The three-point problem

In many geologic situations, a bedding plane or fault surface may crop out at several localities. If the surface is planar and the elevations of three points on the surface are known, then the classic "three-point" problem can be used to determine the attitude of the plane. Consider Fig. 2.9a, which shows three points (A, B, C) on a topographic map. These three points lie on the upper surface of a sandstone layer. The problem is to determine the attitude of the layer. We will solve this problem in two different ways, using first a structure-contour approach, then a two-apparent-dip approach.

Solution 1

1 Place a piece of tracing paper over the map, and label the three known points and their elevations. On the tracing paper draw a line connecting the highest of the three points with the lowest. Take the tracing paper off the map. Now find the point on this line that is equal in elevation to the intermediate point. In Fig. 2.9b, point B has an elevation of 160 ft, so point B′, the point on the AC line that is equal in elevation to point B, lies 6/10 of the way from point A (100 ft) to point C (200 ft).

2 The bed in question is assumed to be planar, so B′ must lie in the plane. We now have two points, B and B′, of equal elevation lying in the plane of the bed, which define the strike of the plane. The structure-contour line B–B′ is drawn, and the strike is measured with a protractor to be N48°E (Fig. 2.9c).

3 The direction and amount of dip are determined by drawing a perpendicular line to the strike line from point A, the lowest of the three known outcrop points (Fig. 2.9d). The amount of dip can be determined trigonometrically as shown:

$$\tan\delta = \frac{\text{change in elevation}}{\text{map distance}} = \frac{60'}{104'} = 0.57$$

$$0.57 = \tan 30°,\ \delta = 30°$$

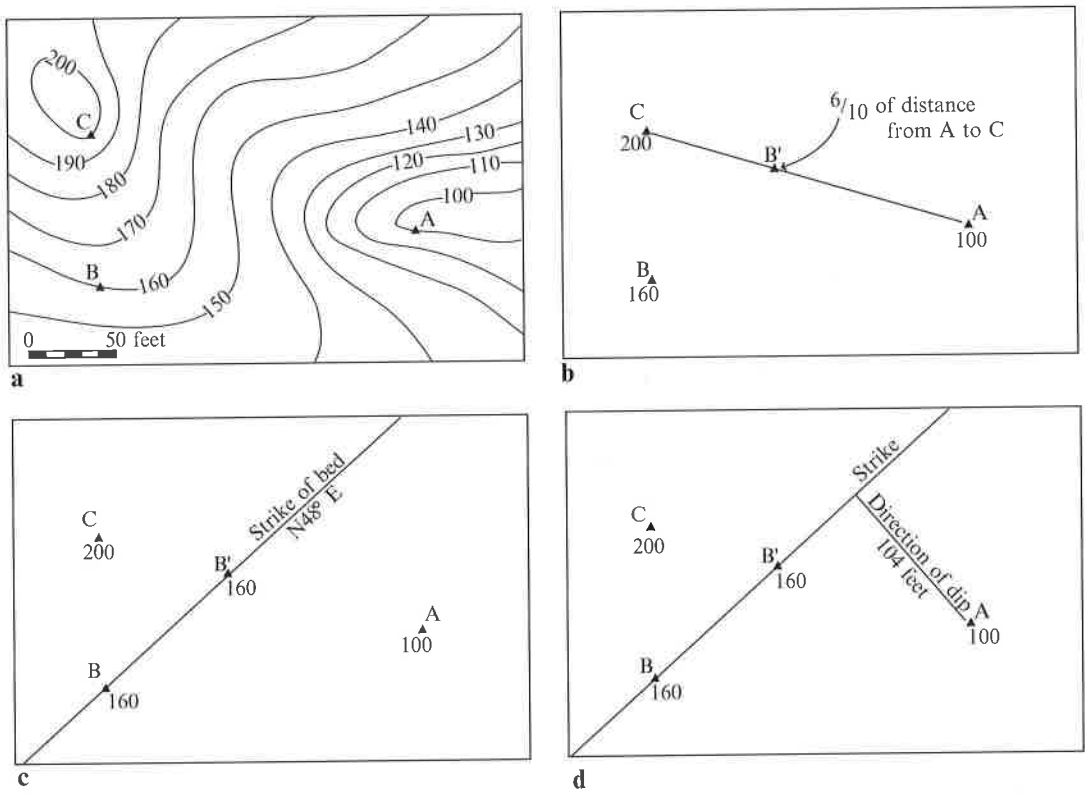

Fig. 2.9 Solution of a three-point problem using a combination of graphical and trigonometric techniques. (a) Three coplanar points (A, B, and C) on a topographic map. (b) Location of a fourth point, B′, at the same elevation as point B. (c) Line B–B′ defines the strike of the plane. (d) Dip-direction line perpendicular to the line B–B′.

Problem 2.3

Points A, B, and C in Fig. G-4 are oil wells drilled on a level plain, and all of the wells tap the same oil-bearing sandstone. The depth (*not the elevation!*) of the top of this sandstone in each well is as follows: A = 5115 ft, B = 6135 ft, and C = 5485 ft.

1 Determine the attitude of the sandstone.
2 If a well is drilled at point D, at what depth would it hit the top of the sandstone?

Name _____

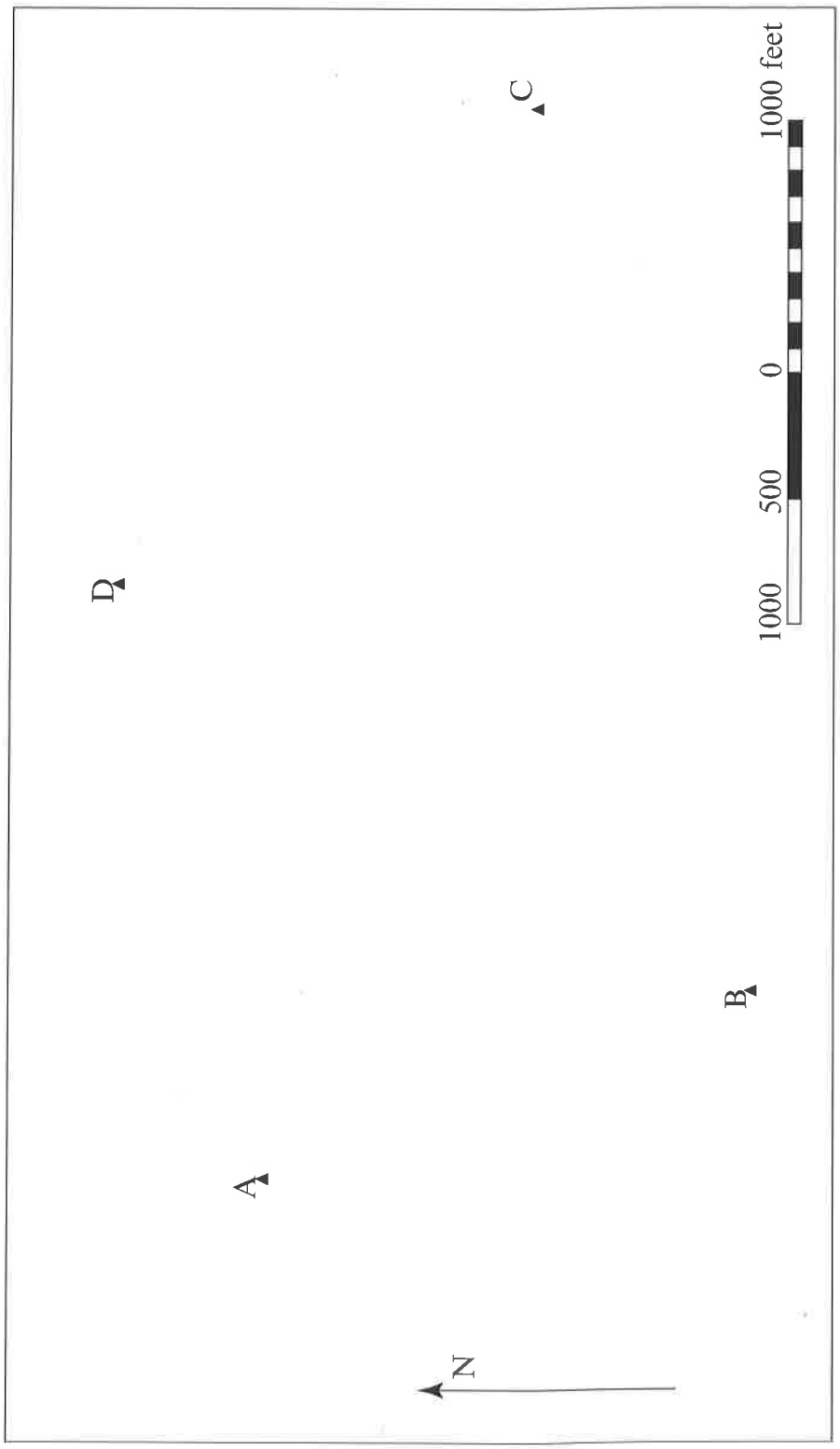

Fig. G-4 Map for use in Problem 2.3.