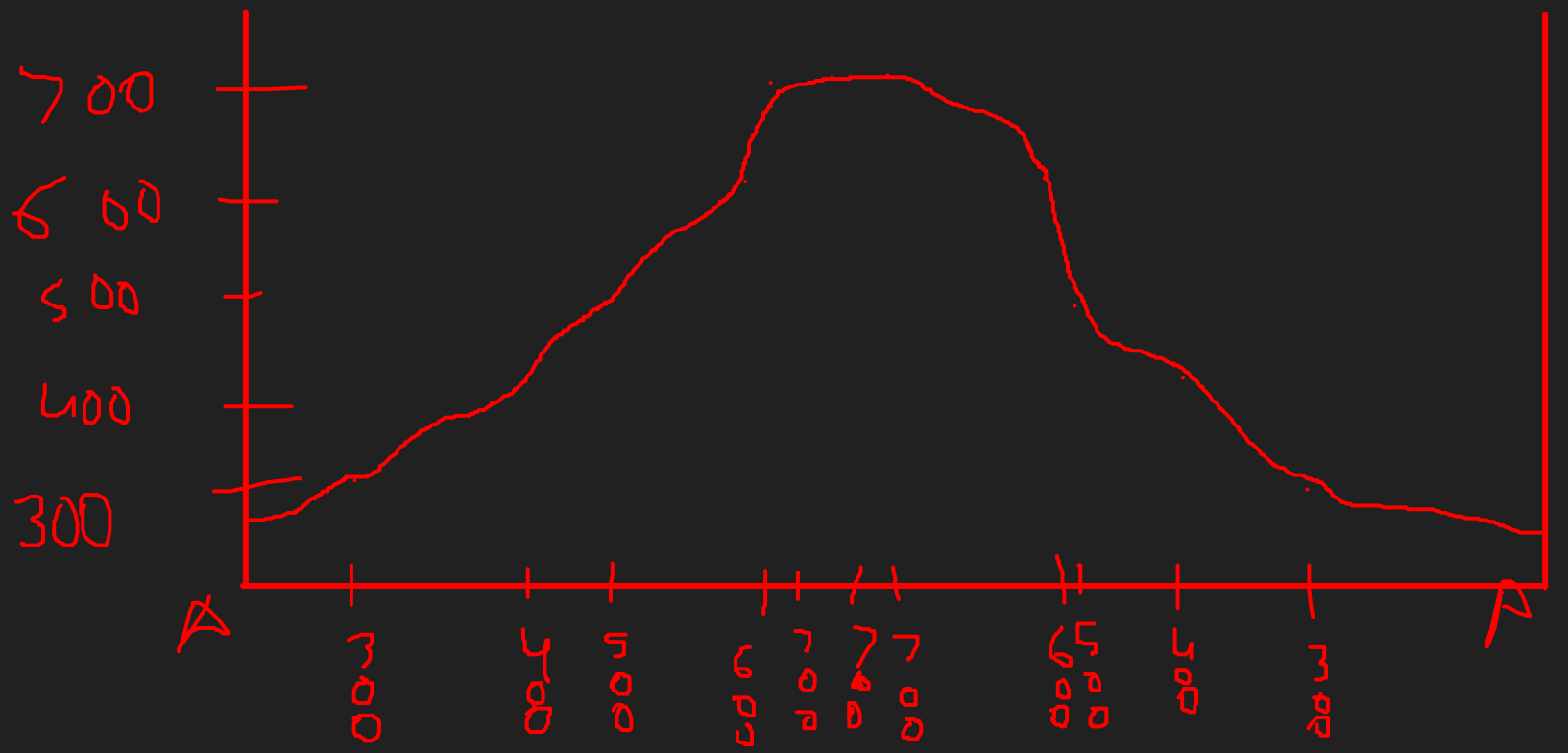



A
B
300
400
500
600
700
700
650
500
300

Profiles

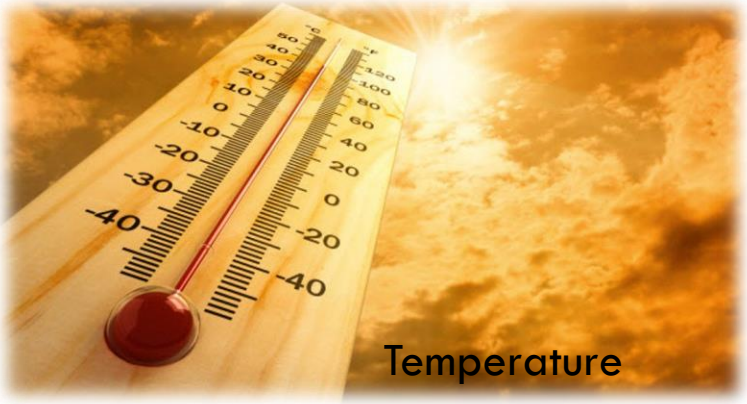


Profiles



GRAPHS TO REPRESENT CLIMATIC DATA

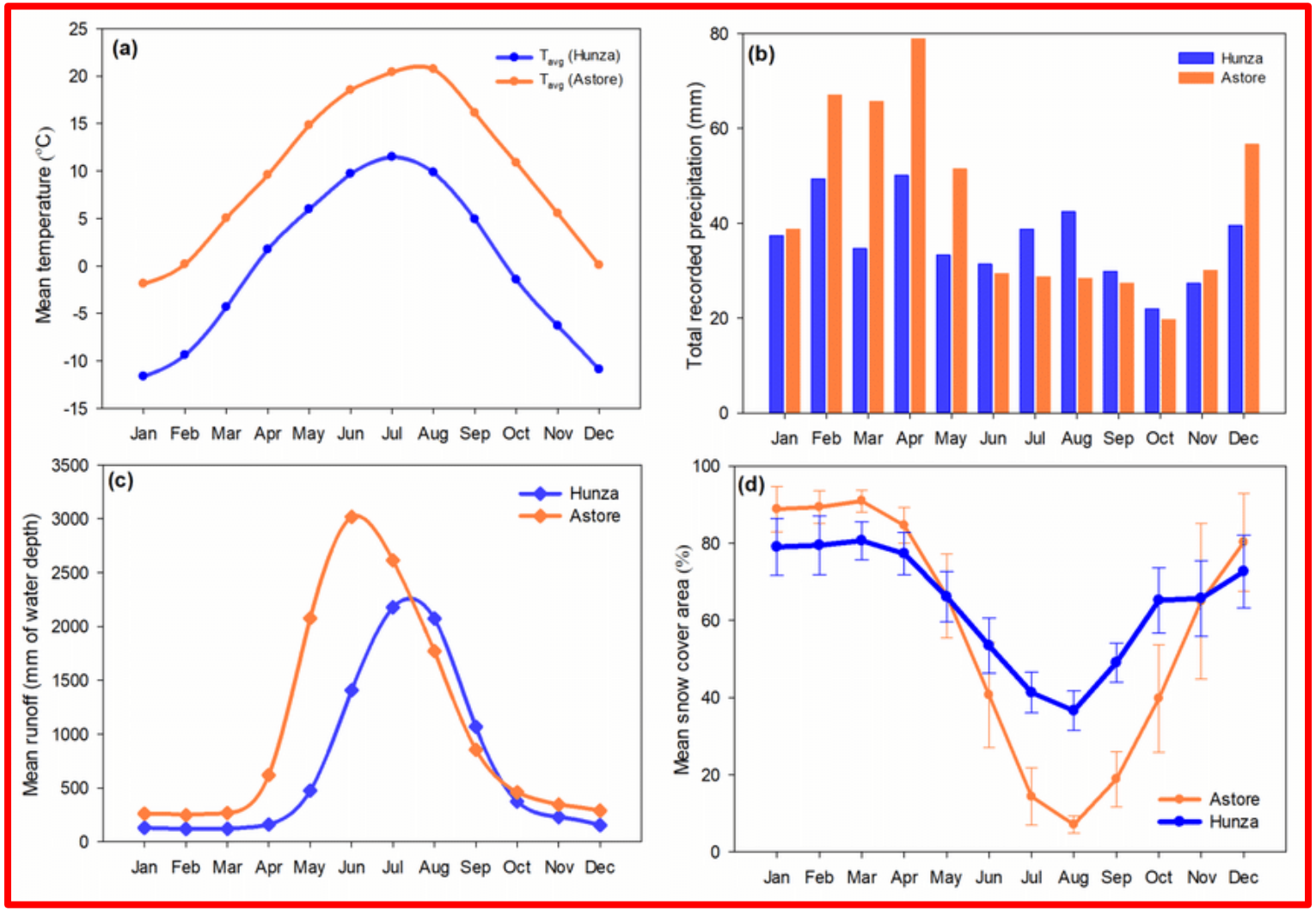
Climatic Data



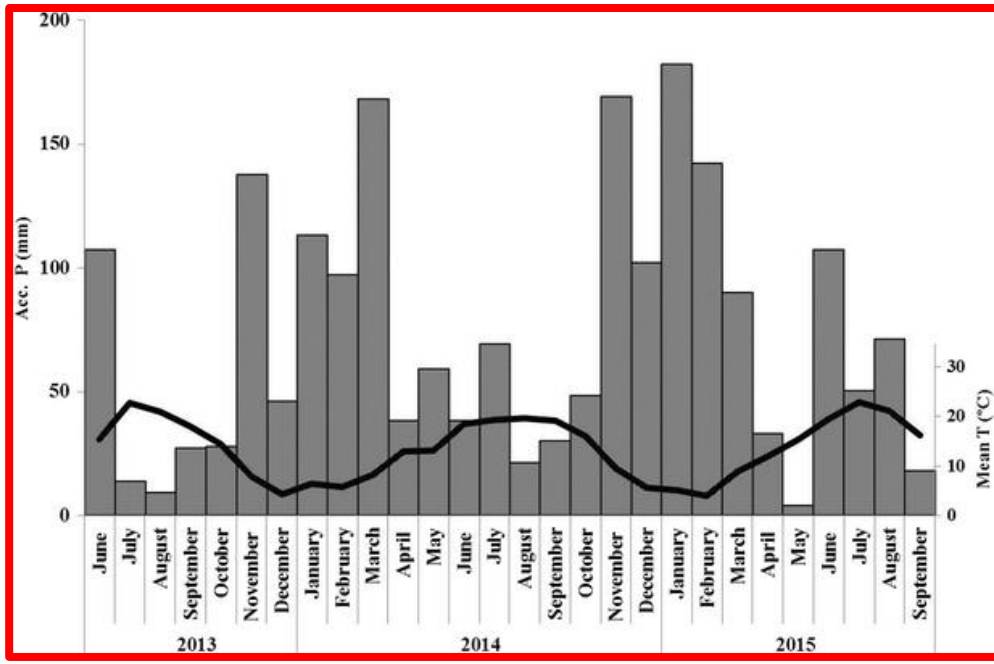
Rainfall

Climate and Weather

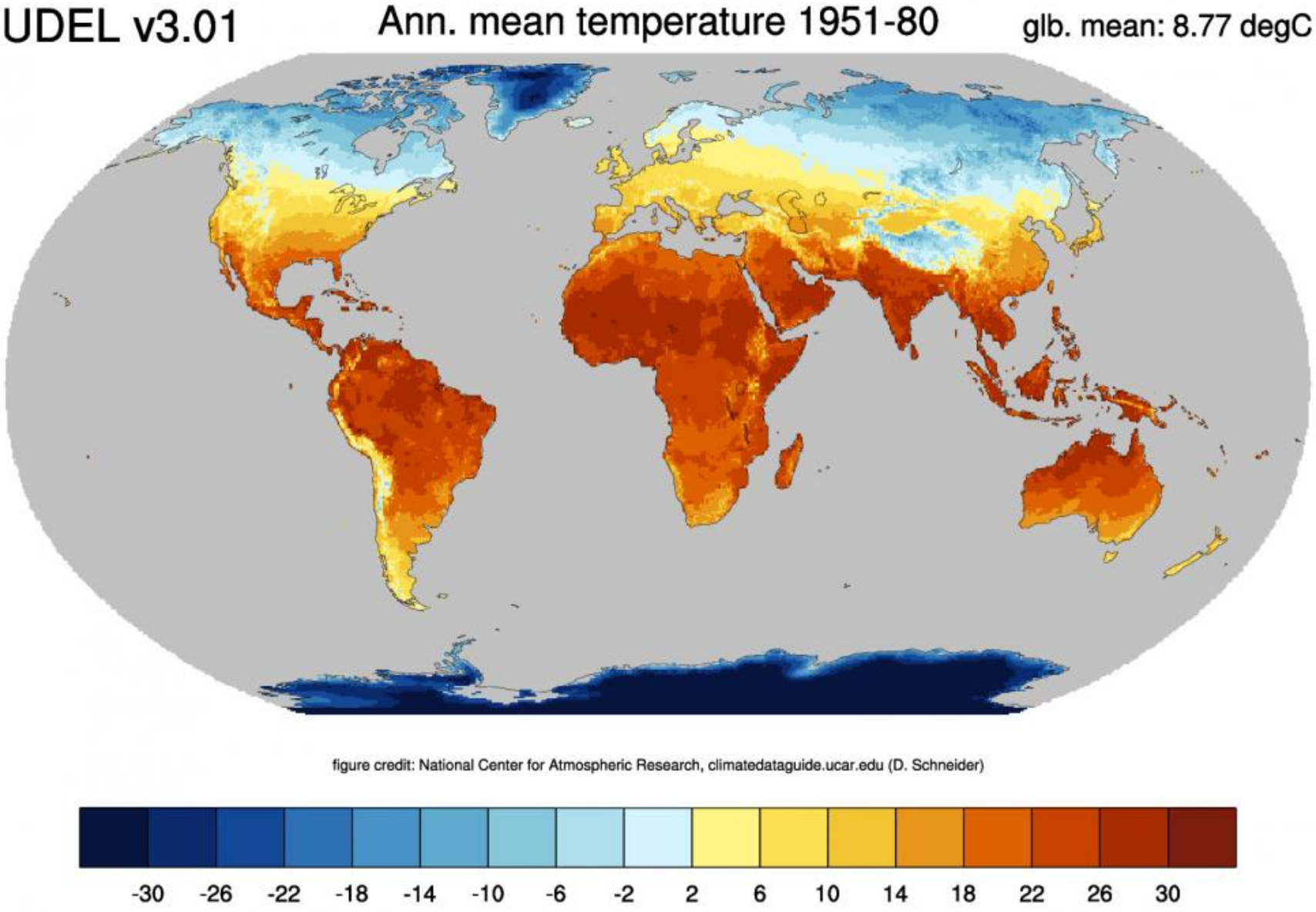
- Weather is the condition of the **atmosphere at a particular place over a short period of time,** whereas **climate** refers to the **weather pattern, using statistical data, of a place over a long enough period** to yield meaningful averages.
- **Climate, is the average of weather over time and space**.
- Weather reflects short-term conditions of the atmosphere while climate is the average daily weather for an extended period of time at a certain location.
- Weather can change from **minute-to-minute, hour-to-hour, day-to-day, and season-to-season.**

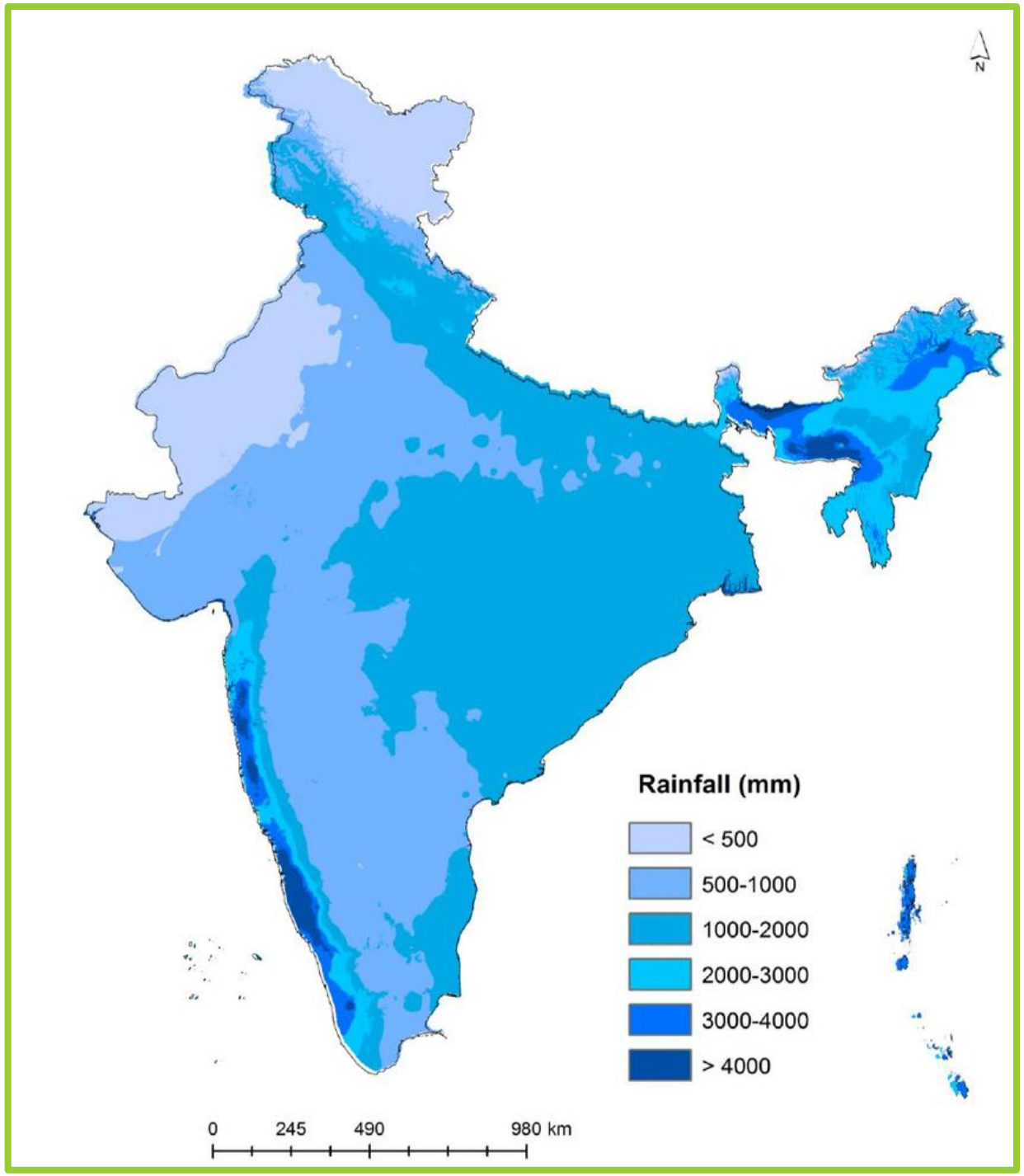


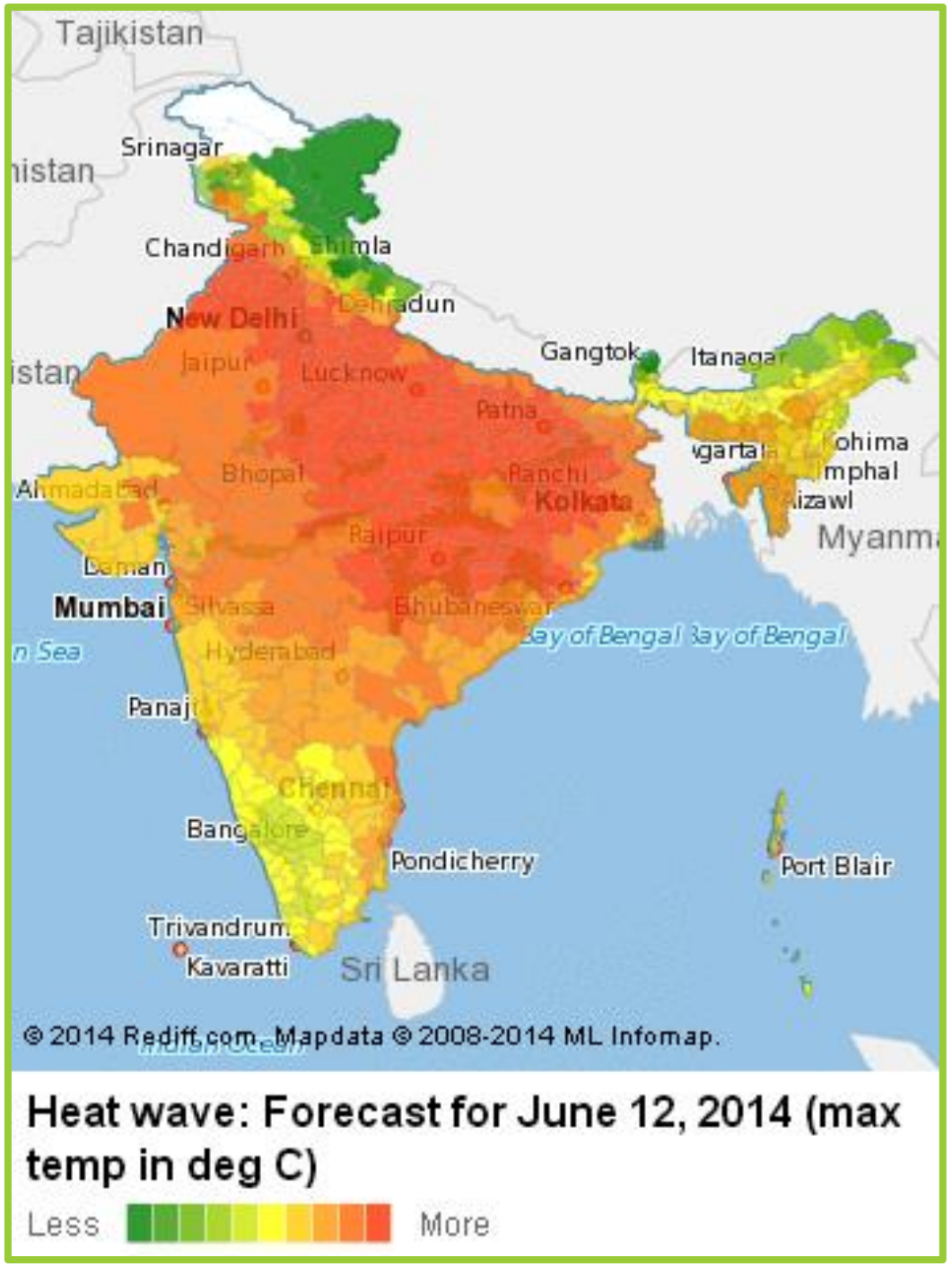
Through GRAPHS



Through MAPS




Rainfall (mm)
< 500
500-1000
1000-2000
2000-3000
3000-4000
> 4000
0
245
490
980 km


Tajikistan
Srinagar
Chandigarh
Shimla
New Delhi
Dehradun
Jaipur
Lucknow
Gangtok
Itanagar
Patna
Bhopal
Ranchi
Kolkata
Raipur
Mumbai
Silvassa
Bhubaneswar
Hyderabad
Panaji
Chennai
Bangalore
Pondicherry
Port Blair
Trivandrum
Kavaratti
Sri Lanka
Myanmar
© 2014 Rediff.com, Mapdata © 2008-2014 ML Infomap.
Heat wave: Forecast for June 12, 2014 (max temp in deg C)
Less
More

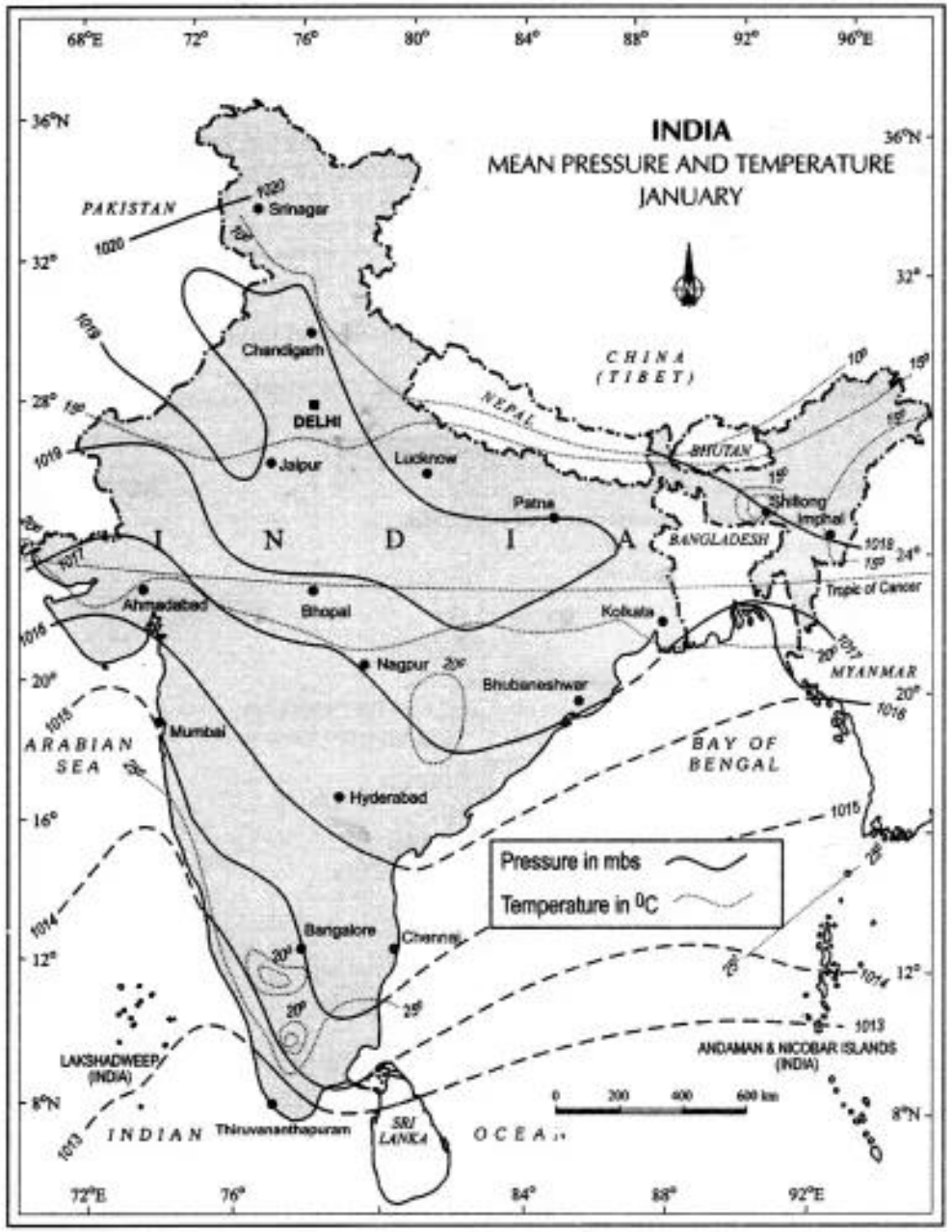
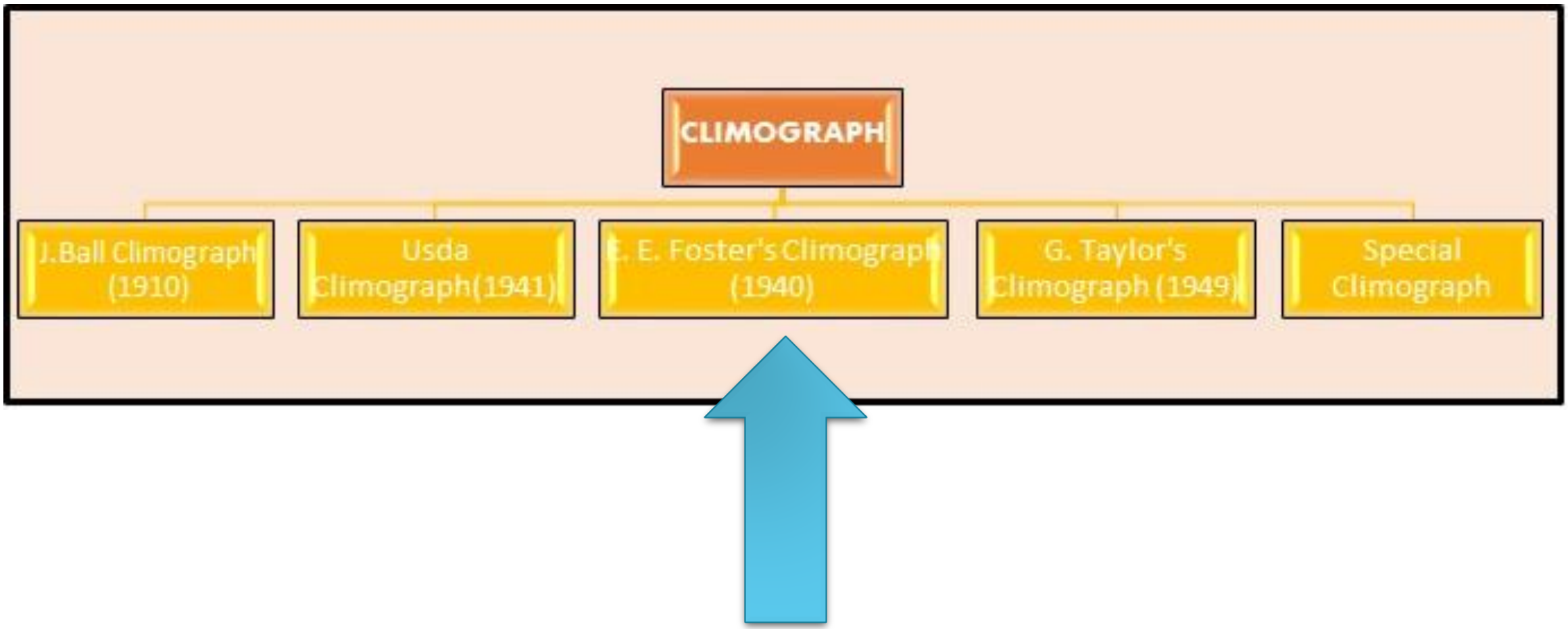


Fig. 2

Through ISOLINES

Climograph

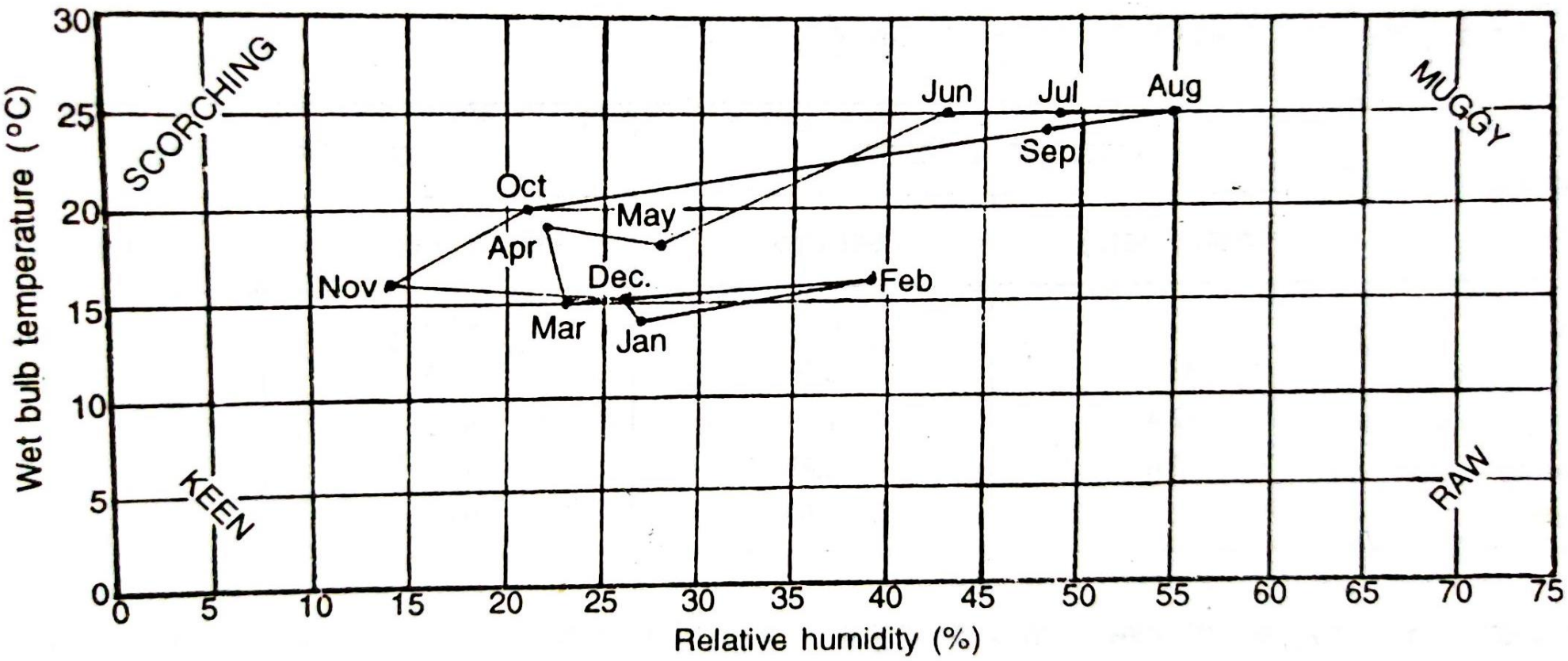
- A Climograph is a graphical representation of a location's basic climate.
- Climograph display data for two variables:
- (a) monthly average temperature and
- (b) monthly average precipitation.
- Griffith Taylor devised such a Climograph which could be used to indicate the physiological effects of climate on man. By using Climograph, Taylor tried to identify those climates within the tropics which were suitable for white skinned European settlers in those areas. For this purpose, he proposed Climographs of several cities of Australia. After Taylor, EE. Faster, E. Huntington and Erwin Raiz also developed Climographs. Taylor's view point is universally accepted in cartography and it has become conventional to study Taylor's Climograph.


CLIMOGRAPH
J.Ball Climograph (1910)
Usda Climograph(1941)
E. E. Foster's Climograph (1940)
G. Taylor's Climograph (1949)
Special Climograph

Griffith Taylor's Climograph

- Griffith Taylor constructed his Climograph by making use of wet bulb temperature and relative humidity.
- He placed relative humidity from 20% to 80 % along the x-axis and wet bulb temperature from - 10° F (-23.3°C) to 90° F (33.2°C) along the Y-axis.
- Twelve points each representing one month of the year were plotted with reference to wet bulb temperature and relative humidity.
- Each point was identified by the first letter of the month i.e. J for January, F for February etc.
- This can be done by putting 1-12 for 12 months.
- All the points are joined by straight lines.
- In the end the point showing December is joined with the point showing January.
- Thus, a closed twelve sided figure is obtained which is called Climograph.
- The attached significant adjective to four corners marked in SE, NE, NW and SW corners. The meaning and significance of these adjectives is as under.
- Taylor's climographs combine wet-bulb temperature and humidity data for each month of the year, producing a twelve-sided polygon for each location to allow easy comparison between them.

Climograph

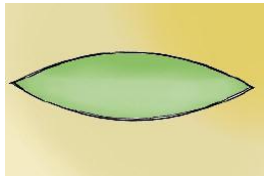


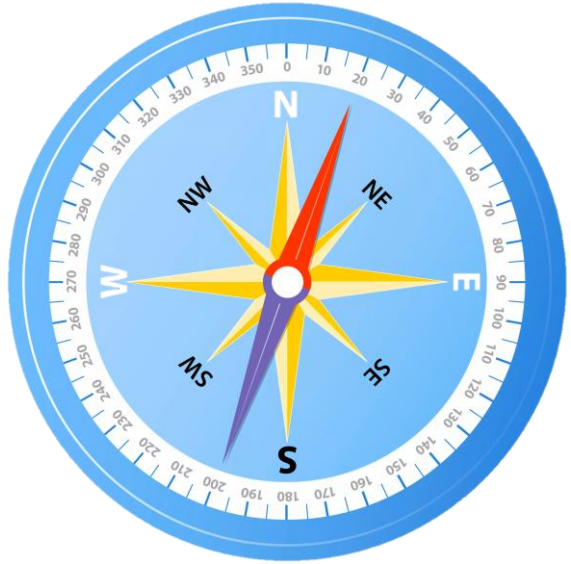
- The attached significant adjective to four corners marked in SE, NE, NW and SW corners.

The Meaning and Significance of these adjectives are as Under:

- **RAW:** Wet bulb temperature below 40° F (4.4° C) and relative humidity over 70%. Cold and moist climate.
- **MUGGY:** Wet bulb temperature over 60° F (15.5 ° C) and relative humidity over 70%. Hot and dry climate (found in deserts).
- **KEEN:** Wet bulb temperature below 40° F (4.4° C) and relative humidity below 40%. Cold and dry climate.
- **SCORCHING:** Wet bulb temperature over 60° F (15.5 ° C) and relative humidity below 40%. Hot and dry climate.

- The shape of the Climograph is also helpful in knowing the nature of climate.
- A spindle shaped Climograph shows **dry continental climate.**
- A Climograph oriented diagonally in **NE to SW direction indicates monsoon type** of climate.
- Similarly, a diagonal climate **NW to SE direction represents Mediterranean climate.**





- **Taylor also suggested the following tentative scale of discomfort for the white people.**

a. 40° F - 45° F - very rarely uncomfortable

b. 45° F - 55° F – ideal

c. 55° F- 60° F - rarely uncomfortable

d. 60° F - 65° F- Sometimes uncomfortable

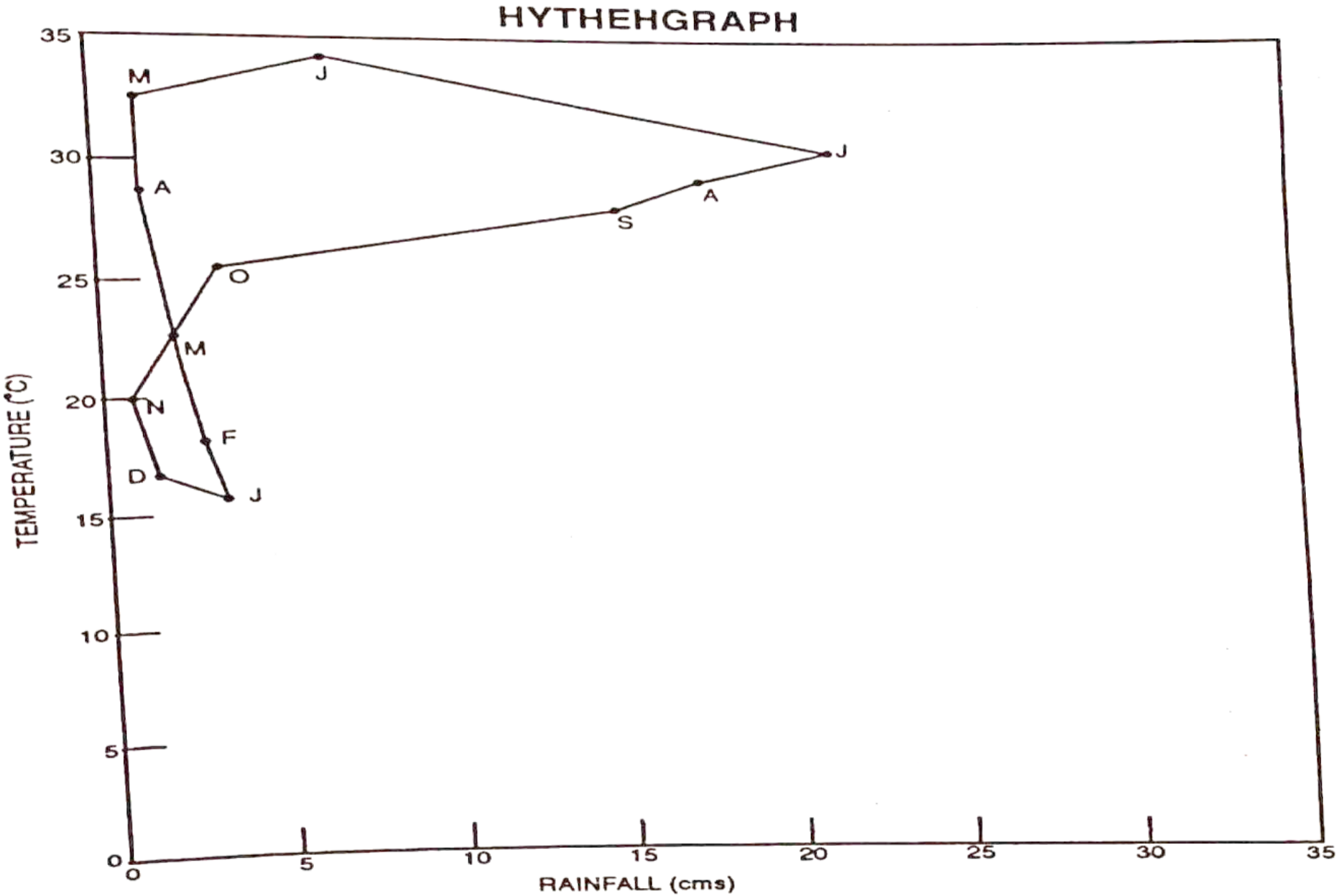
e. 65° F - 70° F- Often uncomfortable

f. Above 70° F- Usually uncomfortable

Hythergraph

- This is another type of Climograph devised by G. Taylor in 1949.
- In this, mean monthly temperature values are plotted on Y- axis and mean-monthly rainfall values on X- axis.
- This is drawn as a 12- sided polygon in the same way as that of the Climograph.
- These are principally used in summarizing broad climate differences in relation to human activity, more precisely in the context of settlement.
- The four quarters naturally denote four distinctive climatic conditions –

cold and dry (SW), cold and wet (SE), hot and dry (NW) and hot and humid (NE)


HYTHEHGRAPH
TEMPERATURE (°C)
RAINFALL (cms)
35
30
25
20
15
10
5
0
0
5
10
15
20
25
30
35
M
J
J
A
A
S
O
M
N
F
D
J

Practical Time

1. Climograph

	ज०	फ०	मार्च	अ०	म०	जू०	जु०	अ०	सि०	अ०	न०	दि०
आर्द्र-बल्ब तापमान (°सेग्रे)	14	16	15	19	18	25	25	25	24	20	16	15
आपेक्षिक आर्द्रता (%)	27	39	23	22	28	43	49	55	48	21	14	26

2. Hythergraph

	ज०	फ०	मार्च	अ०	म०	जू०	जु०	अ०	सि०	अ०	न०	दि०
औसत मासिक तापमान (°सेग्रे)	14	16	22	28	31	32	30	29	27	24	18	14
औसत मासिक वर्षा (सेमी)	3	2	2	1	2	7	19	20	12	1	2	2

Rainfall Variability Graph (Departure From Mean)

It shows the variation in rainfall from a mean value of it over a very long period of time.

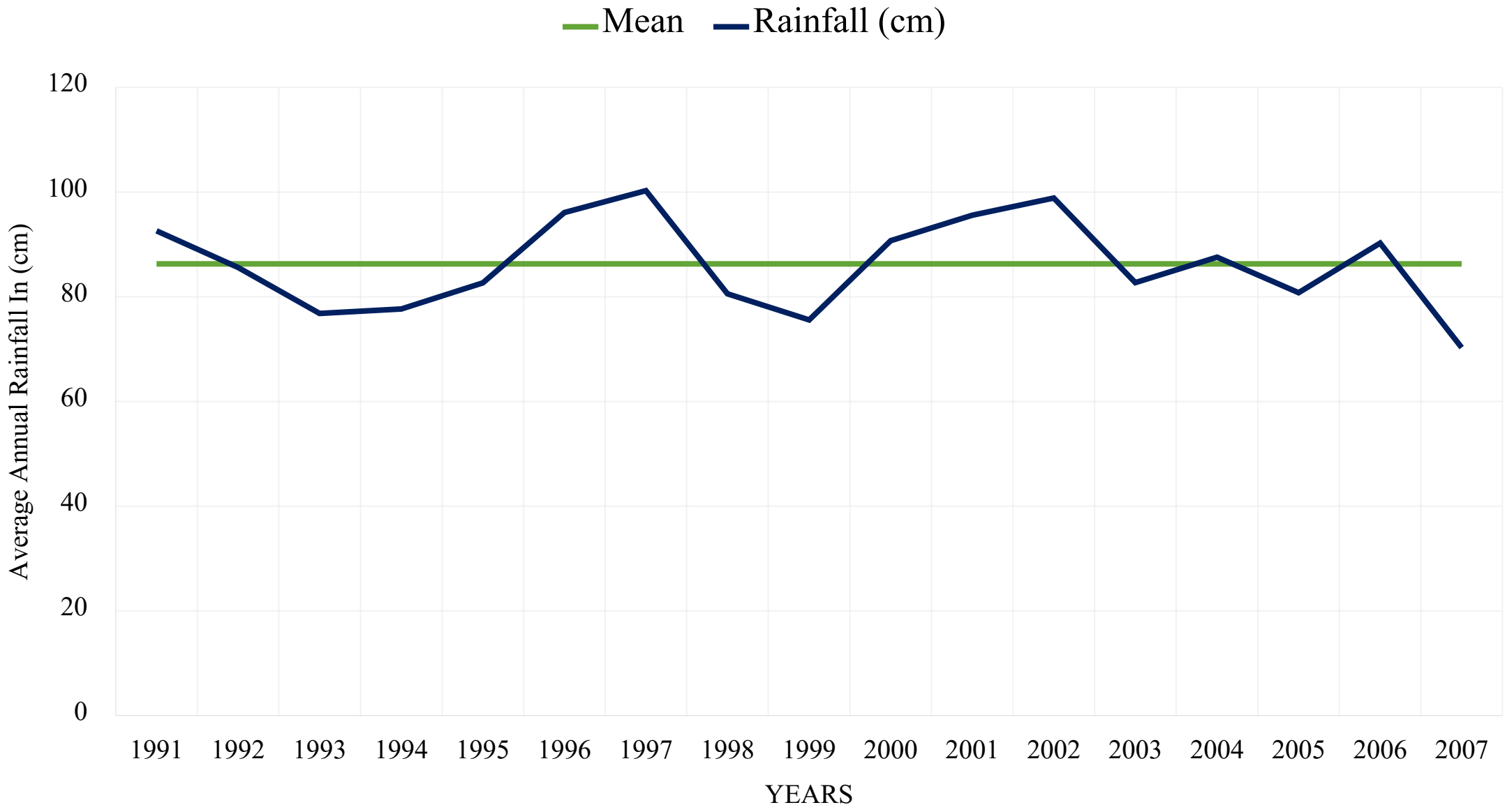
Used to asses the rainfall fluctuations from average

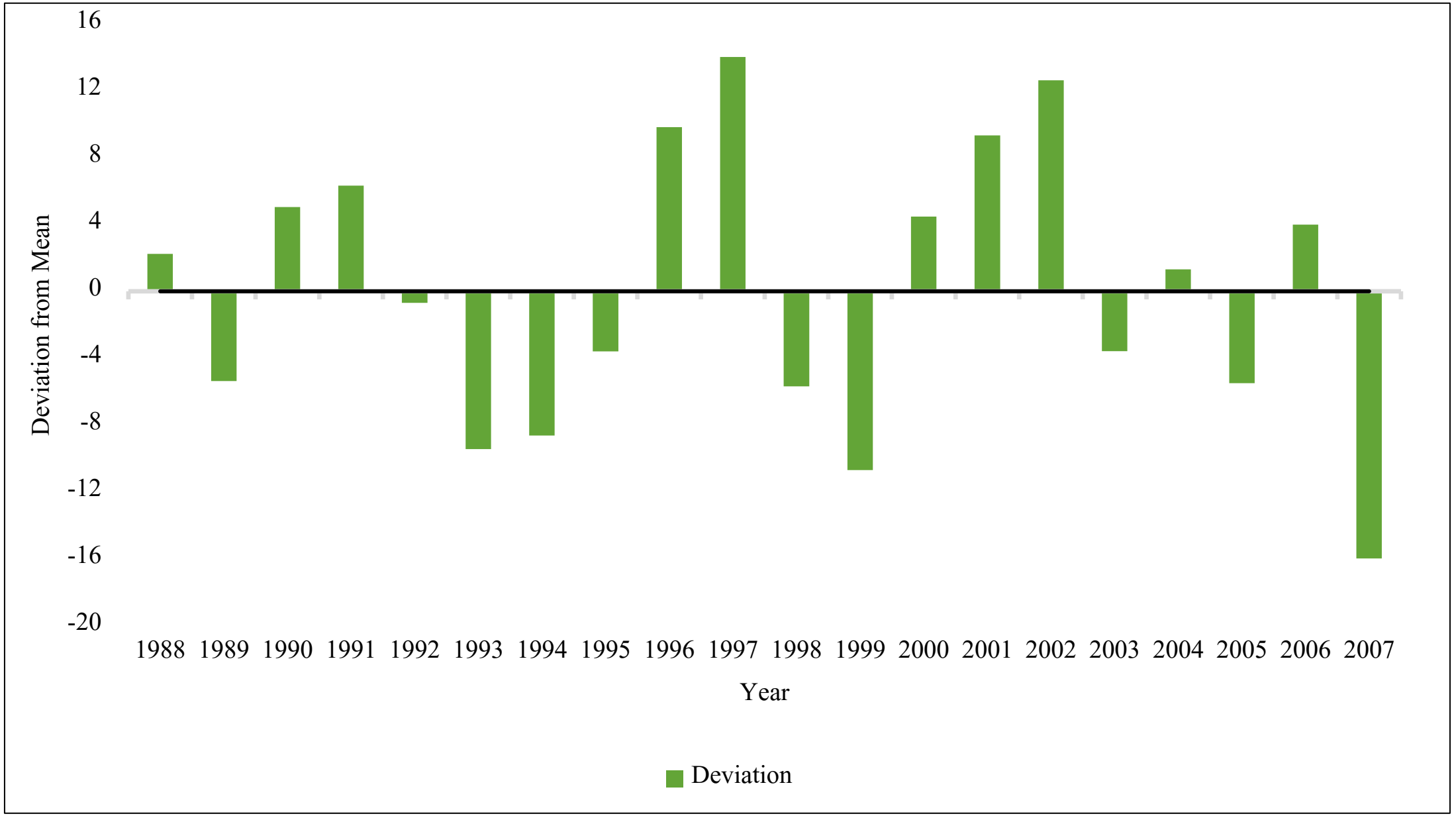
It helps to identify the:

- ✓Average annual (seasonal) rainfall
- ✓Extremes (wettest and driest)
- ✓Frequency of extremes?
- ✓Number of years that the rainfall was less than average or greater than it
- ✓Probability of droughts

Year	Rainfall (cm)
1988	88.52
1989	80.92
1990	91.32
1991	92.6
1992	85.6
1993	76.85
1994	77.67
1995	82.69
1996	96.1
1997	100.29
1998	80.6
1999	75.6
2000	90.75
2001	95.6
2002	98.9
2003	82.71
2004	87.59
2005	80.79
2006	90.27
2007	70.32

Year	Rainfall (cm)	Deviation	Deviation %
1988	88.52	2.24	2.60
1989	80.92	-5.36	-6.21
1990	91.32	5.04	5.84
1991	92.6	6.32	7.32
1992	85.6	-0.68	-0.79
1993	76.85	-9.43	-10.93
1994	77.67	-8.61	-9.98
1995	82.69	-3.59	-4.16
1996	96.1	9.82	11.38
1997	100.29	14.01	16.24
1998	80.6	-5.68	-6.58
1999	75.6	-10.68	-12.38
2000	90.75	4.47	5.18
2001	95.6	9.32	10.80
2002	98.9	12.62	14.63
2003	82.71	-3.57	-4.14
2004	87.59	1.31	1.52
2005	80.79	-5.49	-6.36
2006	90.27	3.99	4.62
2007	70.32	-15.96	-18.50
Sum =	1725.69		
Mean =	86.28		


Mean
Rainfall (cm)
120
100
80
60
40
20
0
Average Annual Rainfall In (cm)
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
YEARS


16
12
8
4
0
-4
-8
-12
-16
-20
Deviation from Mean
1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007
Year
Deviation