

In addition, it should be remembered that the unconformabilities between the upturned rocks of a mountain and those underlying are usually confined to the mountain region. A score or so of miles to one side, the rocks may often be found resting beneath the same strata, perhaps horizontally, with perfect conformability between them. The unconformabilities are on this account none the less important as time-boundaries in geological history.

When, in consecutive epochs of mountain-making, the upturned strata of the later epoch have been thrust up against those of the earlier, by force acting in the two cases from the same direction, the two sets of strata will have more or less nearly the same strike. But their unconformability may possibly still be proved (1) by difference in dip; (2) by difference in kinds of rocks, when the rocks are studied over a long belt in the line of strike; and (3) by fossils, if the beds are fossiliferous. But when the strata are metamorphic, and fossils are therefore absent, the difficulties are great. Examples occur in western Connecticut and eastern New York, where the metamorphic Taconic rocks come into contact with Archæan. The first and second of the above criteria may still be available, though with great uncertainty; the second may be used especially when the two sets of strata differ in grade of crystallization or metamorphism, or in the presence of some distinctive mineral masses, as of metamorphic beds of iron ore. The belt should, further, be traced along the range of outcrops in order to find, if possible, a region where there is a bend in the strike; for at such a bend the two sets of strata probably would not be found to bend alike; and to make the investigation complete, all possible strikes and dips should be measured and plotted on a large map of the region. Special care is needed in order that unconformity produced by a fault is not mistaken for true unconformability or that in the bedding.

3. GENERAL RESULTS OF OROGRAPHIC WORK.

1. *Effect of orographic work on the earth's circumference.*—Faults and plications are a measure of the *shortening of the earth's circumference* that has taken place in an orographic crisis. During the ages of preparation, the amount of shortening in the making of the geosyncline has been small; for the slowly accumulating strain reduces widths only by the difference between the shallow arc and its chord. But at the collapse, as already shown, the amount has been a score or more of miles: 74 for the Alps (Heim); 44 for the Appalachians in Pennsylvania; 25 for the Laramide Range in British America (McConnell).

The line of the Appalachian Range is transverse to a zone of the globe having a N.W.—S.E. direction; and the Taconic Range and the Acadian of Nova Scotia and New Brunswick widen this zone northward. The shortening of the earth's circumference for all these ranges was not east-and-west, but in the direction of this zone. In this zone the Archæan nucleus is to the northwest; but to the southeast lies the Atlantic, in its long range between North and South America. In western America, where the mountains made range northwestward instead of northeastward, the shortening was in the direction of a zone N.E.—S.W. in course. It was the same zone of the globe that includes the Alps. The whole amount of shortening on the Atlantic border was probably not over 50 miles along the course of the zone; and on the Pacific border for the Laramide and other systems later than the Archæan, not over 75 miles.