

example, the line passes through the primitive so that the 80° is measured in two segments ($25^\circ + 55^\circ$).

5. Measure 41° from R to P' in the great circle L/R.

ROTATIONAL PROBLEMS

It is often of interest to determine the orientation of a given feature as it existed before tilting (Fisher, 1938). Simple examples include the restoration for paleogeographic studies of primary sedimentary features such as current lineations (see Potter and Pettijohn, 1963, p. 259), and the pretilt attitude of structures below an angular unconformity. The most common type of tilting movement occurs during folding, but may also be associated with faulting. With flexural folds, it is a simple matter to unfold the structure and thus restore the beds to a horizontal position. Provided there are no distortions due to strain the various features contained within the folded rocks are thereby also returned to their original positions.

To restore to horizontal the beds of a nonplunging fold, the bedding planes are rotated about an axis parallel to the strike of the beds, which is also parallel to the fold axis, through an angle equal to the dip angle.

PROBLEM

An inclined bed of sandstone (N 20 E, 20 W) contains cross-bedding (N 72 W, 21 S). Determine the original current direction.

CONSTRUCTION (Fig. 11.15)

1. First plot the pole of the cross-beds ($-P$), and then the sandstone bed as a great circle ($-$ Plane 1).
2. With Plane 1 still in the plotting position, the rotational axis, which is also the line of strike of the sandstone bed, is north-south.
3. To restore the sandstone bed to horizontality Plane 1 rotates 20° to the primitive. At the same time P moves along a small circle in the same direction and by the same amount to P' .
4. From this new pole position P' the great circle representing the restored cross-bedding can be drawn ($-$ Plane 2). The original current direction is parallel to the dip.

ANSWER

The original attitude of the cross-beds was N 67 E, 30 S, and the associated current moved toward S 24 E. Note that if the orientation of the tilted cross-beds is assumed to reflect the original current direction, an error of 41° is introduced.

The movement leading to the development of a plunging fold can be considered to have two rotational axes: one of them the fold axis, and the other a horizontal axis perpendicular to the fold axis. Reversing the rotation about these two axes unrolls the fold.

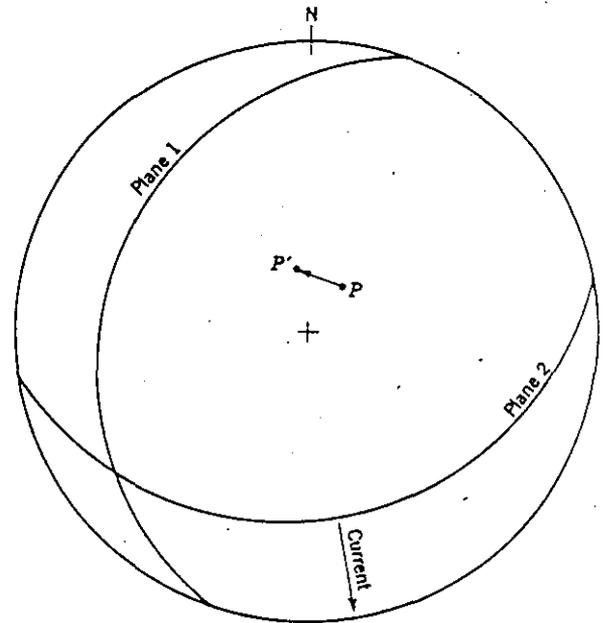


FIGURE 11.15 The two tilt problem.

PROBLEM

Given an anticline plunging 30° due north. Beds on the east limb (N 19 W, 60 E) contain sole markings which trend due east. Determine the original orientation of this sedimentary lineation.

CONSTRUCTION (Fig. 11.16; after Ramsay, 1961)

1. Plot the geometrical elements of the problem: Plane 1 = plane bedding, l = lineation within bedding, and F = fold axis.
2. The rotation of Plane 1 and l about the inclined axis F could be constructed (as in Fig. 11.14), but there is a simpler approach. If the beds are unrolled about the fold axis, the result will be a plane dipping 30° due north. During this rotation, the angle between l and F remains constant. Thus the plane after the first rotation ($-$ Plane 2) and the associated lineation ($-l'$) can be plotted directly.
3. In rotating Plane 2 about its line of strike to horizontality, the lineation moves along a small circle to the primitive ($-l''$).

ANSWER

The original trend of the sedimentary lineation was N 65 E. Again, if the correction is ignored, a considerable error results.