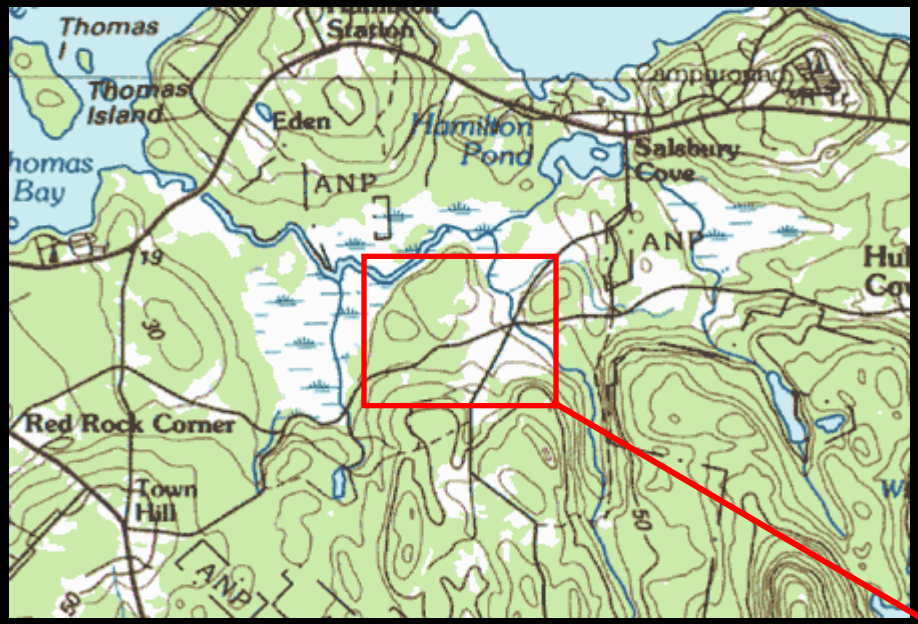
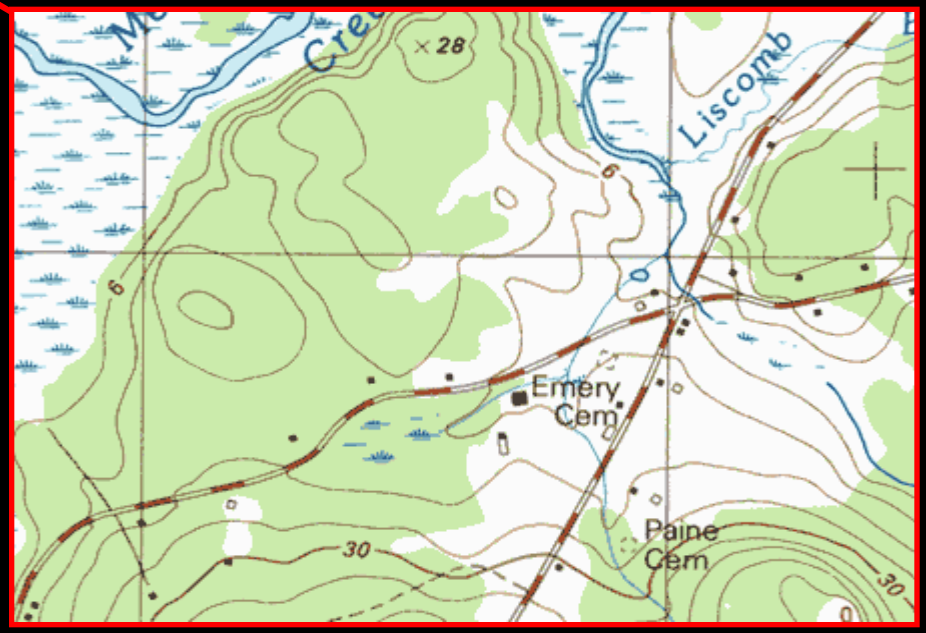
Map Scale

- Map scale is the relationship between distance on a map and the corresponding distance on the ground. Scale is expressed as a ratio, such as 1:24,000, and shown graphically by bar scales marked in feet and miles, or in meters and kilometers. Maps with a small scale for example, 7.5-minute maps, are often called large-scale maps because they show more detail (by covering less area) than a large bar-scale (30- x 60-minute) map.
- You must know the scale to determine ground distances between objects or locations on the map, the size of the area covered, and how the scale may affect the amount of detail being shown.
- The terms "*small scale*," "*medium scale*," and "*large scale*" may be confusing when read in conjunction with the number.
- However, if the number is viewed as a fraction, it quickly becomes apparent that 1:600,000 of something is smaller than 1:75,000 of the same thing. Therefore, the larger the number after 1:, the smaller the scale of the map.
- (1) ***Small***. Maps with scales of 1:1,000,000 and smaller are used for general planning and for strategic studies. The standard small-scale map is **1:1,000,000 (1 inch = 16 miles).** This map covers a very large land area at the expense of less detail.
- (2) ***Medium***. Maps with scales larger than 1:1,000,000 but smaller than 1:75,000 are used for operational planning. They contain a moderate amount of detail, but terrain analysis is best done with the large-scale maps. The standard medium-scale map is **1:250,000 (1 inch = 4 miles).** Medium-scale maps of 1:100,000 are also frequently encountered.
- (3) ***Large***. Maps with scales of 1:75,000 and larger are used for tactical, administrative, and logistical planning. These are the maps that you as a Soldier or junior leader are most likely to encounter. The standard large-scale map is 1:50,000; however, many areas have been mapped at a scale of **1:25,000 (1 inch = 2,000 feet).** Lots of detail is shown on this type of map.

Map Scale

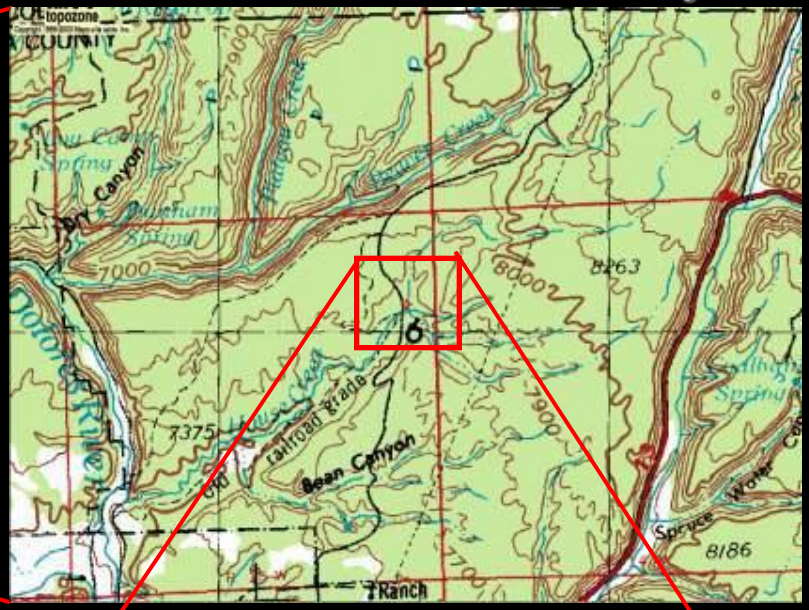


Medium-scale topo map (1:150,000)
SOME DETAIL



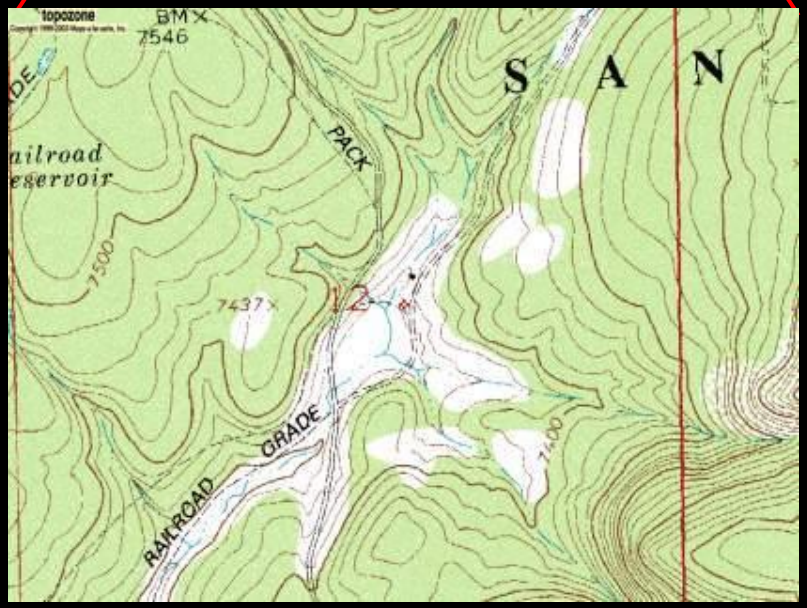
Large-scale topo map (1:24,000)
LOTS OF DETAIL

Small-scale map (1:100,000,000)
VERY LITTLE DETAIL



Medium-scale map (1:250,000)
MORE DETAIL

Map Scale



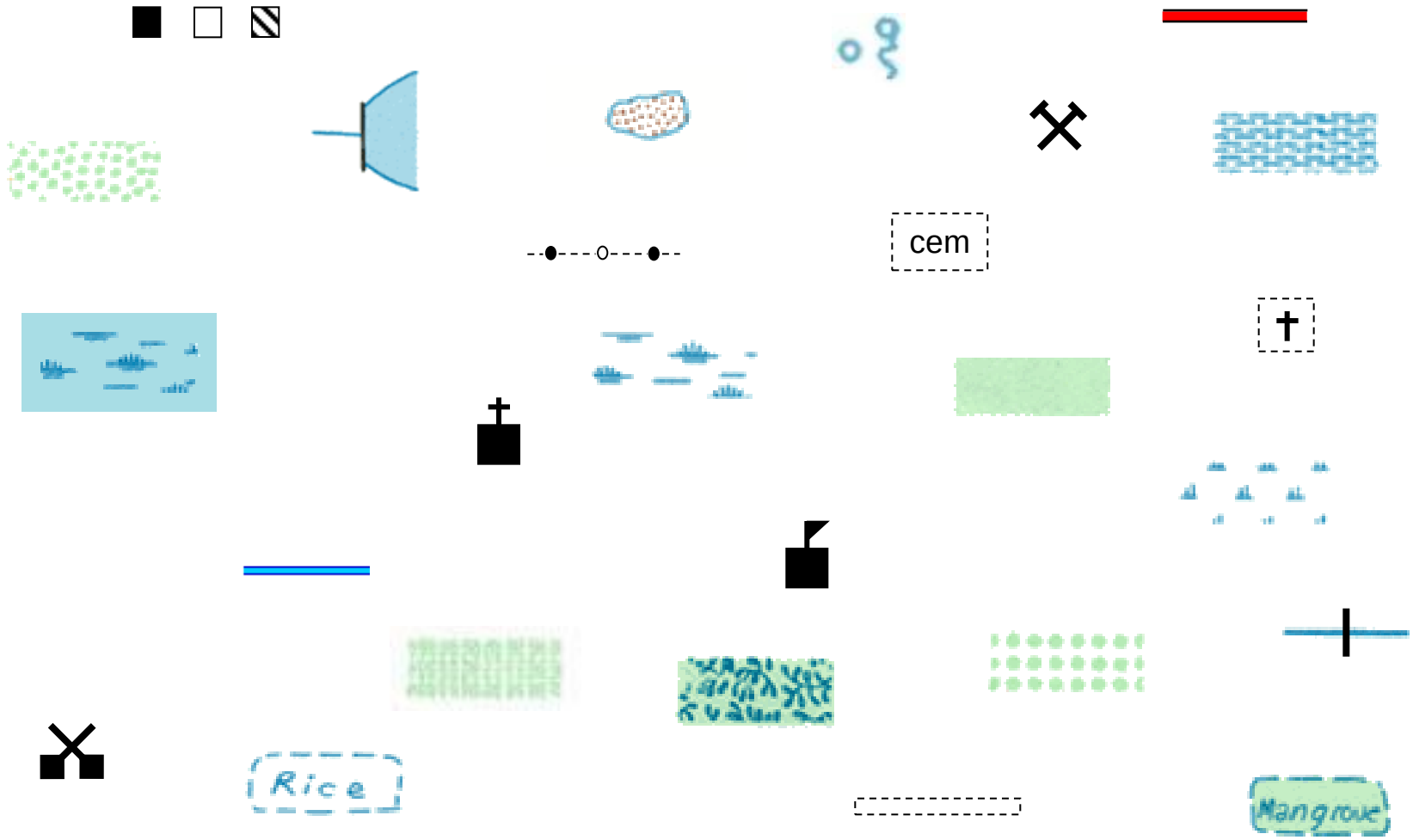
Large-scale map (1:24,000)
LOTS OF DETAIL

Any Questions?

Map Symbols

Symbols are used to represent the natural and man-made features of the earth.

It is a map language that is simple to read and understand. BUT you must first know what the map symbols represent, in order to understand, read and speak map language to others.



Map Symbols

VEGETATION

Woods



Shrub



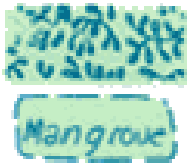
Orchard



Vineyard



Mangrove

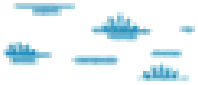




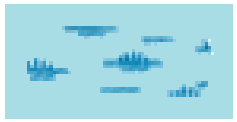
Map Symbols

SUBMERGED AREAS AND BOGS

Marsh or swamp

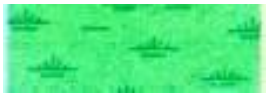


Submerge marsh or swamp



Wood marsh or swamp

Submerge wood marsh or swamp



Rice field

Land subject to inundation

Map Symbols

RIVERS, LAKES, AND CANALS

Intermittent stream

Perennial stream

Intermittent river

Perennial river

Small falls; small rapids

Large falls; large rapids

Perennial lake or pond

Intermittent lake or pond

Dry lake

Well or spring

Dam

Canal

MAN-MADE FEATURES and HIGHWAY & LAND GRIDS

Map Symbols

Built-up Areas

Buildings

School

Church

Airports

Landing Strip

Cemetery cem

Mine

Gravel Pit

Highway

Road

Dirt Road

Bridge

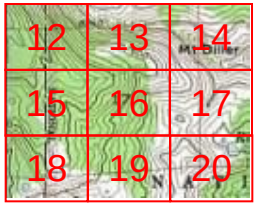
Foot Bridge

Trail

Power Lines

Railroad

Land Grids



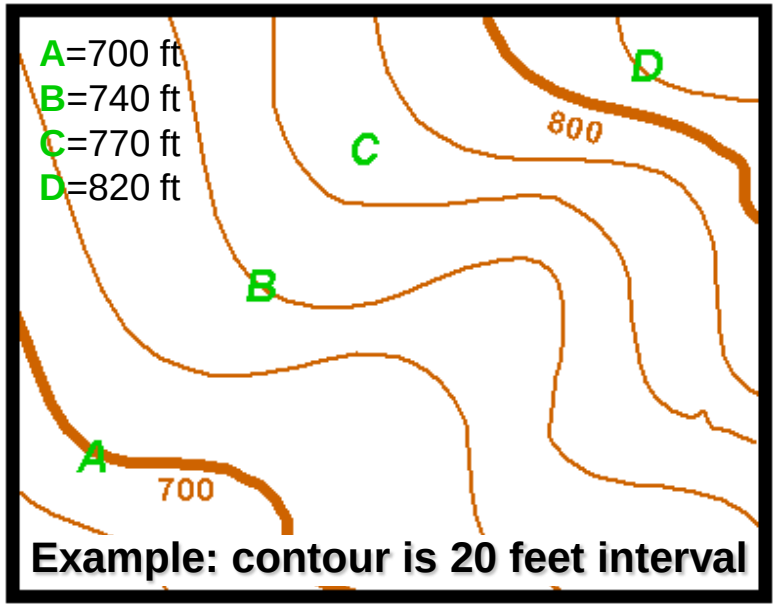
Any Questions?

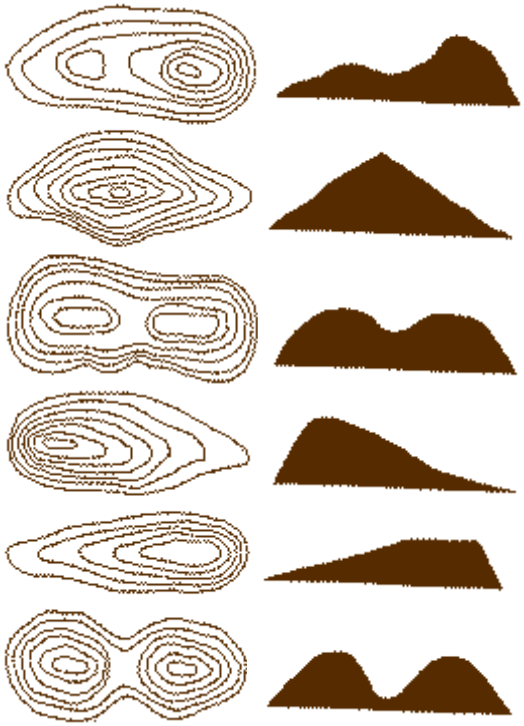
CONTOUR LINES

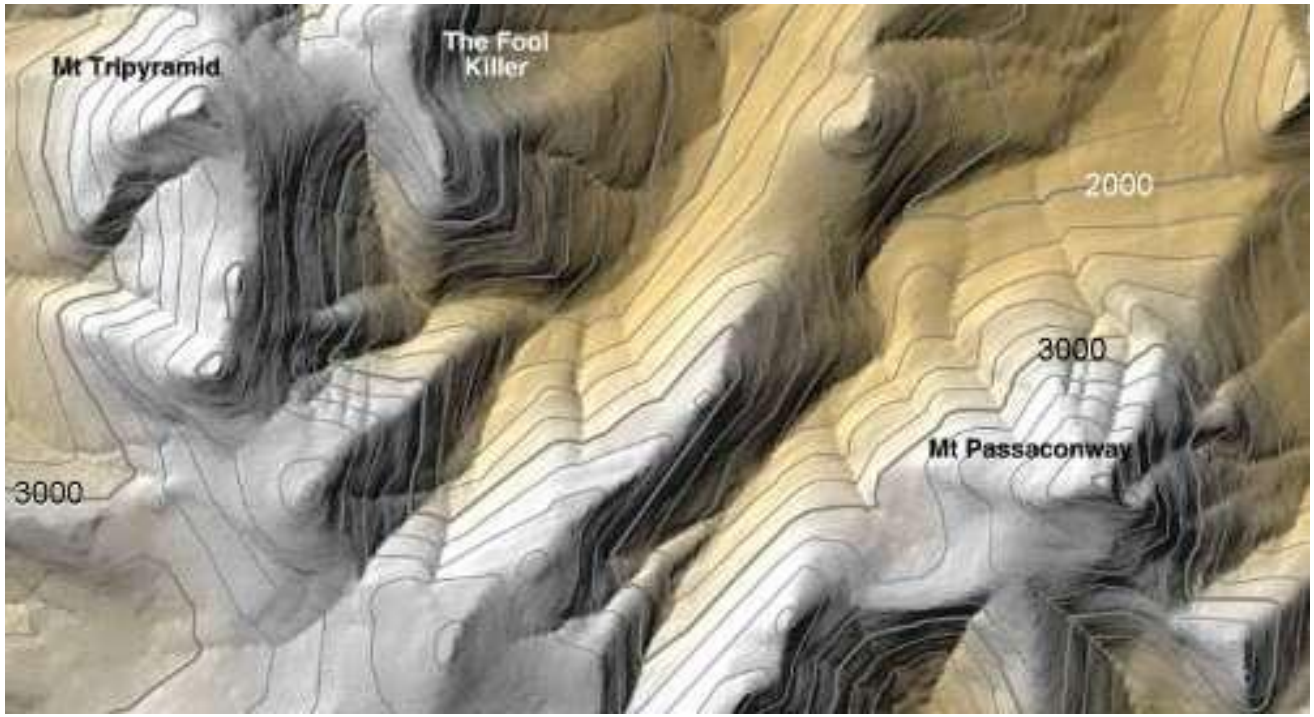
Contour Interval ~ The contour interval is the distance between each contour line. The contour interval is found along the bottom edge, center of the map.

Intermediate Contour ~ a brown line on a topographic map and represents a line of equal elevation.

Index Contour ~ a bolder/wider brown line that has the elevation value marked at various intervals as a part of the line.

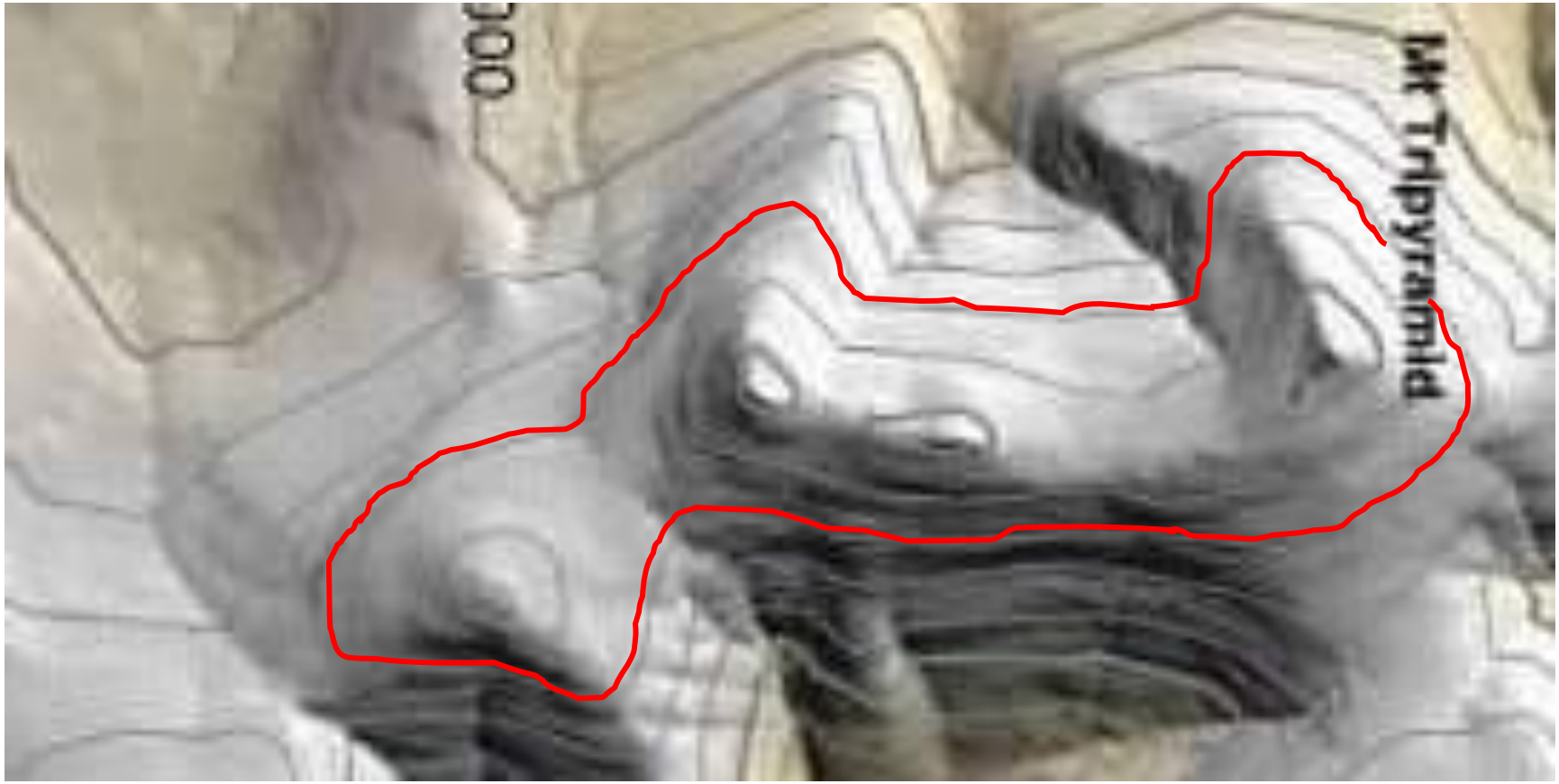






CONTOUR LINES

- There is a dimension to establishing position which does depend on map reading skills.
- This is the vertical dimension. On a map it is referred to as “relief”.
  - Knowledge of the relief of an area is extremely important to a wilderness navigator.
- The most graphic technique ever devised to show relief information is the contour line.
  - If you were to walk a contour line you would never go down hill and never up hill, and eventually you would arrive back where you started.



Any Questions?

Terrain Relief Features

Five Major

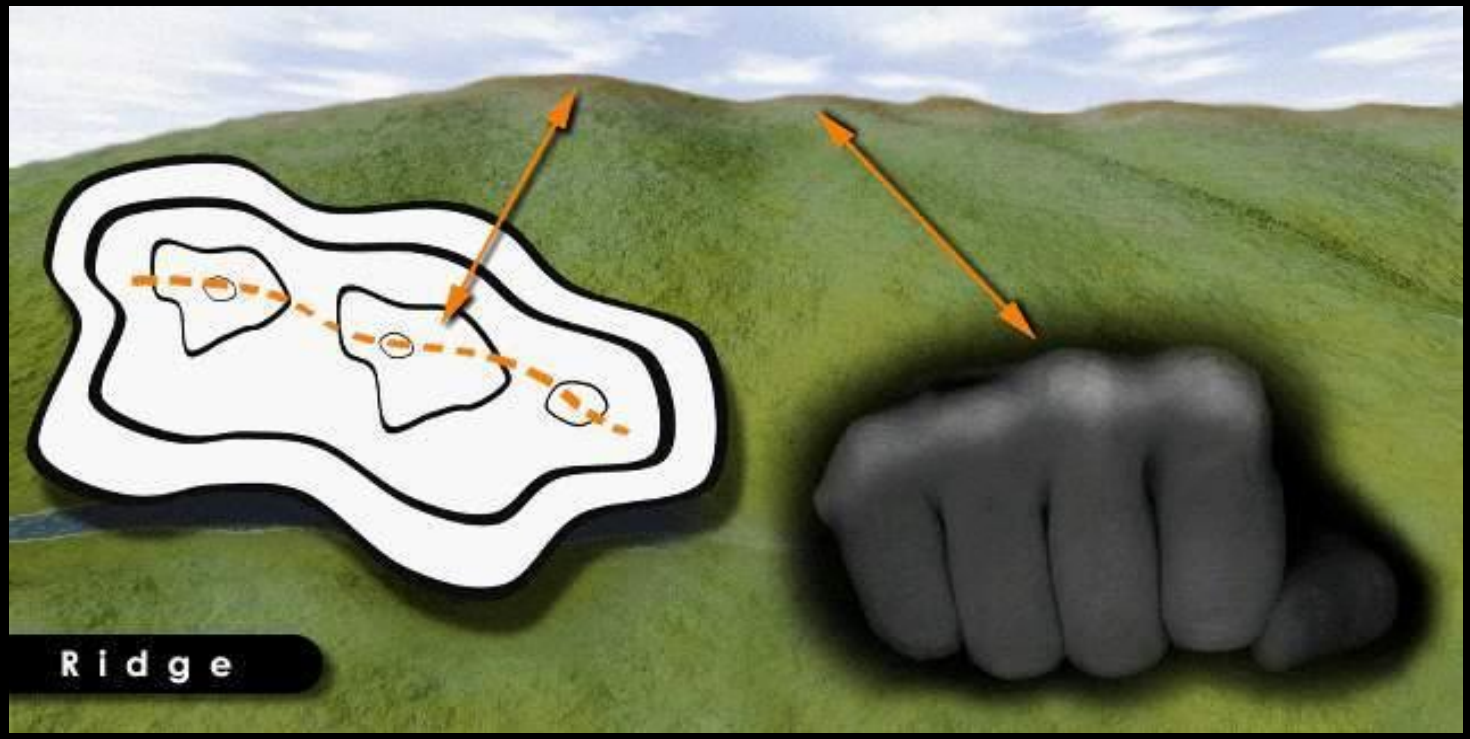
- Ridge
- Hill
- Saddle
- Valley
- Depression

Three Minor

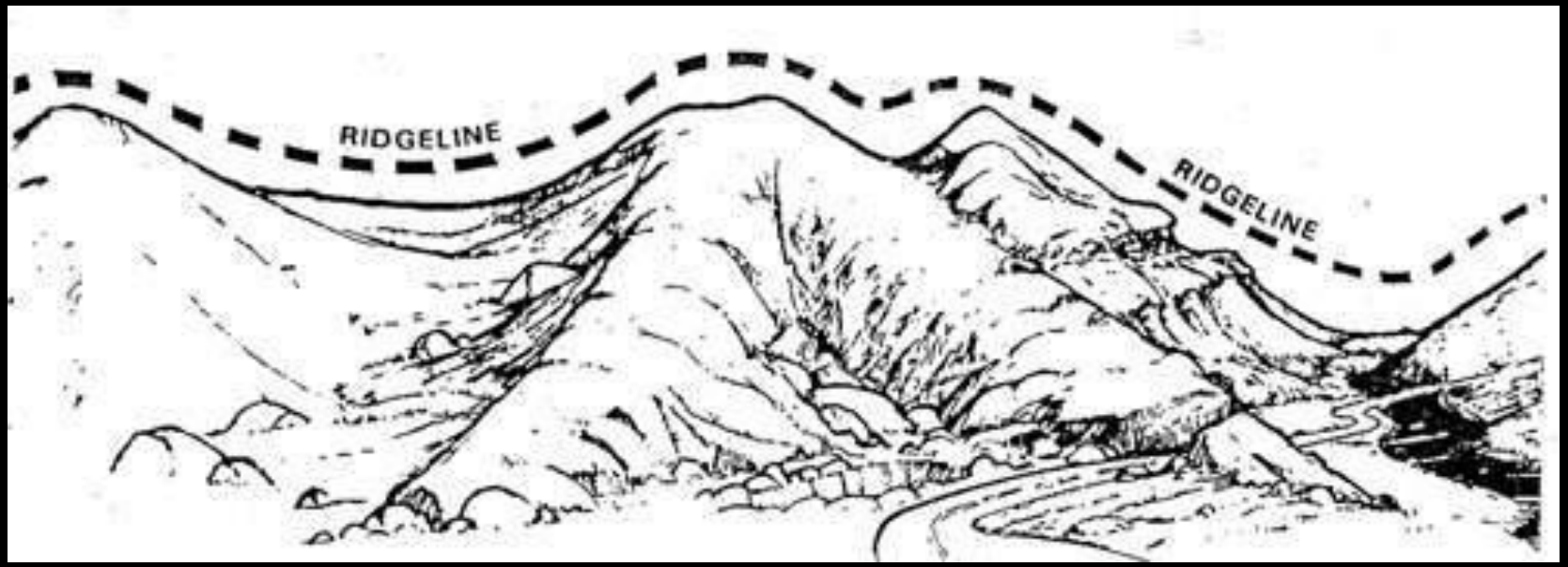
- Spur
- Draw
- Cliff

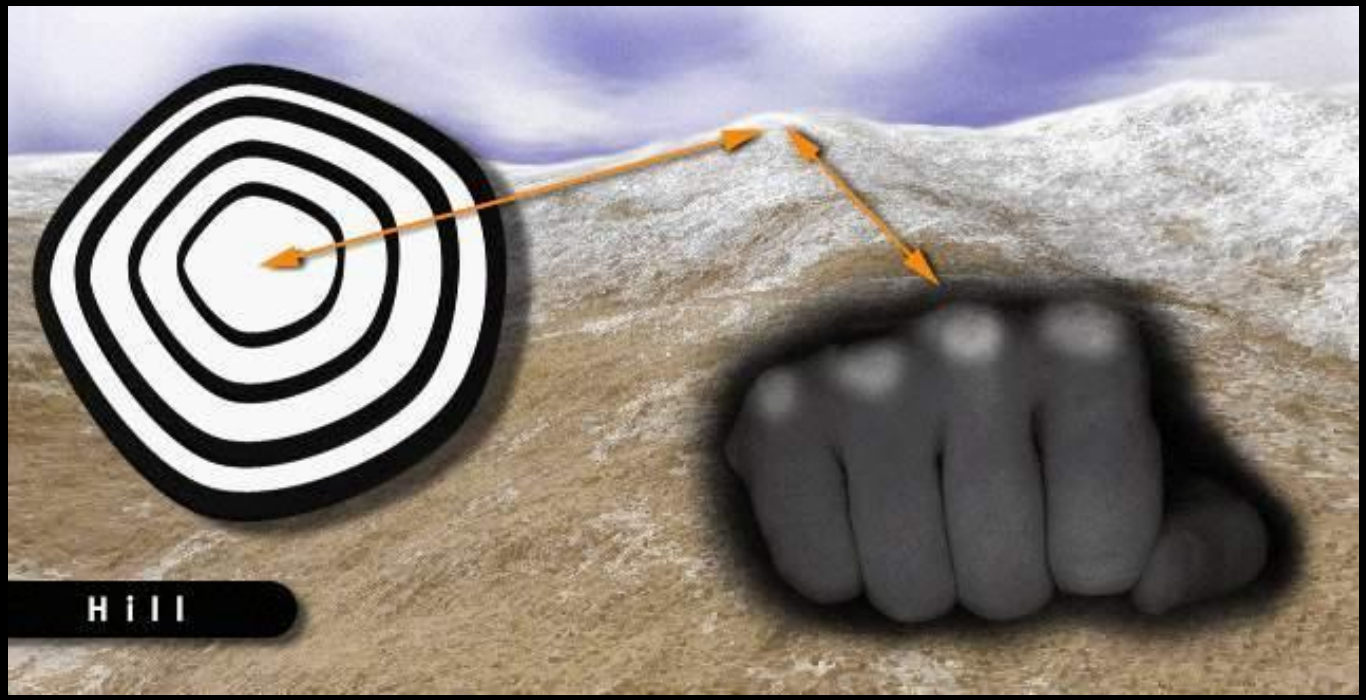
Two Supplemental

- Cut
- Fill

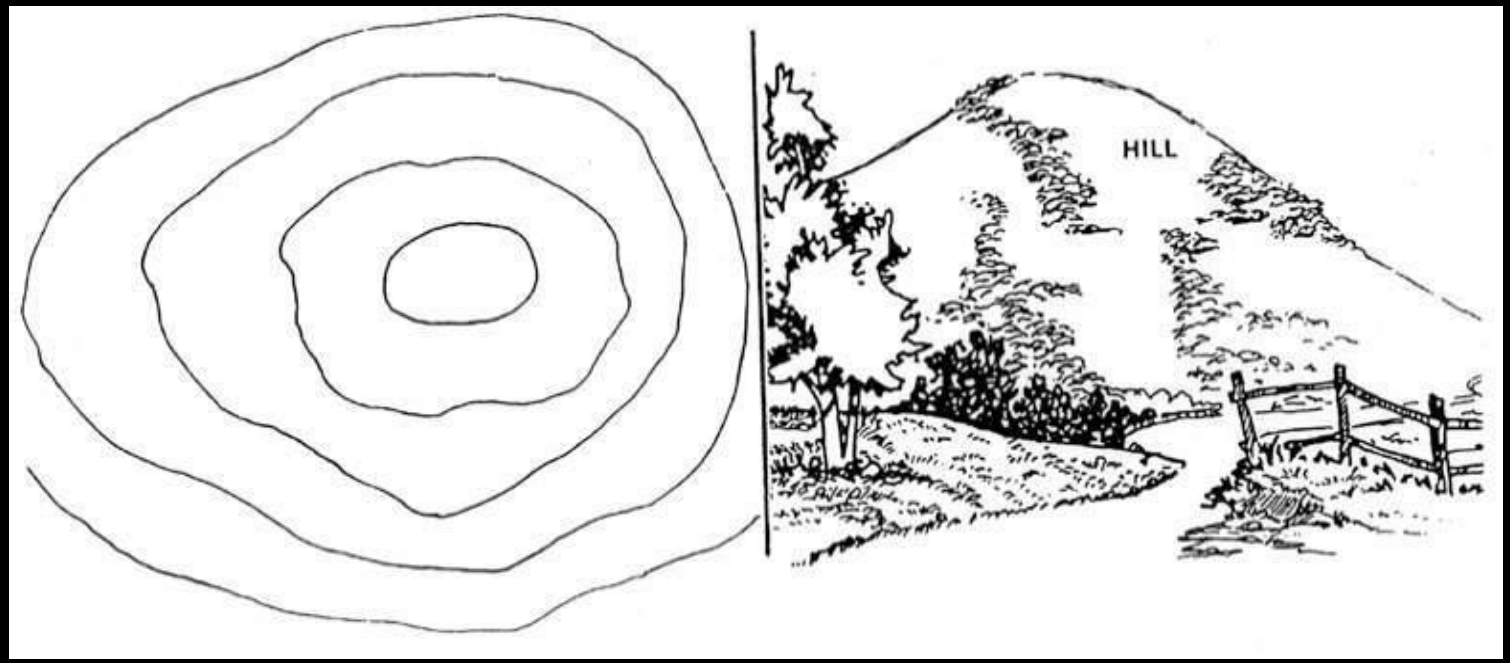


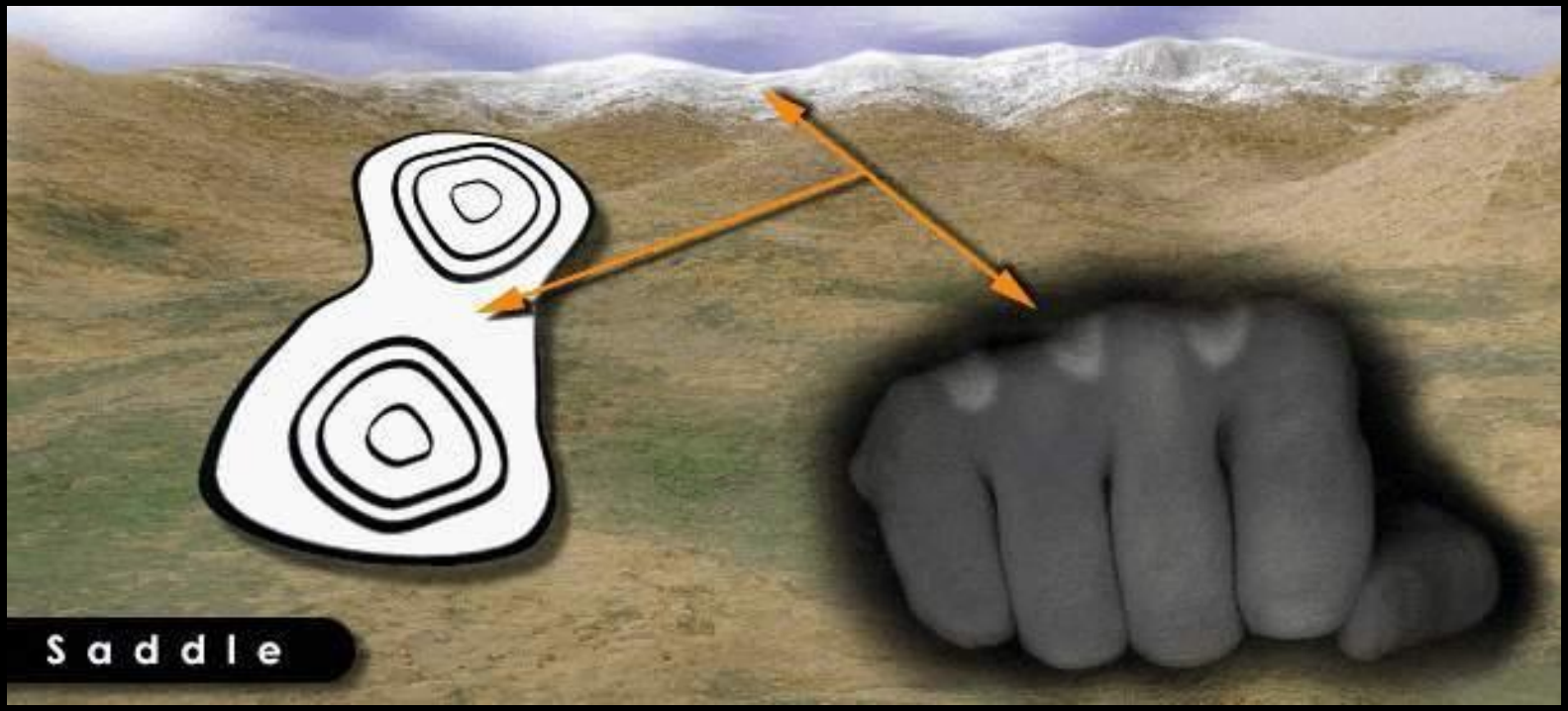
RIDGE



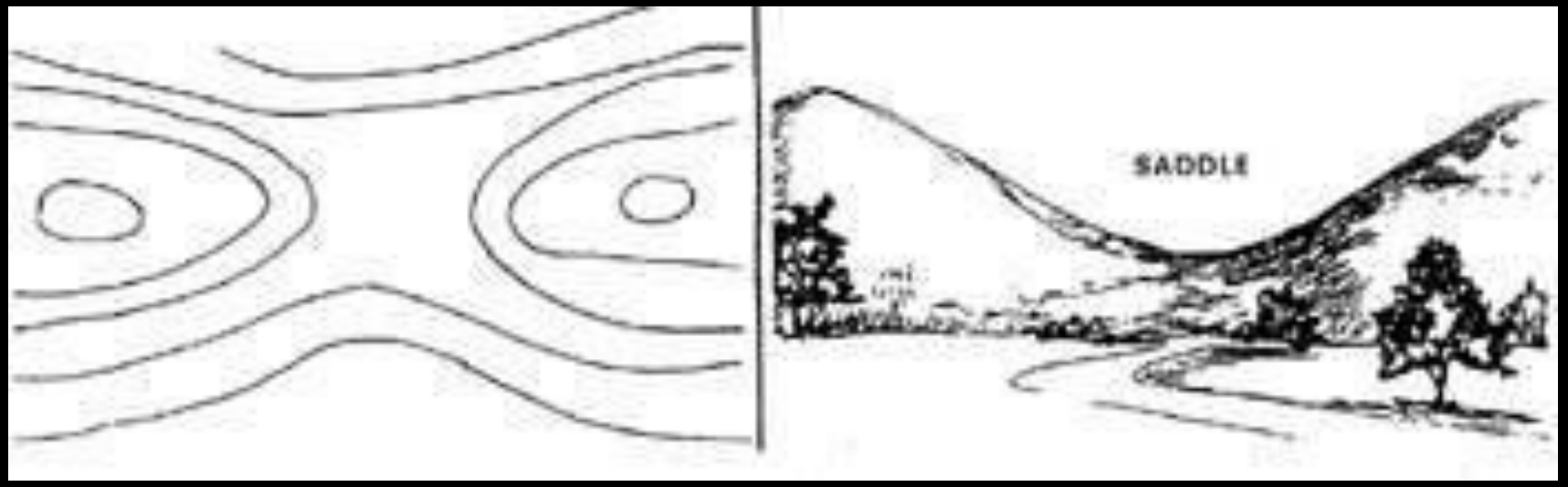


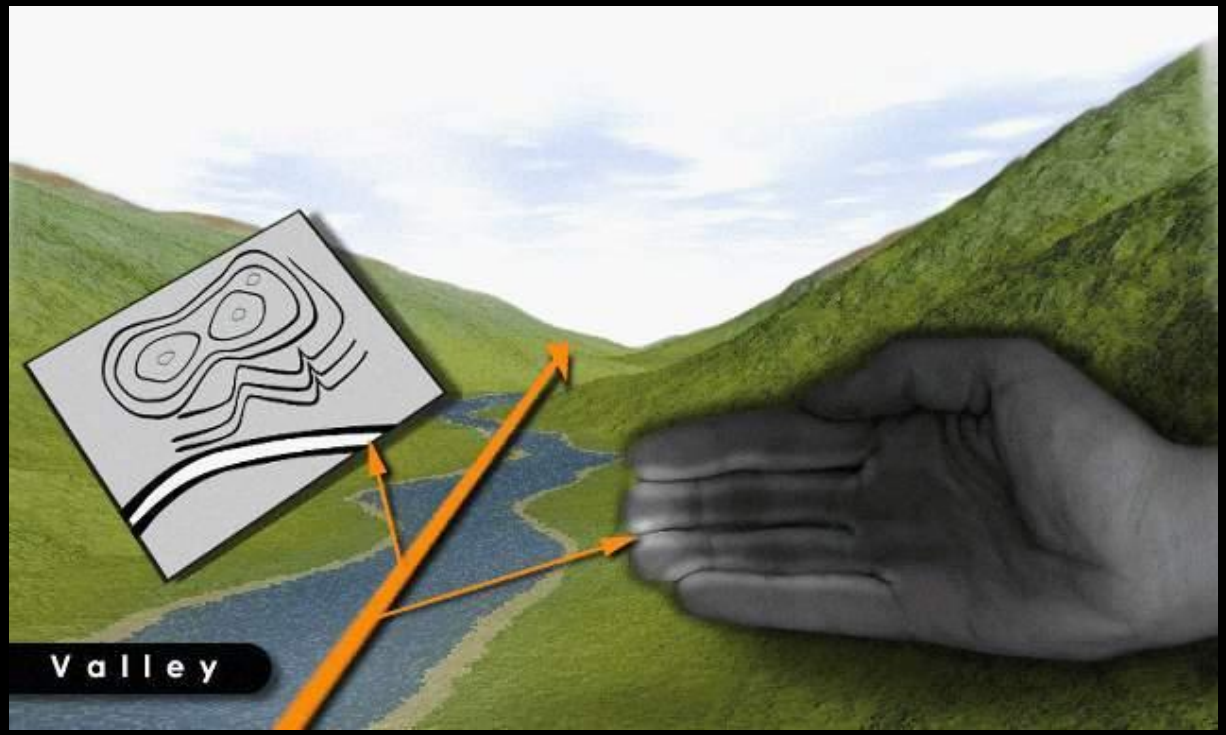
HILL



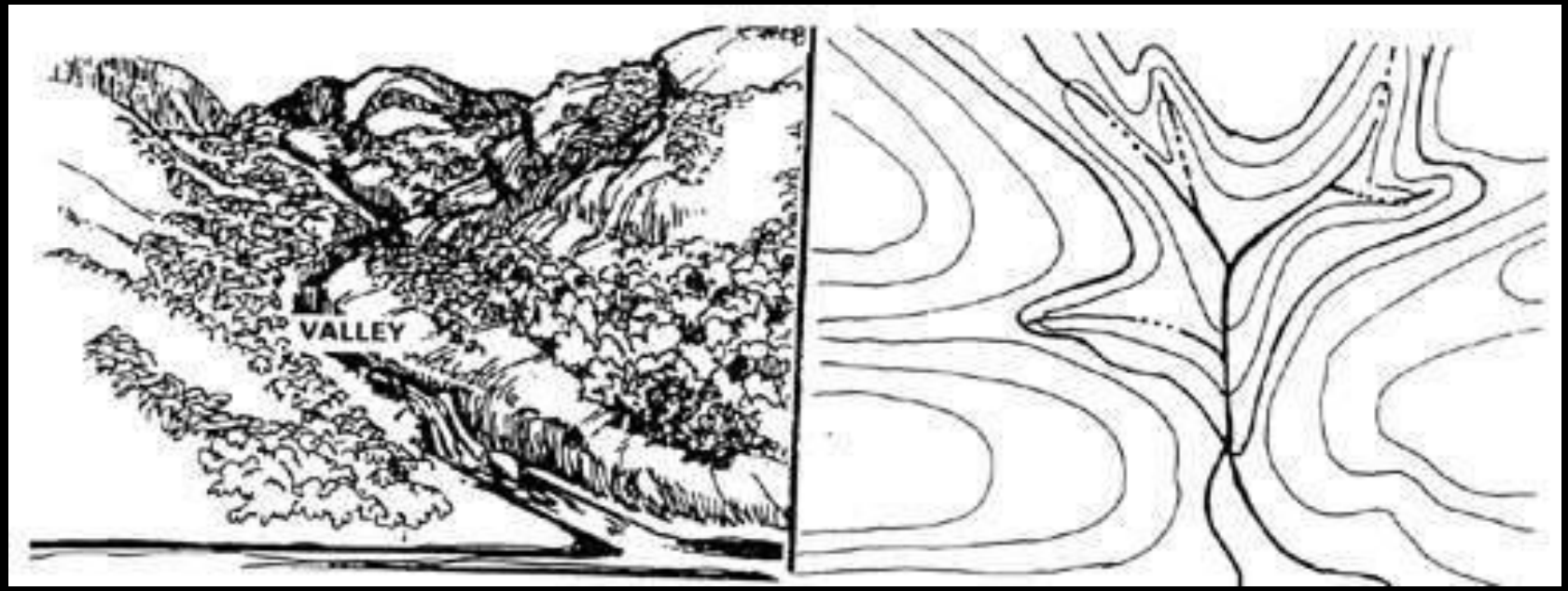


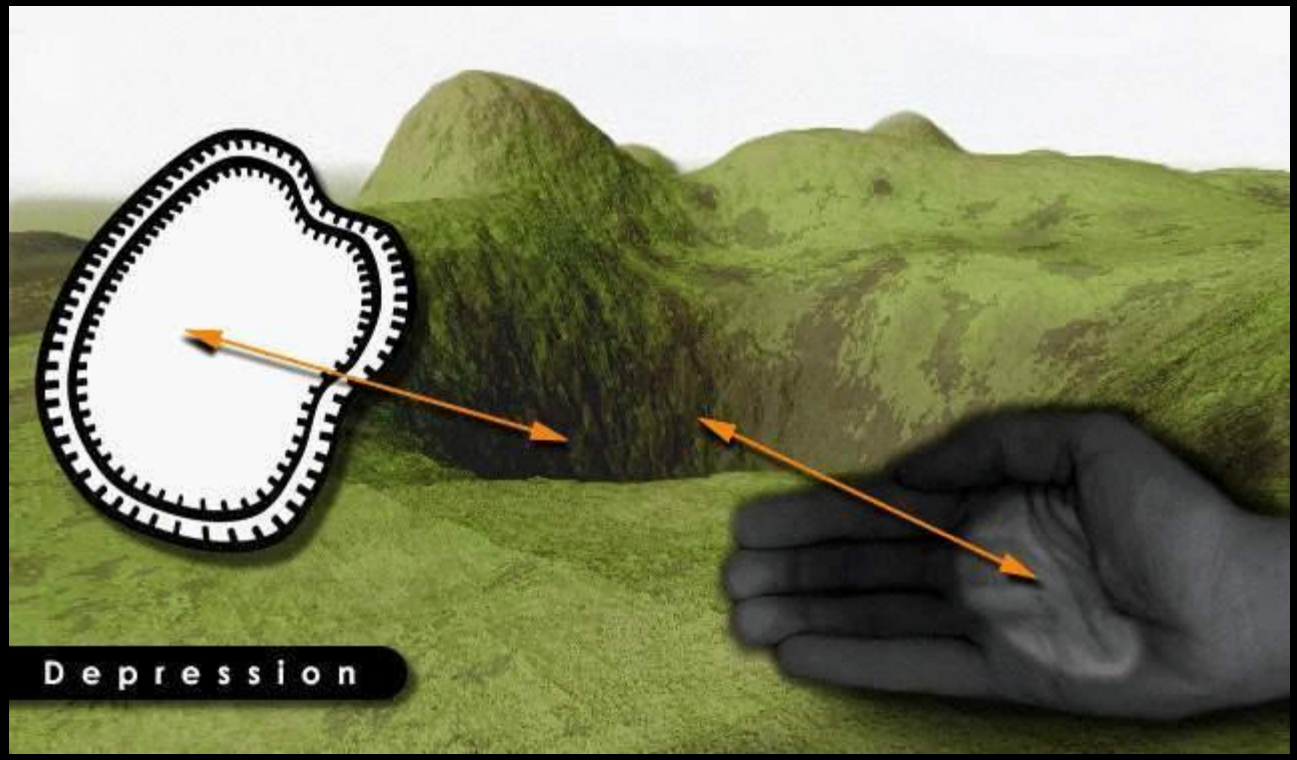
SADDLE



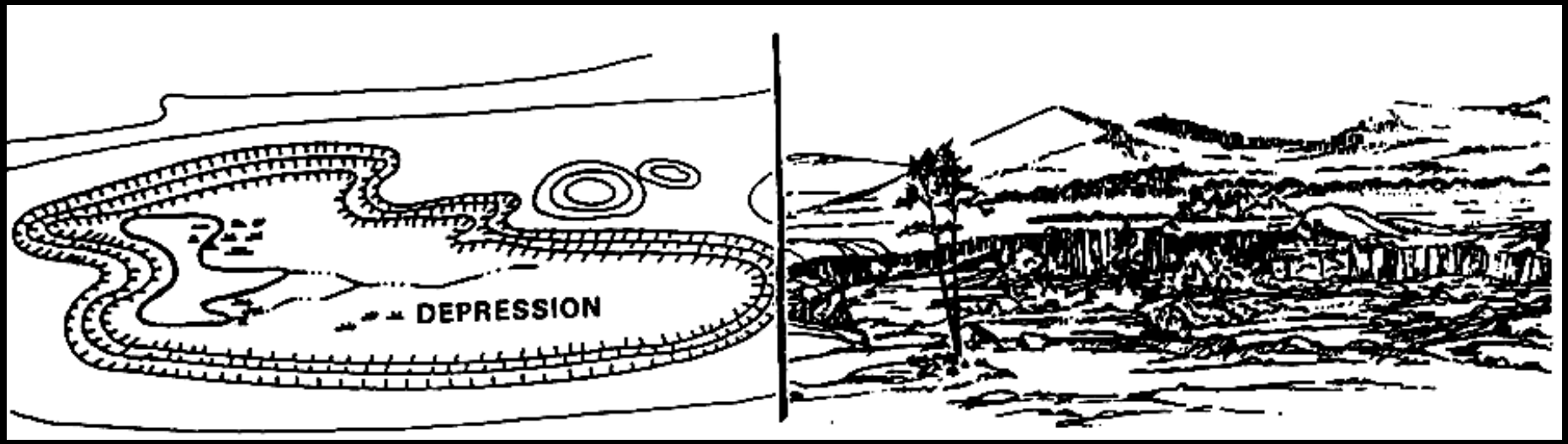


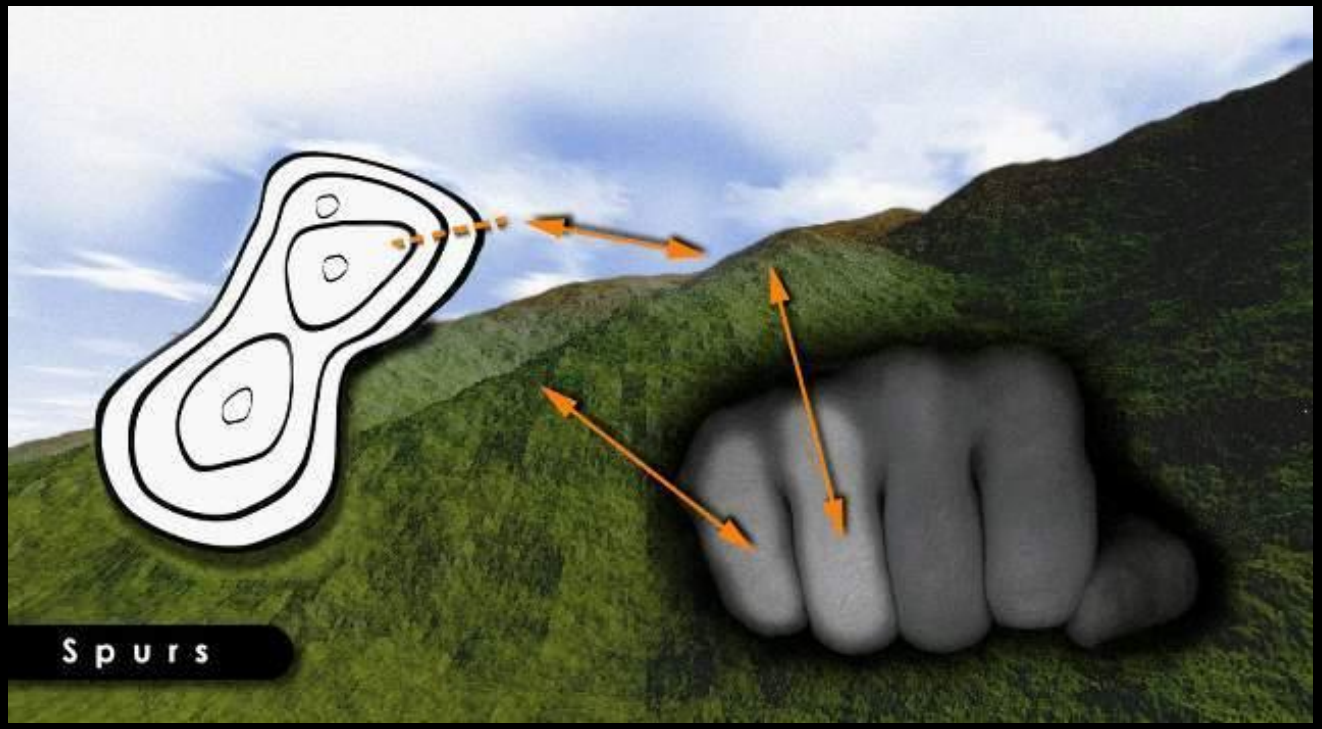
VALLEY



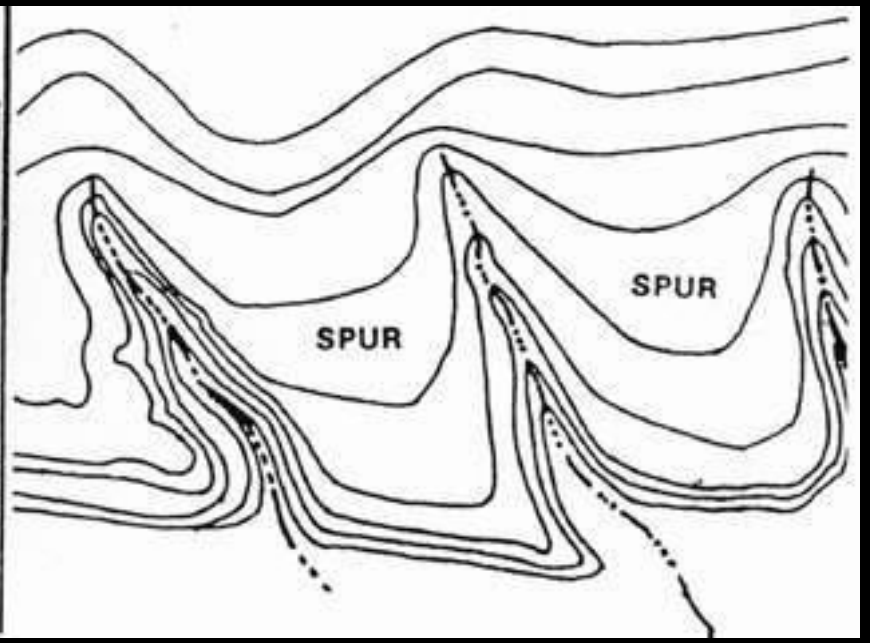


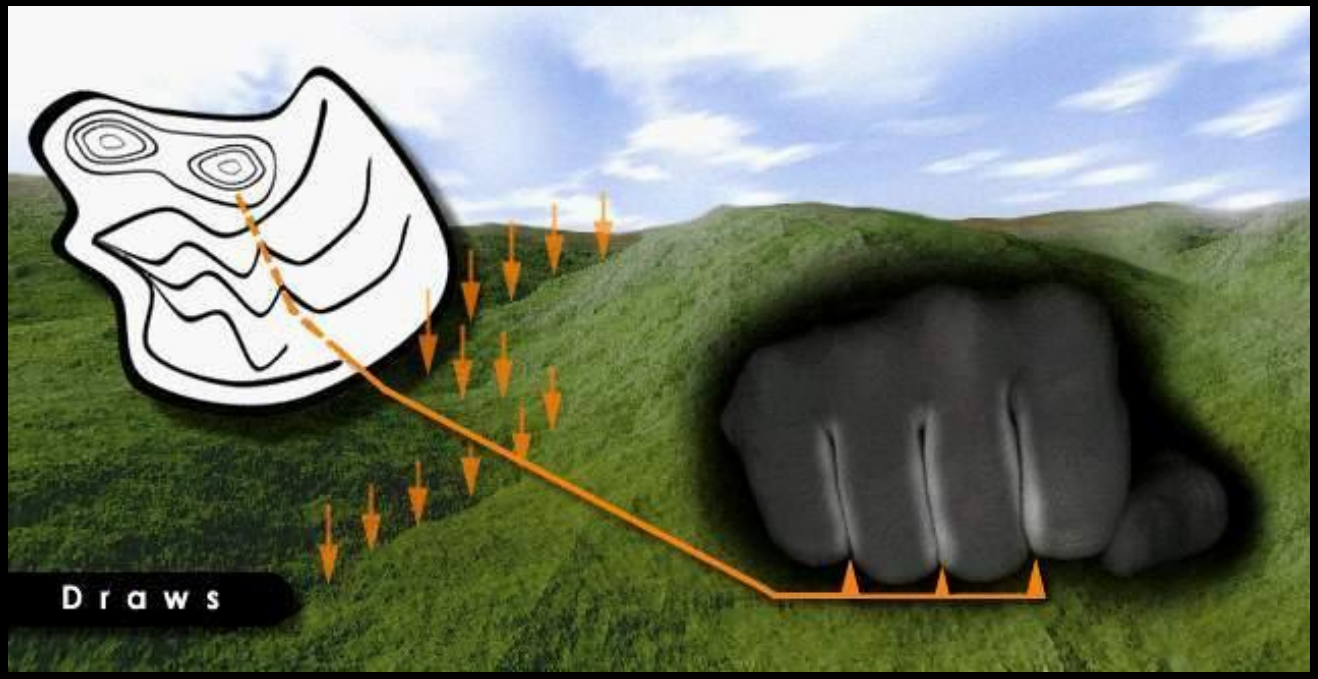
DEPRESSION



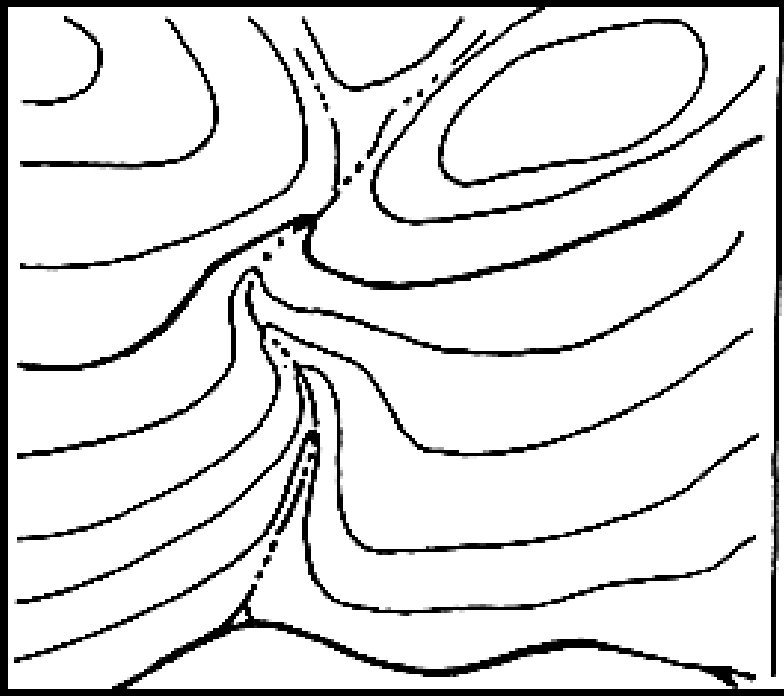


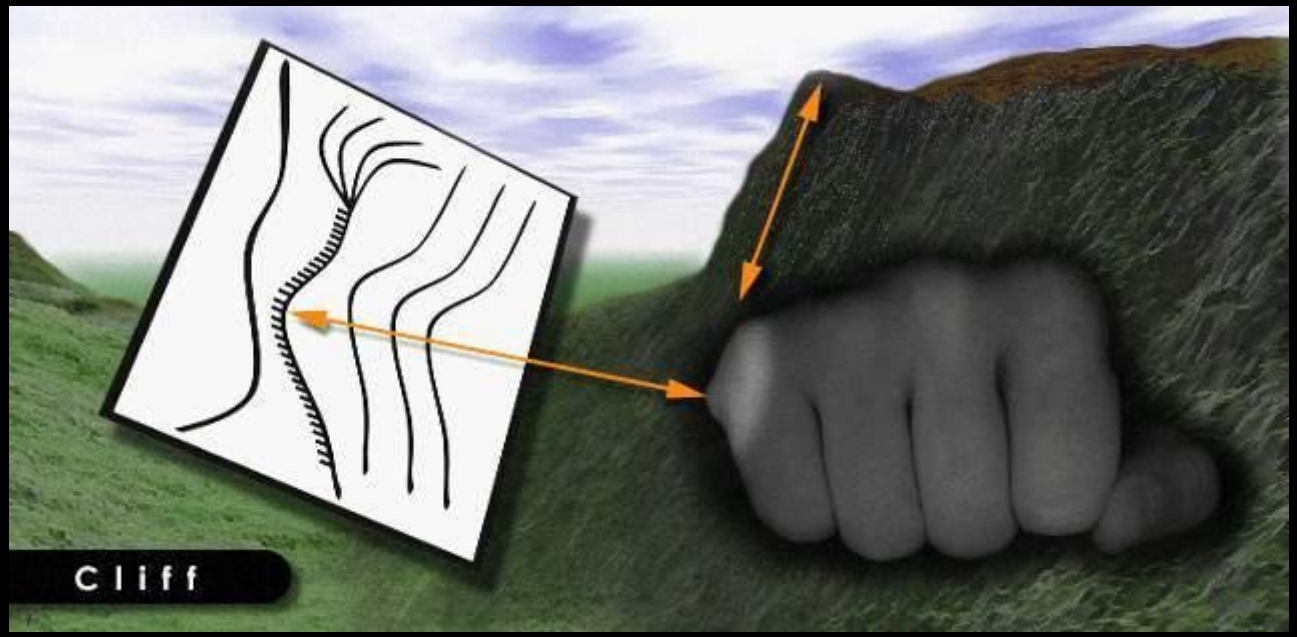
SPURS



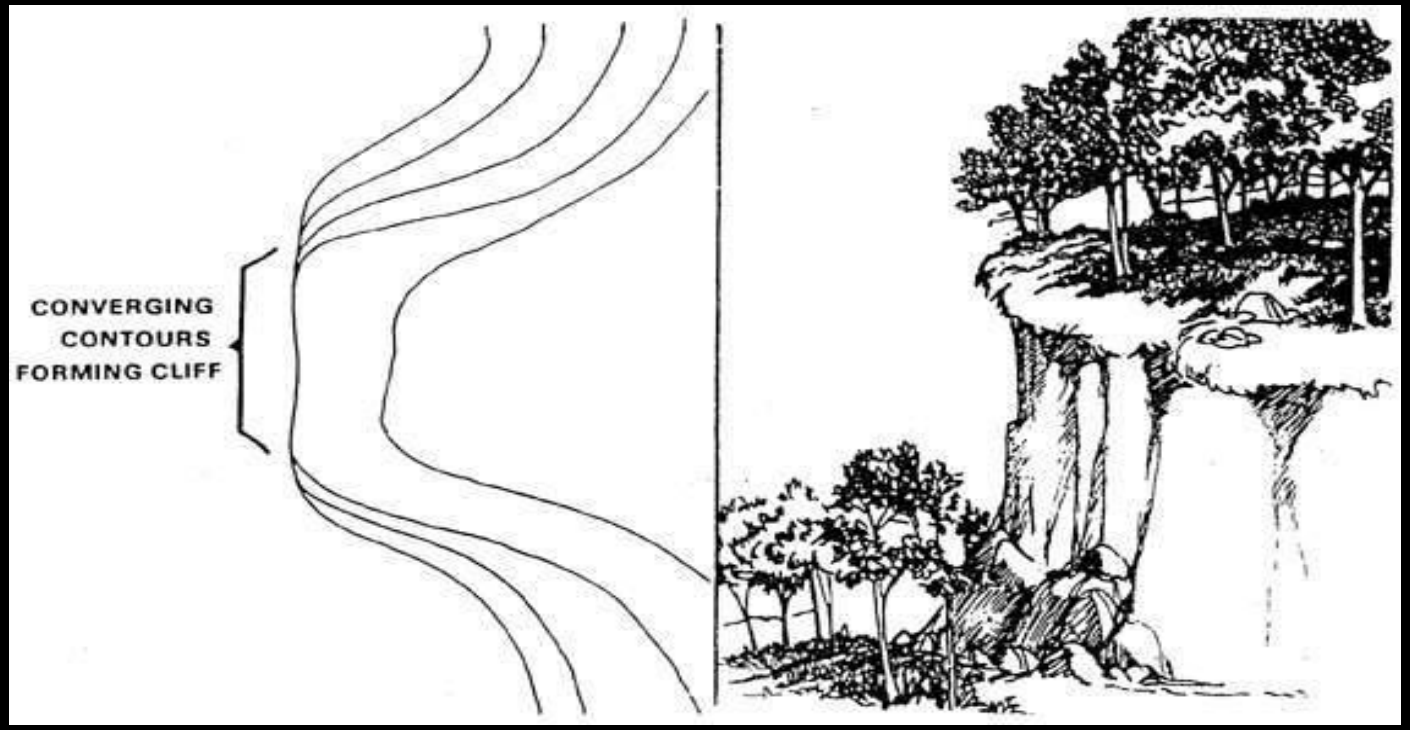


DRAWS

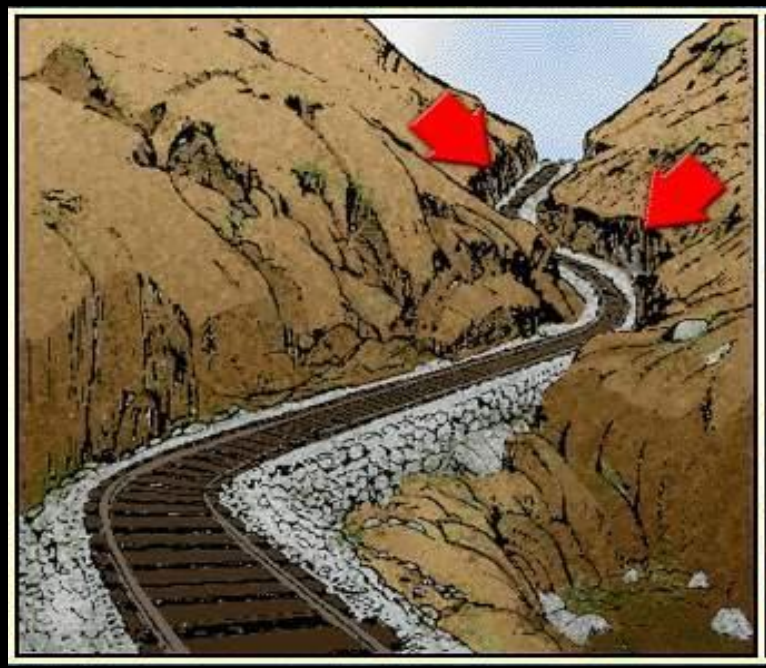


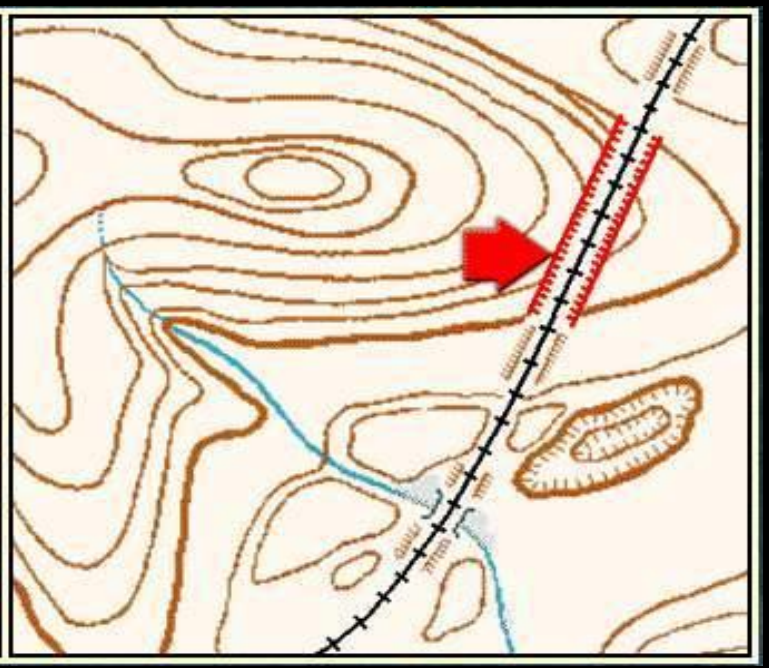


CLIFF

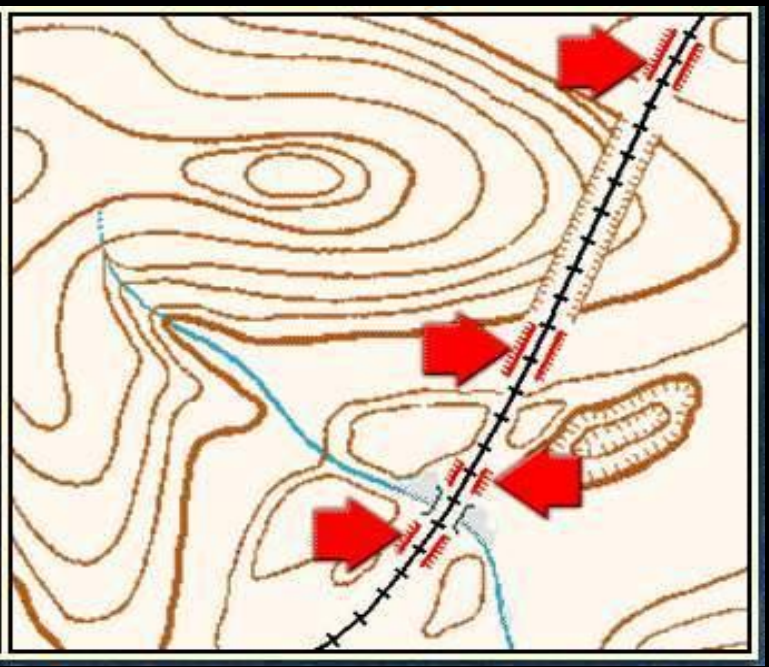


CUT

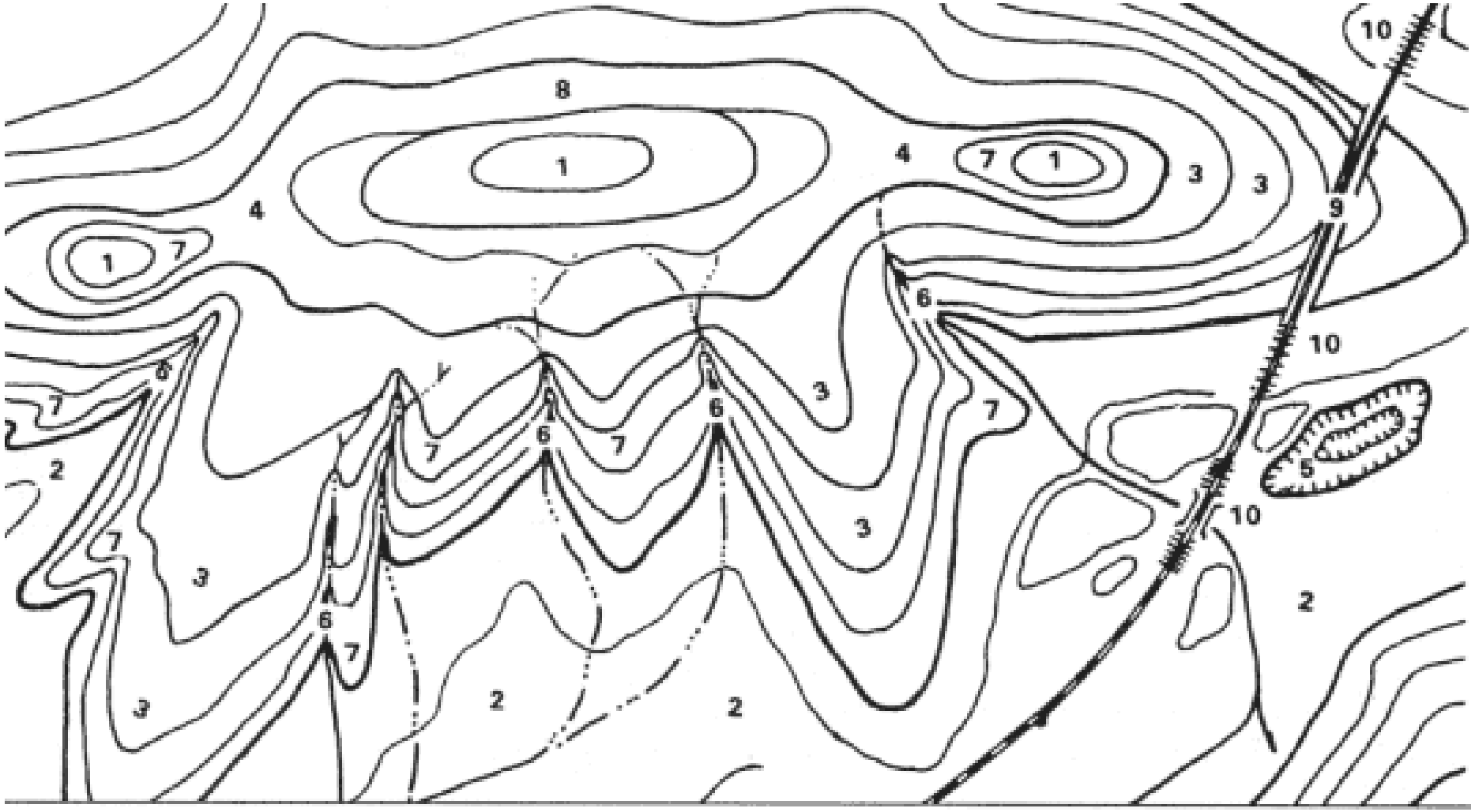




FILL



Terrain Features



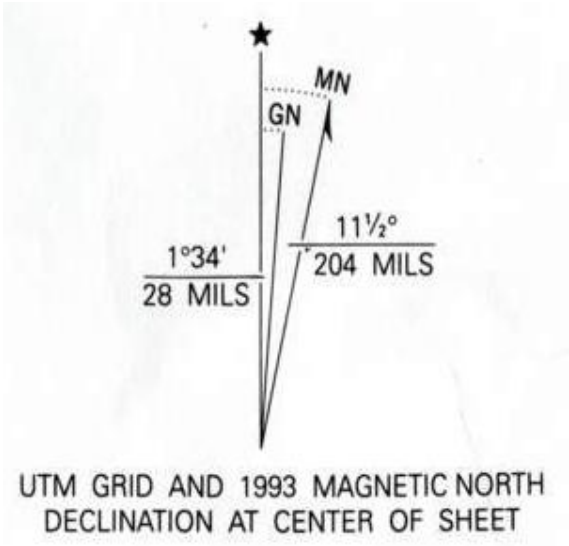
1. HILL
2. VALLEY
3. RIDGE
4. SADDLE
5. DEPRESSION
6. DRAW
7. SPUR
8. CLIFF
9. CUT
10. FILL

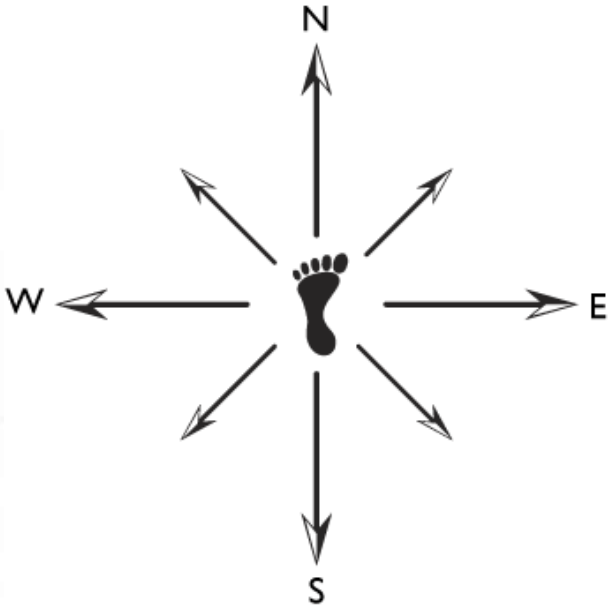
Any Questions?

Map Information – Direction

EXPRESSING DIRECTION

- You need a way of expressing direction that is accurate, is adaptable to any part of the world, and has a common unit of measure. Directions are expressed as units of angular measure and direction implies a reference point.
- The common reference point for maps is True North, and map direction is figured in degrees from that point.
- Azimuths - The direction from one point to another point (either on the map or on the ground) is called an azimuth.
  - Azimuths are given in degrees in a clockwise direction. Since there are 360° in a circle, an azimuth can be any number up to 360°. East is 90°, South is 180°, West is 270°, and North is 360°.
- Maps are laid out with the top toward the top of the earth – True North (geographic north) and map north. The side edges of the map are the only lines on the map guaranteed to run true north-south.
- The many north-south lines on a map give grid north. The compass needle points to magnetic north. Grid north and magnetic north usually have a few degrees difference. Neither points straight at the North Pole; that is called “true north.”
- With compass and map you can know what direction you are heading.





Map Information – Direction

THREE TYPES OF DIRECTION

- **True North.** A line from any point on the earth's surface to the north pole. Is represented by a star.
- **Magnetic North**. The direction to the north magnetic pole, as indicated by the north-seeking needle of a magnetic compass. The magnetic north is usually symbolized by a line ending with half of an arrowhead.
- **Grid North.** The north that is established by using the vertical grid lines on the map. Symbolized by the letters GN. Used for UTM grid by military and rescue teams for its accuracy and simplicity.

G-M ANGLE. The angular difference between GN and MN.

<u>Why do we need to know all this?</u>
So that we can navigate using a **map**, the **ground** (we often forget the ground is important) and **compass**.

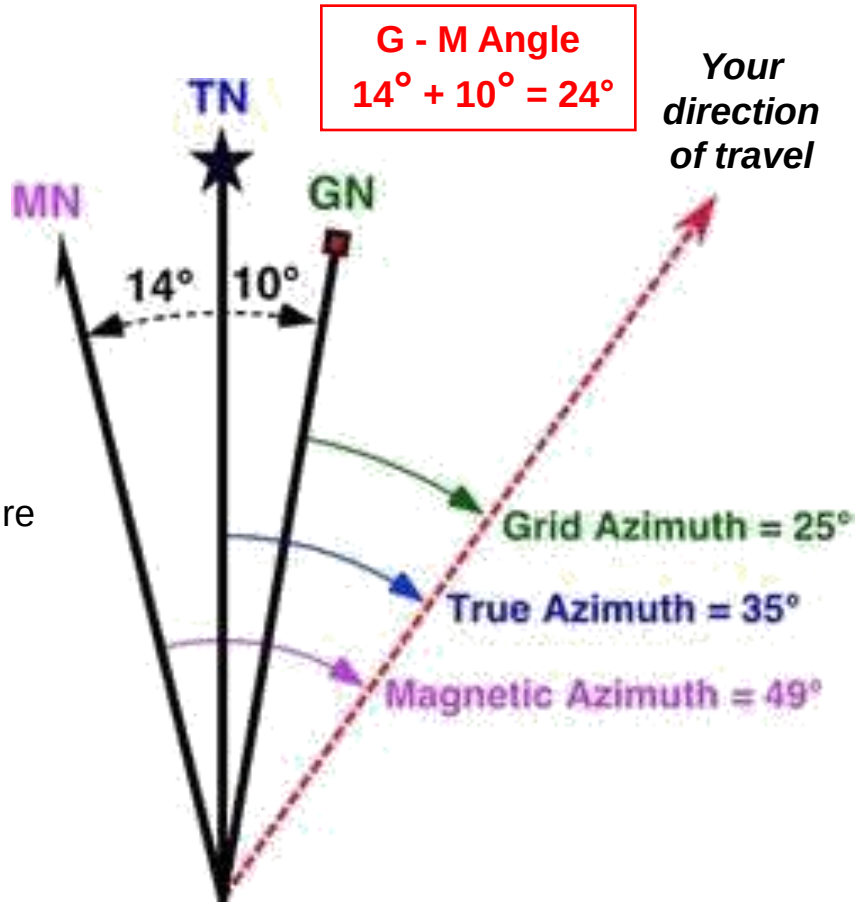
You cannot follow a GN with a compass; nor can you plot a MN with a protractor. To assist you in making the conversion from MN to GN, and vice versa, a declination diagram is placed on the map margin.

<u>Remember the following.</u>
When using a **map** - use a protractor (next slides) to measure **GRID** Bearings. Do not use the compass magnetic needle.
(*unless map has MN Lines – see Part 2 Intermediate Land Nav*)

When using the **ground** – use a **Compass** to Measure **MAGNETIC** Bearings.

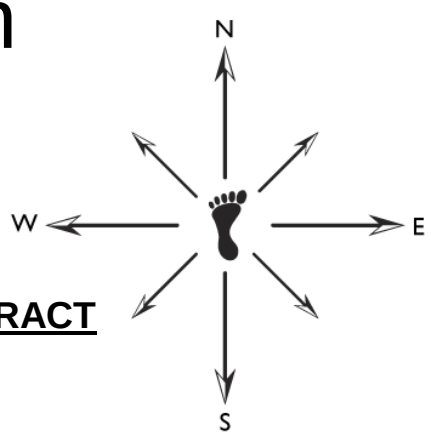
With GN and G-M ANGLE you can find the MN.

With MN and G-M ANGLE you can find the GN.



Map Information – Direction

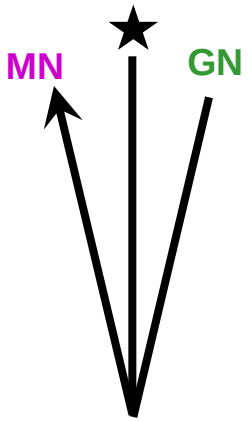
CONVERSION (three ways to remember)

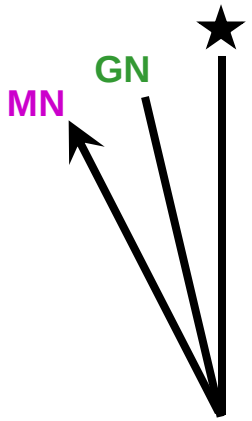


Left to Right → **SUBTRACT**
Right to Left ← **ADD**

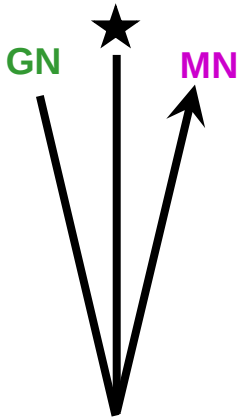
WEST to EAST is least (-) **SUBTRACT**
EAST to WEST is best (+) **ADD**

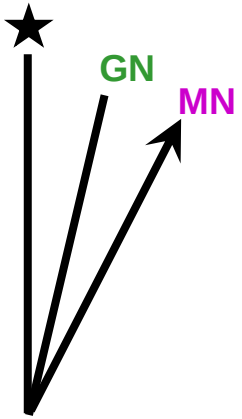
When **MN** is to the west (left) of **GN**
MN to GN **subtract** G-M ANGLE
GN to MN **add** G-M ANGLE





When **MN** is to the east (right) of **GN**
MN to GN **add** G-M ANGLE
GN to MN **subtract** G-M ANGLE



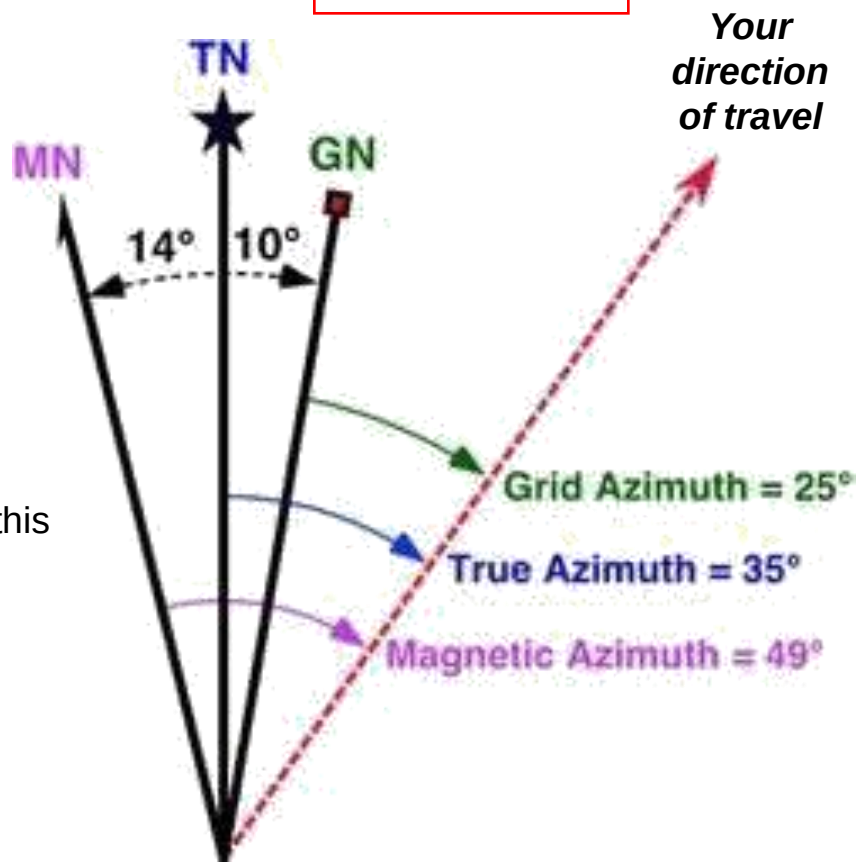


Map Information – Direction

CONVERSION
(example 1)

G - M Angle
14° + 10° = 24°

Left to Right → **SUBTRACT**
Right to Left ← **ADD**



HOW?

*From **ground** to **map**.*

1. You measure the bearing of a landmark on the ground with a compass. It is 49° MN.
2. The G-M ANGLE on the Map is 24°
3. So MN to GN **SUBTRACT** 49° - 24° = 25° GN (Draw this on your map)

*From **map** to **ground**.*

1. You measure the bearing of a point on the map with a protractor (next slides). It is 25° GN.
2. The G-M ANGLE on the Map is 24°
3. So GN to MN **ADD** 25° + 24° = 49° MN (Put this on your compass)

Map Information – Direction

CONVERSION
(example 2)

Left to Right → **SUBTRACT**
Right to Left ← **ADD**

G - M Angle
14° - 5° = 9°

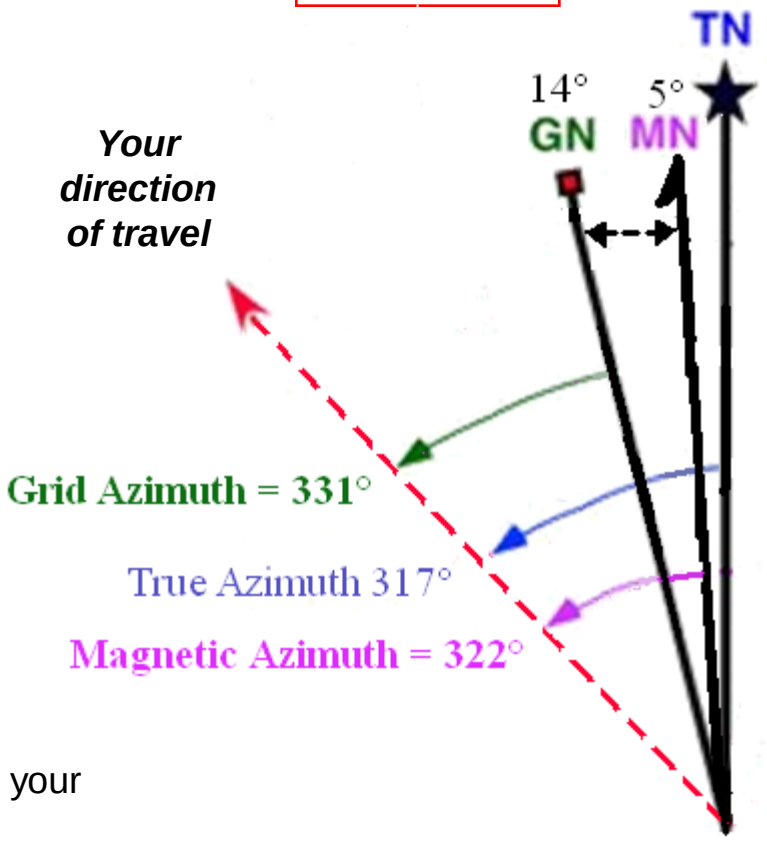
HOW?

*From **ground** to **map**.*

1. You measure the bearing of a landmark on the ground with a compass. It is **322°** MN.
2. The G-M ANGLE on the Map is **9°**
3. So MN to GN **ADD** **322°** + **9°** = **331°** GN (Draw this on your map)

*From **map** to **ground**.*

1. You measure the bearing of a point on the map with a protractor (next slides). It is **331°** GN.
2. The G-M ANGLE on the Map is **9°**
3. So GN to MN **SUBTRACT** **331°** - **9°** = **322°** MN (Put this on your compass)



Any Questions?

Map Information – Direction

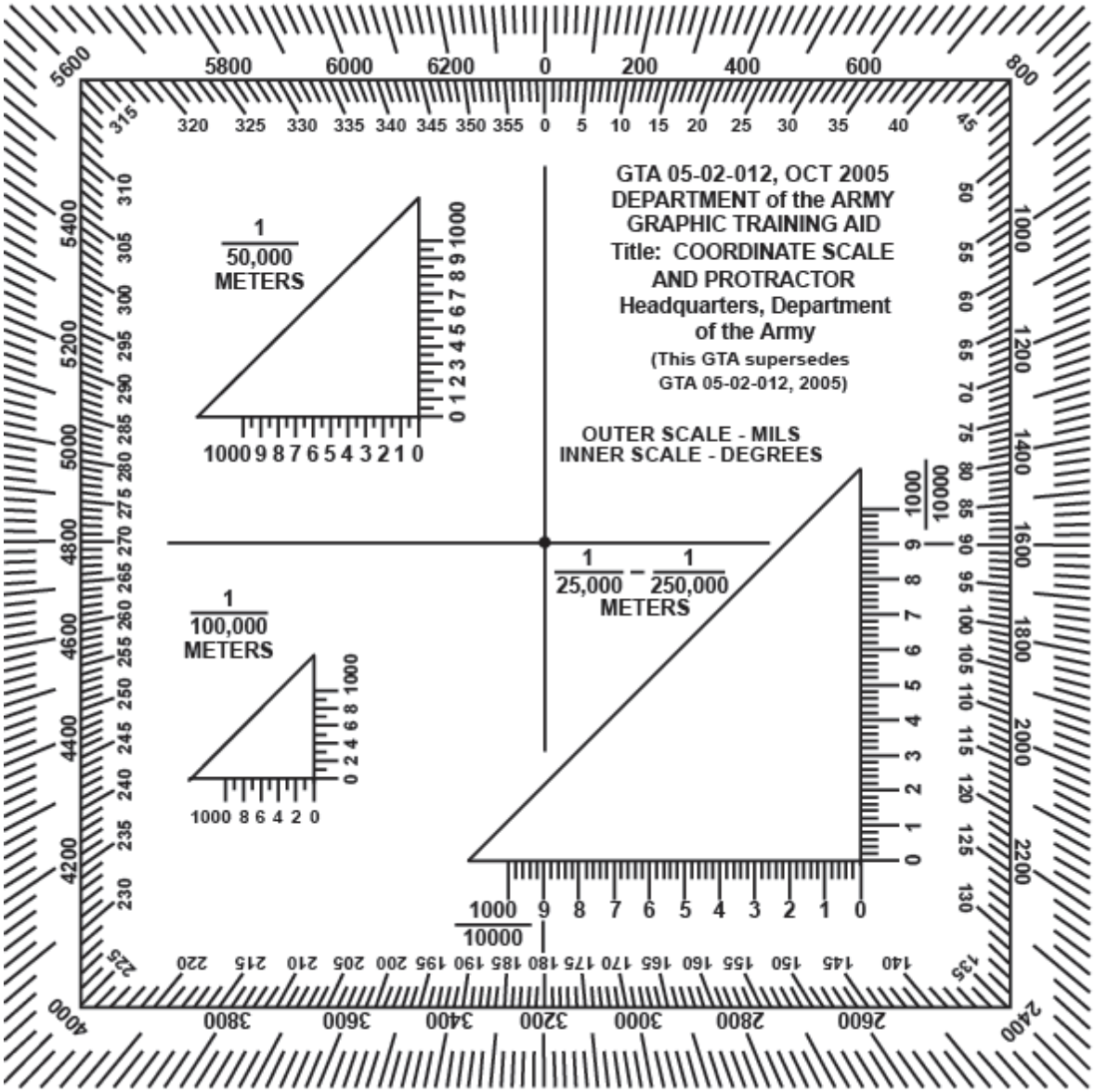
PROTRACTOR

1. With a protractor the map does NOT have to be oriented.
2. It is used to calculate direction from **map** to **ground** (**compass**) by converting the protractor GN to a MN for the compass.
3. It is used for –
   - Plotting azimuths
   - Plotting position
   - Plotting UTM coordinates

NOTE

If you have MN LINES drawn on the map, you can align the protractor to a MN LINE, get the MN azimuth on the protractor and you DO NOT have to do any MN conversions.

(see Part 2 Intermediate Land Nav)



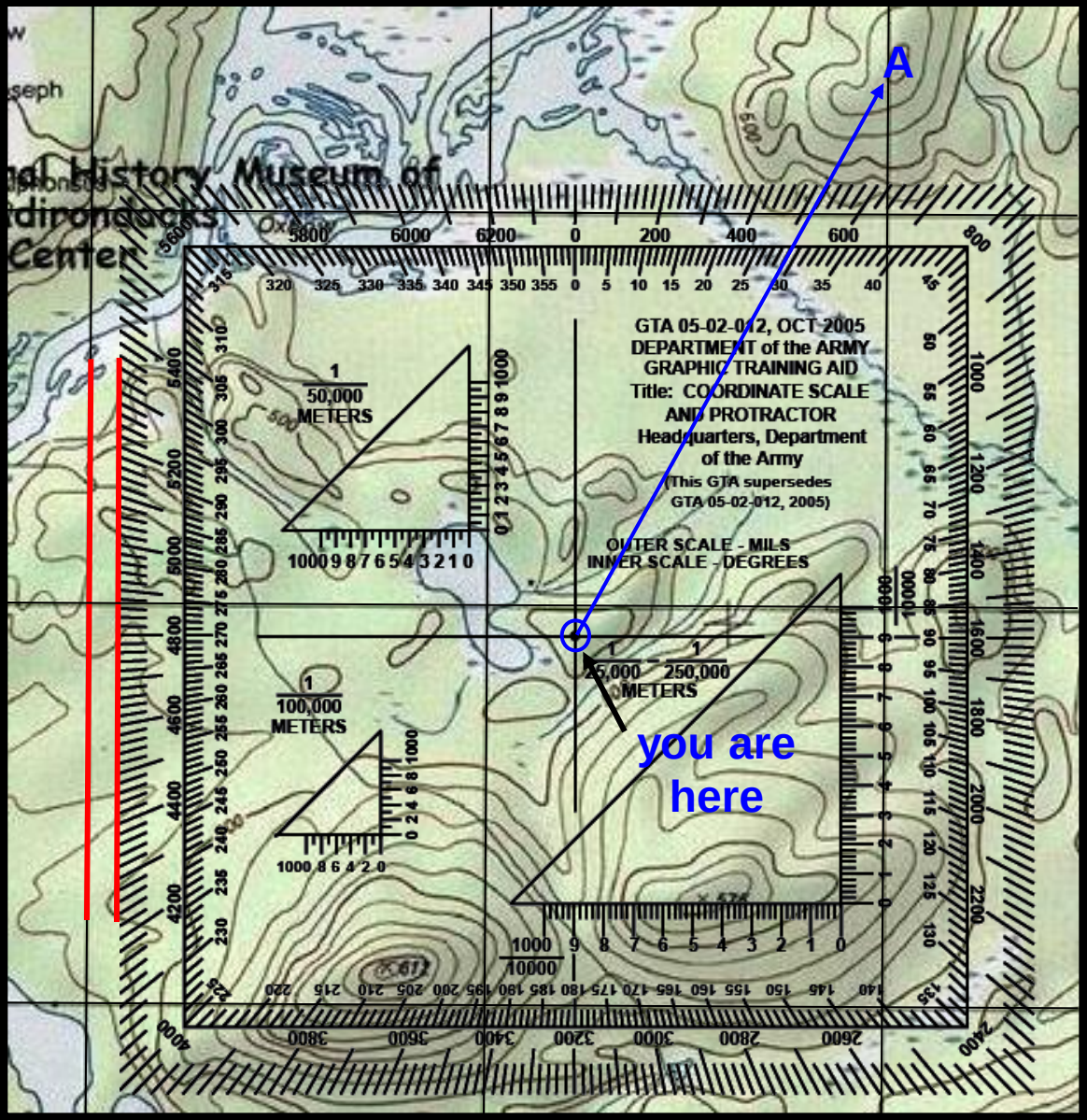
Map Information – Direction

PROTRACTOR (with a protractor the map does NOT have to be oriented)

From **map** to **ground**.

1. You are in thick woods and cannot see any landmarks. But you decide to go to a hill (**A**) on the map.
2. With protractor aligned with GRID LINES drawn on the map and the center of the protractor aligned on your map position (**you are here**).
3. You see that the azimuth is **29°** or **520** MILS. *Next page for closer view*
4. Convert this to MN azimuth and put this on your compass.

NOTE
If you have MN LINES drawn on the map, align the protractor to a MN LINE, get the MN azimuth and you DON'T have to do MN conversions. *(See PART 2 Intermediate Land Navigation)*



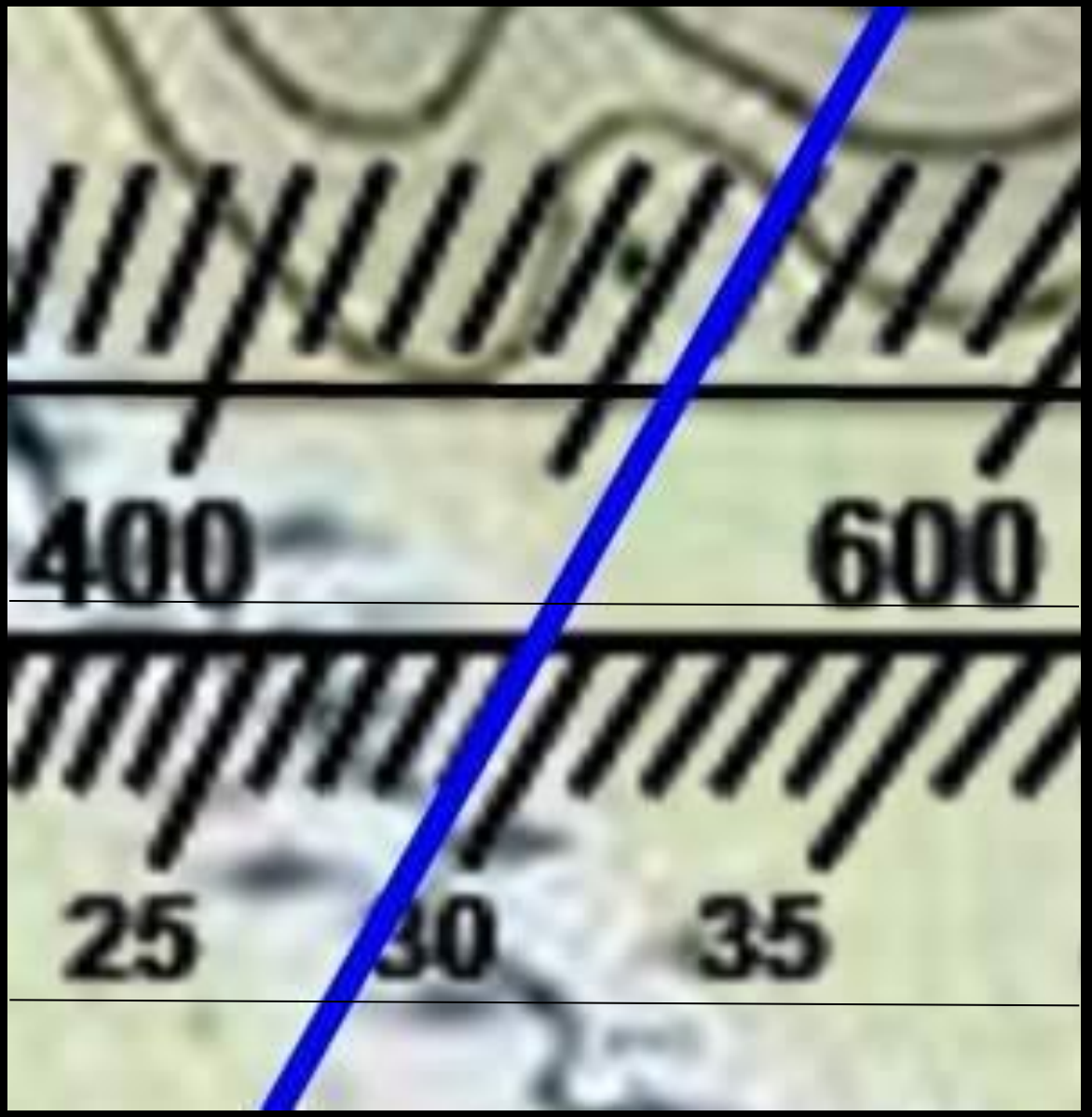
Map Information – Direction

PROTRACTOR (with a protractor the map does NOT have to be oriented)

From **map** to **ground**.

1. You are in thick woods and cannot see any landmarks. But you decide to go to a hill (**A**) on the map.
2. With protractor aligned with GRID LINES drawn on the map and the center of the protractor aligned on your map position (**you are here**).
3. You see that the azimuth is **29°** or **520** MILS. *See previous page*
4. Convert this to MN azimuth and put this on your compass.

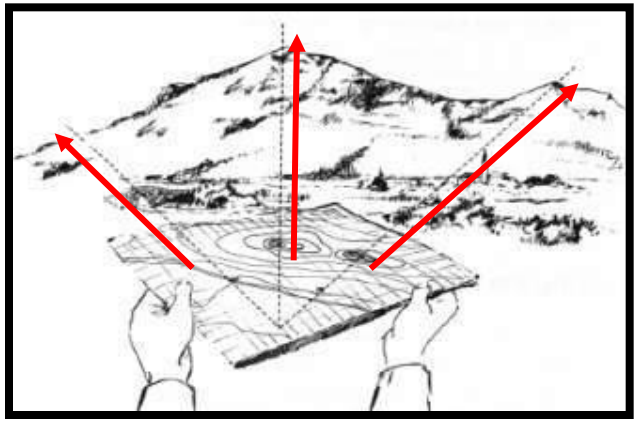
NOTE
If you have MN LINES drawn on the map, align the protractor to a MN LINE, get the MN azimuth and you DON'T have to do MN conversions. *(See PART 2 Intermediate Land Navigation)*



Any Questions?

Map Information - Direction

Orienting the Map with the Landscape (MN and True North)



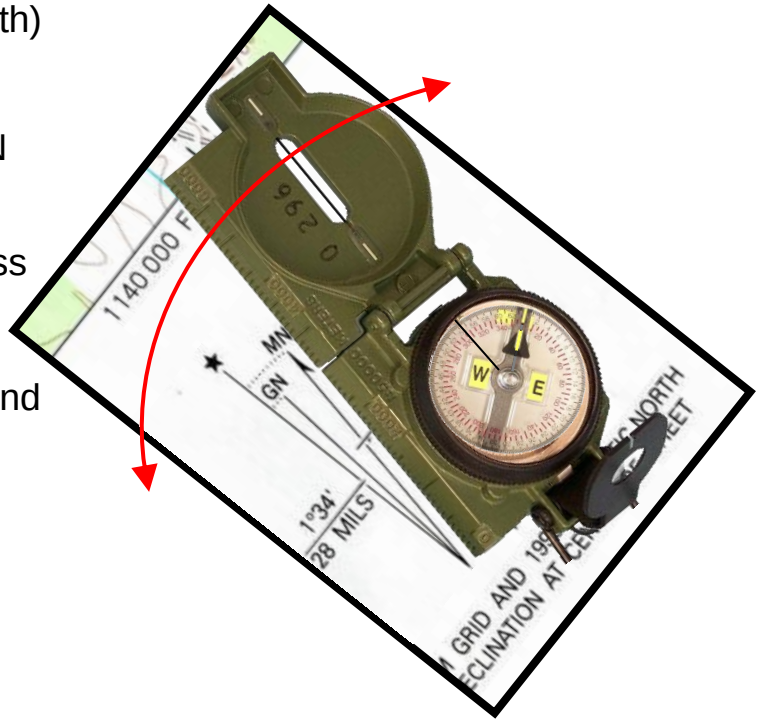
TECHNIQUE # 1 (True North)

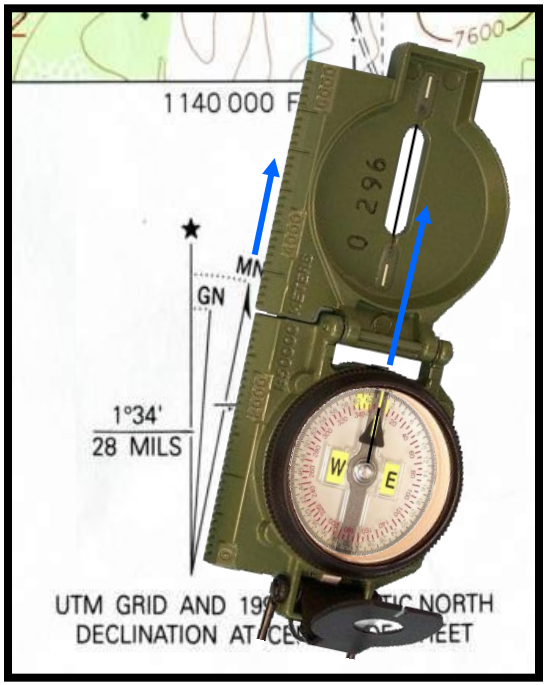
1. Identify several landmarks on the map and on the terrain.
2. Visually orient the map landmarks with the terrain landmarks.
3. The map is oriented to True North.

TECHNIQUE # 2 (Magnetic North)

With compass & map:

1. Lay the compass on the MN line on the map.
2. **Rotate** the map and compass together until the compass bearing reads 0° degrees Magnetic North (compass and MN line on the map are **aligned** / **parallel**).
3. The map is oriented to MN.





Map Information - Direction

Orienting the Map with the Landscape (True North)

TECHNIQUE # 3

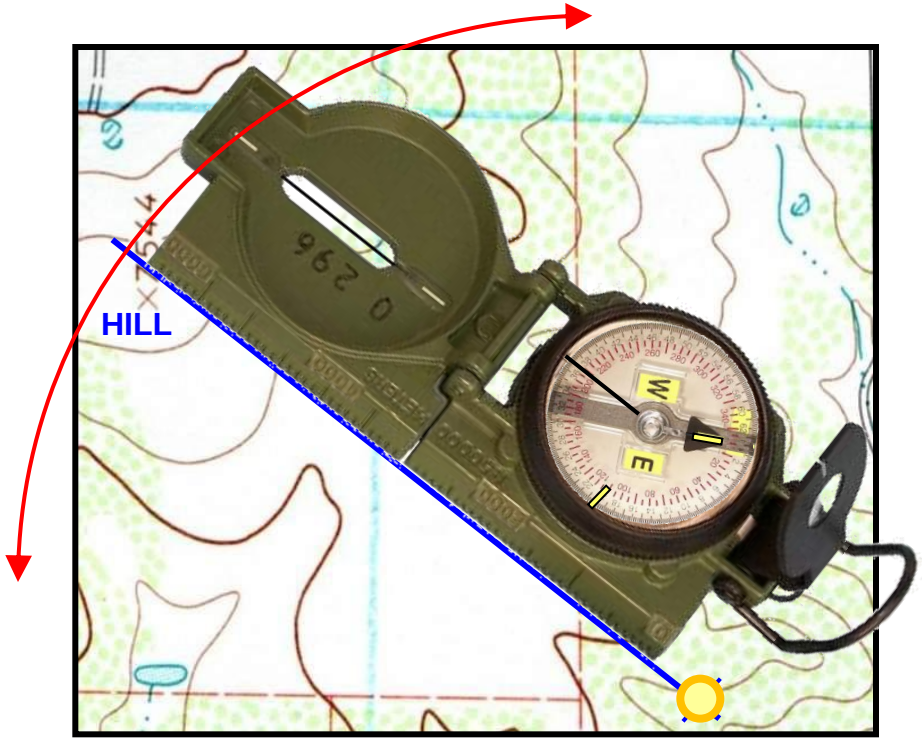
1. Find Magnetic Declination value in the map margin (bottom left corner), example **East 11.5°**.
2. Place compass edge on edge of map North/South line with front of compass facing top of map.
3. **Rotate** map and compass together until **North Arrow** is **11.5° east** of **Black Index Line**.
   Note: **Black Index Line** is aligned with **348.5°**(360° – 11.5° = 348.5°), map is oriented to TRUE NORTH.

Map Information - Direction

Orienting the Map with the Landscape (Magnetic North)

TECHNIQUE # 4 – ***when your position on the map is known***.

1. Select a terrain feature on the ground that you can find on the map, example the **HILL**.
2. With the compass, sight the azimuth to the **HILL(295 °)** from your **position** ( ).
3. Align the compass edge through the **HILL** and your **position** ( ).
4. **Rotate** map and compass together until **295°** is aligned with the **Black Index Line**. Map is oriented MN.



Any Questions?

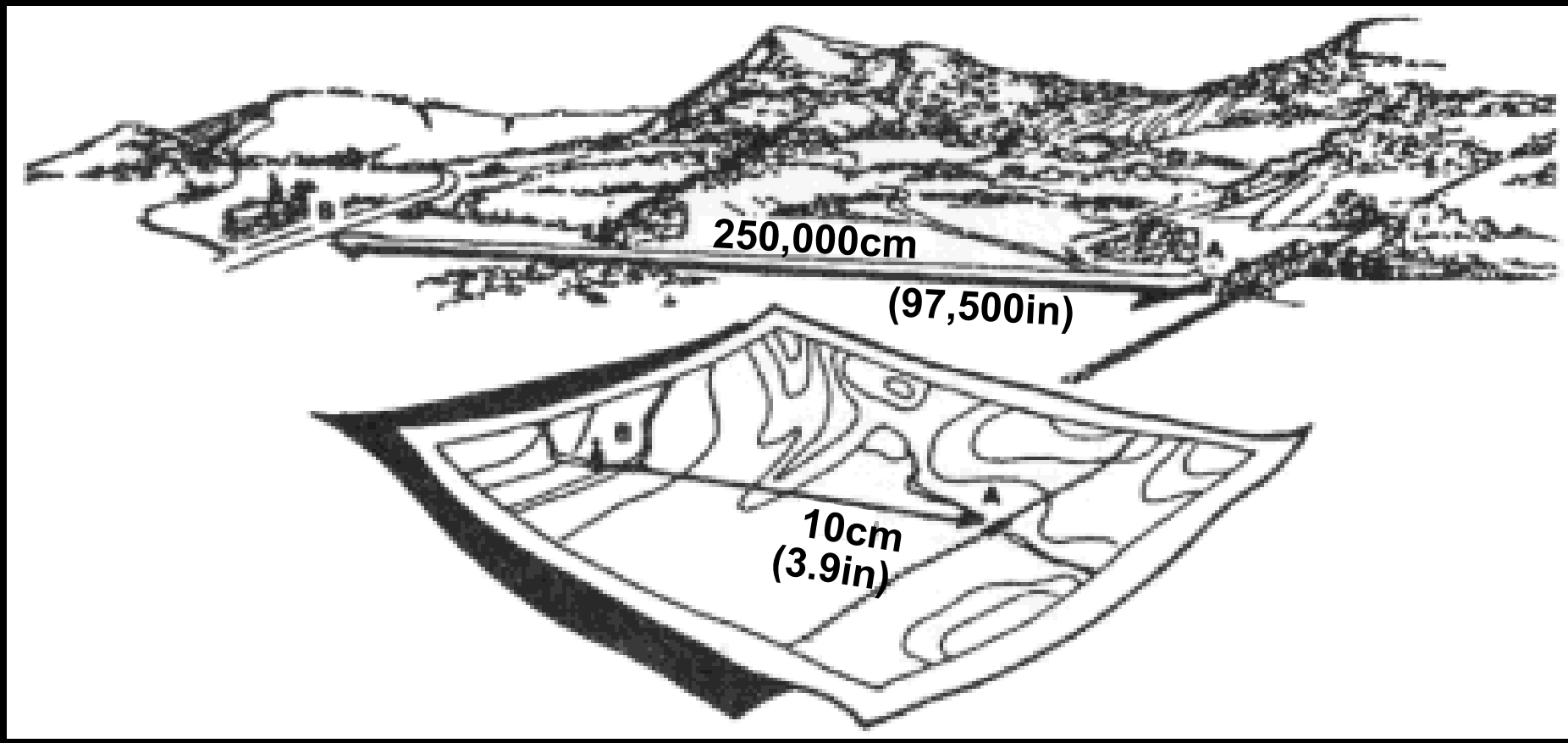
Map Information - Distance

- The relationship between map and ground distance is the function of the bar scale.
- The bar scale looks like a small ruler and usually has 3 to 4 bar scales; feet, miles, meters, and kilometers.
- The ability to determine distance on a map, as well as on the earth's surface, is an important factor in planning and executing safe, practical routes.
- The map scale of 1:xx,xxx means that one unit of measure on the map is equal to xx,xxx units of the same measure on the ground.
  - Example
    - A map scale of 1:25,000 means that one unit of measure on the map is equal to 25,000 units of the same measure on the ground.
      - On map 1 inch = 25,000 inches (2083 feet, 694 yards) on the ground.
      - On map 1 cm = 25,000 cm (250 meters, ¼ kilometer) on the ground.
    - A map scale of 1:100,000 means that one unit of measure on the map is equal to 100,000 units of the same measure on the ground.
      - On map 1 inch = 100,000 inches (8333 feet, 2778 yards, 1¾ miles) on the ground.
      - On map 1 cm = 100,000 cm (1000 meters, 1 kilometer) on the ground.
    - A map scale of 1:500,000 means that one unit of measure on the map is equal to 500,000 units of the same measure on the ground.
      - On map 1 inch = 500,000 inches (41667 feet, 13889 yards, 8 miles) on the ground.
      - On map 1 cm = 500,000 cm (5000 meters, 5 kilometer) on the ground.

Map Information - Distance

- EXAMPLE - a map scale of 1:25,000 means that one unit of measure on the map is equal to 25,000 units of the same measure on the ground.
  - On map 1 inch = 25,000 inches (2083 feet, 694 yards) on the ground.
  - On map 1 cm = 25,000 cm (250 meters, ¼ kilometer) on the ground.
- Example below shows the navigator using centimeters (cm) as a measurement, therefore the map 10cm measurement is equal to 250,000cm on the ground. (3.9 inches map = 97,500 inches ground)

10cm x 25,000 = 250,000cm (2.5 Km) 3.9in x 25,000 = 97,500in (1.5 miles)



Map Information - Position

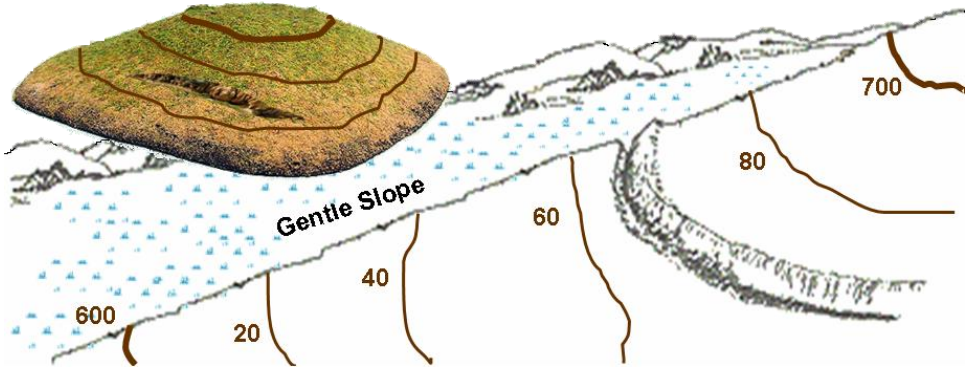
- Finding one's position on a map in the usual sense, such as at the intersection of two compass bearings, is more a matter of compass technique than of map reading skills. . . BUT . . .
- It is possible to locate your **POSITION** on a map without a compass, by land feature and map association.
- It is **IMPOSSIBLE TO BE TOTALLY LOST**. Finding your location is a process of narrowing down the options until you can determine a point on a map.
  - By determining the lay of the land and finding prominent features, then relating them to your map, the narrowing-down process will not take long.
  - Landmarks can be anything that you recognize as being on the map. Classically these are hill tops, but you can use the intersection of two roads, a building such as a power grid sub-station, the abrupt edge of a ridge, the edge of an island, the bend in a trail, anything that you can recognize as being on the map and that you can see.
- There is a second dimension to establishing position which does depend on map reading skills. This is the vertical dimension. On a map it is referred to as "relief".
  - Knowledge of the relief of an area is extremely important to a wilderness navigator.
  - The most graphic technique ever devised to show relief information is the contour line.
  - If you were to walk a contour line you would never go down hill and never up hill, and eventually you would arrive back where you started.
- **Navigation is not about finding yourself after you are lost (although that's what happens sometimes); navigation is about keeping track of your POSITION as you move away from a known point. As you move you have to remain cognizant of the terrain you are leaving, of the terrain you are passing, and of the terrain that is coming up.**

Map Information - Identification

- The identification of significant features, both natural and man-made, is partly a matter of knowing the language of maps.
  - One category of map language is lines. In addition to showing contour relief, lines are used to portray roads, trails, railroads, power lines, and drainage features.
  - Another category of map language is composed of various picture symbols.
  - A third part of map language is color.

- If part of identification is in knowing the language of maps, the rest is a problem of interpretation. What is the relationship among certain lines, symbols, and colors?

- Reading contour lines is literally reading between the lines. ***Contour lines represent the shape of the terrain only at specified intervals***. The user must be aware that what lies between may be quite different. There could be rugged terrain, vertical bluffs, or deep ravines that might not be shown.



- A river may be drawn some what straight on a map, but the terrains actual river meanders, with many curves, turns, and with wide and narrow banks.

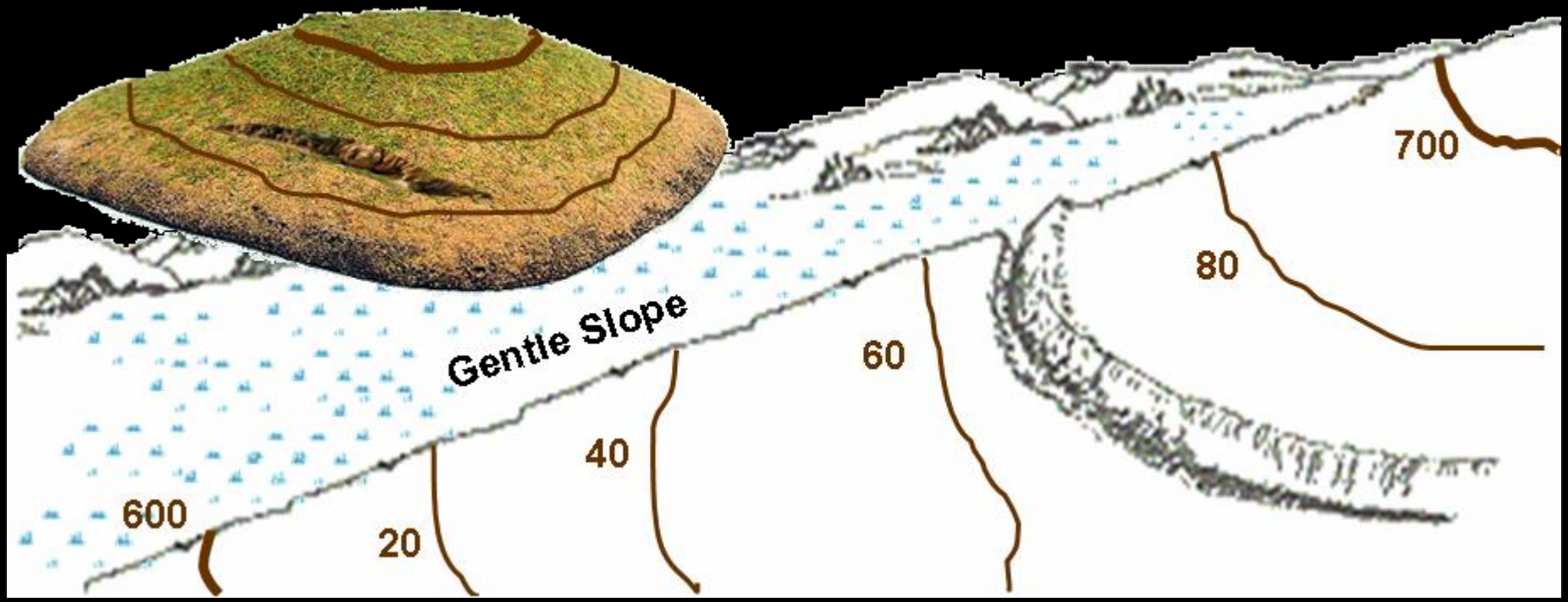
- What a topographic map shows is as accurate as possible, BUT can give you a false sense of what you might mentally think what is ahead of you and what actually is shown on an aerial photo map and actual land features. (see next slides)

Map Information - Identification

CONTOUR LINES

Contour Lines on a map
Do not show everything.

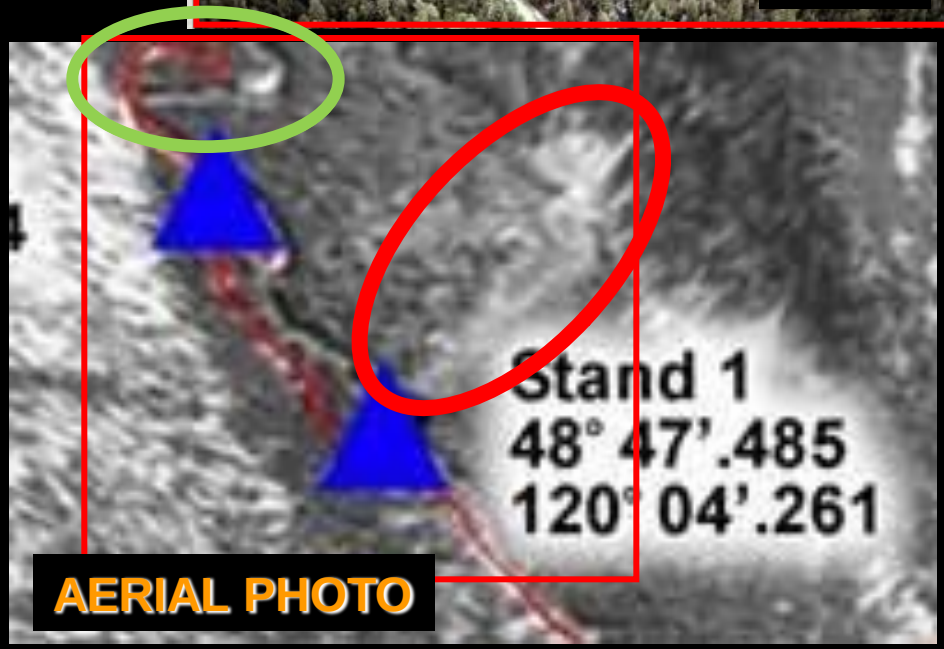
Scan the Landscape,
read between the lines.

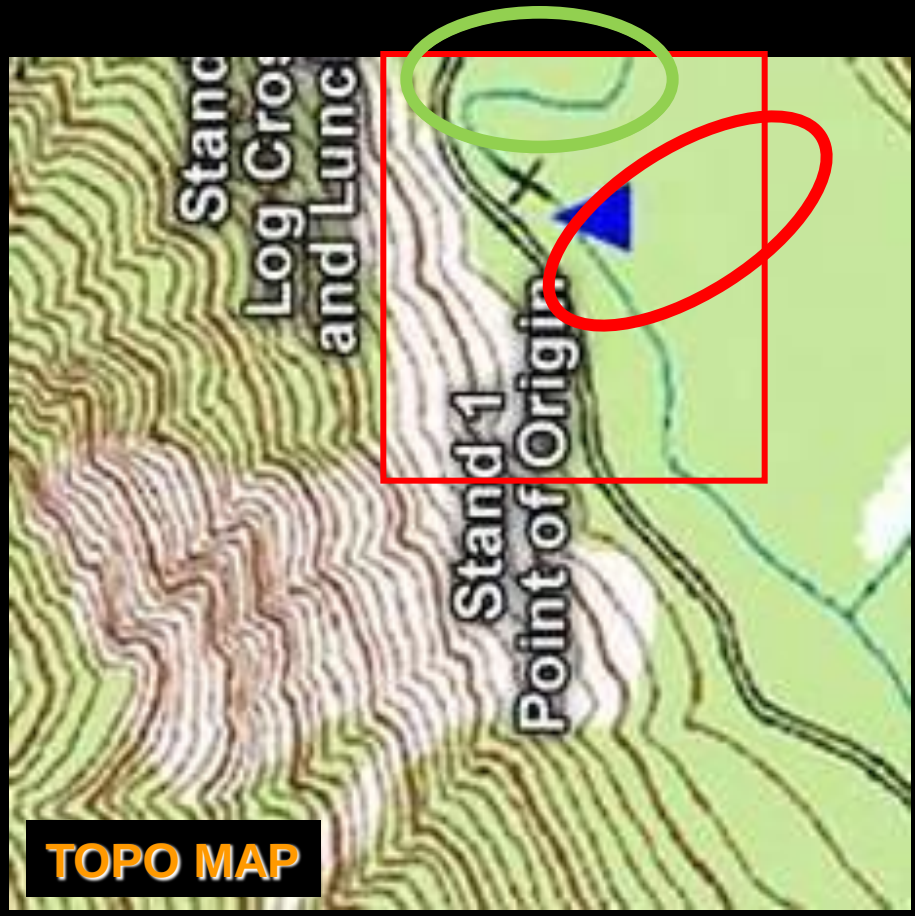


Any Questions?

Map Information – Identification

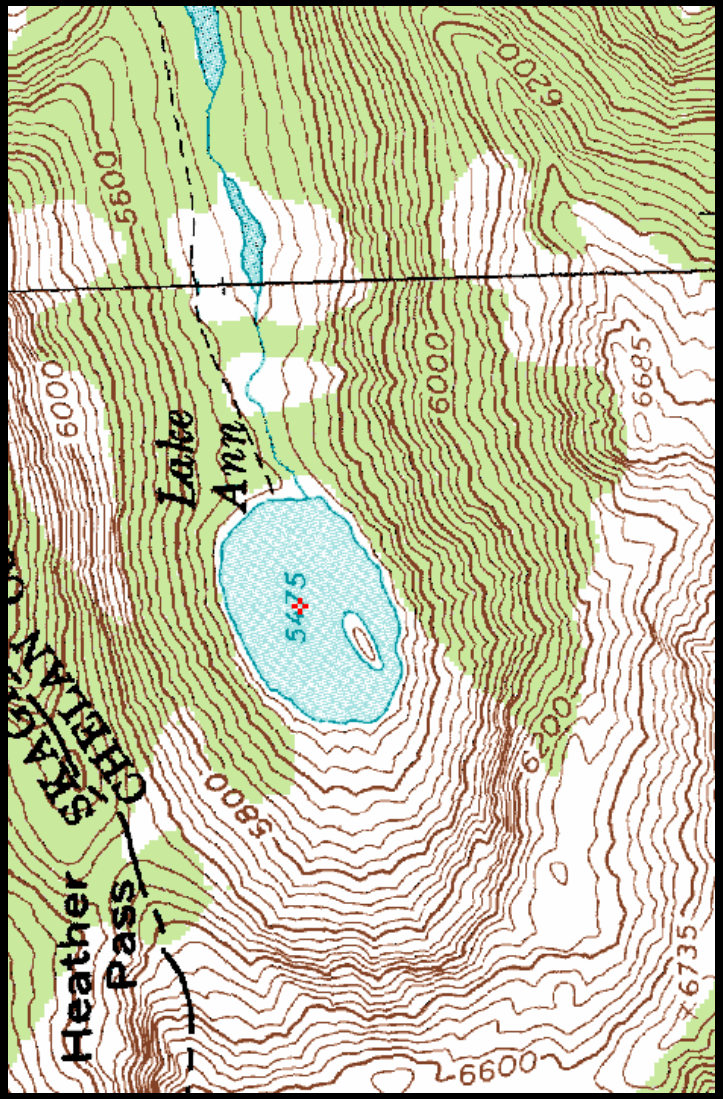
What a Topo map,
Aerophoto map,
And actual Land features show





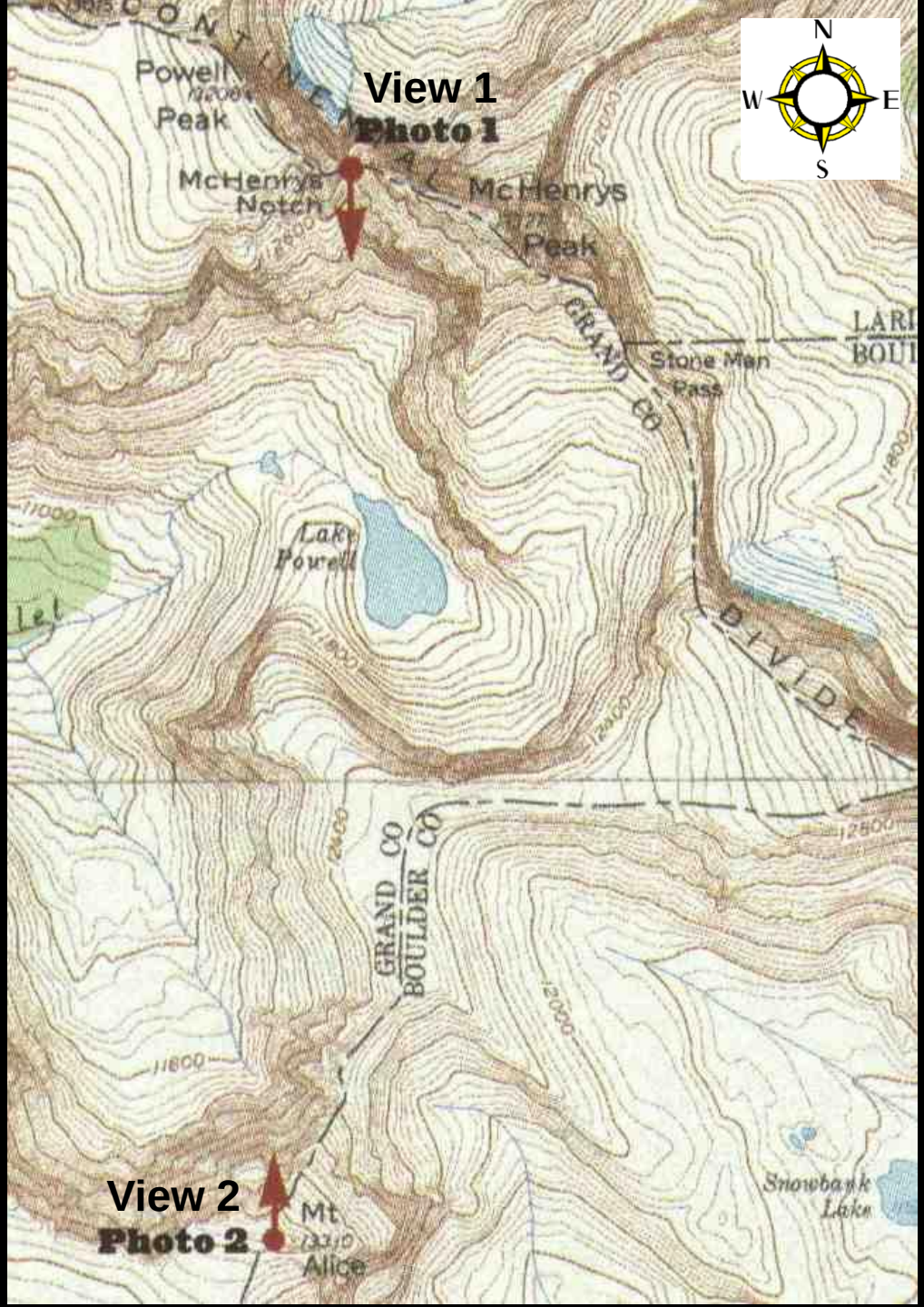
Map Information – Identification

What a Topo map
and actual Land features show



Map Information – Identification

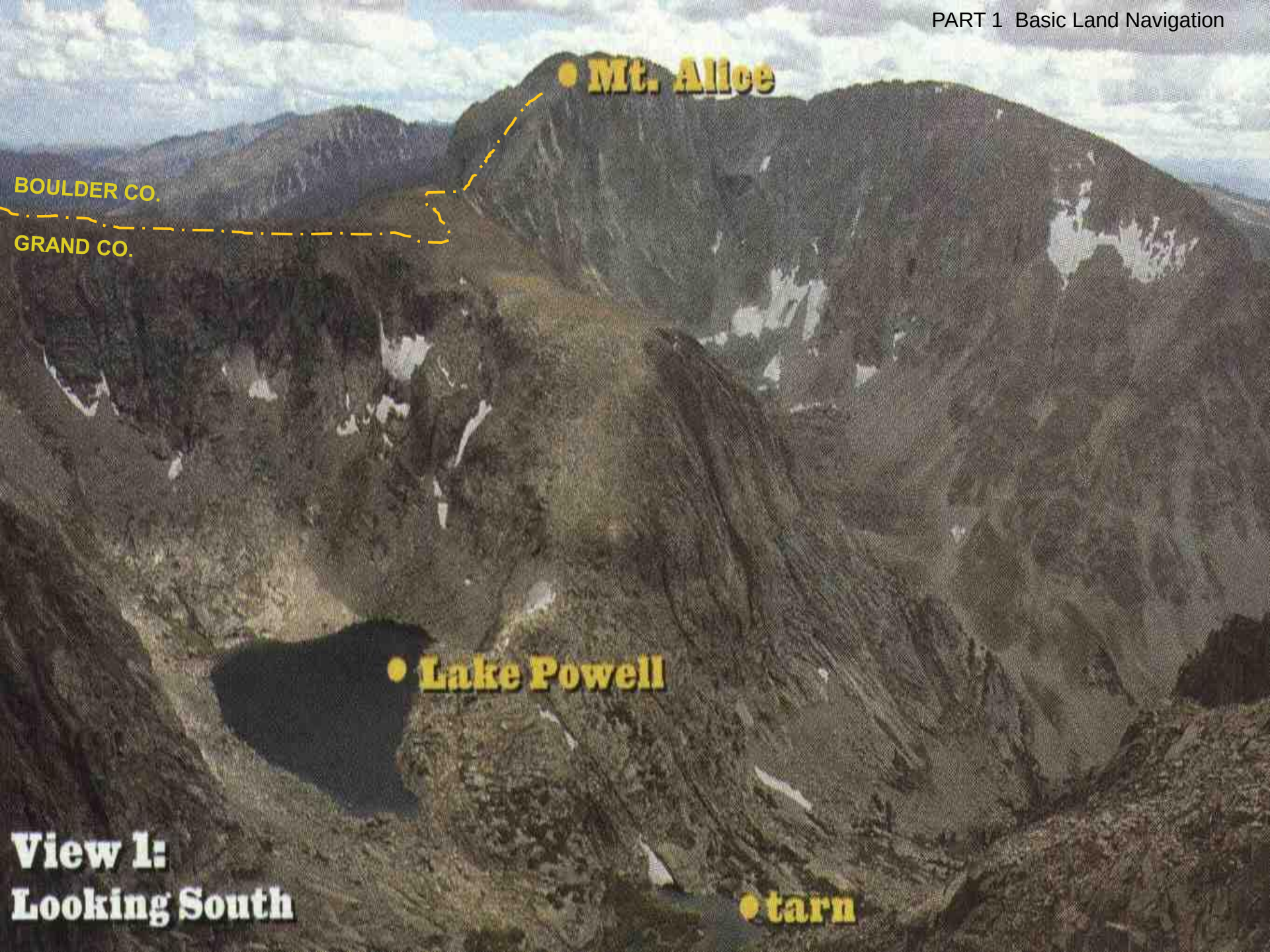
What a Topo map
and actual Land features show

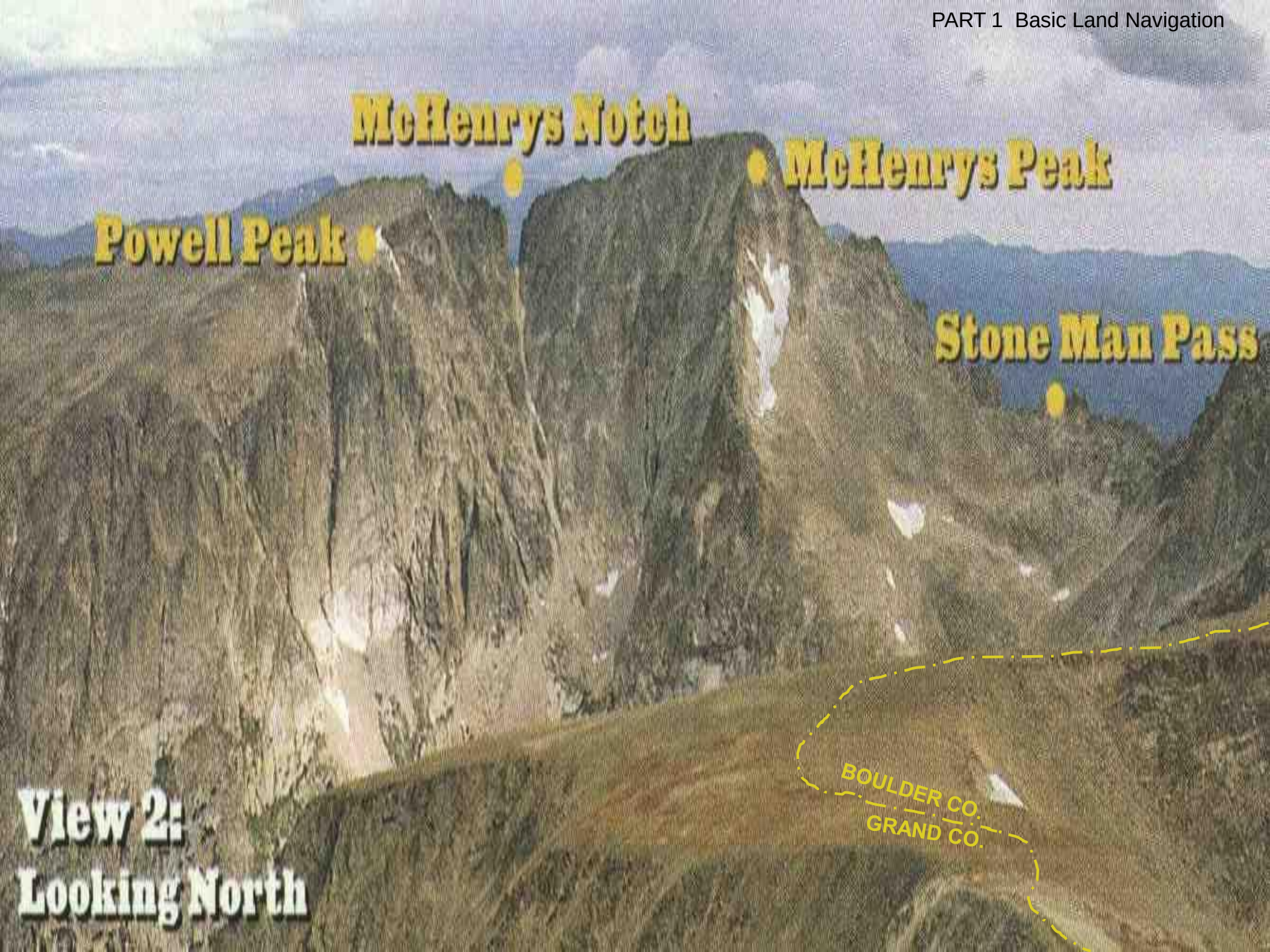


Map Information – Identification

What a Topo map
and actual Land features show

Compare the next five slides with this map, to get view point perspective of what you see on this map and what you see on the landscape in front of you.


Mt. Alice
BOULDER CO.
GRAND CO.
Lake Powell
tarn
View 1:
Looking South

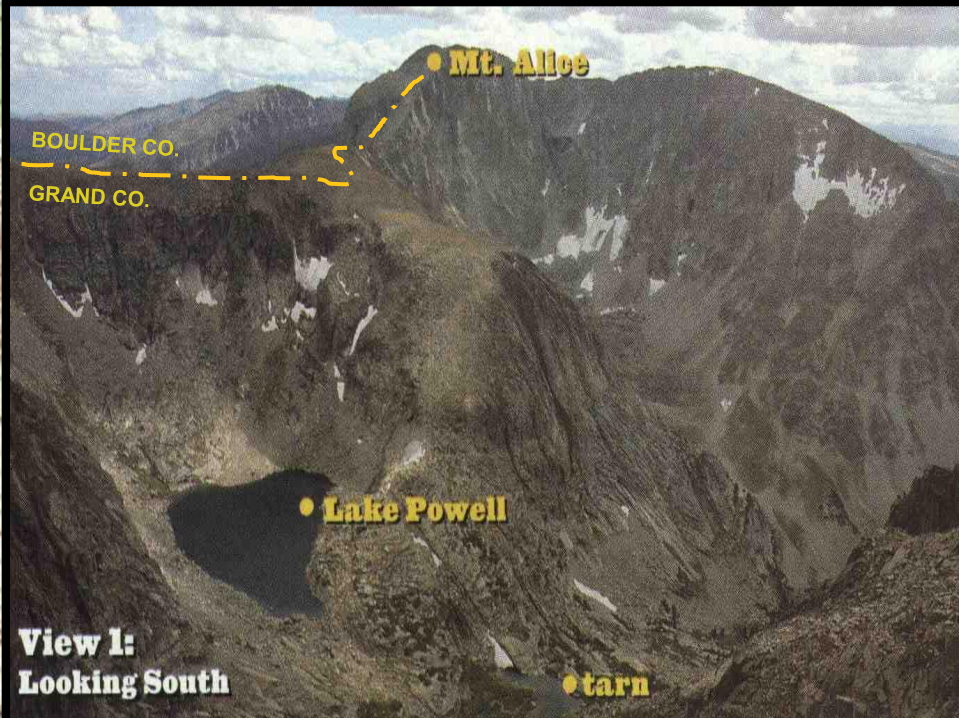

McHenrys Notch
McHenrys Peak
Powell Peak
Stone Man Pass
BOULDER CO.
GRAND CO.
View 2:
Looking North

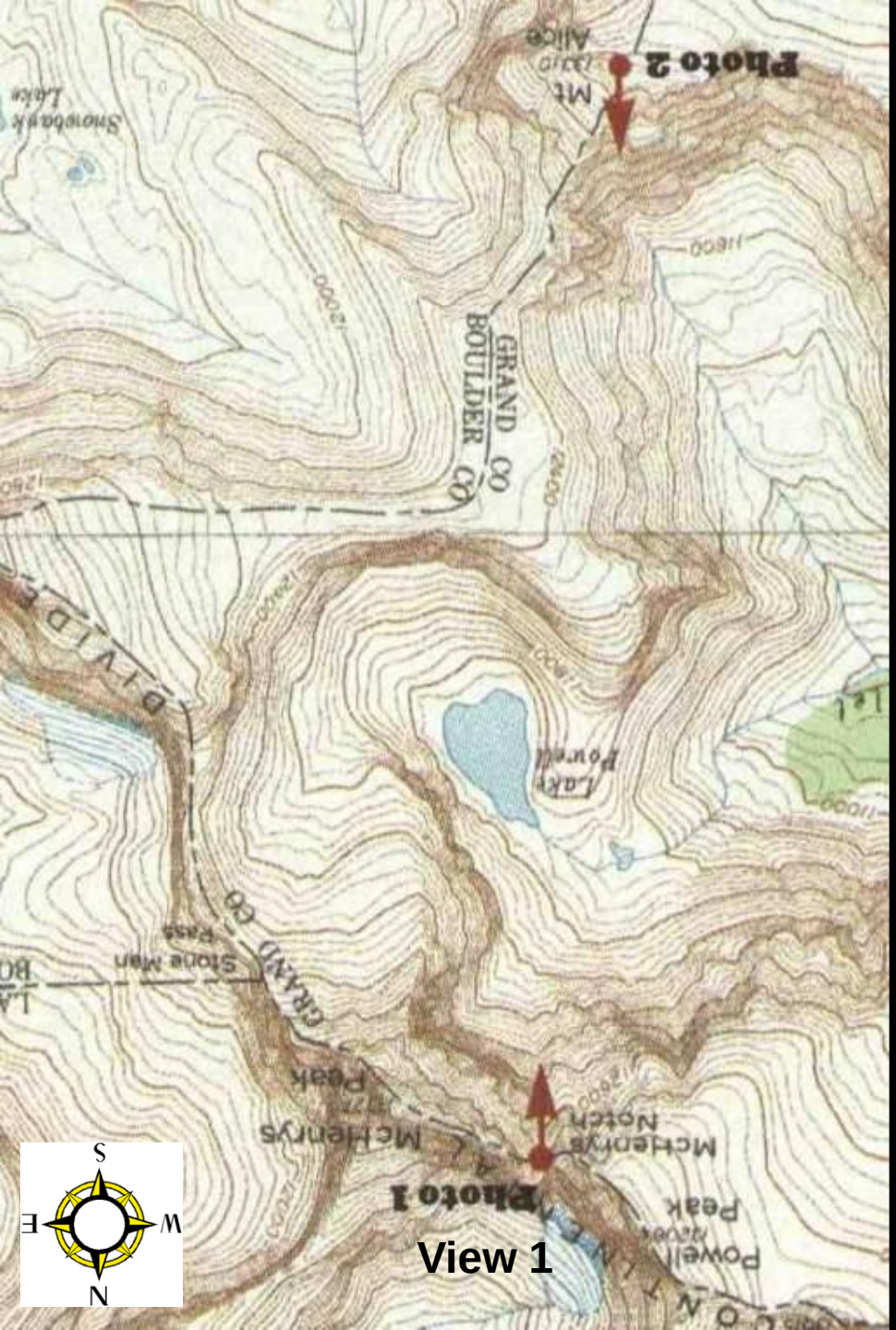
Map Information – Identification

What a Topo map
and actual Land features show

Note: here the map is turned upside down so you can get a better perspective

View 1





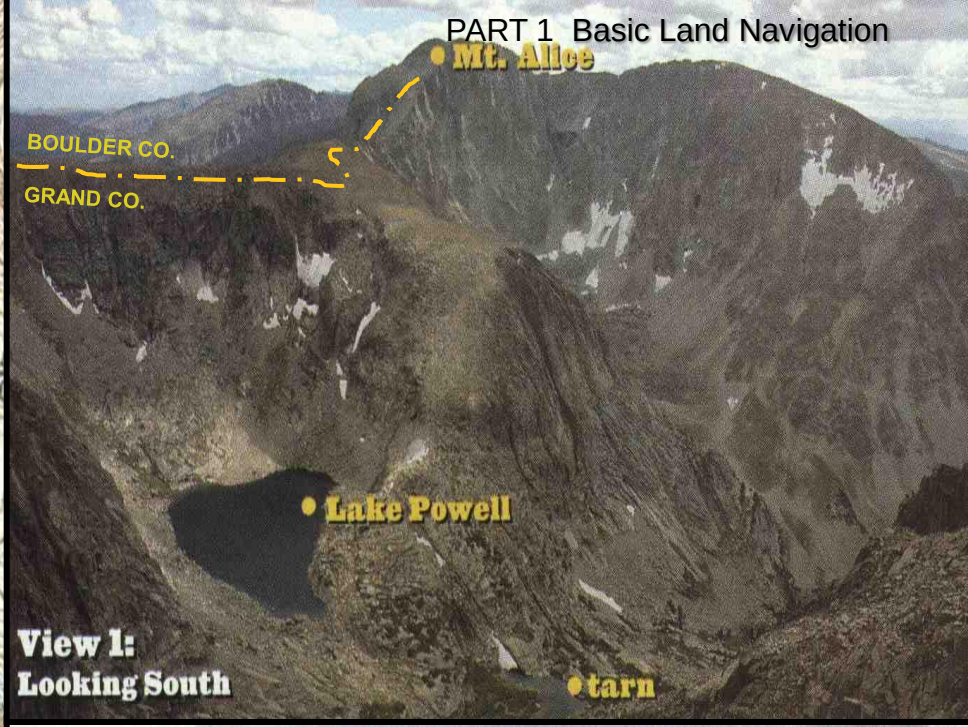
View 1

Map Information – Identification

What a Topo map
and actual Land features show

View 2


View 1
Photo 1
View 2
Photo 2
N
W
E
S
Powell Peak
McHenrys Notch
McHenrys Peak
Stone Man Pass
Lake Powell
GRAND CO
BOULDER CO
DIVIDE
Mt Alice


Mt. Alice
BOULDER CO.
GRAND CO.
Lake Powell
tarn
View 1:
Looking South


McHenrys Notch
McHenrys Peak
Powell Peak
Stone Man Pass
BOULDER CO.
GRAND CO.
View 2:
Looking North

Any Questions?

Map Folding and Map Care

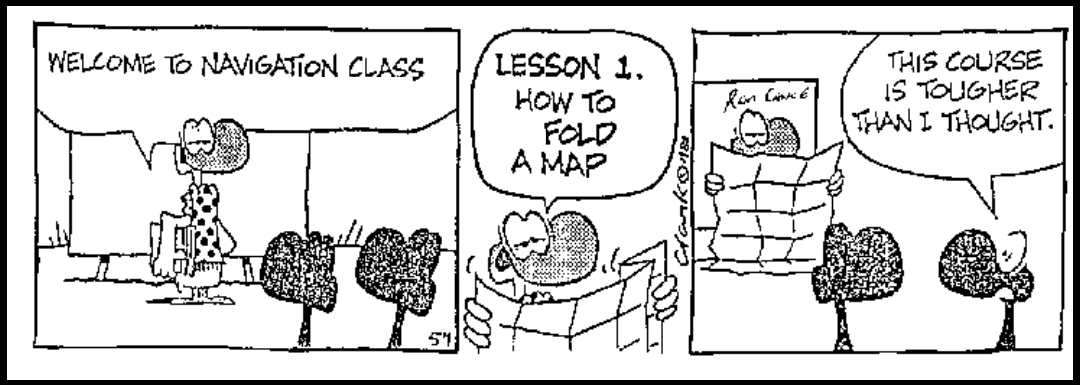
- Maps should be correctly folded.
  - Maps should be folded to make them small enough to be carried and still be available for use without having to unfold them entirely.
  - After a map has been folded it should be placed in a folder for protection. This will prevent the corners and edges of the map from wearing out and tearing easily when opened.

- It is hard to navigate accurately with a dirty, grimy, wet or damaged map. Take care of your map and it will take care of you.
  - Most maps are printed on paper and require protection from water, mud, weather, and tearing.
  - Whenever possible, a map should be carried in a waterproof packet to prolong its life.
  - Waterproofing maps.

All members of the group should know the map's location at all times.

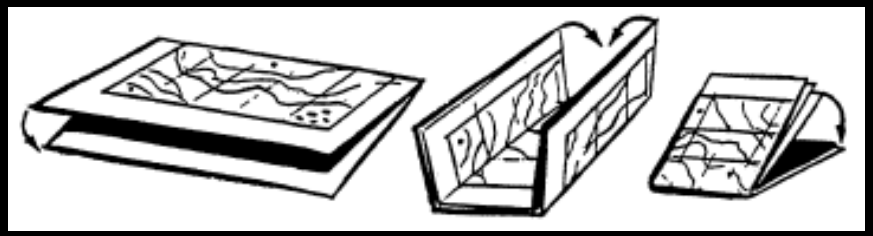
- Marking a map.
  - If it is necessary to mark a map, use light lines so that they may be erased without smearing or smudging. If the margins of the map must be trimmed note any marginal information which may be needed, such as grid data or magnetic declination data, on the back of the map.

- Special care should be taken of a map that is being used in any situation, especially in a small group; the mission may depend on that map.

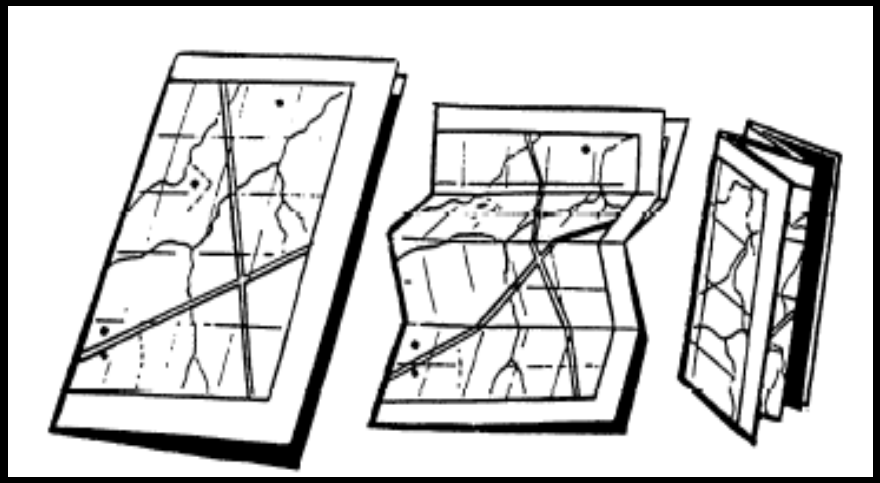


Map Folding

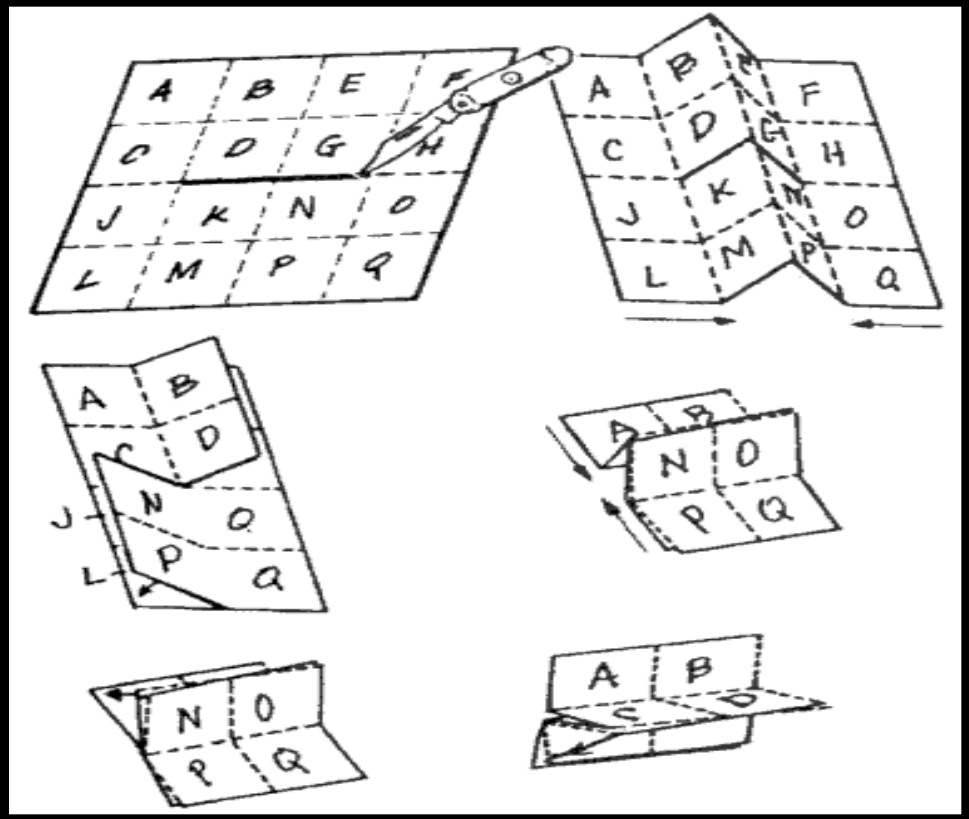
Technique # 1



Technique # 2



Technique # 3



Any Questions?

Note:

Prior to being issued any training *equipment, you will be required to sign a "statement of liability" agreeing to pay for anything you damage or lose.

All items will be inspected and inventoried prior to your signature and at the end of the training day too.

If you do not intend to sign this statement, then you may be denied training.

* **You may use your own equipment.**

TESTING

Now it is time for the following . . .

- Written exam
- Hands-on / Outdoors exam

THE END OF
LAND NAVIGATION
PRESENTATION
PART 1