One Method of Formation of the Valleys of Underfit Streams.

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An underfit stream is one that appears to be too small for the width of the valley in which it flows. The usual explanation of such a condition is that either the stream at one time was much larger than now or that the valley has been widened by stream meandering at a time when it has been flowing at, or near baselevel. Frequently the present channels of underfit streams, even though their valleys are far above baselevel, are bordered by broad, flat terraces. Such a condition is common in Oklahoma and other parts of the Southwest and also in the area formerly covered by the Wisconsin ice sheet. In Oklahoma, excellent examples of this can be seen in the Washita and Canadian River valleys and, in Michigan, the same is true of the valleys of the Pere Marquette and Kalamazoo rivers.

Such broad flat valley bottoms are not limited to the larger streams but are also found clear to the heads of most of the well developed tributaries. The glaciated region has a young topography and that of the southwest is old. Also, neither region has been peneplained during the history of its present drainage. Thus it is hard to explain the origin of these broad flat stream terraces either as being caused by a former base-leveling or as having been formed by an older stream of large volume. In the glaciated area, the streams have all the usual characteristics of those of a moderately humid region. Their volumes vary somewhat with the seasonal rainfall but they never go dry, as do so many streams of the southwest, and when they are in flood their waters are contained within the areas of their beds and immediate flood plains. On the other hand, the streams of the Southwest are either dry or flow in very small volume during the dry season which often lasts for many months. But the wet season often brings torrential floods during which the streams may burst from their immediate channels and spread widely across the whole width of their valleys. Then the floods usually recede as suddenly as they arose, leaving a layer of alluvium over the flooded area.

Frequent repetition of this process produces, after a time, a broad flat terrace on one or both sides of the stream channel. This is the way the terraces of the Washita, the Canadian and many of the other rivers of the Southwest were formed, and the same process can be seen operating at the present time on some of their tributaries. For example, Little River which rises near Norman, Oklahoma and flows east some 60 miles before joining the Canadian is ordinarily only a few feet wide. But where Highway 77 crosses it north of Norman, its channel is contained in a broad flat bottomed valley nearly a half mile wide which, during heavy floods, is often covered with water from side to side. And this same condition prevails all the way to the heads of its various branches.

Most of the streams of Oklahoma have a rather steep gradient and flow in valleys cut in solid rock and partly filled with alluvium, so that except at the very head waters of the tributaries, the terraces are true flood plains rather than valley flats. In the glaciated area, they flow over unconsolidated glacial till of varying thickness up to several hundred feet. Thus in both areas, the broad terraces have been formed by the working over of unconsolidated sediments. In Oklahoma, the process is still going on but in Michigan it is finished and the terraces are no longer covered by water during the floods of the present time.

But at the close of glacial time when the front of the ice sheet was melting back, the area was subject to extremely heavy floods during the warm season with almost no flow in winter. Thus the great flat bottomed

valleys of the glaciated area were formed under much the same conditions of alternating flood and drouth as that which prevails in the Southwest at present.

In both the area of the Wisconsin glaciation and in the Southwest, the elevation is moderate. In central Oklahoma at a distance of about 400 miles from the sea, it is around 1,200 feet. In Michigan, the average elevation of the heads of the streams at a distance of 100 miles from the shores of the Great Lakes is about 300 feet. In neither case is the gradient steep enough to cause a rapid down-cutting such as that of the Colorado River which resulted in the formation of the Grand Canyon.

Thus, one set of favorable conditions for the formation of valleys of this type is moderate elevation, the presence of abundant alluvium, and violent and frequent fluctuations of stream volume.