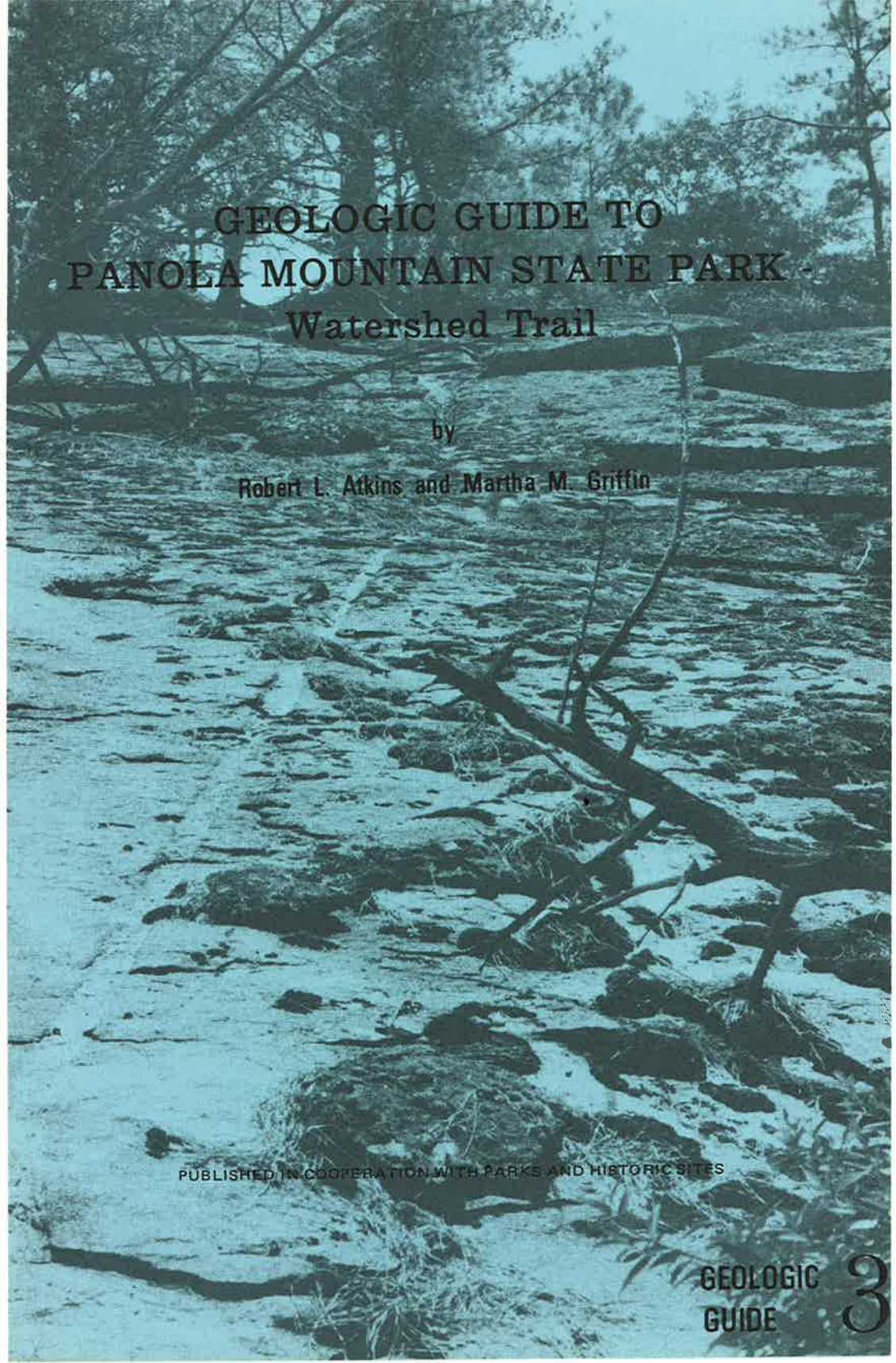


GEOLOGIC GUIDE TO PANOLA MOUNTAIN STATE PARK - Watershed Trail

by

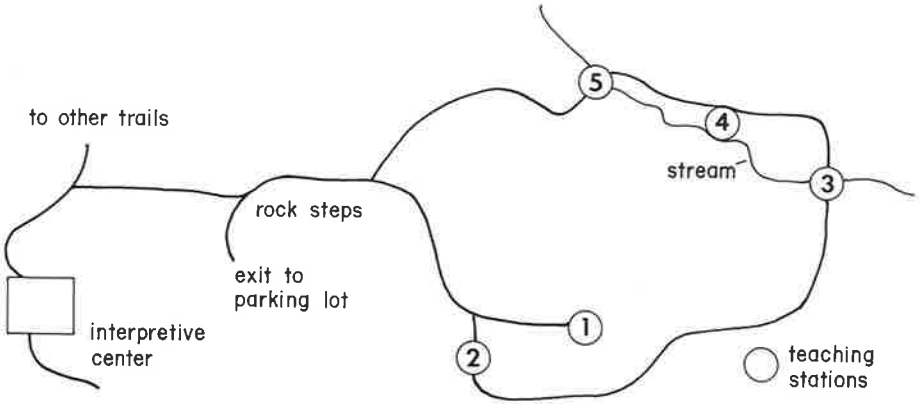
Robert L. Atkins and Martha M. Griffin

PUBLISHED IN COOPERATION WITH PARKS AND HISTORIC SITES

GEOLOGIC GUIDE 3

Watershed Trail Guide
Self-Guided Trail
(A Geologic Trail Guide)

by Robert L. Atkins and Martha Griffin
with illustrations by Kathleen Webster



Lettered stops in this guide refer to lettered 4x4 posts along the trail. Follow the trail map as you walk.

Please remain on the trail and remember to let plants and animals live in your eyes, not die in your hands.

STATE OF GEORGIA
DEPARTMENT OF NATURAL RESOURCES
Joe D. Tanner, Commissioner

THE GEOLOGIC AND WATER RESOURCES DIVISION
Sam M. Pickering, State Geologist and Division Director

ATLANTA
1977

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List of Illustrations

Italicized words appear in the glossary.

The cover is a picture of a granite pavement outcrop near Panola Mountain. This pavement outcrop illustrates exfoliation and a pegmatite crosscutting the Panola granite.

Introduction to Stream Development

In most of the world, runoff from rainfall is the primary agent at work shaping the landscape. The development of a regional landscape occurs through orderly processes. These processes are constantly at work, causing an ever changing scene. The following is a brief summary of the stages in stream development according to classical theory.

Youthful Stage

1. Valleys are narrow and V-shaped.
2. Downcutting is the dominant process.

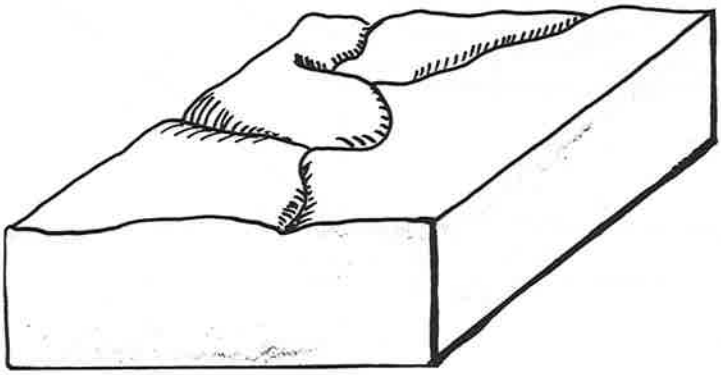

Figure 2 - Youthful stage of stream development.

Mature Stage

1. A well-developed drainage system is established.
2. Valleys are deeper and wider; but do not greatly exceed *meander* widths. *Flood plains* in flat valley floors develop as the valley widens.
3. Local *relief* is at a maximum.
4. Most of the land appears as sloping land with very few level areas except along stream valleys and in isolated areas along stream divides.

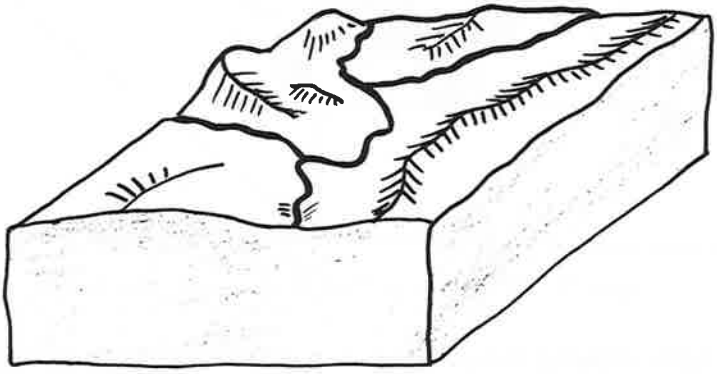

Figure 3 - Mature stage of stream development.

Old Age Stage

1. Streams have low *gradients* and meander over extensive flood plains.
2. Valley width exceeds width of meander belts.
3. Erosional remnants (*monadnocks*) remain but most of the area is broad, gently rolling terrain.

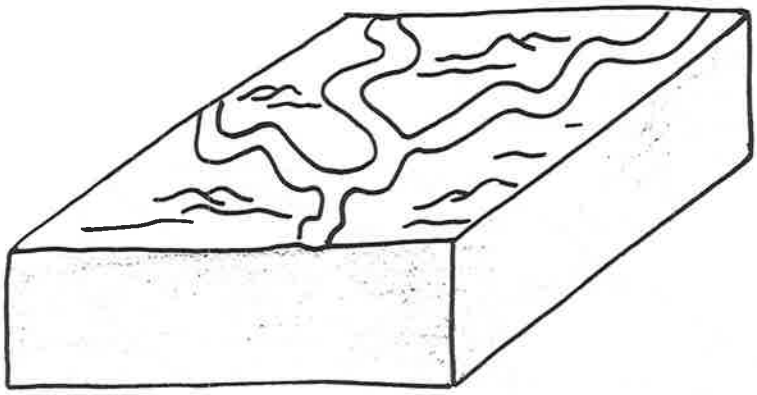

Figure 4 - Old age stage of stream development.

Rejuvenation

Rejuvenation is an event by which the land rises and the stages of stream development repeats themselves. Down-cutting by the streams is the dominant process in this stage.

1. Erosion begins to dissect the broad plateau and develop deep canyons.
2. Steep gradients which do not follow meander patterns may be present.

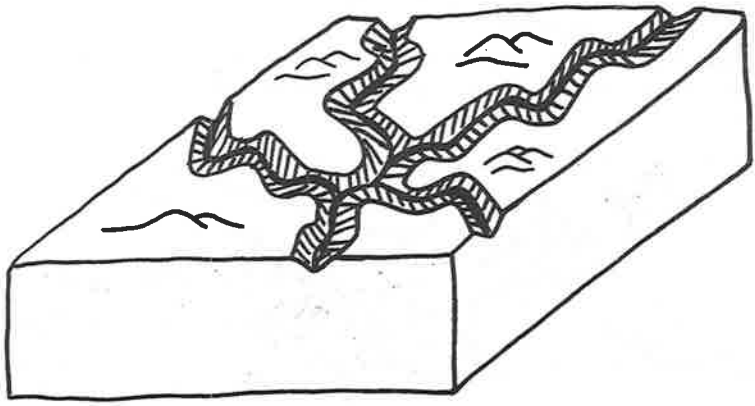

Figure 5 - Rejuvenated stage of stream development.

A large region classified as having mature topography may have individual valleys which are in the earlier stages. It is the picture of the total assemblage of land forms that determines its topographic age.

Trail Walk

This guide is intended to help the visitor identify stream development stages and causes. Although the processes that you will study today are small in scale, they are also applicable to larger streams in the Piedmont. Proceed to Station 1.

Station 1.

Valley Depth

The valley depth attained by this small stream suggests that man, as well as the force of nature, has played a part in landscape shaping. The effect of runoff is greatly enhanced on sloped land that is cultivated, as seen by the valley depth. Would you expect this downcutting process to continue, or will th stream now proceed to widen its course? Proceed to Station II.

Station 2.

Knick Points

What is the dominant process of erosion in this stream? (Horizontal or downcutting, vertical? Look downstream.)

A hard rock barrier representing a temporary *base-level* (the lowest point to which a stream can erode its channel) is generally known as a *knick point*. A knick point interrupts the gradient profile the stream is seeking to establish and causes the stream to be more level above this point and steeper below it. Typically, waterfalls or shoals form at a knick point. Streams may have more than one knick point. Continue to Station 3.

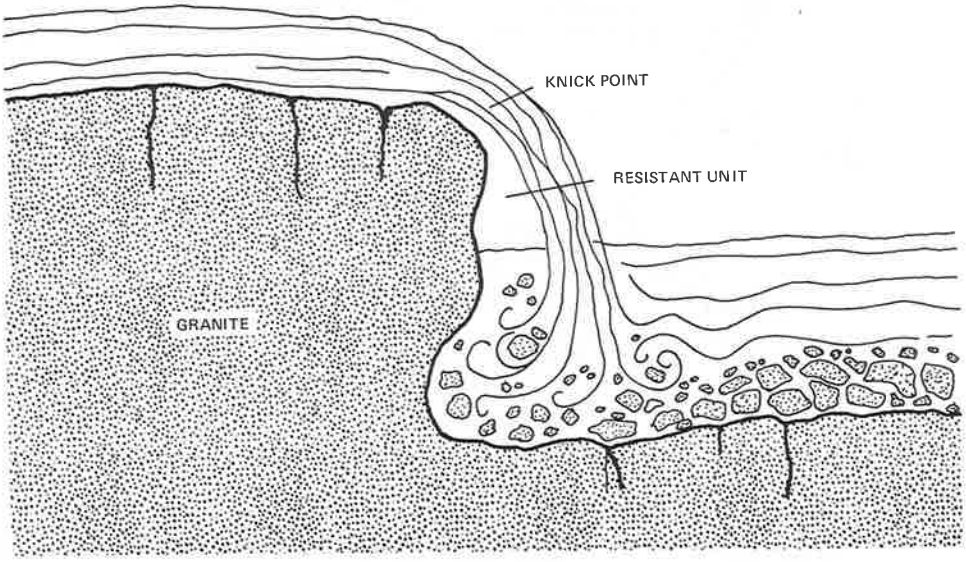

Figure 6 — Knick point in a stream.

Station 3.

Joint Control of a Stream

Many streams in the Piedmont exhibit patterns controlled by *joints* (fractures in the rock). Because streams invariably follow the course of the least resistance, they are controlled by these joints. Do you see any evidence for joints controlling this stream? Look both upstream and downstream from the bridge. Continue to Station 4.

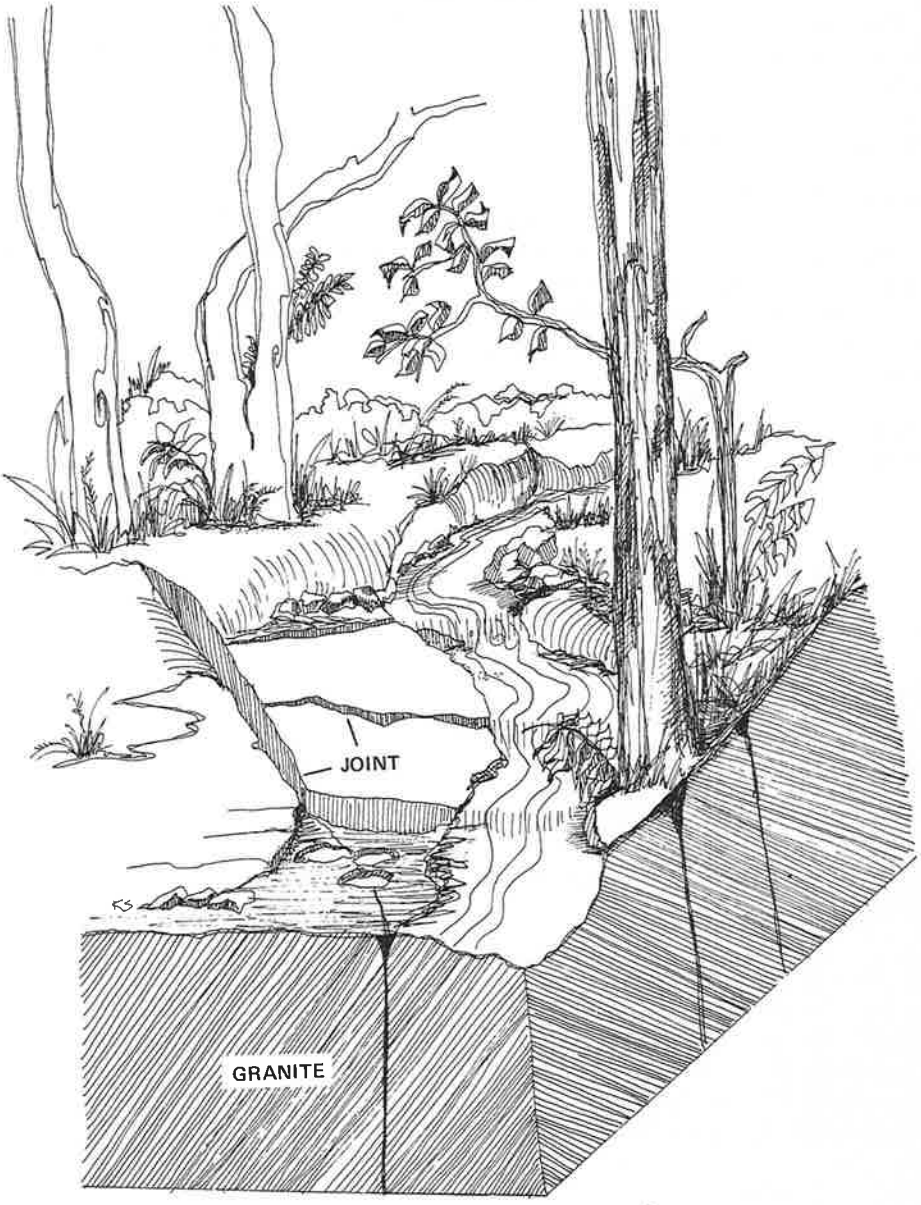

Figure 7 - Joint controlled stream.

Station 4.

Meanders

Streams that flow upon flood plains move in sweeping bends called meanders. Meanders continually change position because the maximum velocity of the stream increases toward the outside of the bend undercutting and eroding the outer bank. At the same time, the slower current at the inside of the meander results in the deposition of sediment.

Does evidence here lead you to expect any change in the stream's course at this point? What are the major differences in the inside and outside curves?

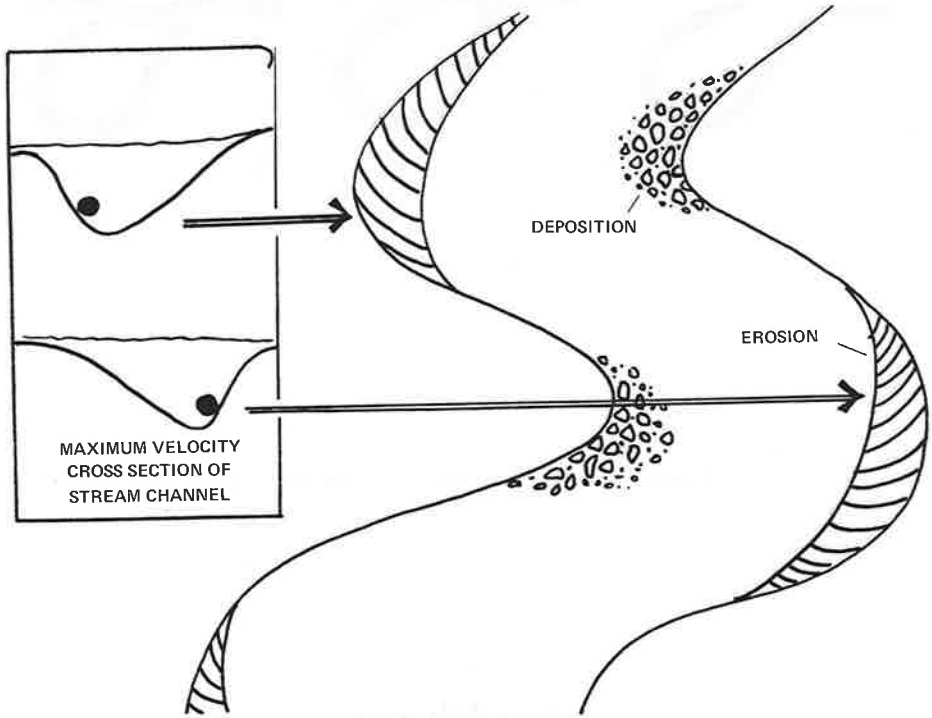

Figure 8 - Meandering stream.

Acknowledgements

The writers are indebted to the following for their assistance and helpful suggestions: Rochelle Vernen, Sam Pickering, Joseph Murray, David Lawton, and Charlotte Abrams. In addition the writers would like to thank Mildred Graham and her students at Georgia State University and the Earth Science class at Atlanta Street Academy "A" for their participation in the group-investigation field exercises. Thanks are due to the valuable assistance from the personnel at Panola Mountain State Park, especially David Miner and Kathleen Webster.

Finally, the writers are indebted to all those who helped make this guide possible.

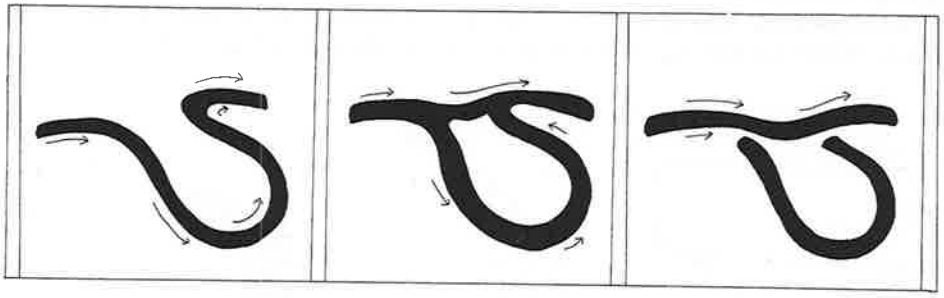

Figure 9 - Development of a meander cutoff.

Cut-off Meander

Does it appear that a change is imminent at this point in the stream? Is there any evidence that the stream may change course during a period of heavy runoff? Occasionally, one meander moves downstream faster than another and erodes the neck of land between them. When this happens, the meander is said to be *"cutoff."* A cutoff appears to be forming and may result in an *oxbow lake.*

Across the stream and to your left, notice the gulley intersecting the stream. This is the mouth of the gulley that you saw at Station 1. This gully has been carved by run-off waters. The depth may be explained by former cultivation, which increased the run-off. Once a stream reaches its base level (the lowest point to which a stream can erode its channel), downward erosion becomes less dominant, and more of the stream's energy is directed from side to side. As the valley widens, a flat valley floor, or flood plain is produced. It is so named because the stream is confined to its channel except during floodstage, when it overflows its banks and enriches the flood plain with silts (fertile sediments).

What is the dominant erosional direction at this station? Lateral or downcutting? Proceed to Station 5.

Station 5.

Flood Plain

Striking changes are evident here, affecting both the landscape and the plant growth. The clearing, produced by the back and forth meanderings of the stream, is a site of fertile soil which supports a luxuriant growth of ferns and trees.

This flood plain looks like it would make a beautiful site for a home. What possible consequences may occur if a home were constructed on a flood plain? After heavy rains a home on this site would be flooded.

During this trail walk, you have observed the alteration of landscape due to the erosion and deposition along a small stream and tributaries. The same processes of stream development which are actively at work in this watershed *drainage system* may also be observed in other streams of greater or lesser size. Even a brief observation of a watershed is convincing evidence that water, as runoff from rainfall, is indeed the major sculptor in landscape formation in many parts of the world.

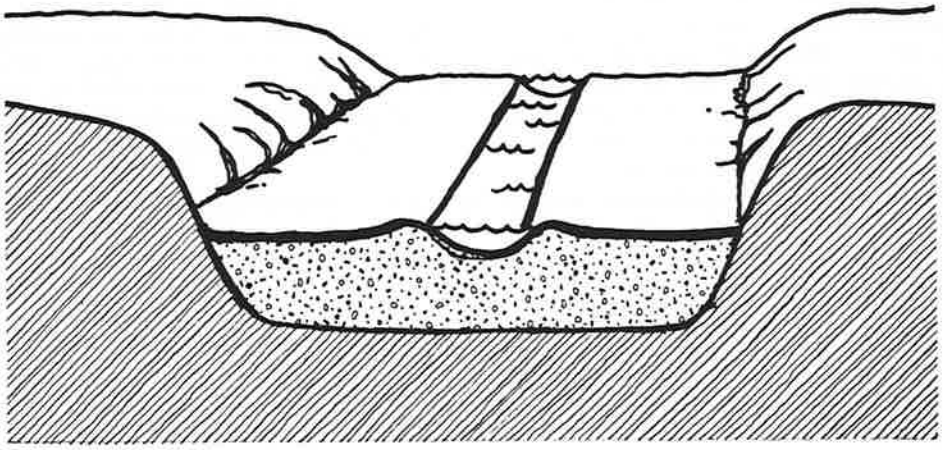

Figure 10 - Flood plain.

Glossary

Base level — the lowest level toward which stream erosion progresses. Ultimate base level is sea level. Temporary base level may be created by rocks of different resistance where erosion is temporarily limited.

Cut-off meander — a stream meander which has been abandoned in order for the stream to shorten its course in that area.

Drainage system — a surface stream (or body of water) together with all other surface streams that contribute to it that drain a particular region.

Flood plain — a nearly flat tract of land bordering a river, mainly in its lower reaches and consisting of river-lain deposits such as sand, silt, clay or gravel that may be covered in times of high stream flow.

Stream gradient — slope of a stream channel.

Joint — a fracture in a rock in which there has been little or no movement.

Knick point — a temporary resistant point in a stream which results in the development of shoals and/or water falls.

Meander — any naturally occurring bend which a river or stream may develop along its course.

Monadnock — an isolated hill which stands above an erosion surface.

Oxbow lake — meander loops tend to enlarge themselves by the erosion of their outer banks which gradually narrows the neck between successive loops. In time of flood the neck may be breached and the ends of the loop become silted up, the river taking the new straighter course. The cutoff loop is called a cut-off meander and if a lake exists it is called an oxbow lake. The lake subsequently becomes a marsh and in time dries out.

Relief — difference in elevation between the highest and lowest points in a given area.

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