TRUE AND APPARENT DIP

CONTENT

1. Dipping Strata

2. Determination of Dip

   ✓ True dip

   ✓ Apparent Dip

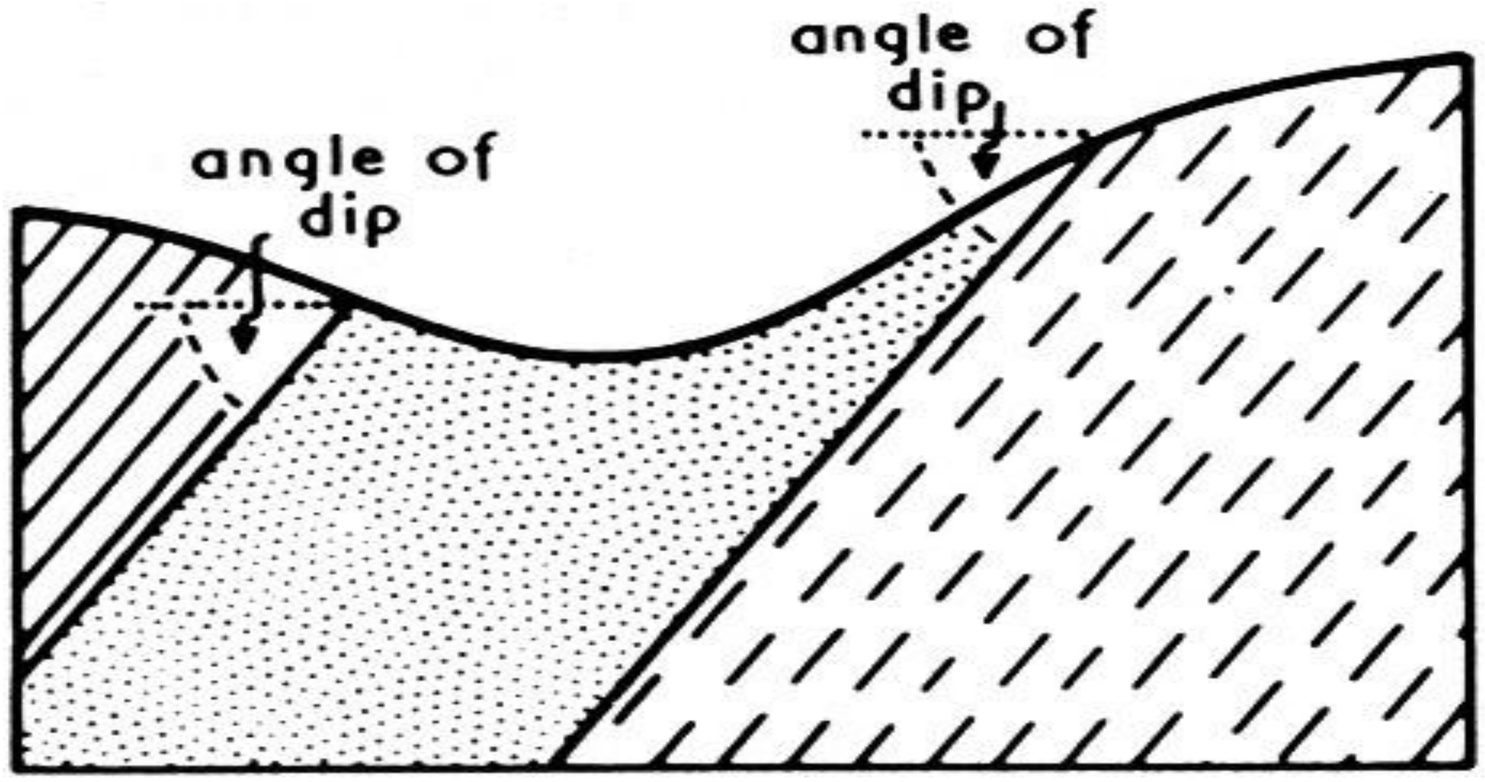
3. Calculation of Vertical & True Thickness

4. Three-Point Problems

DIPPING STRATA

Inclined strata **are said to be** dipping**.**

The angle of dip **=** maximum angle measured between the strata and the horizontal (regardless of slope of the ground).



Section showing dipping strata. Angle of dip is measured from horizontal

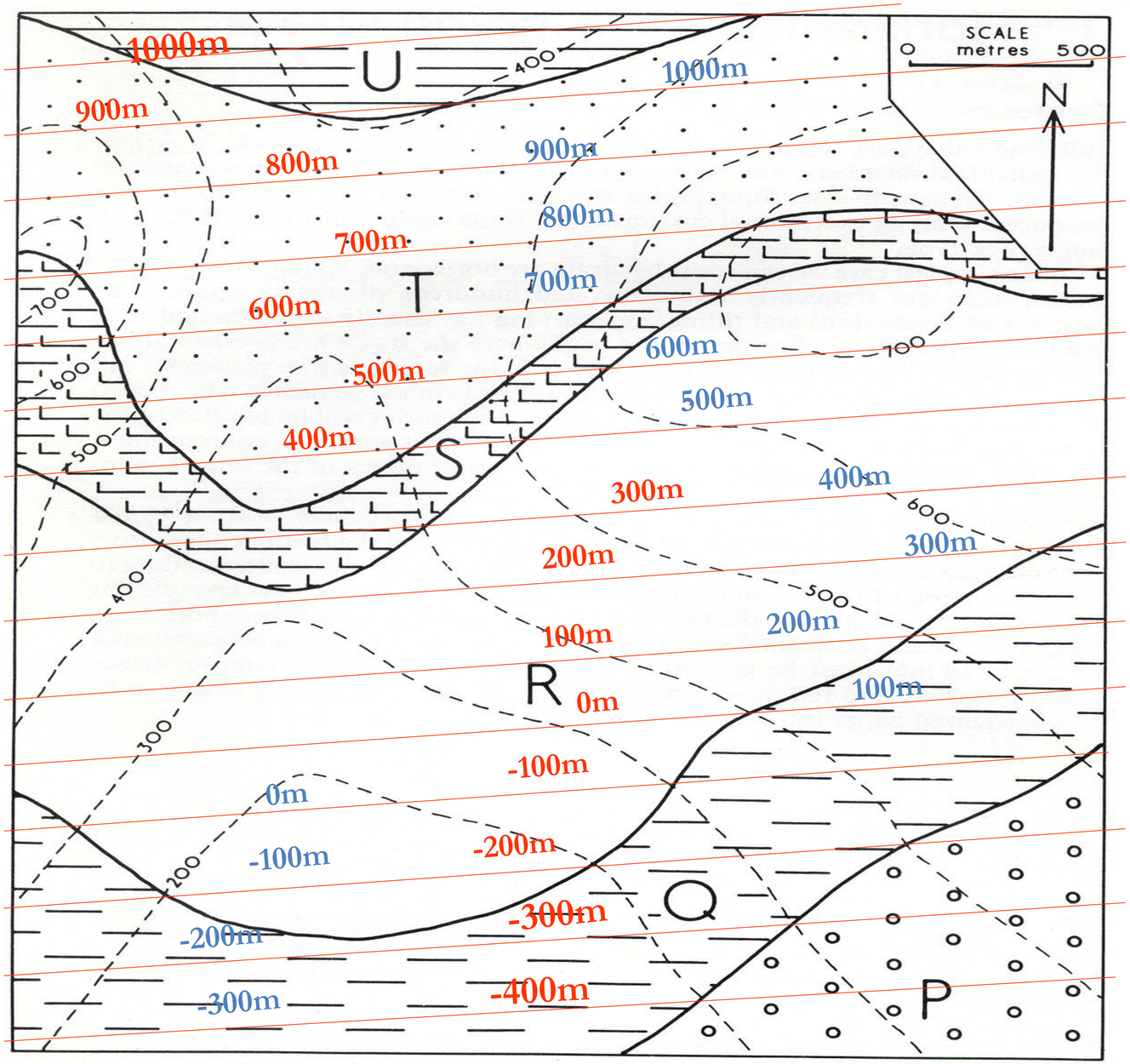
DIPPING STRATA…..contd.

Structure contours (= Strike Lines)

Just as it is possible to define the topography of the ground surface by means of **contour lines**, so can we also draw contour lines on a bedding plane. These we call structure contours or strike lines:

- ✓ The former (contour lines) since they join **points of equal height**
- ✓ The latter (structure contours) since they are **parallel to the direction of strike**

Construction of Structure contours (Strike Lines)

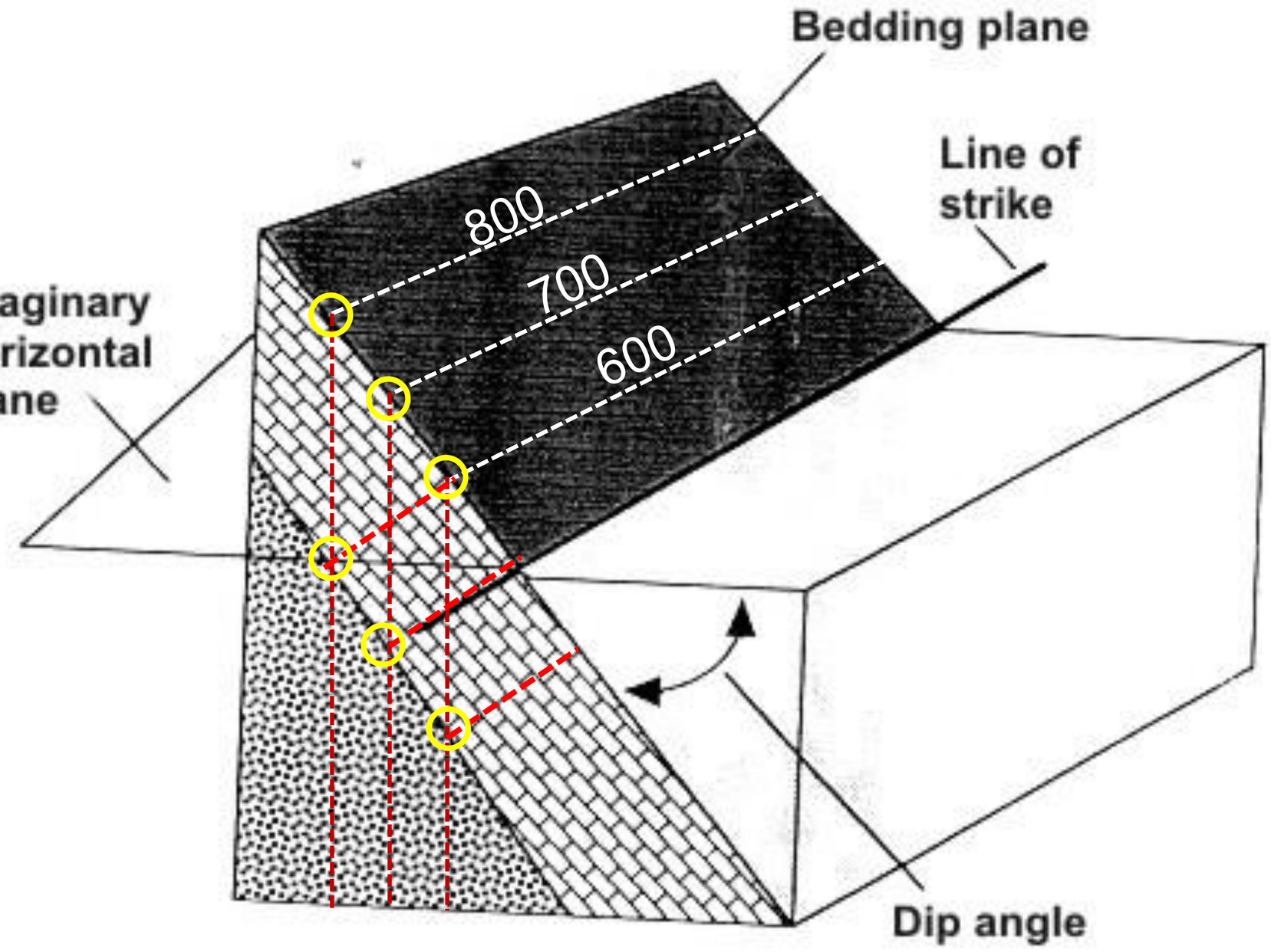


The height of a geologic boundary is known where it crosses a topo contour line.

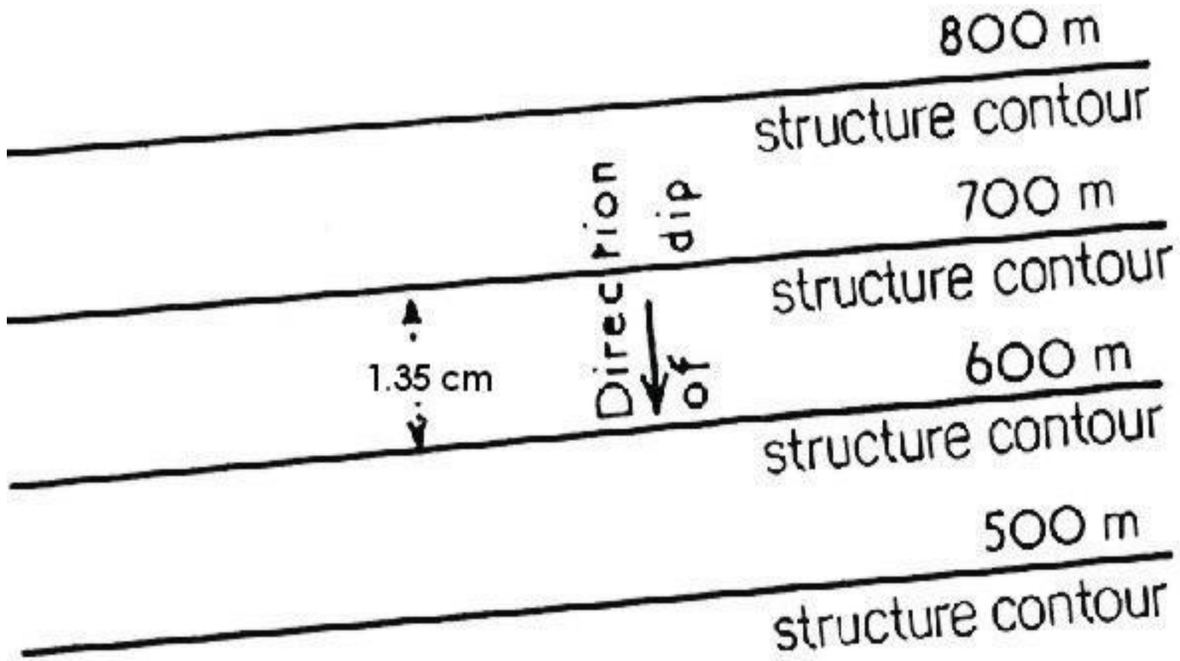
E.g., the boundary between beds ***S*** *and* ***T*** *in map cuts the* ***700 m*** **contour at 3 points. These points lie on the 700 m structure contour [Strike Line].**

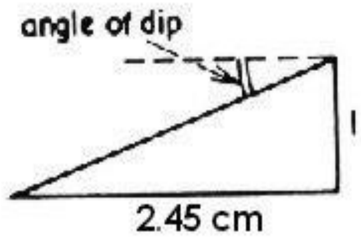
Since these maps portray simply inclined plane surfaces, the *structure contours will be straight, parallel* **and - if dips are constant -** *equally spaced*.

Construction of Structure contours (Strike Lines).....contd.



Determination of Angle of Dip





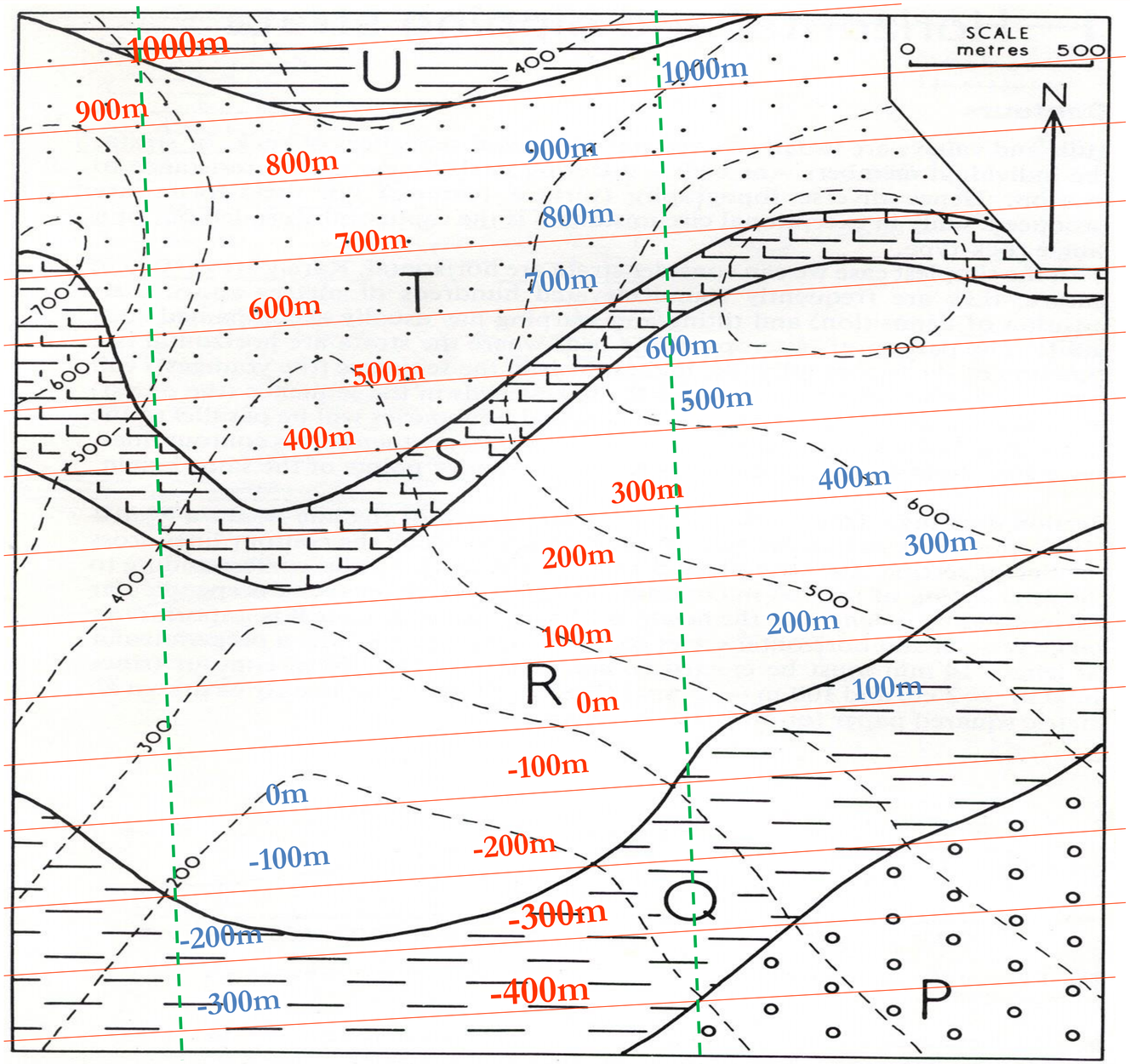
Gradient = 700 m - 600 m in ‘X’ cm

i.e. = 100 m in ‘X’ cm.

As the scale of the map is given as ‘Y’ cm = 500m, ‘X’ cm = ‘Z’ m

Hence, **the gradient** is 100 **in** ‘Z’.

Section Drawing

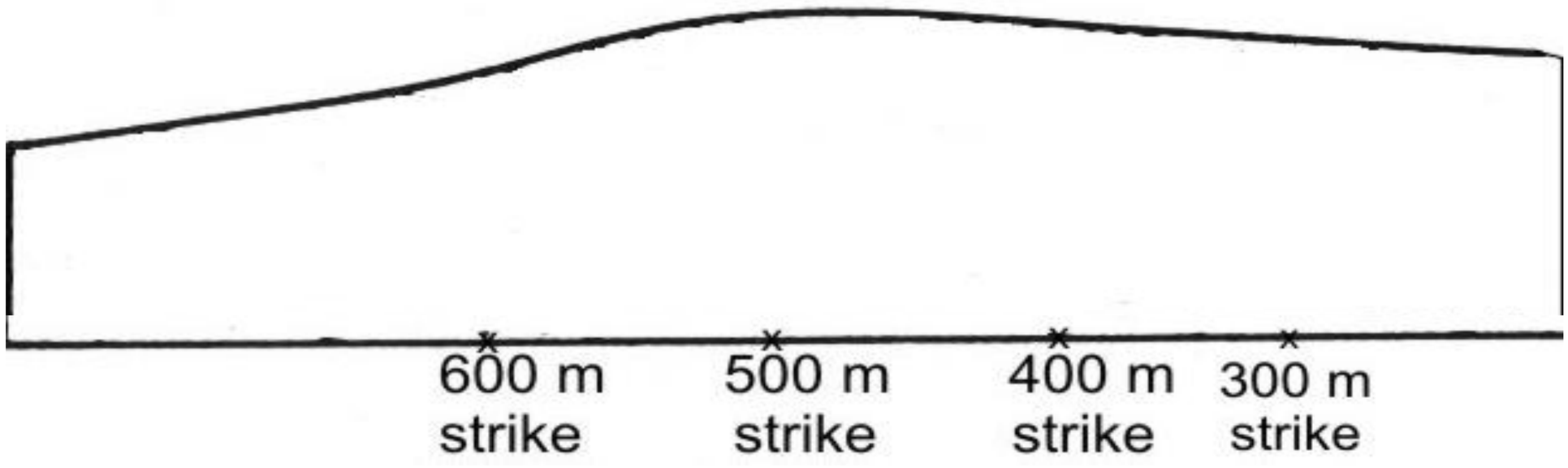


- Choose an appropriate line of section.
- Draw a topographic profile, as already described before

Section Drawing…..contd.

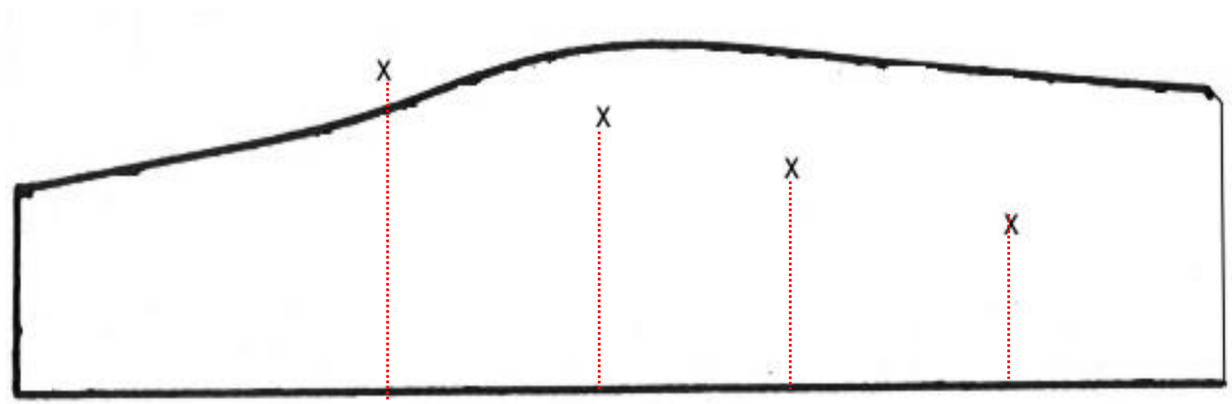
With the topographic profile drawn……

- Mark geological boundaries (interfaces) at points where they are crossed by the section line:

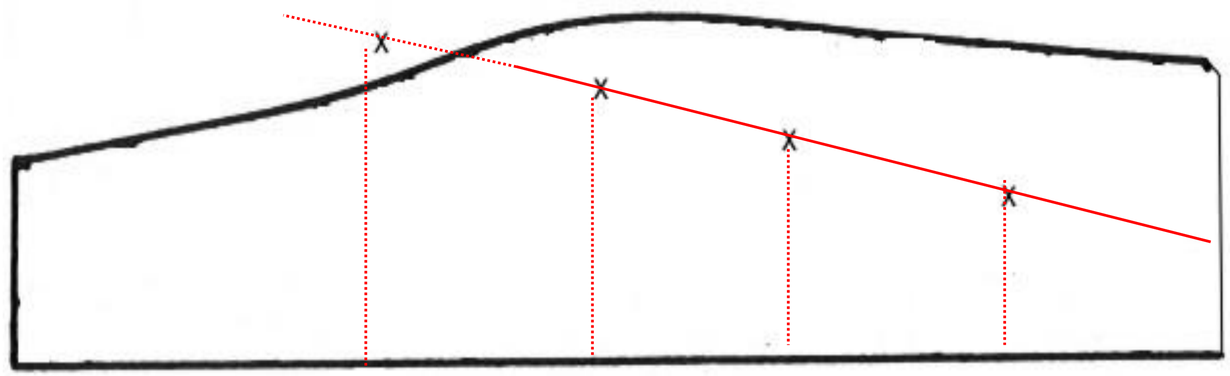


Section Drawing…..contd.

- Then draw perpendiculars (from the base line) of length corresponding to the **respective heights** of the structure contours.

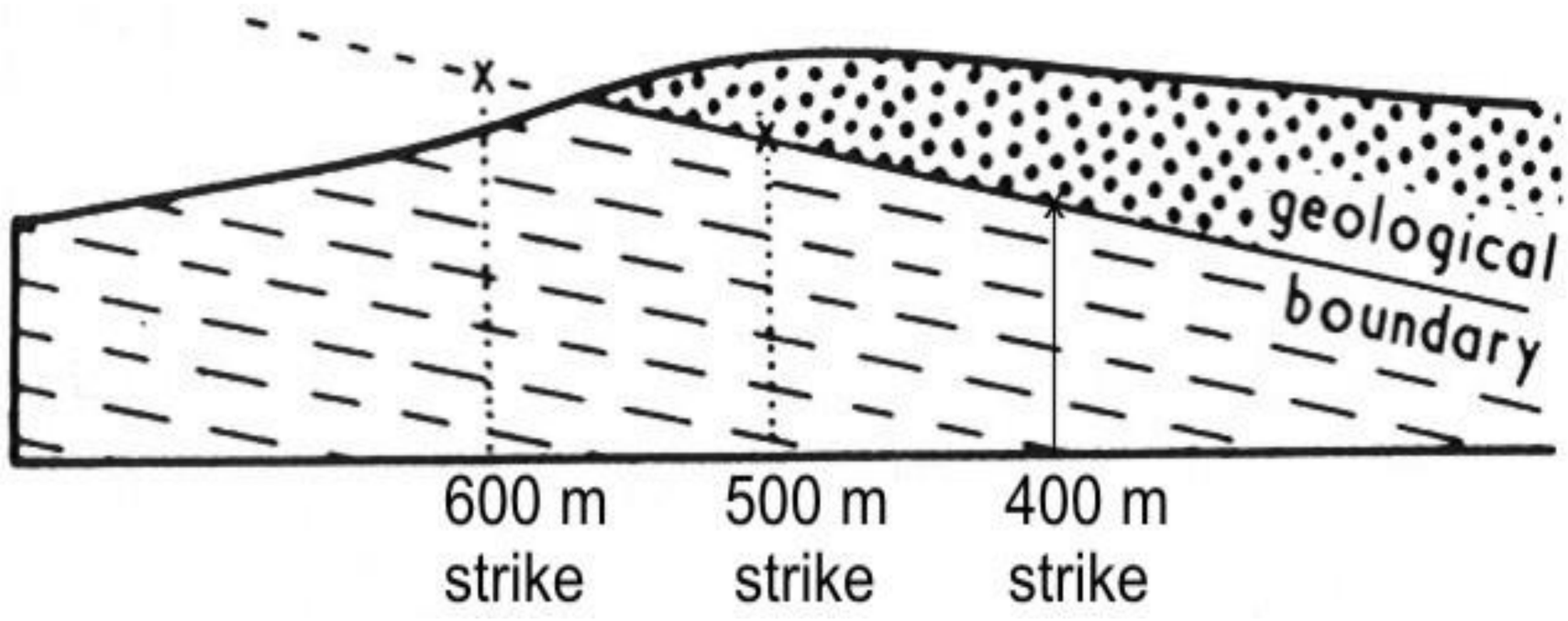


- Join the points representing the respective heights of the structure contours. This forms a geologic boundary at the angle of dip of the lithologies [rock formations].



Section Drawing.....contd.

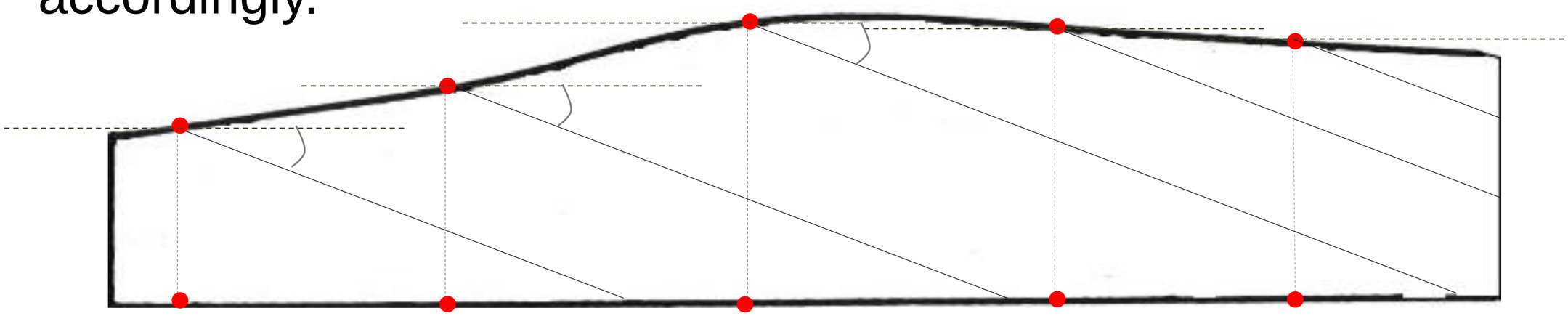
- Shading-in of the geology.....:



Section Drawing.....contd.

Alternative method, and which might turn out to be **simpler**, is:

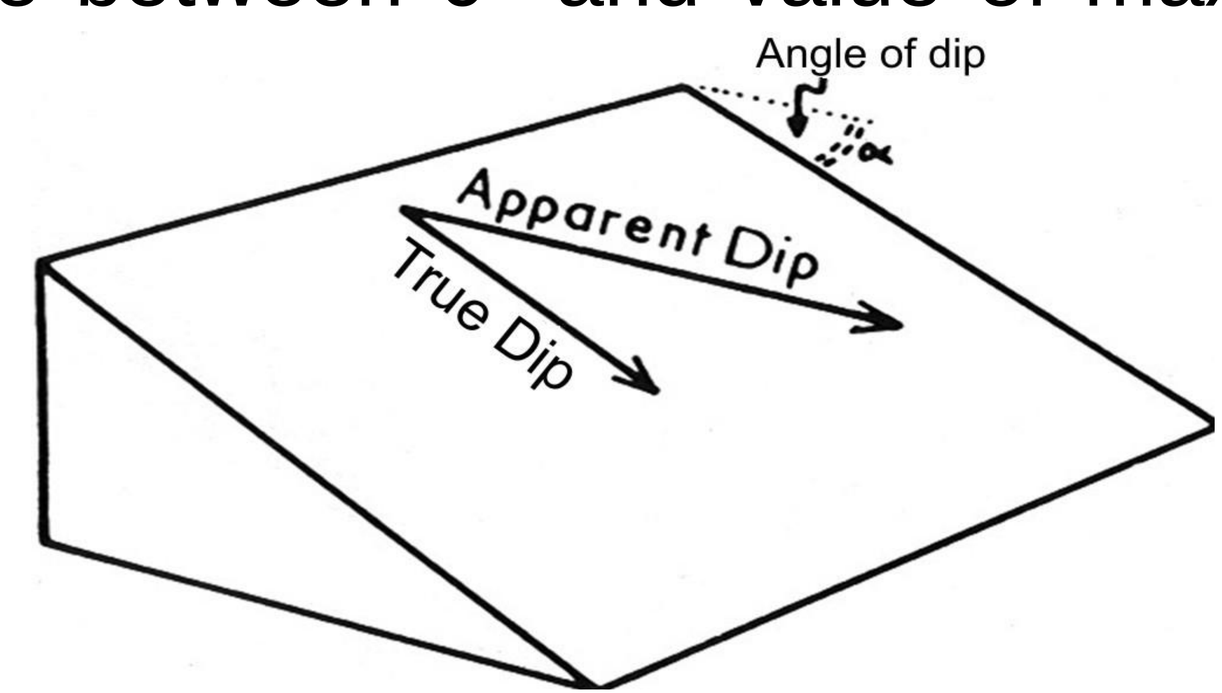
- Mark geological boundaries (interfaces) at points where they cross section line.
- Place these along the section line and project them up to where they intersect topography.
- Using the angle of dip calculated, slant the geological boundaries accordingly.



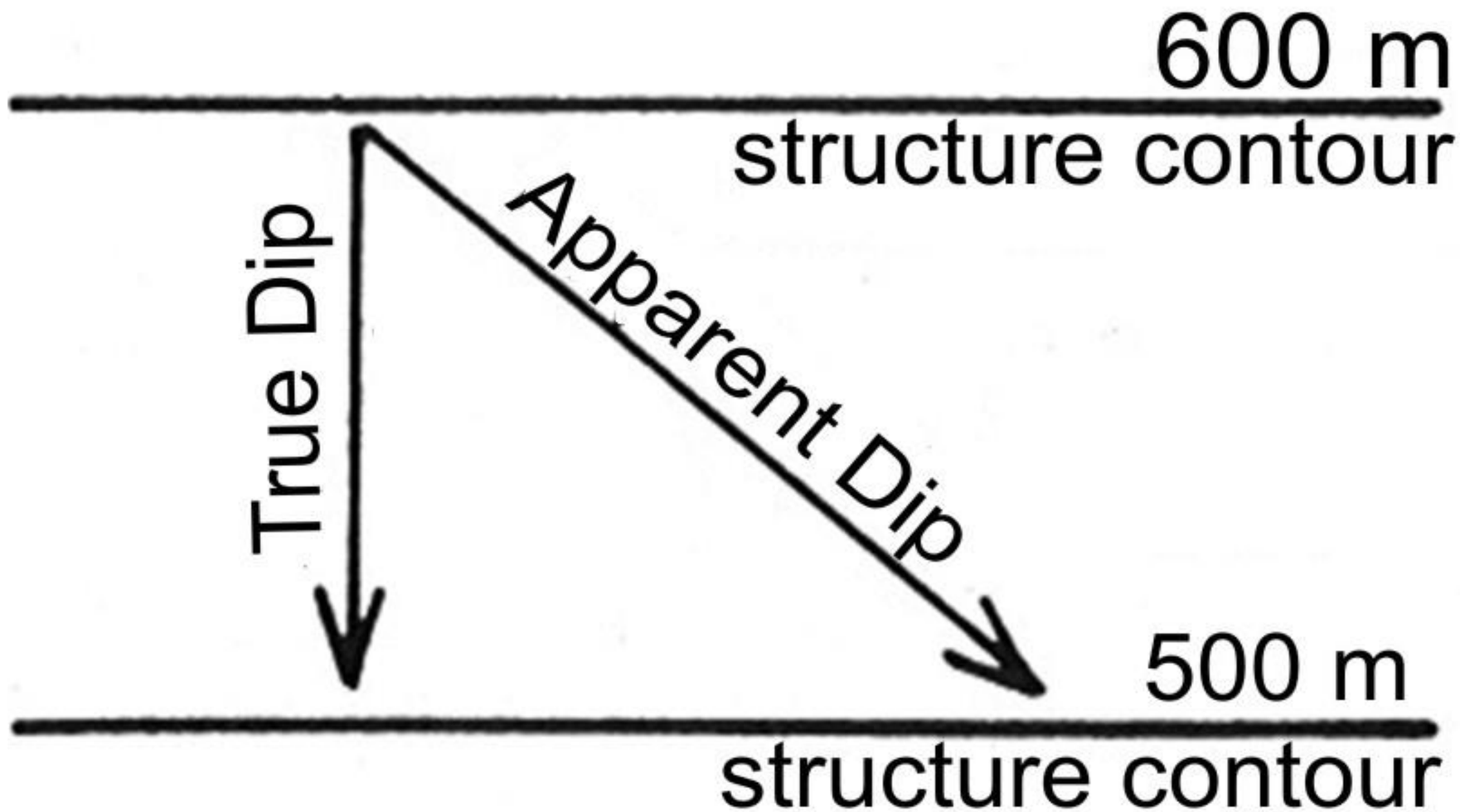
Determination of Apparent Dip

True and Apparent Dip

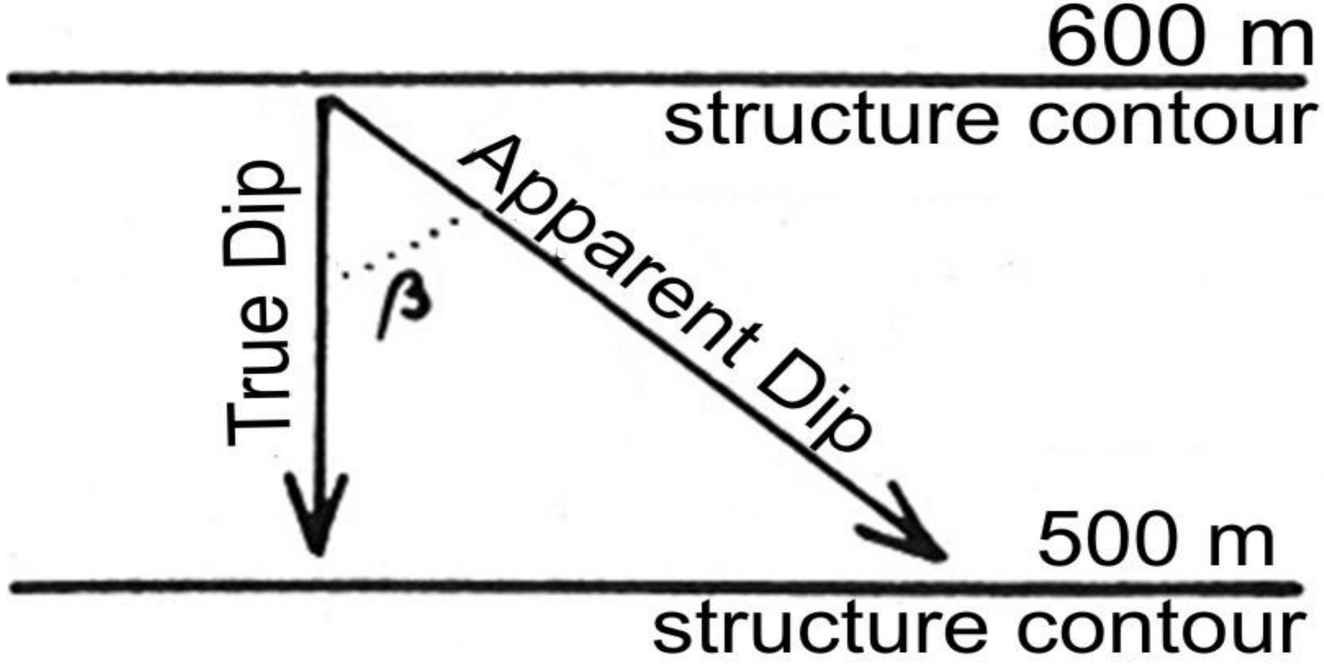
- If the slope of geological boundary is measured in any direction between strike direction and direction of maximum dip, angle of dip in that direction is known as an **apparent dip.**
- Its value will lie between 0° and value of maximum or true dip.



True and Apparent Dip.....contd.



True and Apparent Dip.....contd.



The trigonometric relationship is given by:

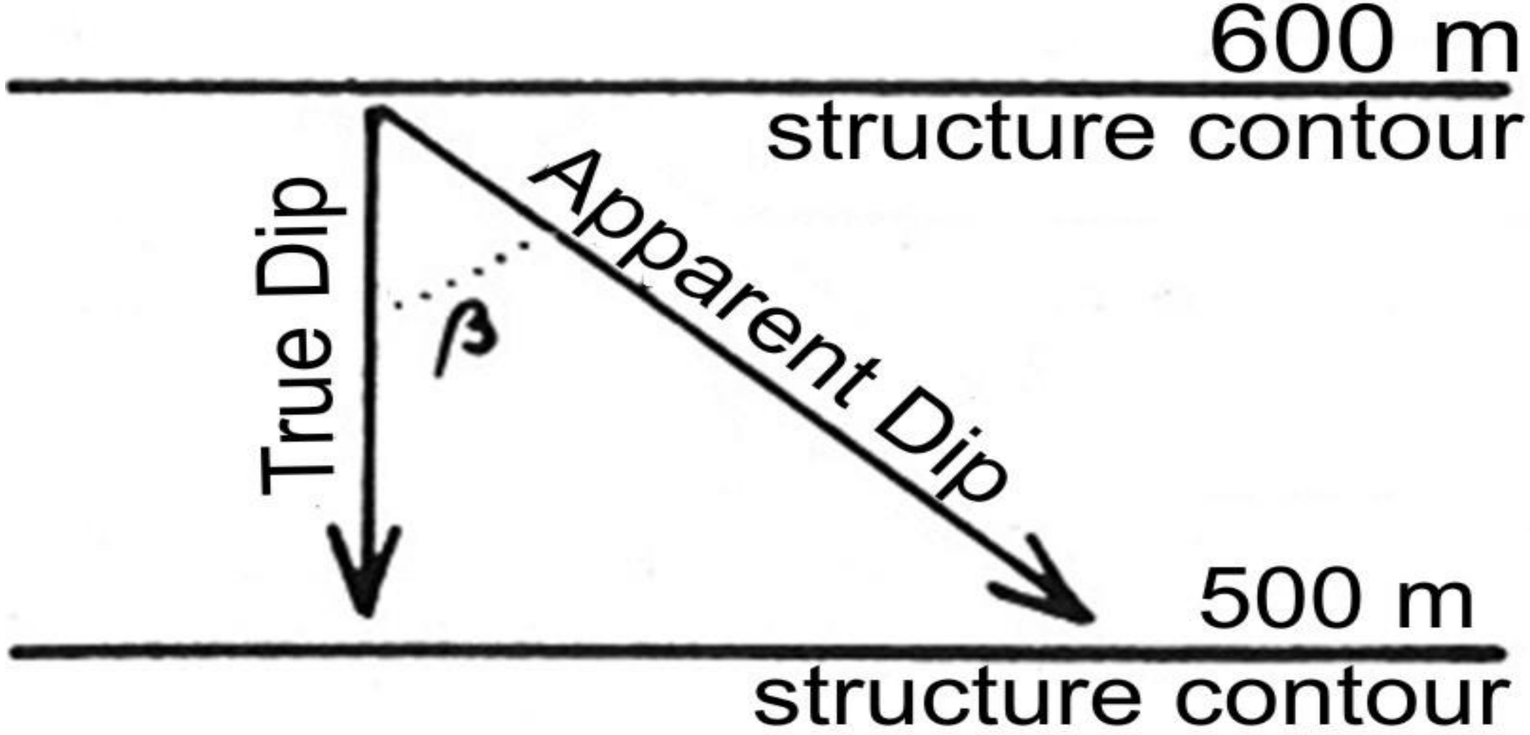
Tangent AD = Tangent TD x Cosine β

$\tan \alpha = \tan \theta \times \cos \beta$

where α = Apparent Dip, θ = True Dip and β = angular divergence between the two angles.

True and Apparent Dip.....contd.

- Put differently, the **gradient** in the direction in which we wish to obtain the apparent dip is given by the structure contour spacing measured in that direction.



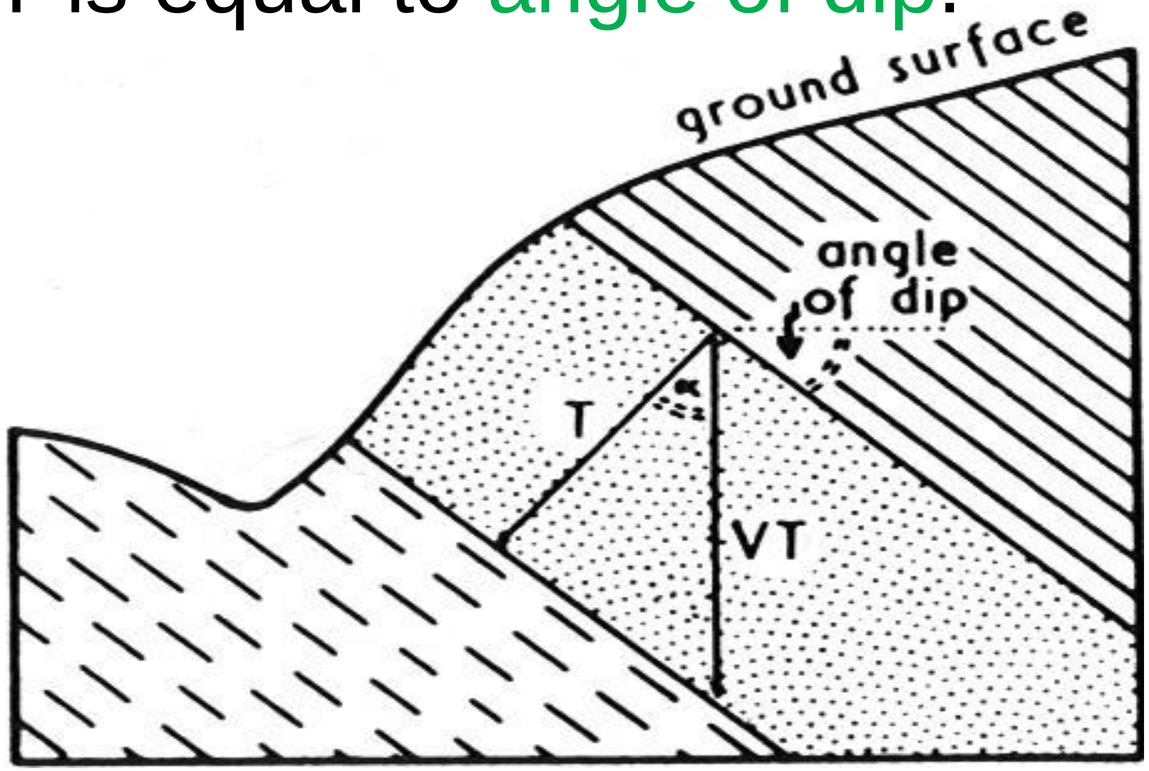
VERTICAL & TRUE THICKNESS

Vertical & True Thickness

- For inclined beds, the Vertical Thickness (VT) penetrated by a borehole is greater than True Thickness (TT) measured perpendicular to the geological boundaries.
- The angle α between VT & TT is equal to angle of dip.

Cosine α = TT/VT

$\therefore$ TT = VT x Cosine α



Vertical and True Thickness.....contd.

TT of a bed is equal to:

- **Vertical Thickness** multiplied by the **cosine** of the angle of dip.

Where dip is low **(<5°)** cosine is high (**over 0.99**) and **TT** & **VT** are **approximately** the same.

THREE-POINT PROBLEMS

Introduction

If the height of a bed is known at three or more points, it is possible to:

- Find the direction of strike and
- Calculate the dip of the bed, **provided** dip is uniform.

THIS PRINCIPLE IS CALLED THE **THREE POINT PROBLEM**

This principle has many applications to **mining**, **opencast** and **borehole** problems encountered by **applied geologists** and **engineers**.

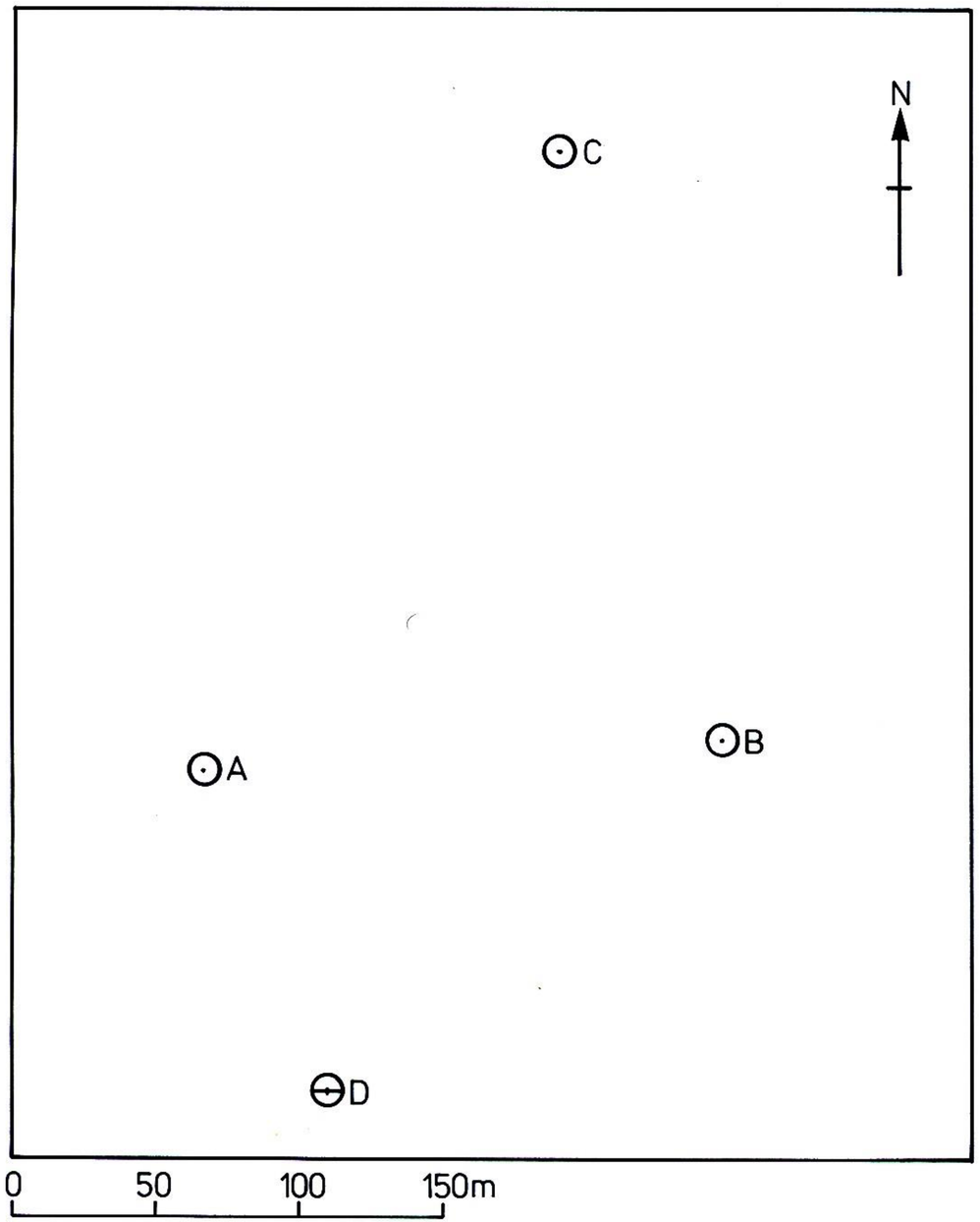
Practical Exercise 4

Information

The map depicts a level land surface lying at an elevation of **30 m above sea level**. Below the surface, a granite sill occurs, the top of which has been intersected in three boreholes, **A**, **B** and **C**, at depths of **40 m**, **30 m** and **15m**, respectively.

Answer the following:

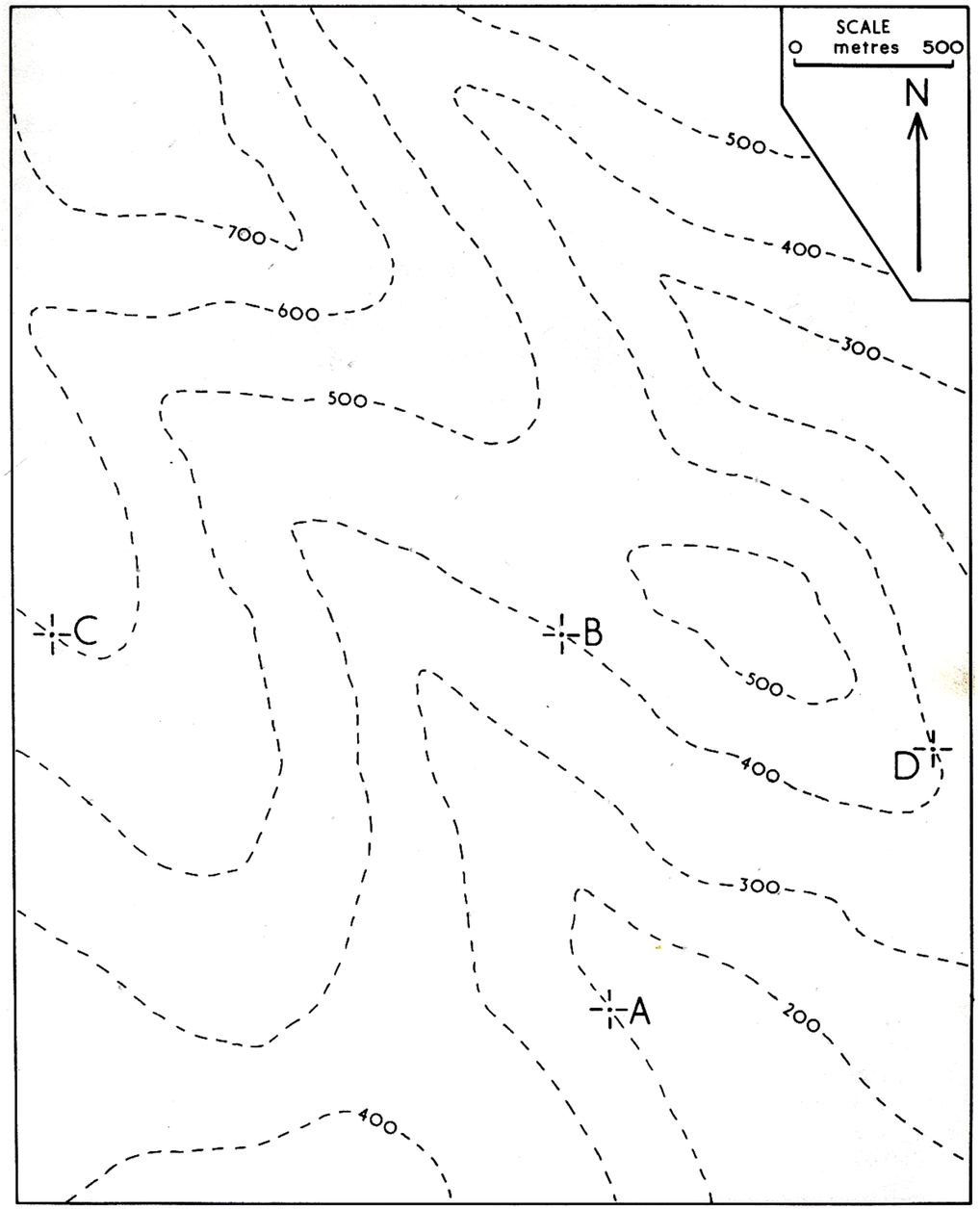
1. Assuming the sill to be planar, project onto the map contours on the sill (strike lines) above and below sea level, at 5m vertical intervals.
2. Determine the **magnitude** and **direction of true dip**.
3. Find the rate of apparent dip in the direction 270° (due west).
4. State at what depth the sill would be encountered in a shaft sunk at D.



Practical Exercise 4

Granite sill is outcropping at points **A**, **B** and **C**.

1. Deduce the dip and strike of granite sill
2. At what depth would the sill be encountered in a borehole sunk at point D?
3. Complete the outcrop pattern of the sill. (*Contours are in metres)*



Procedure to be followed to complete exercise

Observe heights of granite sill at points A, B and C where it outcrops.

a) Join highest point on the sill, C (600 m) to lowest point on the sill, A (200 m).
b) Divide the line A-C into four equal parts (since 600 m - 200 m = 400 m).
c) As the slope of the sill is constant, we can find a point on AC where the sill is at a height of 400 m (the mid-point).
d) We also know that the sill is at a height of 400 m at point B. A straight line drawn through these two points is the 400 m structure contour.

Procedure to be followed to complete exercise.....(2)

e) On a simply dipping stratum, such as this, all structure contours are parallel.

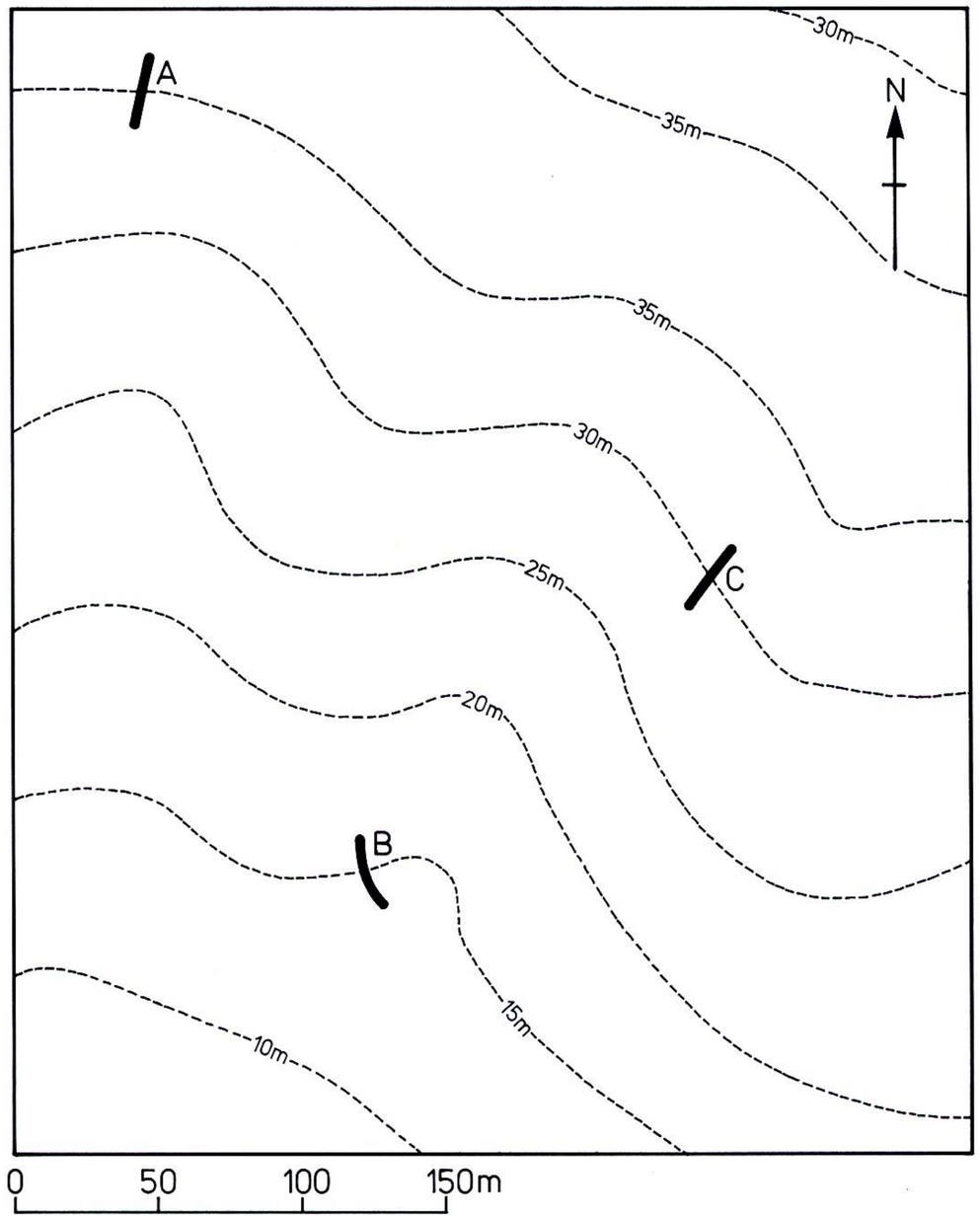
f) Construct the 200 m structure contour through point A, the 300 m, the 500 m and the 600 m structure contour - the latter through point C.

g) Having now established both the direction and the spacing of the structure contours, complete the pattern over the whole of the map.

Practical Exercise 5

Information

The Map depicts a land surface contoured at 5m intervals, with a granite body outcropping at A, B & C.



Answer the following:

a) Indicate on the map the probable location of the remainder of the granite outcrop.

b) Shade the area underlain by granite.

Practical Exercise 6

Information

The Map above depicts a land surface contoured at 5m intervals on which the outcrop locations of three bed boundaries are marked; the base of a sandstone outcrops at A, the base of a limestone outcrops at B, and the base of a mudstone at C. Assume that between B and C only limestone is present and that only mudstone is present in the succession above C.

<u>Answer the following:</u>

Complete the outcrops of the bed boundaries.

Shade the lithologies as appropriate.

Note: The rate of true dip of the beds is 1 in 10 on a bearing of 210°.