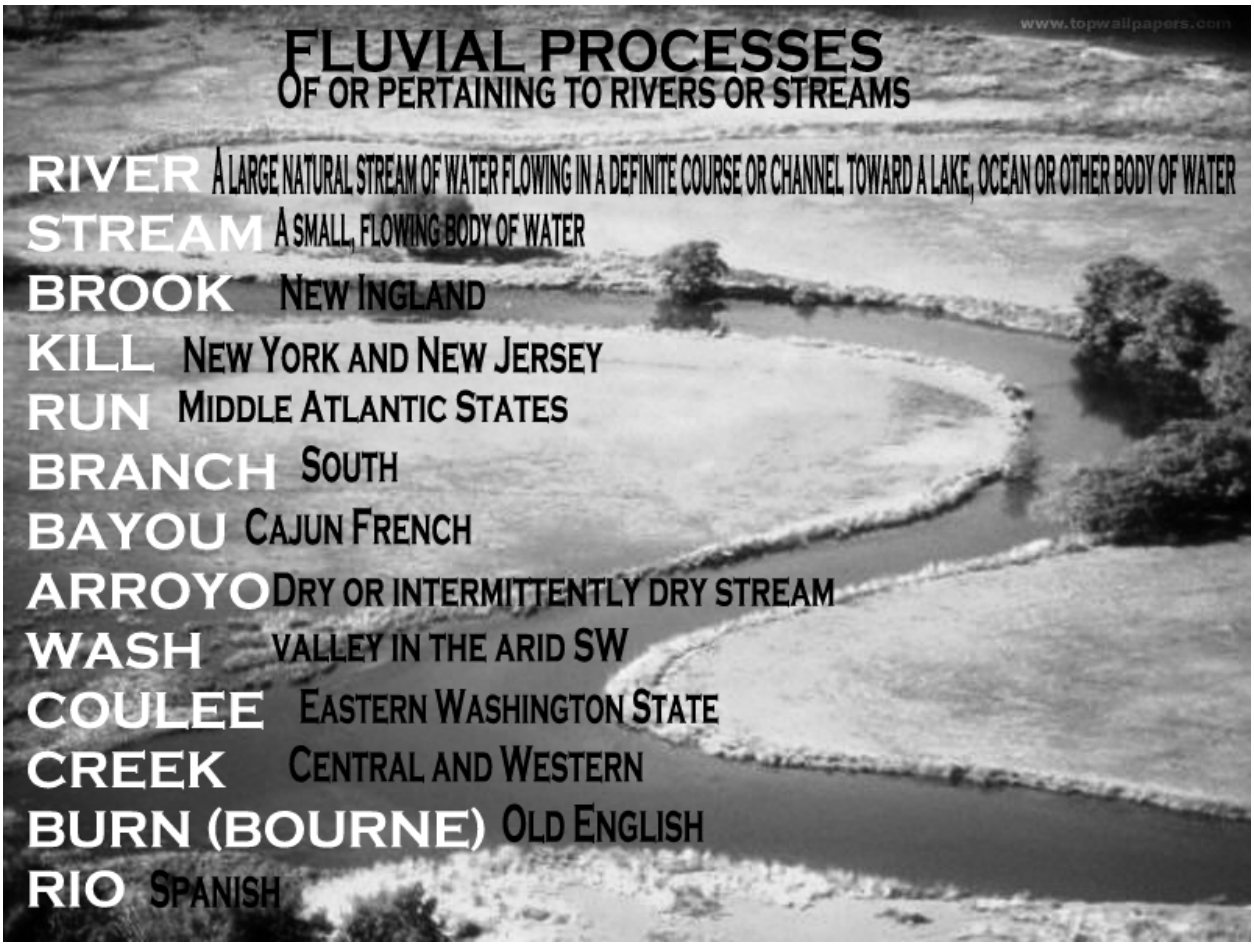
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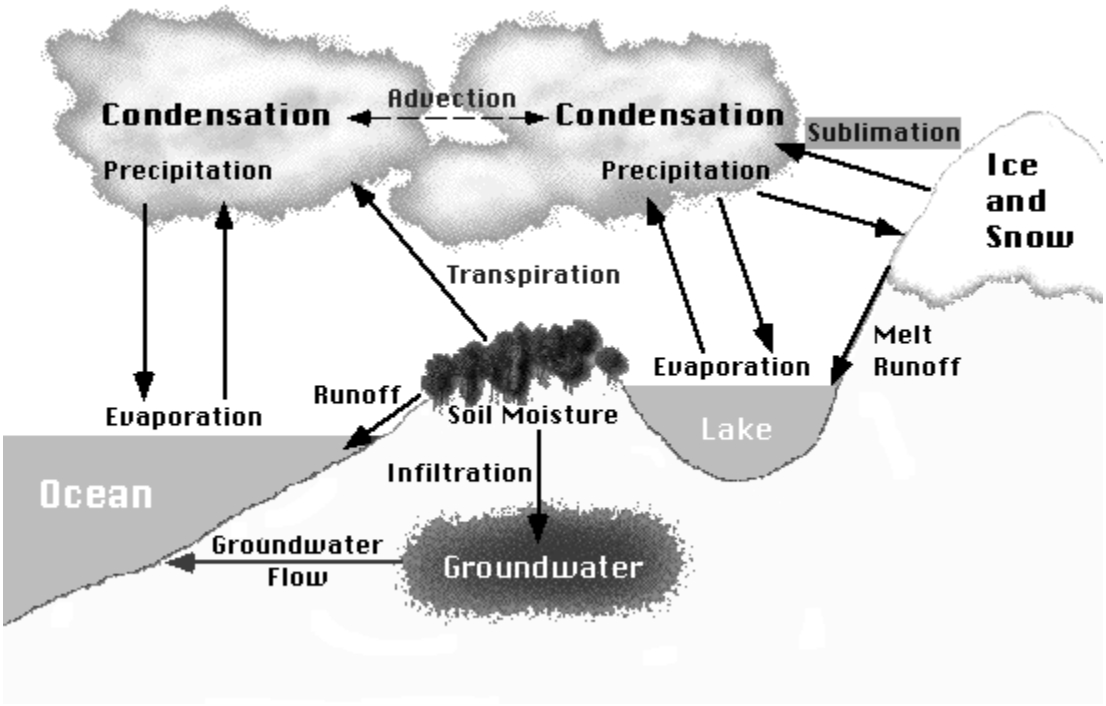
FLUVIAL PROCESSES
OF OR PERTAINING TO RIVERS OR STREAMS
RIVER A LARGE NATURAL STREAM OF WATER FLOWING IN A DEFINITE COURSE OR CHANNEL TOWARD A LAKE, OCEAN OR OTHER BODY OF WATER
STREAM A SMALL, FLOWING BODY OF WATER
BROOK NEW INGLAND
KILL NEW YORK AND NEW JERSEY
RUN MIDDLE ATLANTIC STATES
BRANCH SOUTH
BAYOU CAJUN FRENCH
ARROYO DRY OR INTERMITTENTLY DRY STREAM
WASH VALLEY IN THE ARID SW
COULEE EASTERN WASHINGTON STATE
CREEK CENTRAL AND WESTERN
BURN (BOURNE) OLD ENGLISH
RIO SPANISH

HYDROLOGIC (WATER CYCLE)
Water is in constant circulation
powered by sunlight - energy from the sun

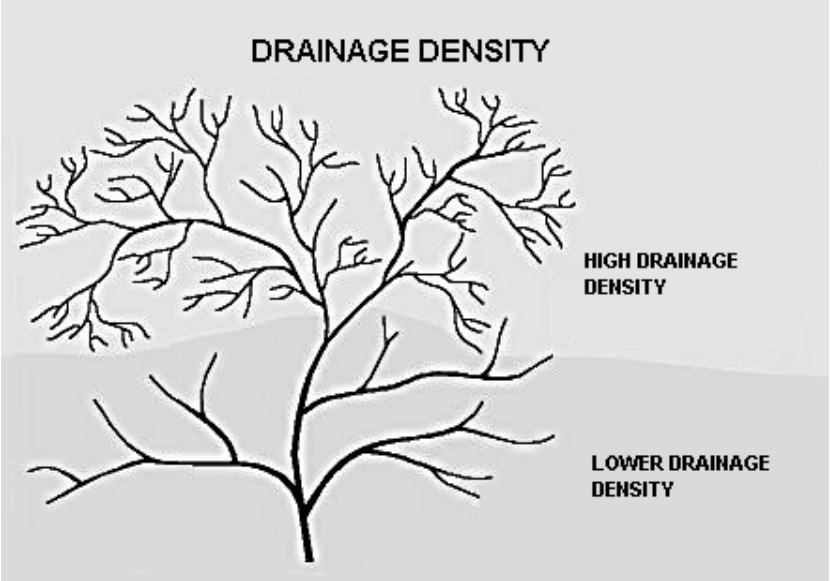
Runoff = Precipitation – (Infiltration + Evaporation & Transpiration)



Reservoir	Volume (Km^3 x 10,000,000)	Percent of Total
Oceans	1370	97.25
Ice Caps and Glaciers	29	2.05
Groundwater	9.5	0.68
Lakes	0.125	0.01
Soil Moisture	0.065	0.005
Atmosphere	0.013	0.001
Streams and Rivers	0.0017	0.0001
Biosphere	0.0006	0.00004

Most of earth's water is not very useful too salty, solid…
only about 0.64% can be consumed or used in agriculture.

DRAINAGE DENSITY. Amount of streams in a given area.

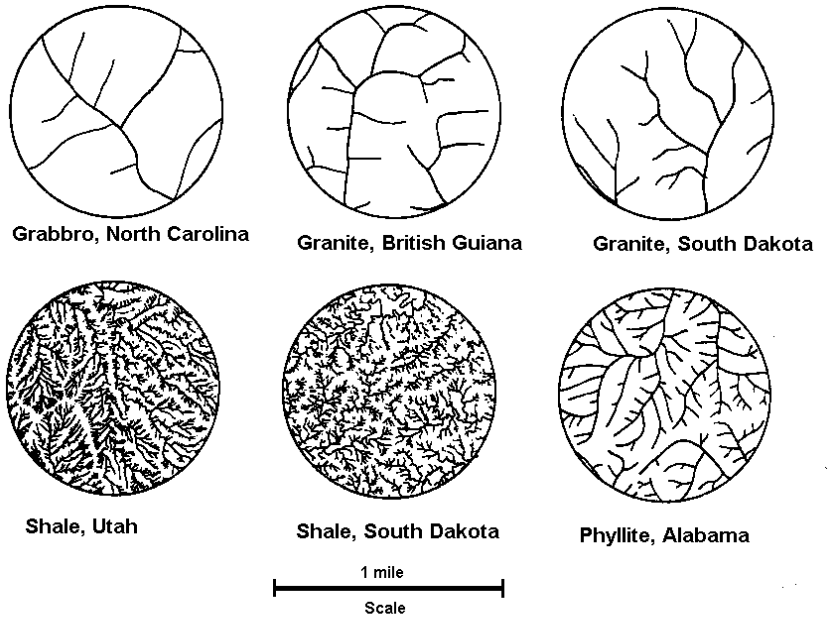


Amount of precipitation absorbed (infiltrated) by the ground = f(permeability)
PERMEABILITY. Ability to transmit water.

ROCKS

Low Permeability ⇒ Absorb less pp. More runoff **Higher drainage density**.
(crystalline or well lithified; sh, sl, phyl, most ig.)

High Permeability ⇒ Absorb more pp. Less runoff **Lower drainage density**
(weakly cemented ss, cg or slightly soluble ls)

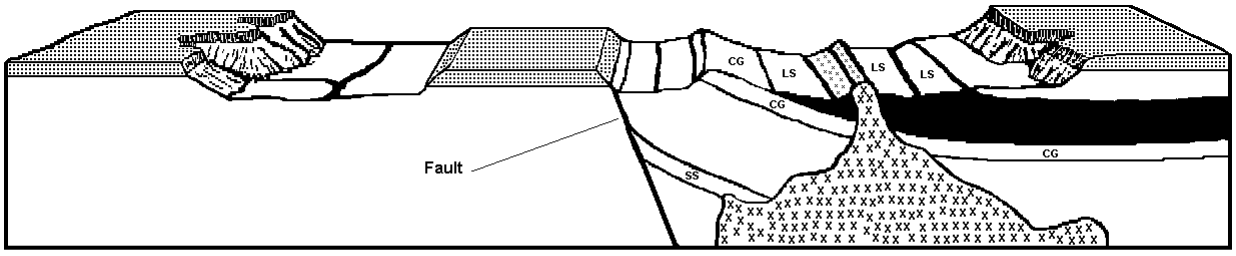


(After Ray and Fischer, 1990)

DIFFERENTIAL STREAM EROSION -Resistance of the bedrock to stream erosion.
Different rock types erode at different rates.

FACTORS

MINERALOGY (Chemical breakdown)
DEGREE OF LITHIFICATION (Mechanical breakdown)
LOCAL CLIMATE (Humid, Arid)

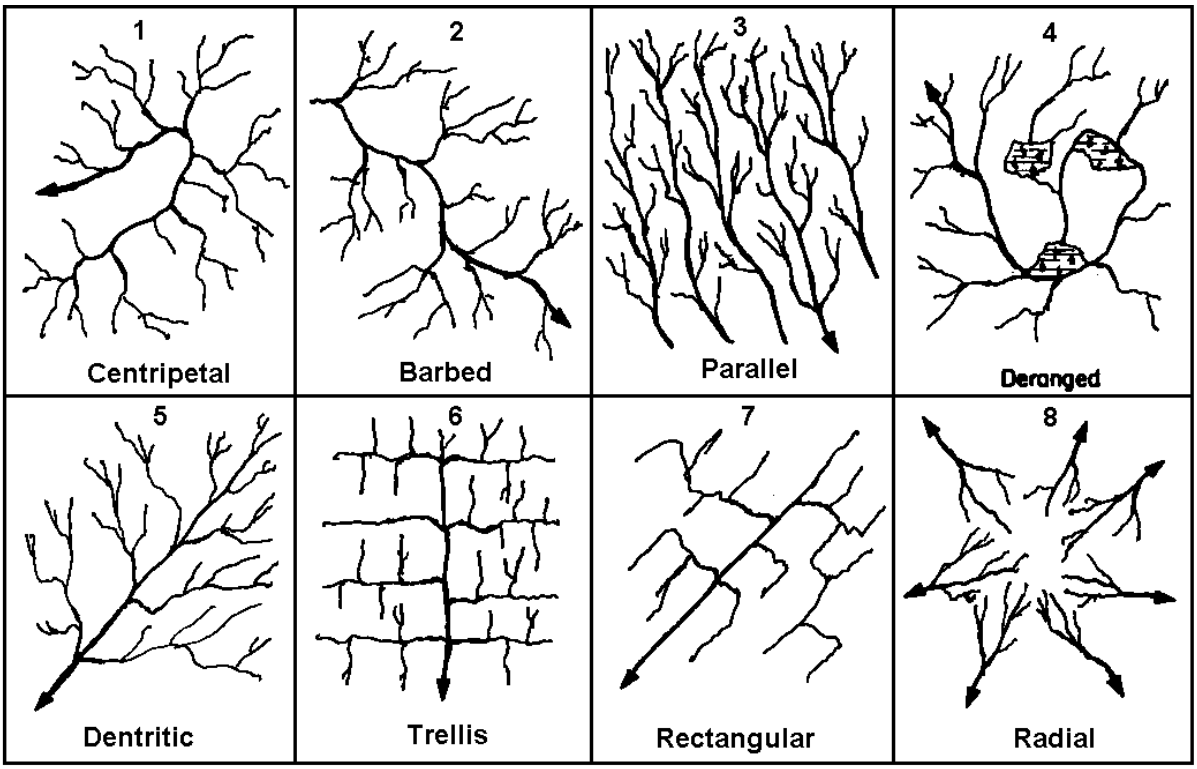


Block diagram illustrating differential stream erosion (HUMID CLIMATE)

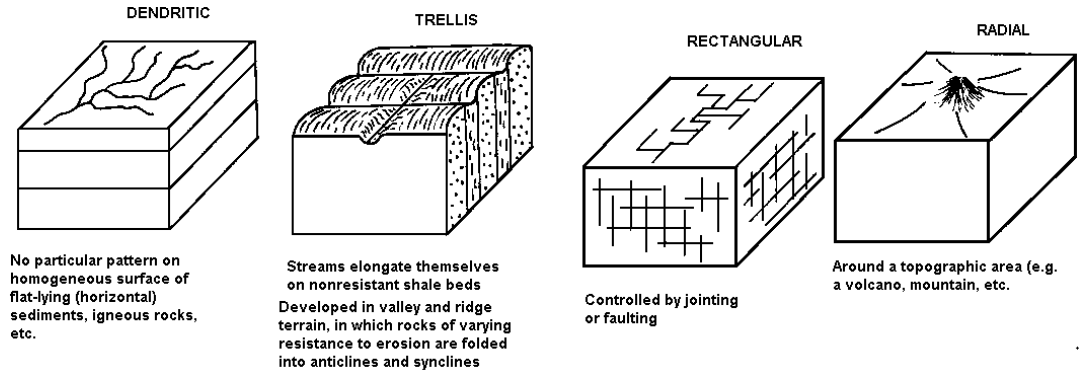
DRAINAGE PATTERN –Geometric distribution of streams within an area
DRAINAGE PATTERN –Geometric distribution of streams within an area

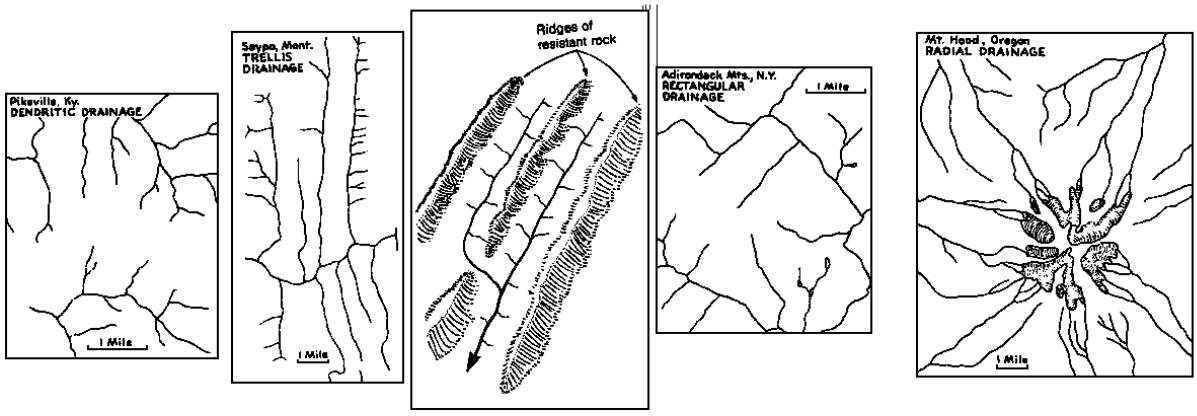
PATTERN	GEOMETRY	SIGNIFICANCE
DENDRITIC	Branches of trees	Areas of no structural control on drainage courses and uniform bed rock (Horizontal layers)
TRELLIS	Major streams have sub parallel orientation. Tributaries converge at nearly right angles.	Areas where resistant and bedrock ridges alternate with valleys underlain by less resistant bedrocks (Folded rock areas)
RECTANGULAR	Streams meet at right angles and have similarly bend shapes. More ordered pattern.	Areas were streams flow along zones of weakened rocks adjacent to intersection of faults or joints. Highly fractured area
RADIAL	Like spokes in bicycle wheel.	Streams that drain an isolated topographic highland (mountain, volcano)
COMBINATIONS		

DRAINAGE PATTERN –Geometric distribution of streams within an area

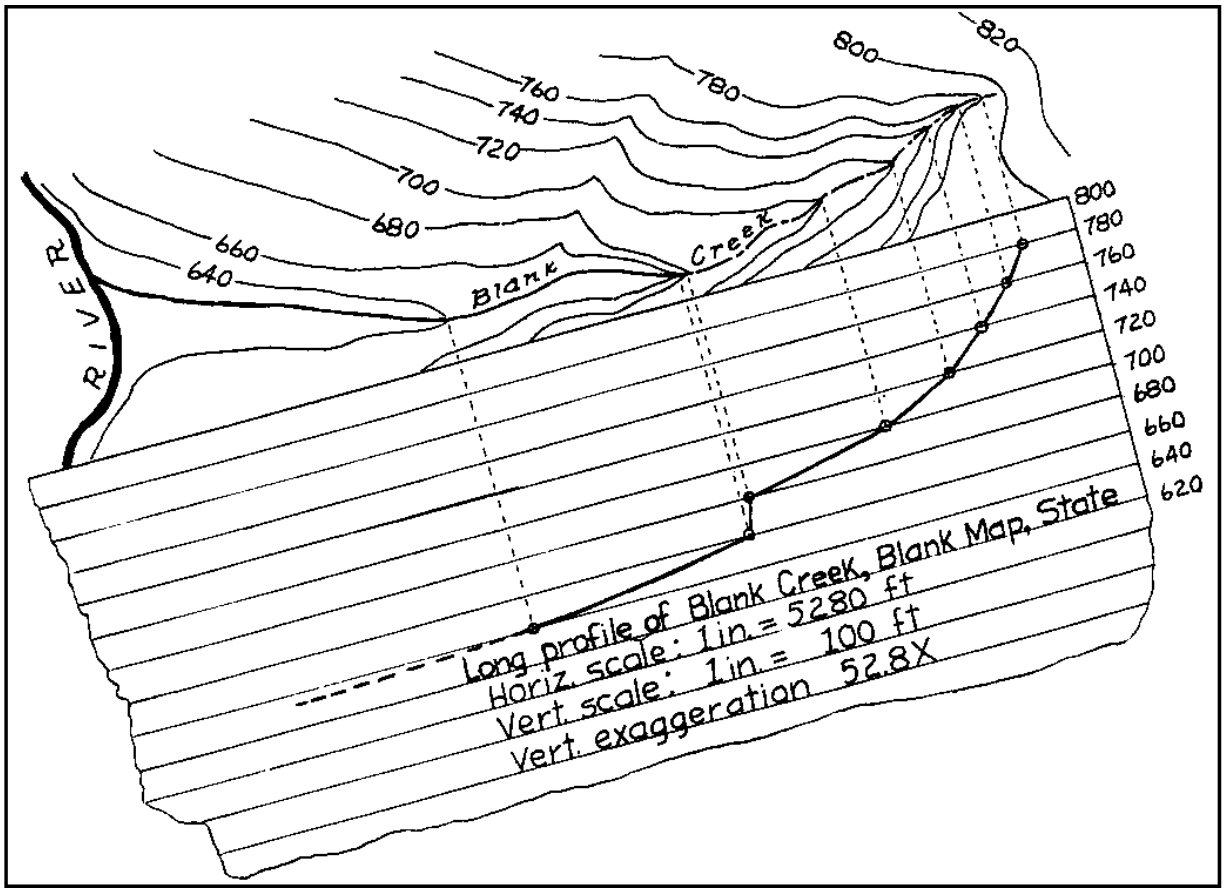


DRAINAGE PATTERNS



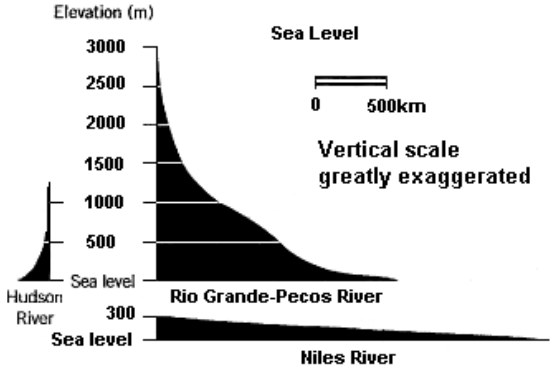


LONGITUDINAL PROFILE. Generalized cross-sectional profile



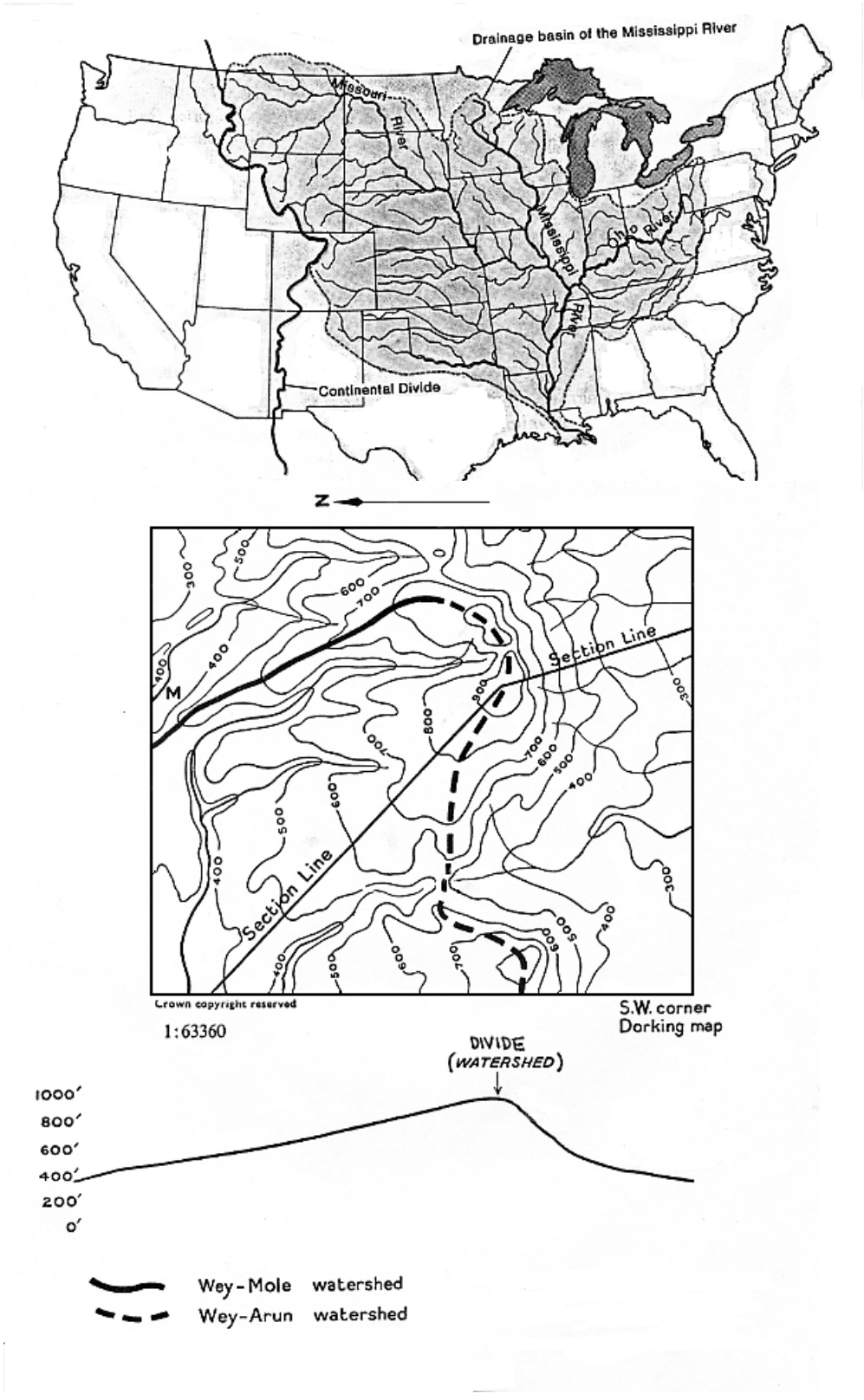
The slope (gradient) of rivers is never constant throughout their course.
Rivers have CONCAVE UPWARDS PROFILES

Mountain streams steep 10-40 m/km 950-215 ft/mile
Lower Mississippi gentle 0.1 m/km 5 ft/mile

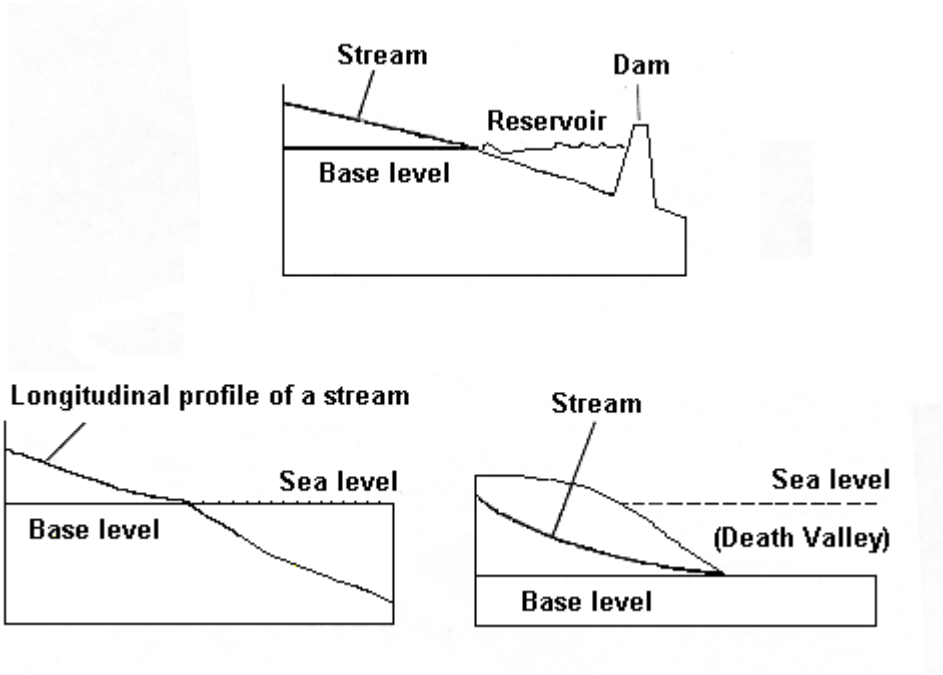


Stream profiles drawn to the same scale.
They all exhiit concave upwards profiles

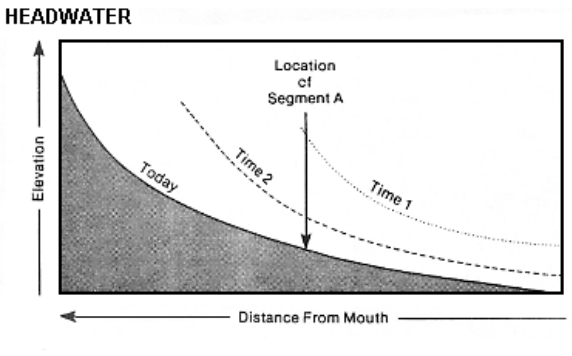
DRAINAGE BASIN. Drainage network in which smaller (tributary) streams feed larger streams. Entire area from which a main stream and its tributaries receive water. The area that streams drain.



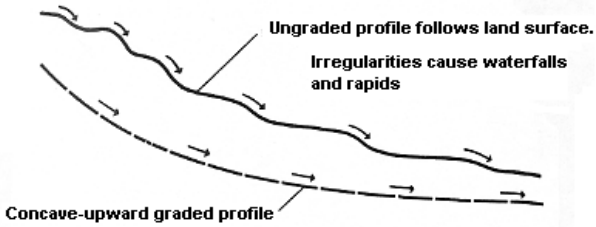
<u>BASE LEVEL</u>. Lowest level of down cutting



HEADWARD EROSION. Basic mechanism by which a drainage system is extended upslope.



Generalized longitudinal profiles.
At some time in the past (time 1), segment A was located at the headwaters.
The system has been enlarged through downward and headward erosion.
At a later time (time 2) segment a is no longer at the headwaters.
Continued erosion until today has extended the river and further lowered segment A's relative position on the longitudinal profile



A graded (or balanced) stream has smoothed out the irregularities in its longitudinal profile.

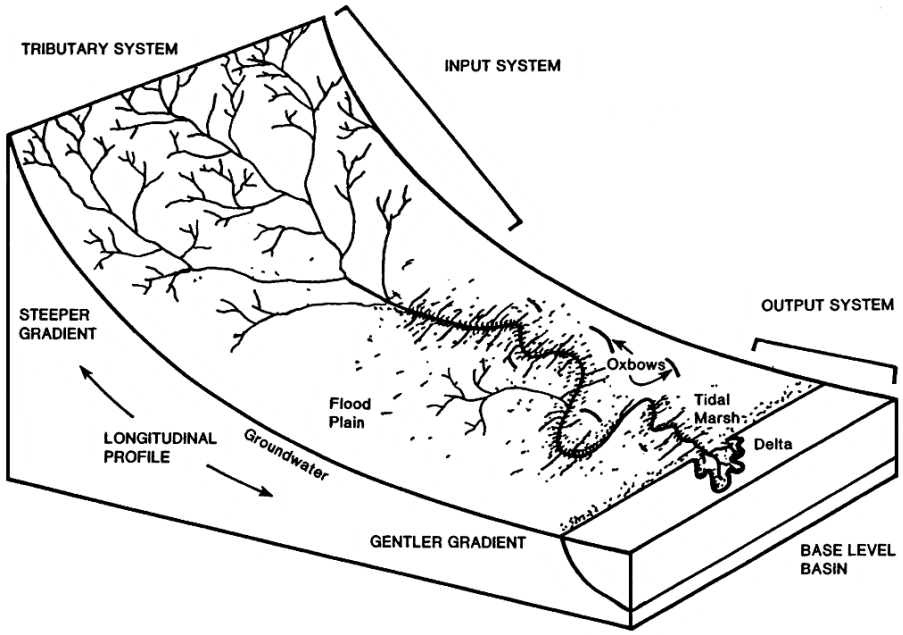
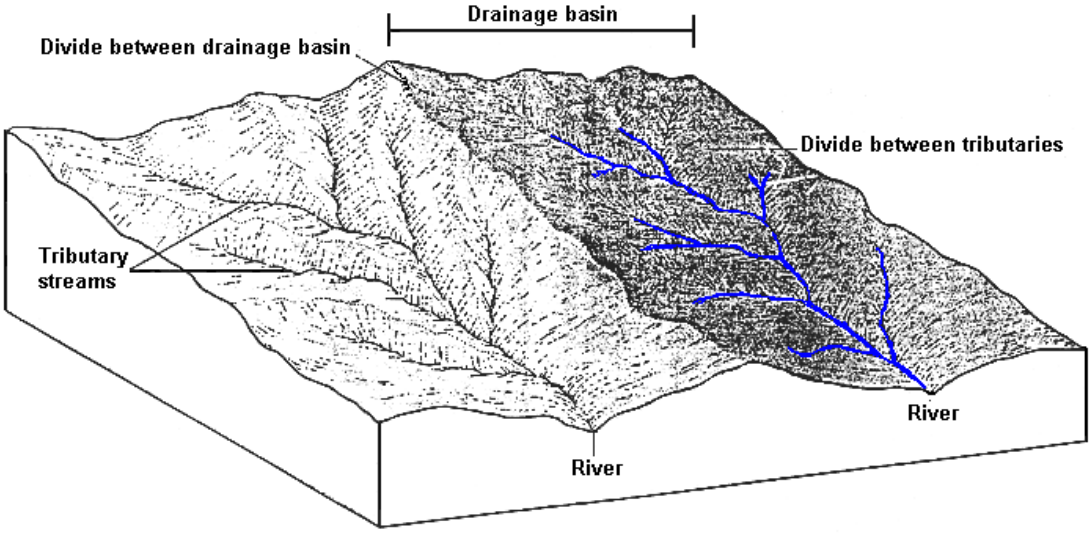


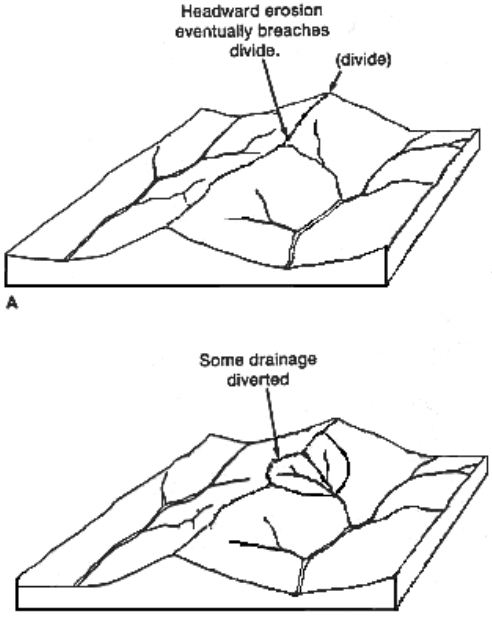
Figure 9.3. Major components of the fluvial system, and influential factors.

STREAM CAPTURE OR PIRACY When one stream is flowing is flowing over less resistant rock, or has steeper slope, that another stream it has an erosional advantage. In this situation, the stream with the advantage may in effect capture the water of the other stream. The best evidence that stream piracy has occurred in an area is the presence of one or more WIND GAPS ==> Empty stream channel cutting through a ridge. (prior WATER GAP)



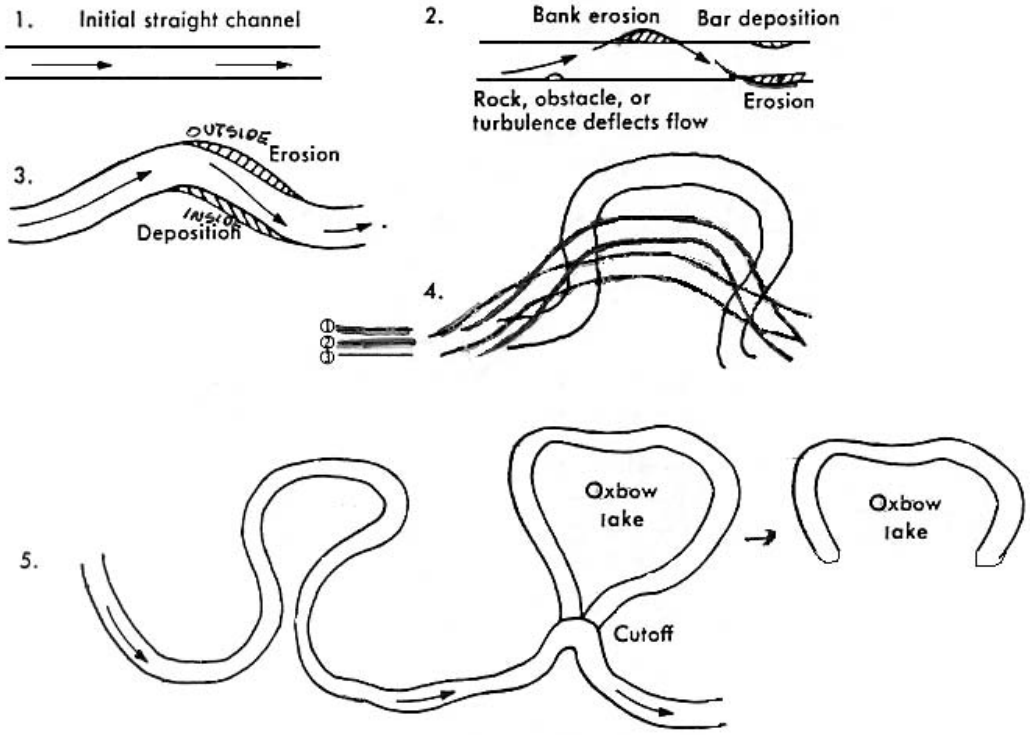
The boundaries of drainage basins (divides or watersheds) are local topographic highs

HEADWARD EROSION
-Basic mechanism by which a drainage system is extended upslope.

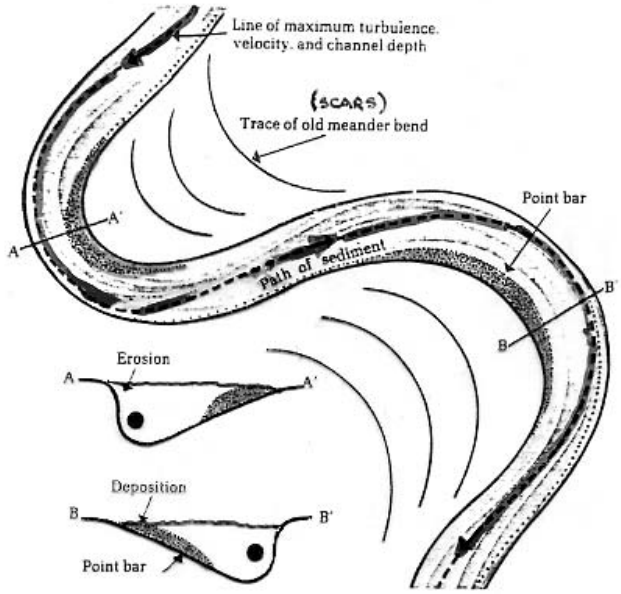


Schematic sream piracy.

MEANDER FORMATION



Meandering stream channel.



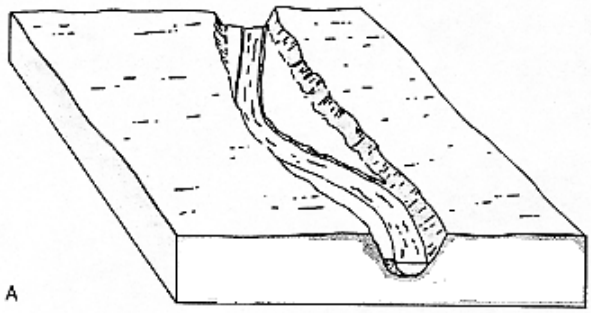
FLOODPLAIN. Portion of a river valley adjacent to the river, that builds up of alluvium (sediments) deposited during the present disposition of the stream flow. It is covered with water when the river overflow during flood periods

FEATURES OF RIVER FLOODPLAINS

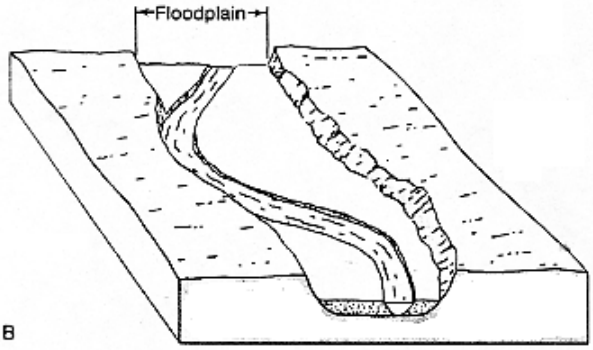
MEANDERS			Moving water that flows in a sinuous pattern because of channel irregularities deflect moving water toward nearby banks. Produce a local increase in velocity ==> Erosive undercutting of channel banks
CUT-OFFS	Formed by the development an migration of meanders	Increase in water velocity ==> Erosive energy. Outside meander bends	
OXBOW LAKES			
DOWNSTREAM BAR POINT BAR		Decrease in water velocity ==> Deposition. Inside meander bends	
MEANDER SCROLLS		Scars	Curved topographic irregularities. Preserve record of meander migrations
NATURAL LEVEES	Decrease in velocity ==> carrying capacity decreased	Coarser sediments are deposited along the river channel. After several floods ==> Formation of Ridges	When a stream floods its overrides its banks and spreads out over its floodplain. As it does this, is slows up and deposits. The heaviest material is deposited near the bank of the stream in mound parallel to the stream's course.
BAYOUS OR BACKWAMPS		Floodplains with poor drainage (swampy).	Disruption of the drainage produced by natural levees
YAZOO STREAMS		Natural levees become barrier to merging tributaries	The flow parallel to a major river before they can find a break

FLOODPLAIN.

Portion of a river valley adjacent to the river, that builds up of alluvium (sediments) deposited during the present disposition of the stream flow. Its is covered with water when the river overflow during flood periods.

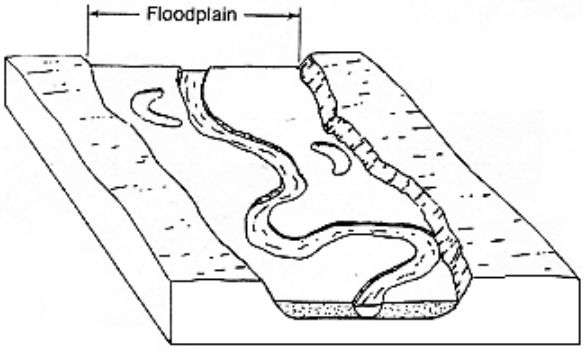


A



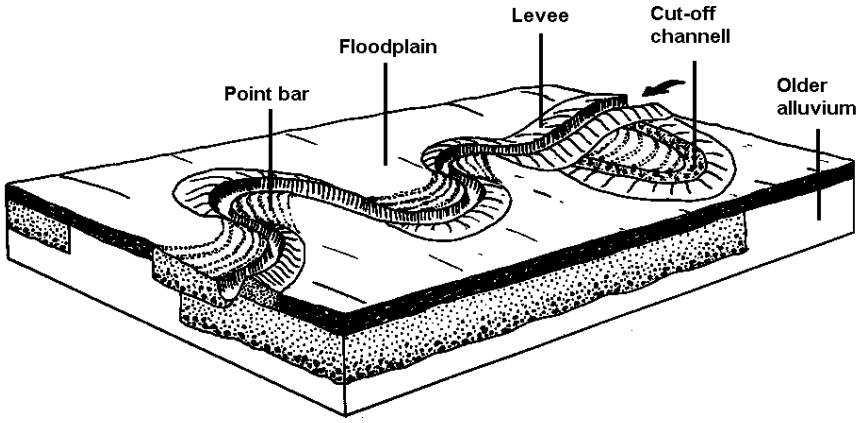
B

Lateral erosion.
Valley widening

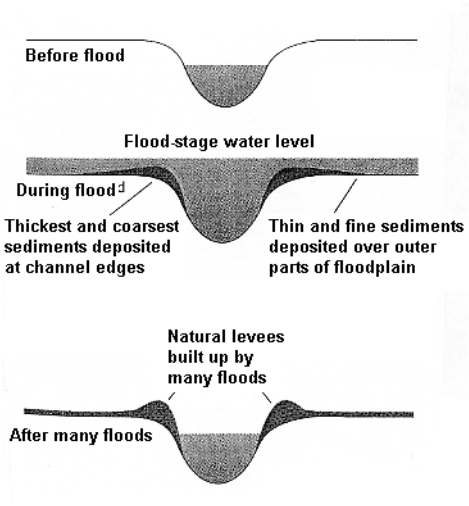


Alluvium accumulates. Meandering river continues to widen the floodplain.

Oxbow lakes are common on a Mature foodplain (From Montgomery, C.W., 1987)



NATURAL LEVEE

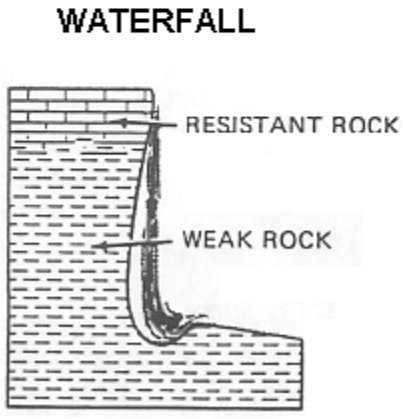


FLUVIALEROSIONAL CYCLE

INITIAL STAGE

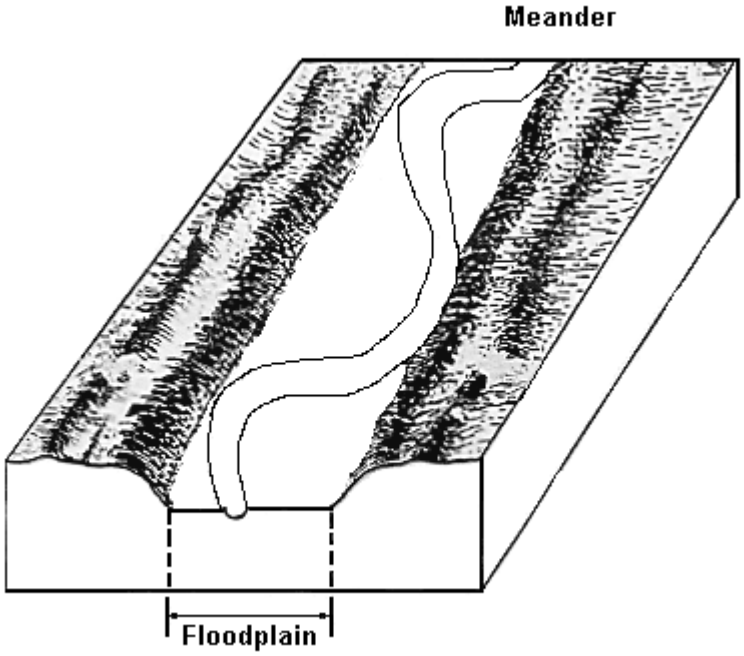
- The stream is flowing down a **steep slope** and therefore has a high velocity and high capability to erode
- Low drainage density
- The stream follows a relatively **straight path**.
- As the stream erodes it cuts a channel that may be described as **straight and V-shaped.**
- The stream is marked by many **waterfalls and rapids**
- Little **or no Floodplain**
- The stream's main activity is **valley deepening**.

V-shaped valley.
Little or no floodplain.



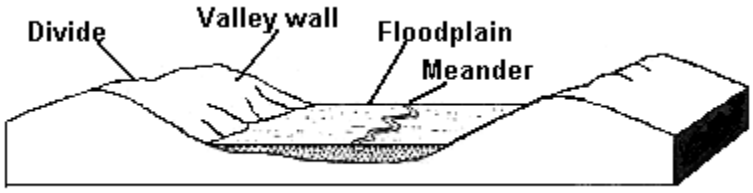
INTERMEDIATE STAGE

- The velocity of the stream decreases. This is accompanied by a proportionate decrease in its ability to erode. (**Decrease in slope**).
- As a result the stream is deflected from its straight course by obstacles in its path. Once deflected in this way, the stream begins to swing from side to side, developing smooth curves called **meanders (unrestricted meanders).**
- Increase of drainage density.
- Drainage system more integrated
- **Ox-bow lakes** ere formed, and **floodplain development begins**.
- The main activity is **valley widening**.
- Much less pronounced V-shapes



TERMINAL STAGE

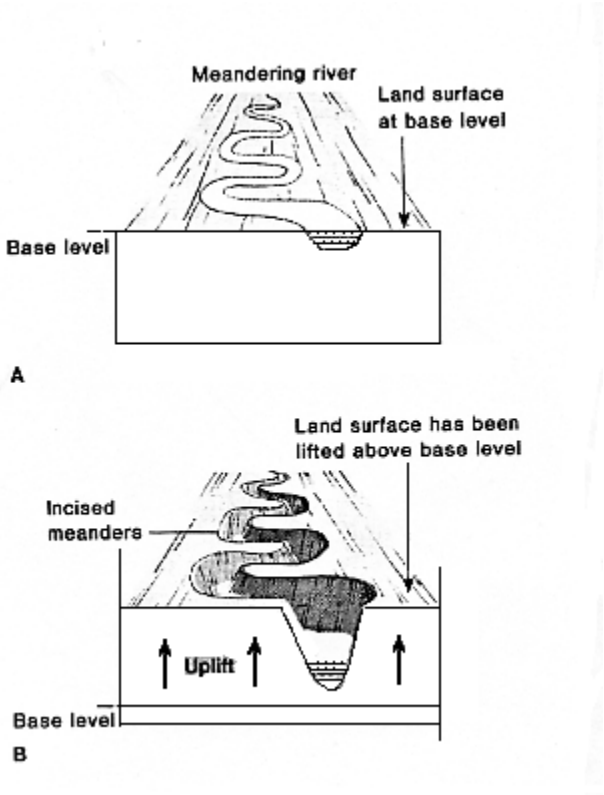
- The floodplain may be many times wider that the meander belt (**restricted meanders**)
- Ox-bow lakes tend to dry op to become swamps. In time the swamps evaporated, leaving dry stream channels called **meander scars**.
- Very low gradients
- Floodplains develop over large areas.
- **Natural levees** are formed
- The land is **lowered to base level**.
- The main activity is **valley widening and deposition**.
- **MONADNOCK** Isolated hill formed by rocks that are particularly resistant to stream erosion.



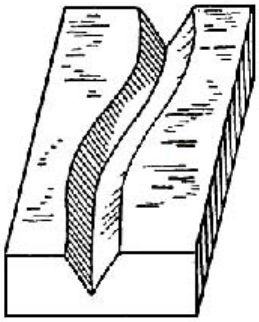
REJUVENATION

- Uplift ==> lowers the base level ==> streams begging active downward erosion
- Complex landscapes (remnants of older landforms are locally preserved)

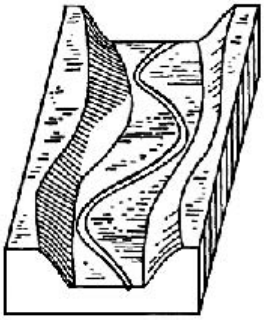
1. **TERRACES** Old floodplains
2. **INCISED OR ENTRENCHED MEANDERS.** Meandering streams become entrenched and have pronounced V-shaped valleys. Interstream divides are not flat plateaus. [Grand Canyon AZ]]



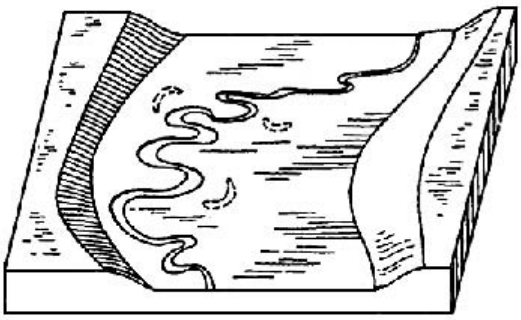
FLUVIAL EROSIONAL CYCLE



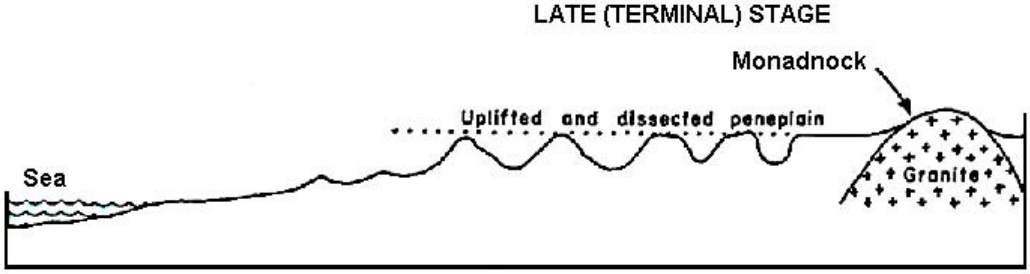
EARLY (INITIAL) STAGE
V- shaped valley.
Steep irregular gradient
Little or no floodplain

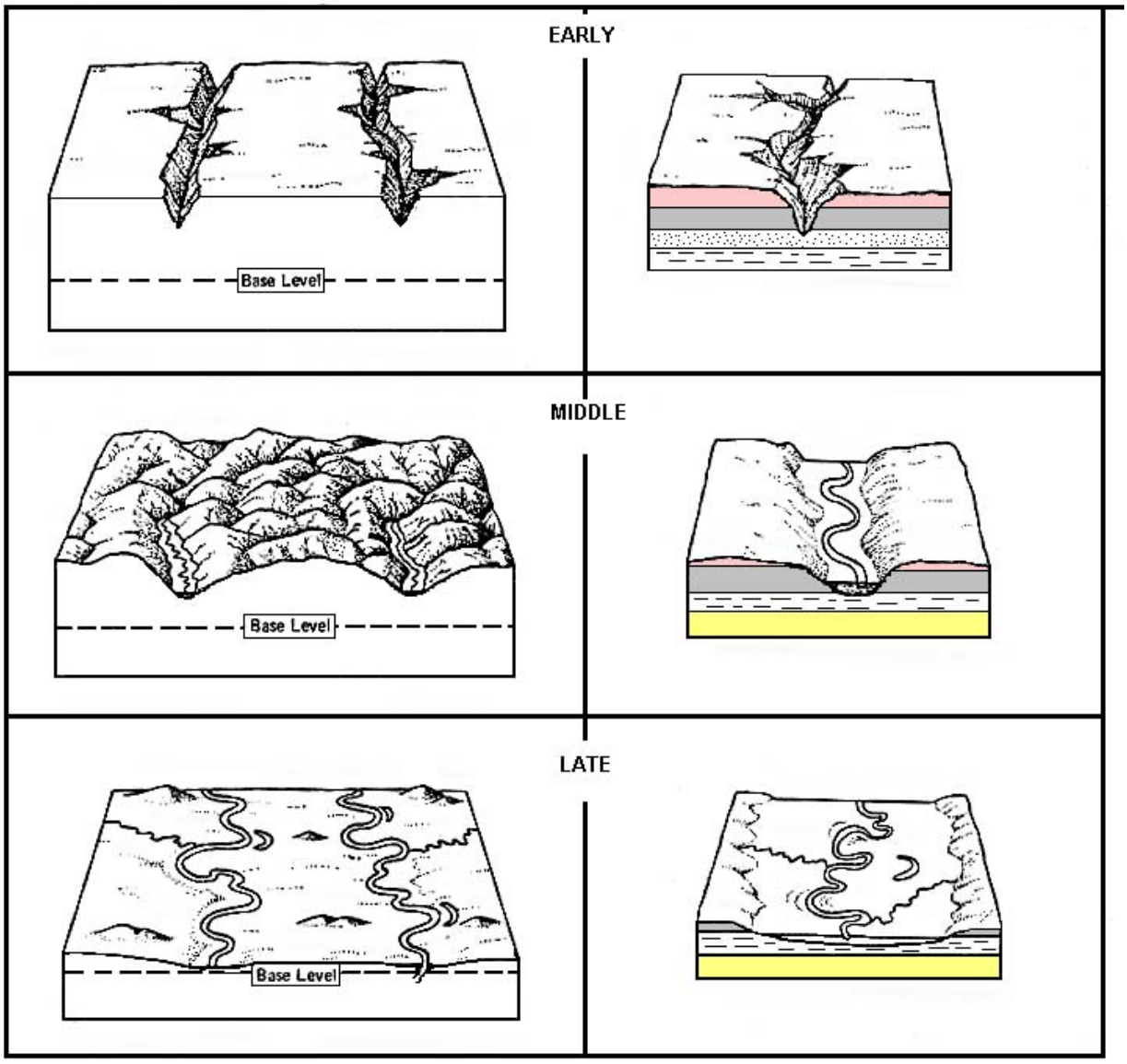


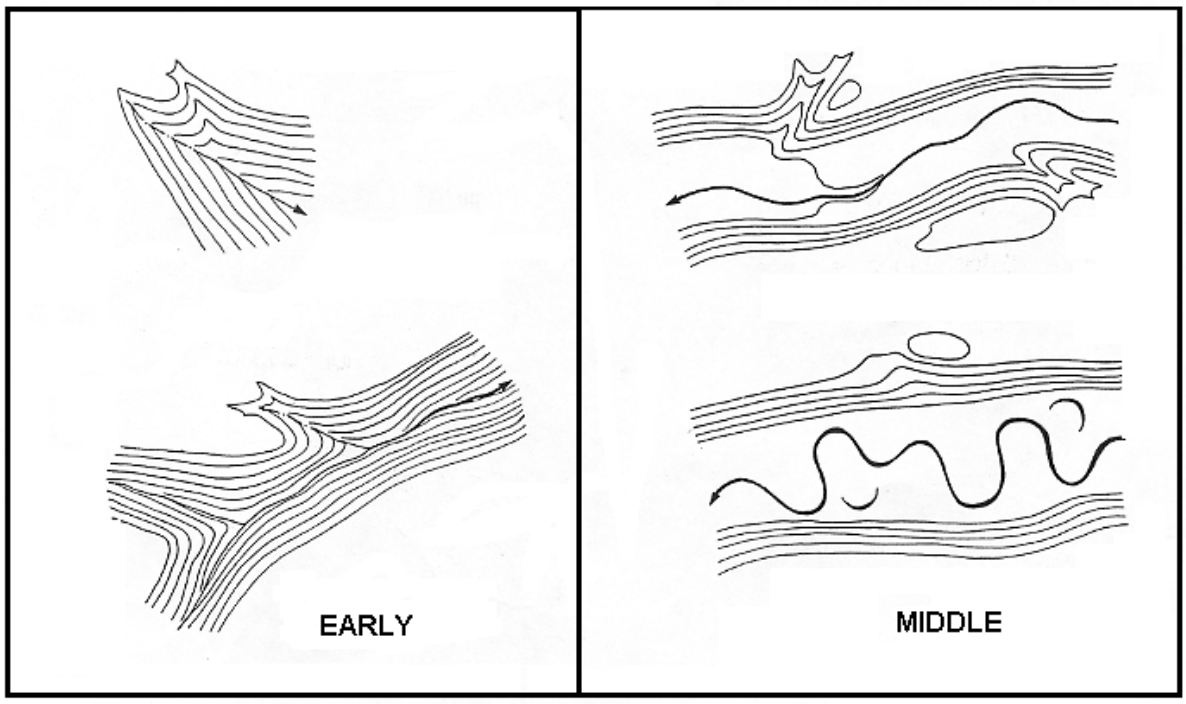
MIDDLE (INTERMEDIATE) STAGE
Valley cross-section has broad rounded "v shape.
Floodplain is present
Meander belt occupies the entire width of the floodplain



LATE (TERMINAL) STAGE
Very broad valley.
Extensive floodplain.
Numerous meanders.
Oxbow lakes.
Floodplain much wider than meander belt




EARLY
Base Level
MIDDLE
Base Level
LATE
Base Level


EARLY
MIDDLE