Geology of Arkansas
Arkansas Geology Commission

Rocks are generally placed into 1 of 3 major categories: igneous, metamorphic, or sedimentary. Igneous rocks have solidified from molten or partly molten mineral matter. Metamorphic rocks have been altered in the solid state from some pre-existing condition in response to significant changes in temperature, pressure, or chemical environment. Sedimentary rocks are composed of particles of sediment, which are derived by the weathering and/or the erosion of pre-existing rock. Most surficial rocks in Arkansas are sedimentary, but there are some igneous rocks (with adjacent contact metamorphic rocks) and very low grade regional metamorphic rocks in Arkansas also.

A sedimentary rock consists of two components: the particles and the cement that holds them together. However, the unconsolidated sediments of eastern Arkansas are considered sedimentary rocks. Sedimentary rocks are classified as clastic (rocks made up of grains of sand, silt, and clay) or chemical (rocks made up of shell fragments, saline water deposits, and other materials that are deposited from solution). The most common clastic sedimentary rocks are shales, siltstones, and sandstones. The most common chemical sedimentary rocks are limestone and dolostone.

To understand how sedimentary rocks form, we must account for the processes that create the original particles of sediment, the mechanisms of sediment transport, the processes of deposition or precipitation of a given sediment, and what has happened to the sediment over time. By studying rocks and depositional systems (the processes by which sediments are deposited), geologists recognize that most of the sedimentary rocks in the Paleozoic Highlands of Arkansas are marine. In the southern and eastern parts of the state, the sedimentary deposits are predominantly fluvial (fresh-water processes).

The exposures of igneous rocks in Arkansas are less than 0.1 percent of the entire area of the state. Most are exposed over 15 square miles, principally in Pulaski, Saline, Hot Spring, Garland, and Pike Counties. A few small igneous dikes and sills are present outside the Ouachita region, mostly in the Arkansas Valley, and in at least one case, in the Boston Mountains. Except for some localized contact metamorphism adjacent to the larger igneous intrusions, only very low grade metamorphic rocks are present in the state.

Arkansas is divided into a highland area in the northwest and a lowland region in the south and east. The rocks in the highland area are dominated by well-lithified sandstones, shales, limestones, and dolostones of Paleozoic age. A thin drape of younger unconsolidated clays, sands, and gravel, termed alluvium, is often found in valley floors and associated with the streams and rivers. The sedimentary deposits of the lowlands are mainly unconsolidated clay, sand, and gravel of Quaternary age, poorly consolidated deposits of clay, sand, silt, limestone, and lignite of Tertiary age, and consolidated (to a limited extent) deposits of Cretaceous marl, chalk, limestone, sand, and gravel (see **Geologic Map of Arkansas**).

When most of the sediments that compose the rocks in the highland region of Arkansas were being deposited, north Arkansas was a shallow south-sloping sea floor (continental shelf), the

Arkansas River Valley was near the edge of the shelf, and the Ouachita area was a deep abyssal plain (see **General Geologic History**). An abyssal plain is the relatively smooth and deep (more than 3,000 feet below sea level) parts of the ocean floor where accumulating sediments have buried the pre-existing topography. In the late Paleozoic Era, a broad uplift domed the Ozark strata with little structural disruption. Simultaneously, a collision of two of the earth's mobile continental plates compressed the sediments of the abyssal plain into the Ouachita Mountains. This multimillion-year-long process folded and faulted the Ouachita strata into a structurally complex mountain chain. The Arkansas River Valley area is the transition zone between the structurally simple Ozarks and the structurally complex Ouachitas with subdued characteristics in each region.

Today, the rocks of the Ozarks tilt slightly to the south and have a dendritic drainage pattern. Since shales and siltstones erode faster than sandstones and limestones, the basic topography is flat-topped mountains with stepped flanks. By contrast, the topographic expression of the Ouachitas is controlled not only by the erosional resistance of the rocks, but also by their internal structure. The strata are complexly folded and frequently faulted. The mountains are mostly east-west-trending ridges supported by erosionally resistant rocks and separated by less resistant rocks. The Arkansas River Valley is characterized by much less intensely folded and faulted strata than the Ouachita region. Erosional processes left the synclines as mountains and the anticlines as valleys.

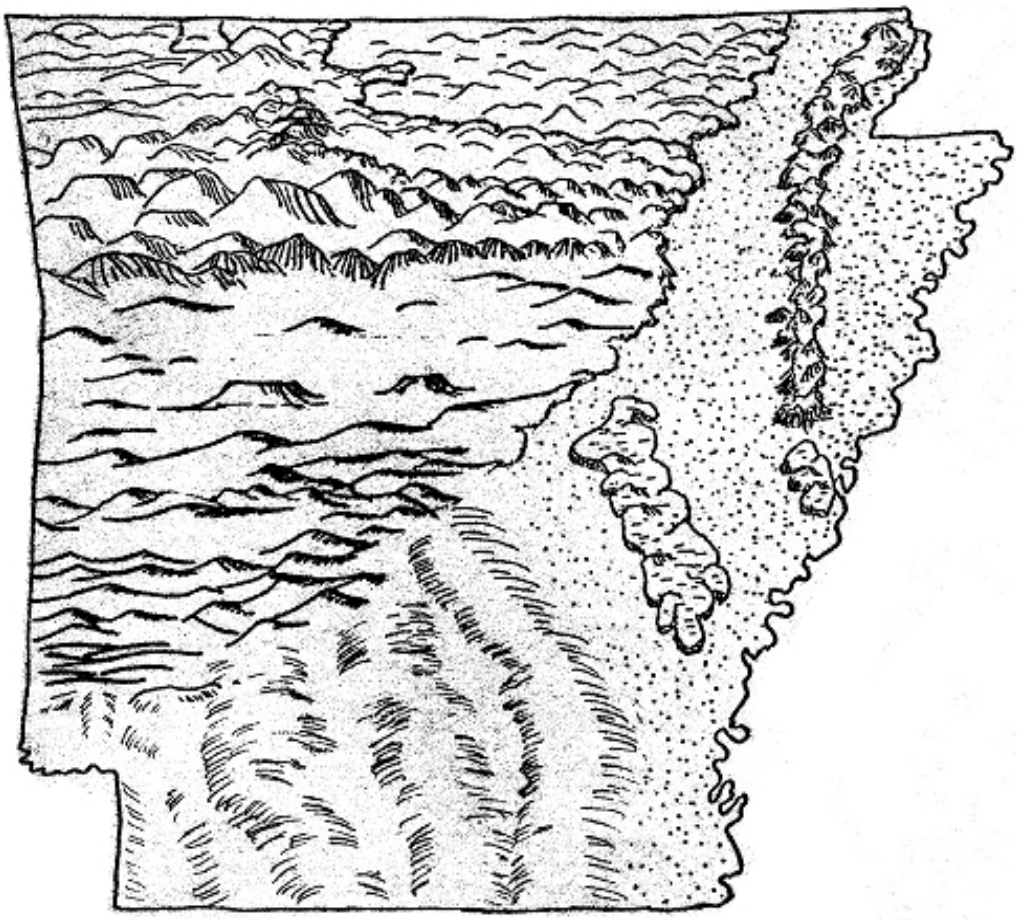
The rocks and sediments of the Mississippi River Alluvial Plain and West Gulf Coastal Plain (both in the south and east portion of the state) are much younger than those of the Interior Highlands. The Cretaceous-age rocks of southwest Arkansas were deposited in and along the margin of a shallow sea. The Tertiary-age materials of southern Arkansas represent marginal marine conditions, both on- and off-shore deposits. The unconsolidated Quaternary sediments of eastern Arkansas were deposited by water released during the interglacial phases of the Ice Age. Crowley's Ridge is an isolated erosional remnant carved by rivers, possibly with structural control from ancient seismic activity. Significant deposits of wind-blown dust (loess) were also deposited across Arkansas during the Quaternary.

Arkansas' rocks, minerals, fossils, fossil fuels, and its water resources resulted from prolonged episodes of deposition, mountain building, and erosion. The interaction of these and other processes was variable throughout Arkansas. Long-term changes in climate were also significant.
Modified from AGC Bulletin 24: Mineral, Fossil-Fuel, and Water Resources of Arkansas, 1997

THE NATURAL DIVISIONS OF ARKANSAS

A CLASSROOM GUIDE

BY THOMAS L. FOTI



ARKANSAS ECOLOGY CENTER

ACKNOWLEDGEMENTS

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Several schools participated in the development of this material, primarily Mills High School of the Pulaski County Special School District and Bryant High School.

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Very special thanks to William Fulton, Environmental Education Specialist of the Arkansas Department of Education and Scotta Sheets, Social Studies Teacher at Mills High School, for three years of advice, encouragement, field testing, and personal support.

THE NATURAL DIVISIONS OF ARKANSAS

A THREE-WEEK UNIT

CLASSROOM GUIDE

Recommended for High School Level
Social Studies, Earth Science and
Biological Science Classes

by Thomas L. Foti

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THE NATURAL DIVISIONS OF ARKANSAS

The central viewpoint of this look at Arkansas is that history develops in relation to land. When people arrived in the territory which was to become Arkansas, they found mountains, prairies and lowlands. As they fitted their uses of the land to the unique characteristics of the natural environments in which they found themselves their own lifestyles changed, sometimes dramatically.

GOALS OF THE NATURAL DIVISIONS UNIT

(1) To get better acquainted with Arkansas.

(2) To learn what an environment (natural system) is, what its parts are, how they are related to each other and <u>in particular</u>, how people relate to the environment as a whole.

There are two important terms we will be using: natural system and natural division. A natural system is an environment. A natural division is a place (a geographical area) which is occupied by one distinctive natural system.

The first two topics will present these concepts in more detail.

WHAT IS A NATURAL SYSTEM?

"Natural system" is another name for an environment. This name is used because it communicates the important idea that an environment is made up of a system of interrelated parts. A natural system is composed of many things, but the major components we will consider are geology, climate, plants, animals, soil and people.

These are the most important aspects of those components:

COMPONENT	ASPECT	EXAMPLE
Geology	Rock Type	Sandstone, Limestone
	Topography	Flat, Rolling
	Geological History	Ocean-bottom sediments
Climate	Temperature	Cool, Hot
	Precipitation	Wet, Dry
	Wind	Exposed (dry)
Plants	General plant communities	Upland Hardwood Forest Upland Pine Forest
Animals	Communities and species related to plant communities	Deer-Lowland Pine Alligator-Swamp Scarlet Tanager-Upland Hardwood
Soil	pH Nutrients Texture Depth How it is formed	Deep, fertile alluvial soils
People	Land Use (the basic way people relate to the natural system)	Agriculture where there is deep soil, Recreation in the mountains
	Culture (as it relates to the natural system)	"Old South" or "Hillbilly"
	History (as it relates to the natural system)	Civil War battlefields on open prairies
	Land-use problems	Pesticides where there is large-scale agriculture

WATER

Even though water is not listed as a "component" of a natural system, it is something which we will give a great deal of attention to. That is because it is a part of all the components. For example, water in the ground or in lakes or oceans is a part of geology; water as rainfall or snow is a part of climate. It is also found in the soil and in the tissues of plants and animals.

TIME

Time is also not a "component" of a natural system, but its importance cannot be overlooked. It is a fact that, given enough time, any natural system will change into a new system. In nature, everything is constantly changing. Time was included in the table as "geological history","how soil is formed" and people's "history".

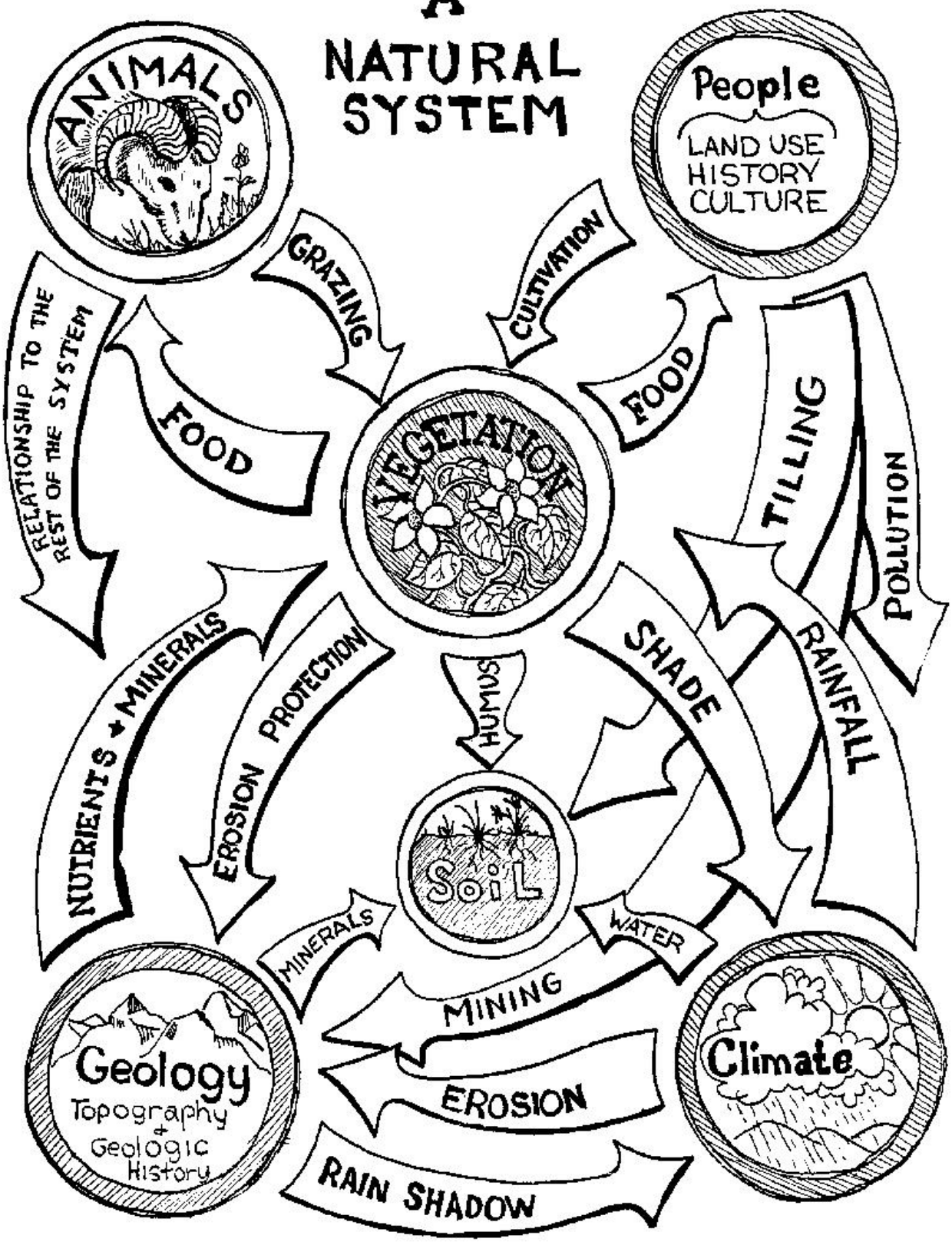
RELATIONSHIPS BETWEEN THE COMPONENTS

Every place on the earth has a distinctive geology and climate. These are the two basic components of any natural system. These two components affect and change each other. They also, in most places, create habitat for plants. Plants affect geology and climate (how?), and they also provide habitat for people and other animals.

People relate to the rest of the natural system through the way they use the land. Their use of the land in turn affects their culture, their history and sometimes leads to environmental problems.

This diagram shows some of the ways the components of a natural system relate to each other (you might want to add others):

A NATURAL SYSTEM



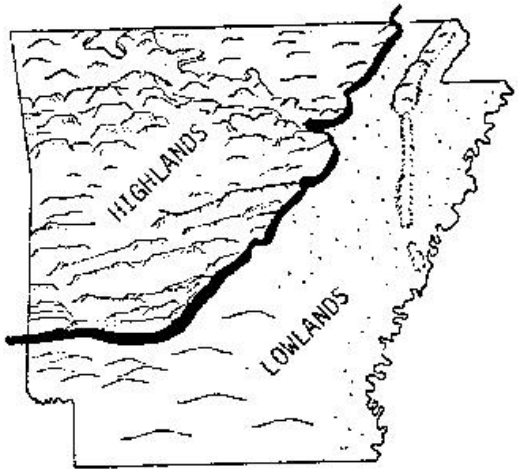
WHAT IS A NATURAL DIVISION?

The easiest way to learn about natural systems is to compare and contrast two or more. In this unit the emphasis will be on general natural systems which extend over large geographical areas or natural divisions.

A natural division is a geographic region which is occupied by one major natural system. The natural systems of any two natural divisions are different.

Since Arkansas is diverse and has several natural divisions, we can limit our study to this state.

In Arkansas there are two major regions, the highlands in the northwest and the lowlands to the south and east:



There are obvious differences here in all the basic components, with the highlands having mountainous topography, ancient rock geology, upland oak-hickory or oak-pine forest, "hillbilly" culture, etc.

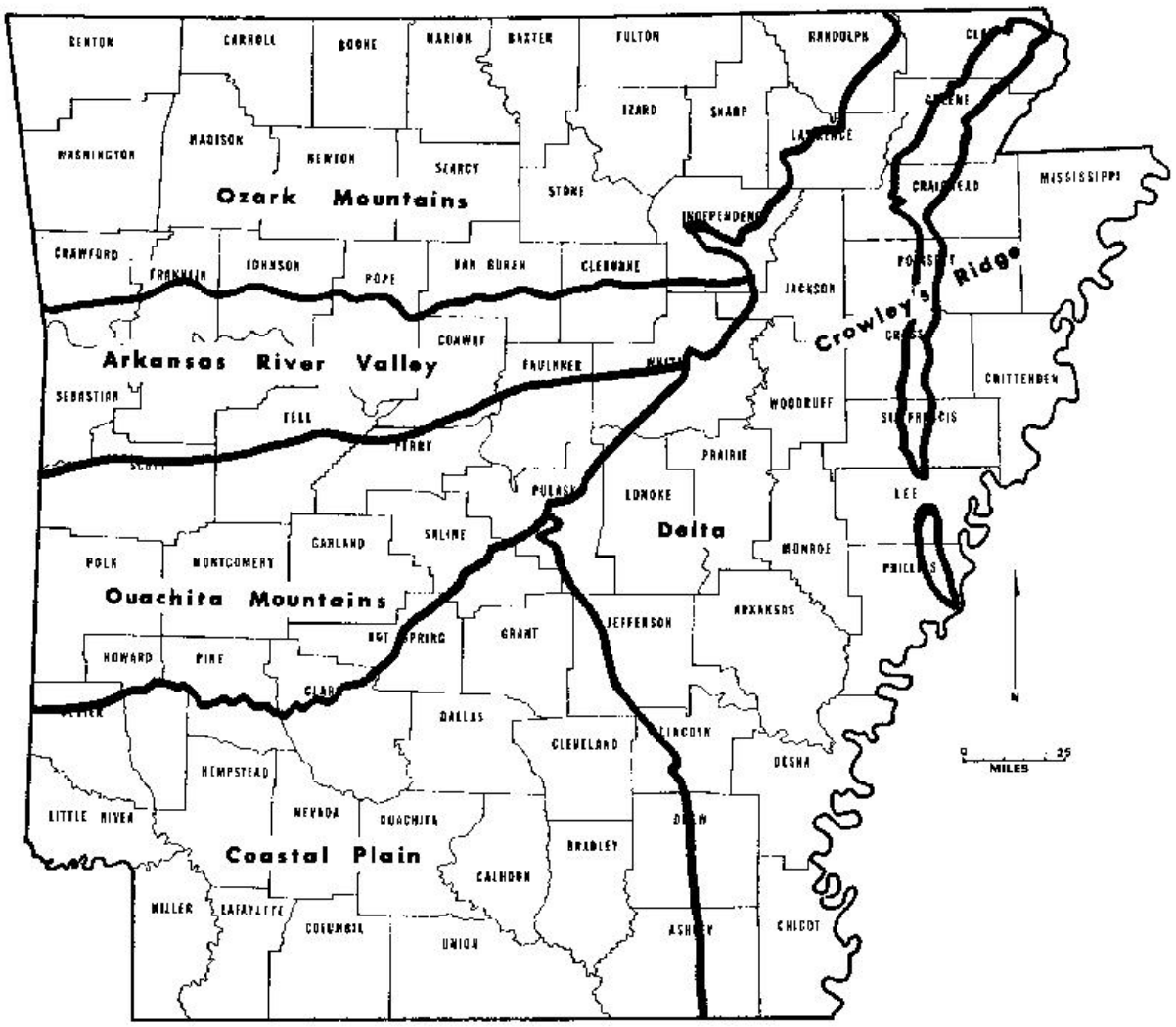
The lowlands on the other hand have rolling to flat topography, moderately recent to very recent sediment geology, bottomland oak-hickory or oak-pine forest and "Old South" culture.

These regions are obvious and knowledge of them and their differences is very valuable. However, they vary enough in themselves to make further division desirable.

This is considered a reasonable set of natural divisions:

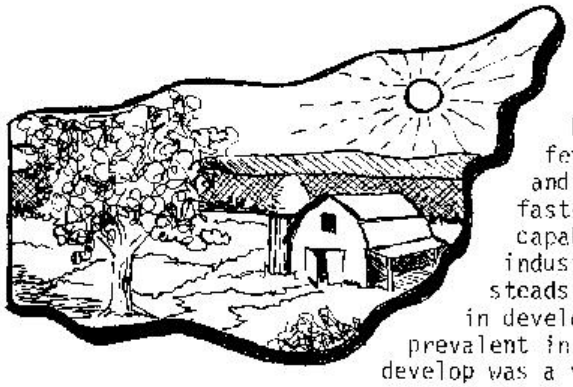
THE NATURAL DIVISIONS OF ARKANSAS

In Arkansas, there are six major natural divisions: the Ozark Mountains, the Arkansas River Valley, the Ouachita Mountains, the Coastal Plain, the Delta, and Crowley's Ridge:



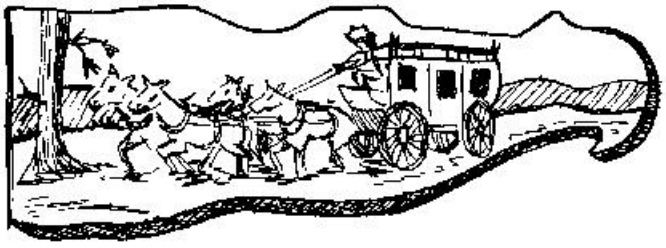
A BRIEF LOOK AT THE NATURAL DIVISIONS

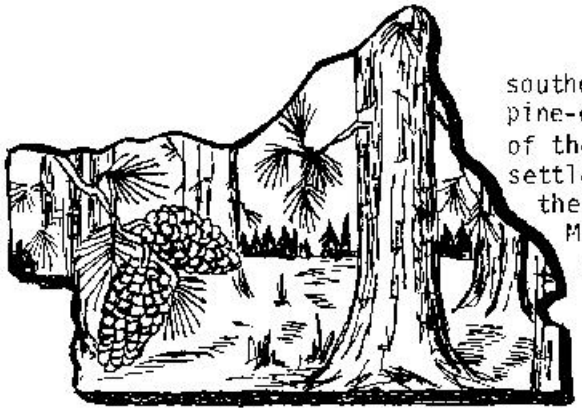
The Ozark Mountain division occupies the northwestern corner of the state. The flat-topped mountains there are the remnants of eroded plateaus whose horizontal layers of ancient sedimentary rock were forced upward millions of years ago. They are covered with an upland forest of oak and hickory. Settlers eked out a bare living from farms in some of the wider valleys and on the level hilltops. In the process they developed a unique mountaineer lifestyle. Cash-crop agriculture was seldom practical in the rocky soils of the Ozarks, and most of the residents of the mountains moved away when their subsistence economy became unacceptable. The Ozarks are currently experiencing a recreational-retirement boom which is bringing people back, this time to enjoy perhaps the greatest resource of the Ozarks region, its beauty. But the new residents bring with them new problems, problems created by the demands they place on the limited water supplies of these headwaters streams and the pressure their sewage places on the life systems of those streams.



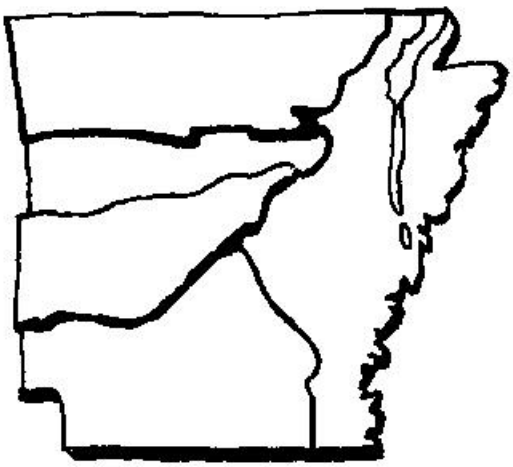
The Ouachita Mountain division, south of the Ozarks, is characterized by long, narrow ridges of folded rock. Many of the valleys between the ridges are large enough and fertile enough for large-scale agriculture, and the mountains themselves with their fast-growing forest of oak and pine are capable of supporting a thriving timber industry. Therefore, the subsistence farmsteads and the isolation that were so important in developing the Ozarks culture were never as prevalent in the Ouachitas. The culture which did develop was a varied blend of upland and lowland, poor mountaineer and rich planter. The uses to which man puts the Ouachitas today include agriculture, forestry and mining. Each of these uses presents potential problems and each must be carefully done in order to protect the natural system which makes them possible.

The Arkansas River Valley division, lying between the two major mountain systems along the river which was an important early path of communications, developed quickly as a focus for settlement in the territory. Dardanelle, Cadron and Ft. Smith sprang up in it. Cash-crop agriculture soon became important in the valley and has remained so since. Because the valley possesses scenic quality, abundant water, fertile land and good transportation, it has become and will remain one of the major centers of population growth and industrial development in Arkansas. The problems encountered there are those which spring from an abundance of people and progress, problems like air and water pollution and the turning of every one of its scenic, free flowing rivers into a water supply reservoir.

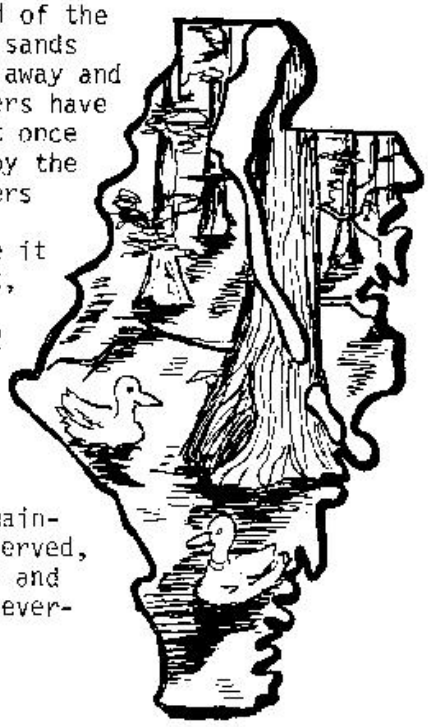


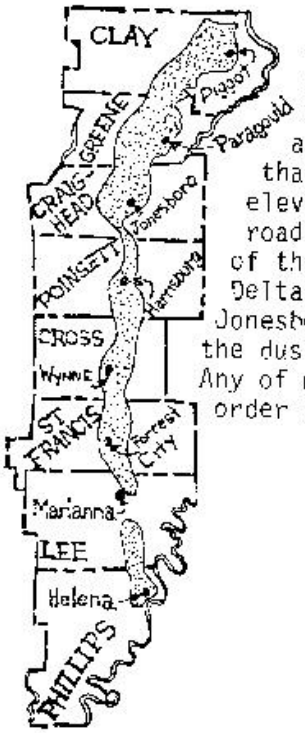


The Coastal Plain division, in southern Arkansas, is an area of rolling, pine-covered hills, which today produces most of the state's forest products. Several early settlements of Arkansas were in this region, in the broad bottomlands along the Red River. Men cleared the forest there for cotton plantations and lived in the grand southern style. The pine forest of the rolling hill-land provided a valuable resource to the northern timber industry. After the timber was cut, much of this land was occupied by small farms, but today most of the farms have been abandoned and most of the people have left or moved to the towns which are sustained by the timber industry. Their farms were bought by the timber companies early in the twentieth century when they began to realize that the best use of this land was growing trees. Today the Coastal Plain is again almost uninterrupted forest which is intensively managed for timber production. In the future, the people of the Coastal Plain must deal with such controversial issues as clear cutting, herbicides and other tools of modern intensive forest management. They must also deal with the problems associated with mineral production from their land, particularly petroleum, bauxite, and that new giant, lignite.



The Delta division, occupying the eastern third of the state, is a land created by rivers. The ocean-bottom sands and gravels of the Coastal Plain have here been swept away and in their place sand, silt and clay carried by the rivers have been deposited. A majestic bottomland hardwood forest once covered the land, except for a high terrace occupied by the tall grasses and flowers of the Grand Prairie. Settlers found the Delta a harsh, inhospitable land with its floods, mosquitos and malaria. But the deep soil made it tremendously fertile, and so men set out to conquer it, first with the labor of slaves, and eventually with huge machines. The antebellum culture which developed here was at the same time romantic and corrupt, a refined culture dependent upon the enslavement of both people and land. Though the men have been freed the land remains conquered. Hardly a natural stream or a bit of the once majestic forest remains. The people of the Delta must determine whether the remaining ten percent of the bottomland forest is to be preserved, whether at least a few streams are to remain unditched and clear, or whether all this is to be sacrificed to the ever-expanding demand for food and fiber.





The Crowley's Ridge division is the exception to the character of eastern Arkansas. It is a two to three hundred foot high ridge capped by dust (loess) deposited by ancient winds. It does not flood and is covered with an upland forest of a type more similar to that of Tennessee than to the forests of the rest of Arkansas. Because of its elevation, the ridge was the site of waystations on the first road from Memphis to Batesville and Little Rock. Later, many of the towns which derived their income from the lowlands of the Delta were located on the ridge to avoid floods. They include Jonesboro, Forrest City and Helena. A unique characteristic of the dust which creates the ridge is its susceptibility to erosion. Any of man's activities there must "tread with light feet" in order to avoid massive destruction of the delicate soil.

These are the major natural divisions of our state. Each division represents a unified system whose representative components are geology, climate, soil, plants and animals. Man, through his use of the land, also plays an important part.

QUESTIONS ON "A BRIEF LOOK AT THE NATURAL DIVISIONS"

Using the information given in this section, outline the natural system of the Ouachitas. Fill in only those blanks for which the information is given.

COMPONENT	ASPECT
Geology	Rock Type-
	Topography-
	Geologic History-
Climate	Temperature-
	Precipitation-
	Wind-
Plants	Plant Communities-
Animals	Species-
Soil	pH-
	Nutrients-
	Texture-
	Depth-
	How it is formed-
People	Land Use-
	Culture-
	History-
	Land-use Problems-

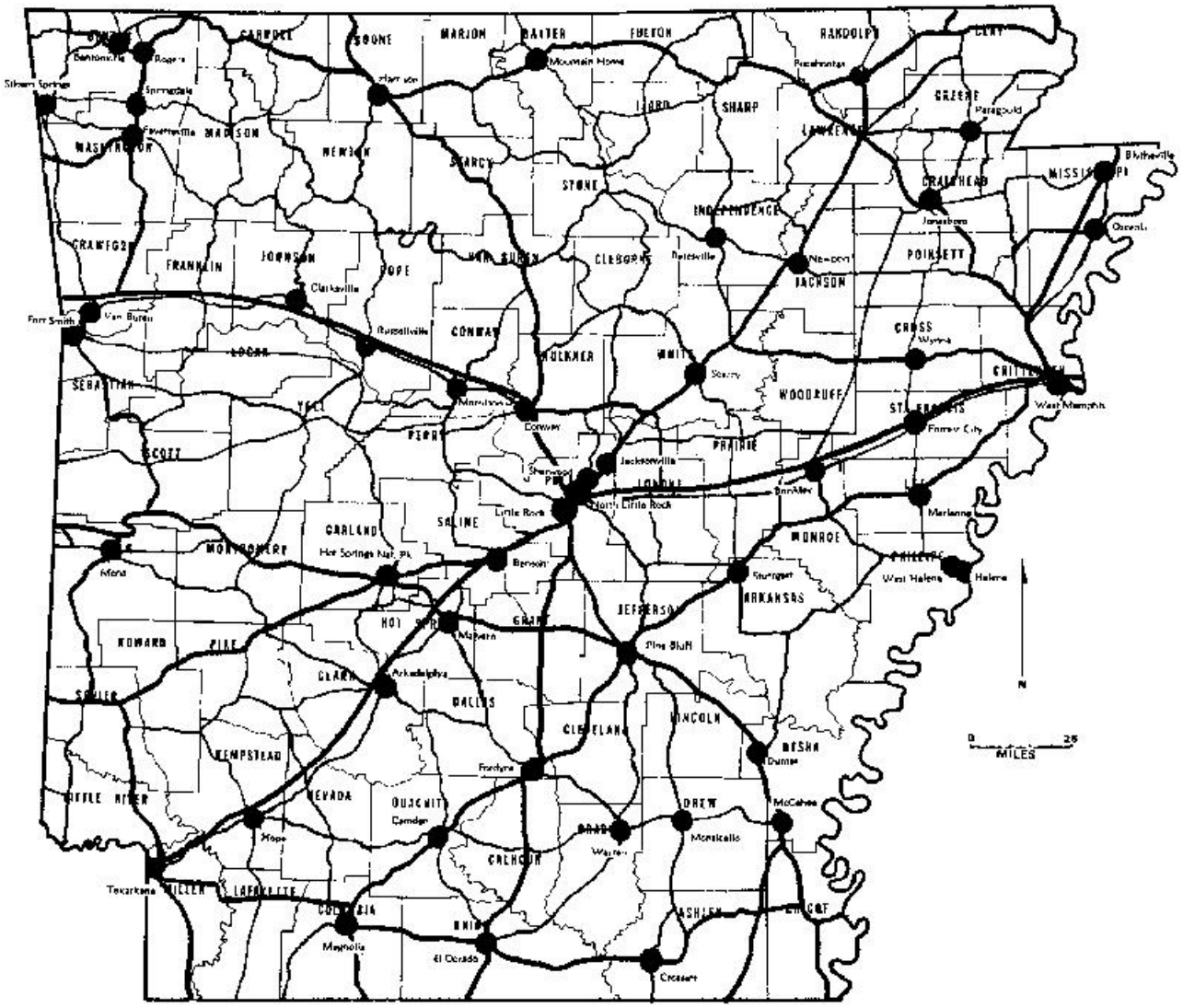
Be prepared to do this exercise for the other Divisions as well.

BACKGROUND INFORMATION ON

ARKANSAS NATURAL SYSTEMS

ARKANSAS GEOGRAPHY

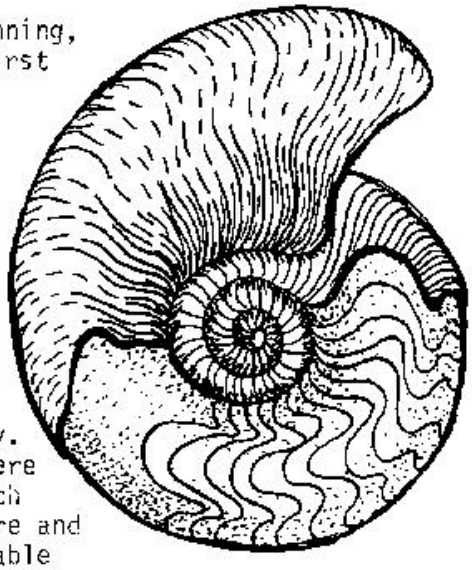
COMPONENT	ASPECT	TYPE OF INFORMATION
Geology	Geologic History	"HOW ARKANSAS GOT TO BE"
	Rock Type	SURFACE GEOLOGY
	Topography	SOIL ASSOCIATIONS
CLIMATE	Temperature and Precipitation	CLIMATE
	Precipitation	MEAN ANNUAL PRECIPITATION
	Precipitation	MEAN PRECIPITATION APRIL TO SEPTEMBER
	Temperature	MEAN JULY TEMPERATURE
	Temperature	MEAN JANUARY TEMPERATURE
	Temperature	MEAN DURATION OF GROWING SEASON
PLANTS	General Plant Communities	PLANT COMMUNITIES
SOIL	Depth, Texture, How it is formed	SOIL ASSOCIATIONS
	Texture	SOIL CLASSIFICATION
PEOPLE	Land Use	TYPE OF FARMING REGIONS
	Land Use	ALL ROADS
	Land Use	FOREST COVER
	History	ARKANSAS CIRCA 1834



ARKANSAS GEOGRAPHY

HIGHWAYS, COUNTIES, CITIES OVER 4500 POPULATION

How Arkansas Got To Be



This story of Arkansas doesn't have a beginning, only a starting place. The story began on the first day of creation, but at this starting place, the continents had been formed and had started their drifting. Arkansas was soon to be but was now covered by the sea. The time was the Paleozoic, in greek, the time of "ancient life."

ARKANSAS IN PALEOZOIC TIME

At the beginning of the Paleozoic, 500 million years, ago, Arkansas was completely covered by the sea, but there were islands nearby. Up in what is now east-central Missouri, there were the St. Francis Mountains, masses of granite which had been formed almost half a billion years before and were destined to continue to exist as a recognizable mountain range even to the present. They would also become the structural center of the Ozark Mountains.

TABLE OF GEOLOGICAL HISTORY

ERA	PERIOD	EPOCH	APPROXIMATE AGE (in years) BEFORE PRESENT
CENOZOIC	QUATERNARY	Recent (Holocene)	10,000
		Pleistocene	1,000,000
	TERTIARY	Pliocene	13,000,000
		Miocene	25,000,000
		Oligocene	36,000,000
		Eocene	58,000,000
		Paleocene	63,000,000
MESOZOIC	CRETACEOUS		135,000,00
	JURASSIC		180,000,000
	TRIASSIC		230,000,000
PALEOZOIC	PERMIAN		280,000,000
	PENNSYLVANIAN		310,000,000
Carboniferous	MISSISSIPPIAN		345,000,000
	DEVONIAN		405,000,000
	SILURIAN		425,000,000
	ORDOVICIAN		500,000,000
	CAMBRIAN		600,000,000

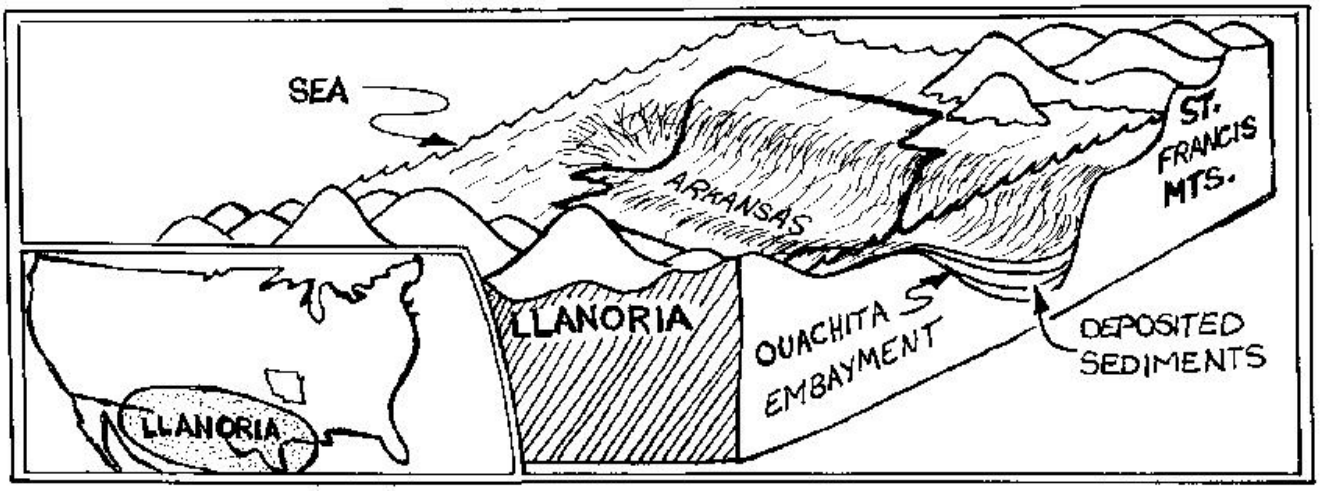
"LLANORIA"

To the south of the Arkansas sea was another land mass, called "Llanoria" by some geologists, a lofty mountain range which was fated to erode away completely. The sediments of Llanoria would eventually form the rock of which the Ouachita Mountains are composed.

ROCKS OF THE OUACHITAS

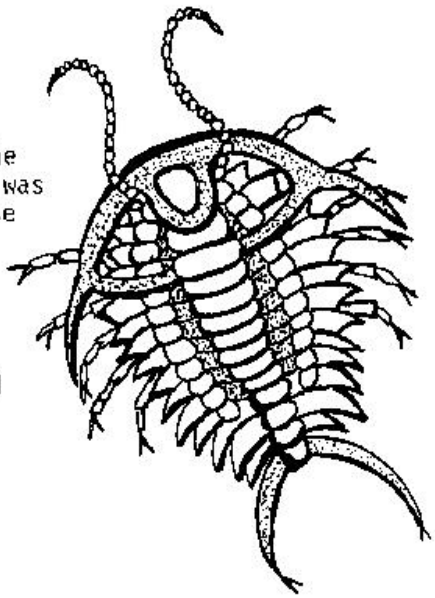
Under the waters of southern Arkansas lay a deep basin, the Ouachita embayment, where 30,000 feet of sediments from Llanoria accumulated (see map below).

The Arkansas sea itself varied in character. To the south, the rivers of Llanoria were bringing in sediments at such a great rate that the waters were continually cloudy with sand or mud. Few living things existed in them. The sands of Llanoria accumulated to such great thickness in the Ouachita Basin that their tremendous weight compressed them into the sandstones typical of the Ouachitas today. Muds were compressed into shale, and the rocks were ready to be formed into mountains.



ROCKS OF THE OZARKS

To the north, just south of the St. Francis Mountains, the sea was different in character. The waters there were shallow and quiet and the water was as warm as the water around today's Bahamas. Those waters teemed with life, mostly tiny plants and animals, but also sponges, corals and clam-like brachiopods. When those animals died, their skeletons (even the shells of the one-celled animals) dropped to the bottom, where they accumulated to great thickness and were compressed into limestone and dolomite.

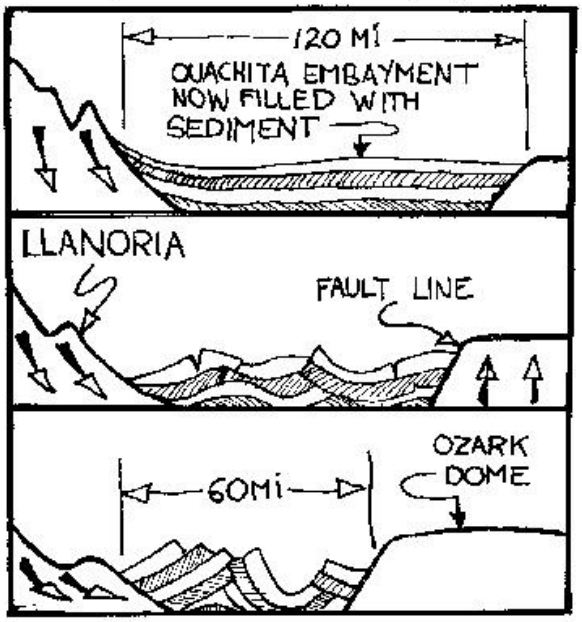


FOSSILS

Occasionally a complete shell would be preserved and the abundance of those remains makes the Ozarks today one of the most productive fossil-producing areas in the country. The muddy waters of the Ouachita Embayment, on the other hand, did not provide good habitat for creatures which could become fossils, and so fossils are relatively rare there.

MOUNTAIN BUILDING

This quiet period of accumulation and consolidation of rocks lasted for a full 150 million years until the middle of the Paleozoic era, a period known as the Mississipian, or maybe the slightly later Pennsylvanian. Then things got more violent. To start it all off, some geologists think that Llanoria sank! It just dropped out of sight and hasn't been seen since.



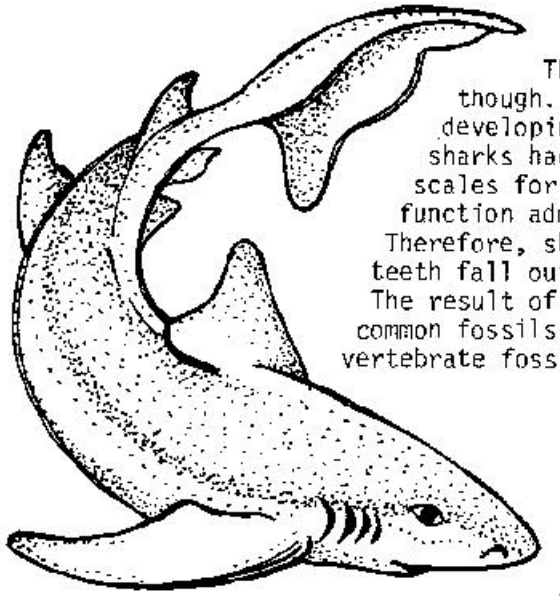
FORMATION OF THE OUACHITAS

Because of that sinking, the whole Ouachita embayment was squeezed together until it was only half as wide. The violence of this activity can only be imagined by going out to the Ouachitas today and looking at road cuts and stream cuts. The rocks are tilted, twisted, torn and wrinkled. The rocks themselves offer silent testimony to the fantastic forces involved. Almost as fast as the mountains were squeezed up, they were eroded down. And after this first burst of violent activity, they settled back, resigned to the effects of the wind and weather, which removed 18,000 feet from their height.

FORMATION OF THE OZARKS

While the Ouachita Mountains were undergoing periods of active formation and others of erosion, activity started to the north. With the St. Francis Mountains as the center, a large area of rock was pushed straight up. There was little folding there, but rather the earth's forces simply lifted the ocean bottom rock from the sea to an elevation of three or four thousand feet.

PLANTS AND ANIMALS



The mountains were not the only things changing, though. Life, both in the sea and on the land, was developing a myriad of forms. In Mississippian times sharks had become abundant. Sharks have modified scales for teeth, and though as anyone will admit these function admirably as teeth, they fall off readily. Therefore, sharks have their teeth in rows and as the outer teeth fall out they are replaced by the teeth of inner rows. The result of this is that shark's teeth are one of the common fossils of Arkansas rock and are the most common vertebrate fossil.

THE ARKANSAS RIVER VALLEY

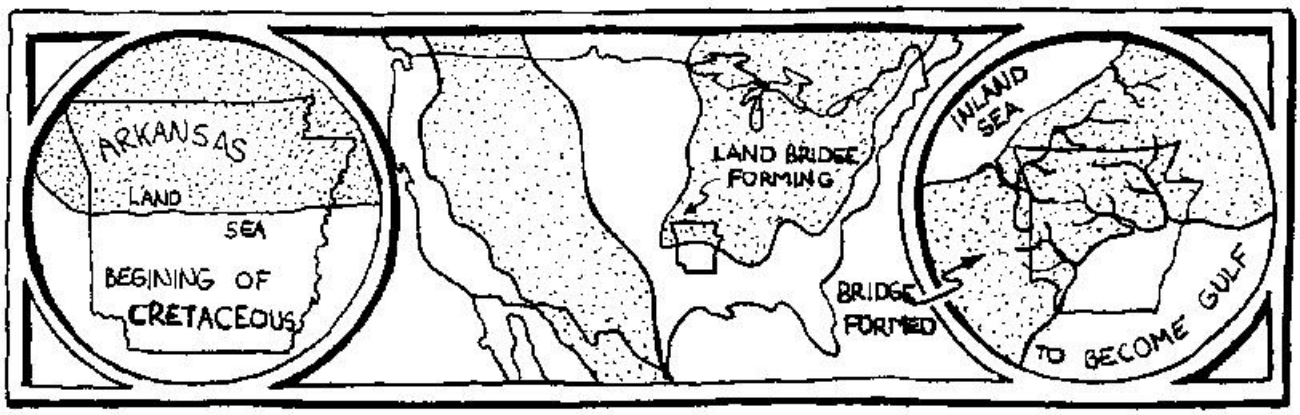
In the lowlands between the two mountain ranges, land vegetation developed. Hundred-foot high Scale Trees grew on the edges of pools, shallow lakes and swamps. Their remains formed immense beds of peat which were later transformed into coal. Amphibians ruled the the land and reptiles and winged insects made their appearance.

ARKANSAS IN MESOZOIC TIME

Two hundred and thirty million years ago, the Mesozoic era (the time of "Middle Life") began.

THE DINOSAURS

In early Mesozoic, drying climate destroyed many of the amphibians but at the same time favored the rise of the dinosaurs.



CRETACEOUS PERIOD

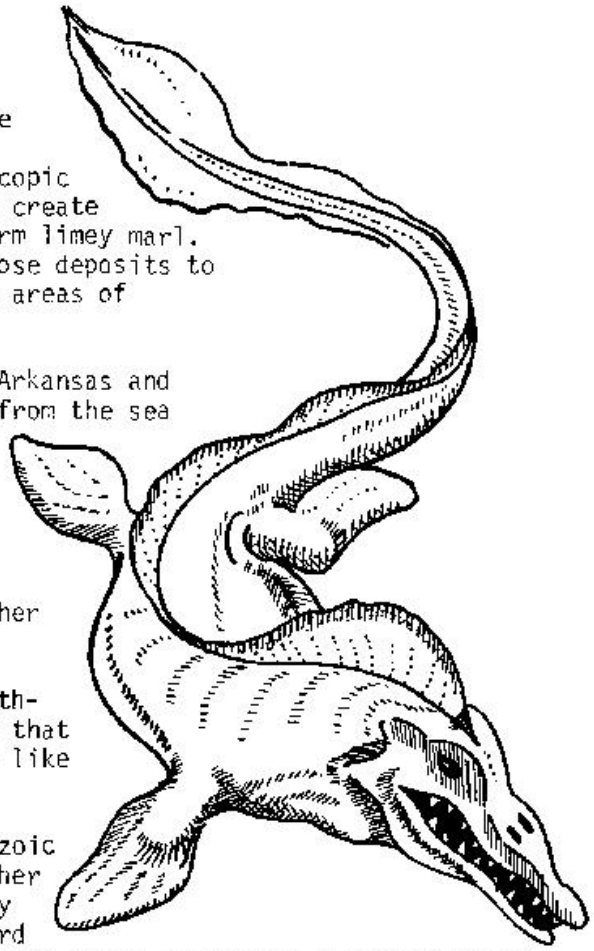
A hundred and thirty-five million years ago, the Cretaceous period of late Mesozoic began. At the time, the northern two-thirds of Arkansas and adjacent areas of states to the east, north, and west had emerged from the sea.

At the beginning of Cretaceous the edge of the sea in the area of Arkansas ran in a more or less east-west direction across the state at about the latitude of Hot Springs.

Dinosaurs roamed the land during the warm climate of those days and a new invention made its appearance, one which was to have profound effects on the character of life to come. The invention was the flower.

Most of the plants in the world today are flowering plants. In Arkansas, flowering plants dominate every plant community except the pine forests. The beauty of flowers brightens the world, but they did not evolve only for that. Flowers evolved to attract pollinating insects, and are a prime example of the dependence of plants on animals.

SOUTHWESTERN ARKANSAS
(The Coastal Plain)



Minute animals were abundant in the Gulf of Mexico which covered southern Arkansas during that time. Their microscopic remains drifted down in a steady rain to create beds of chalk and to mix with clay to form limey marl. Snails and oyster shells drifted into those deposits to form the heavily laden fossil collecting areas of southwestern Arkansas.

Later in Cretaceous, southwestern Arkansas and nearby areas of Oklahoma and Texas rose from the sea and their limey soils are exposed today as the blacklands.

THE DELTA

Meanwhile in eastern Arkansas another major change was taking place.

At the beginning of Cretaceous northeastern Arkansas was much different from that area today. It was rocky and hilly much like the mountain areas to the west.

Then later in Cretaceous the Paleozoic rocks which had been leveled by the weather and time began warping downward. As they did, the Gulf of Mexico advanced northward over them and created a bay which geologists would later call the Mississippi Embayment. Although the base rocks themselves eventually warped downward over four thousand feet, they did so slowly enough that sediments filled the bay almost as quickly as it formed.

PLANTS AND ANIMALS

Toward the end of the Cretaceous, the climate cooled again and the age of the great reptiles ended. That change made warm-bloodeness more valuable and heralded the age of mammals. Birds multiplied. The new era was the Cenozoic, beginning 65 million years ago, the time of recent life.

ARKANSAS IN CENOZOIC TIME

Cenozoic time began about sixty million years ago. The first period of the Cenozoic era is known as the Tertiary.

THE OZARKS

In the mountains, periods of erosion alternated with slight uplifts which helped form their presently existing shapes. During that time the final plateau surfaces of the Ozarks were formed. Both the Ozarks and Ouachitas eroded two or three times during that period into low lying relatively flat lands known as peneplains, then uplifted again as relatively flat topped mountains all of about the same height. The results of this process are far more apparent in the Ozarks where three plateau surfaces are apparent: the Boston Mountains, the Springfield Plateau, and the Salem Plateau.

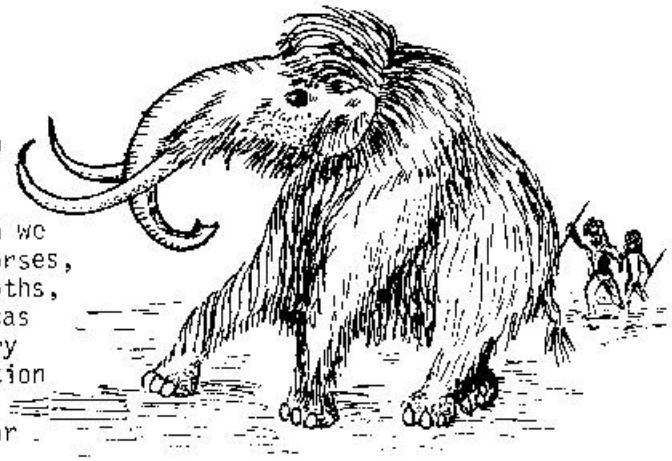
THE COASTAL PLAIN AND DELTA

During the Tertiary period the Coastal Plain, along with the Delta, was characterized by advance and retreat of the Gulf. The sea was never very deep and occasionally was so shallow that land plants could thrive there. The remains of these plants formed beds of peat which in turn was later transformed into lignite, a form of coal.

Finally about 50 million years ago, eastern and southern Arkansas rose from the Gulf for good. In the Coastal Plain today the sands and gravels which made up the bottom and beaches of the Gulf may still be seen.

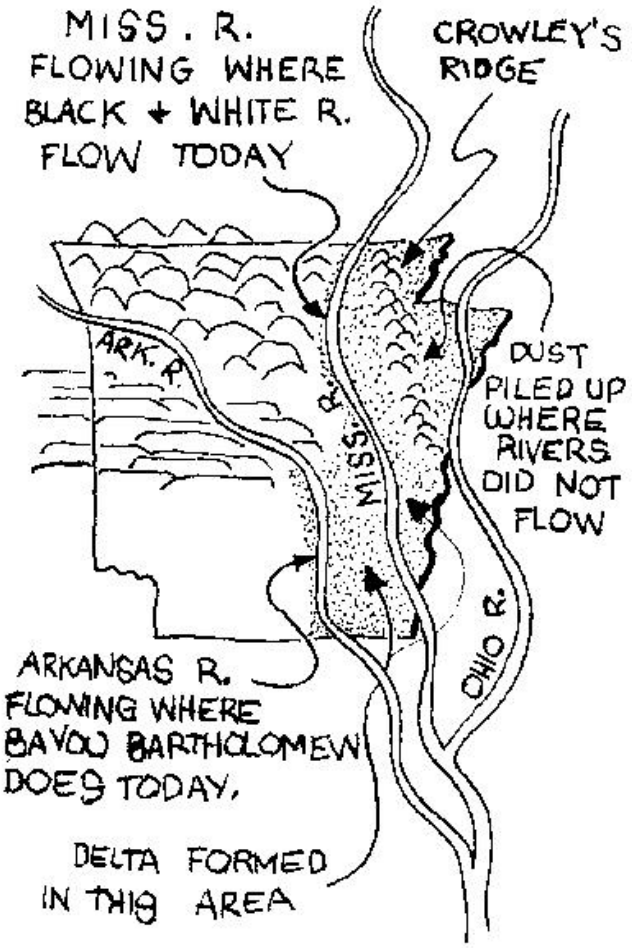
QUATERNARY

Time had advanced to the Quaternary, beginning two million years ago. Across the land wandered most of the animals we know today, but many others which we would consider odd. Primitive horses, camels, saber-tooth tigers, mammoths, and mastodons all traveled Arkansas during that time. The Oak-Hickory forest which reached its culmination in this area was well developed. Much of Arkansas would be familiar to us, but very different in detail.



The mountains had reached the shape they retain today but there were still

important changes to come in the lowlands, especially those of eastern Arkansas. The shoreline of the Gulf of Mexico had more or less assumed its present position, but rivers and lakes were to have a significant effect on the lowlands of Arkansas.



THE DELTA

During the Quaternary the lowlands of southern and southwestern Arkansas (the Coastal Plain) retained their ocean bottom character with rolling topography and a surface of sand and gravel. As the ocean receded from the Mississippi Embayment in eastern Arkansas, however, the embayment was traversed by large rivers which completely reworked the land by hauling away the top layers of ocean-bottom sand and replacing them with the sand, silt and clay which those rivers carried. The rivers meandered over most of the plain of eastern Arkansas. At one time the Ohio River flowed over extreme eastern Arkansas, the Mississippi flowed to the west of it and the Arkansas still further to the west.

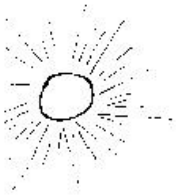
These three great rivers didn't join until they were well to the south of Arkansas. Their power to shape the land varied with the advance and retreat of the glaciers. When the glaciers advanced (never nearer than the middle of Missouri), the rivers would dry to only a trickle. But when the glaciers began melting, the rivers would swell to torrents which would cover the land with sediments. Occasional minor subsidence, or lowering, of the land would create large swamps where deep beds of clay would be deposited.

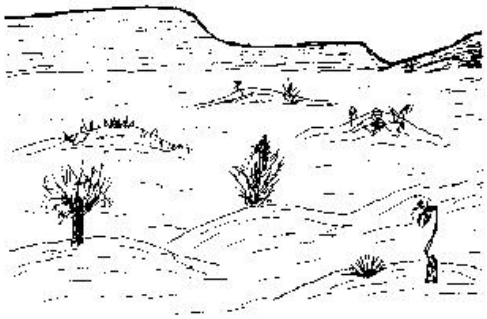
CROWLEY'S RIDGE

In northeastern Arkansas, a slight divide was left where the Mississippi and the Ohio did not meander. Dust piled up on this divide to a depth of up to 50 feet and finished forming Crowley's Ridge.

That probably happened this way: First, the rivers during a period of glacial retreat coated the lowlands with ground-up rock from the north. After the mud dried, the wind began to blow it around at which point the divide acted like a fence which the dust could pile up against. Some of the dust also piled up against the Ozark Mountains.

By late Quaternary, the Mississippi Delta and Crowley's Ridge were formed and Arkansas had reached its present shape.





RECENT CLIMATE

Since the last glaciers retreated, about 12,000 years ago, the climate of Arkansas has changed dramatically. Part of the story of those changes is told by areas around the state where the land surface is covered with low mounds two or three feet high and 40 to 50 feet in diameter. These mounds are usually referred to as prairie mounds or more expressively as prairie pimples, and the explanations for them are numerous.

A common explanation is that they are Indian mounds, but artifacts are usually not associated with them. Another idea, easily disproved, is that the mounds were formed by pockets of gas pushing up the surface, and some people lean toward anthill origins, or even prairie dog colony origins (giant prairie dogs, I suppose).

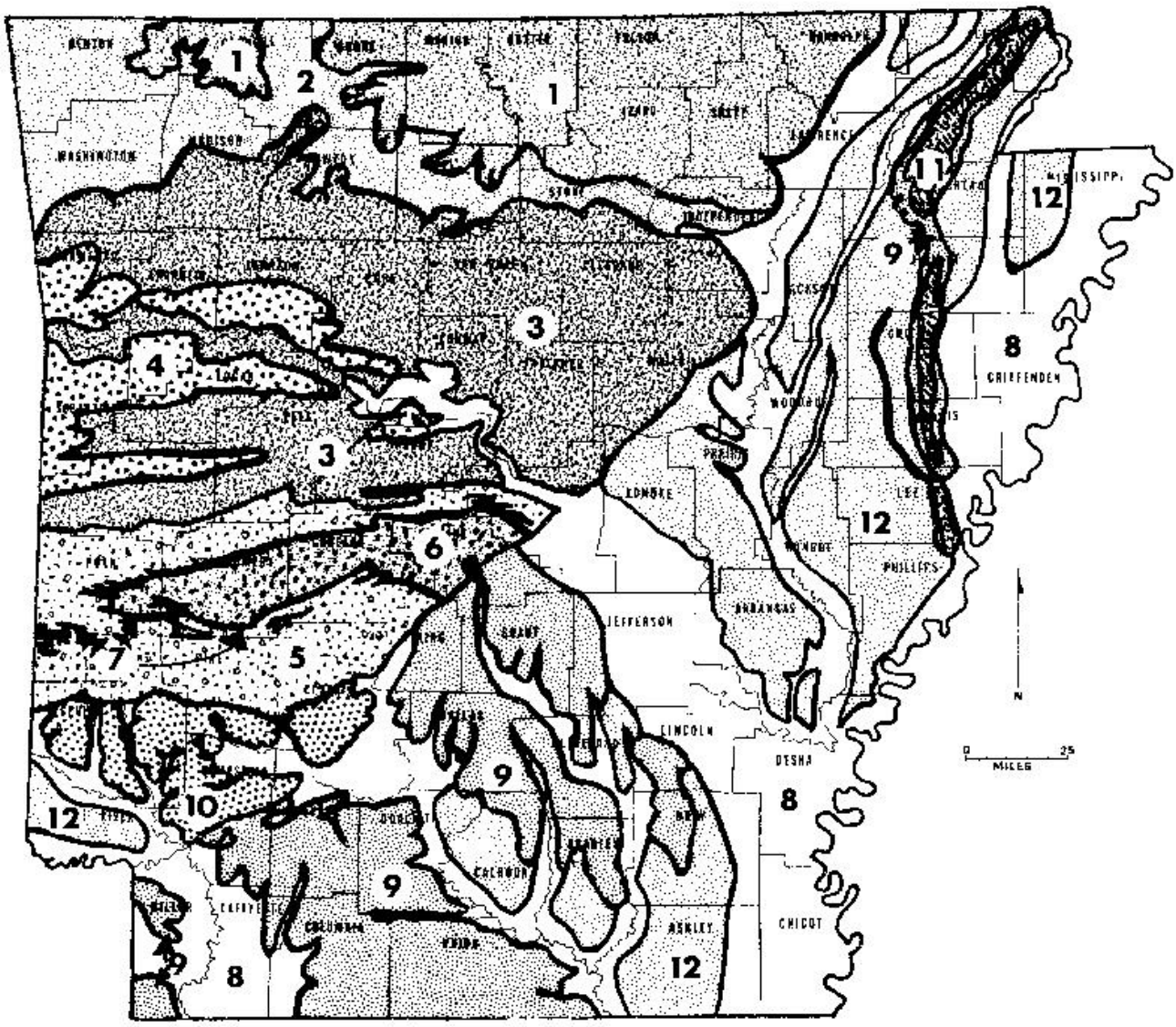
A more scientifically acceptable theory is one which depends on knowledge of the climatic history of the region. It seems that during the period of 3,500 to 7,000 years ago, the climate of Arkansas was cold and arid, and the driest sites were occupied by desert shrubs. These sites characteristically were flat or gently rolling which allowed the wind to circulate freely. That allowed the wind to dry out the surface. These sites also had a subsoil of clay or rock which limited the ability of the plants to obtain groundwater.

Since there was essentially no ground cover between the scattered shrubs, the wind eroded away soil between them and at the same time deposited soil under the shrubs, leading to the formation of the mounded surface.

The climate has moderated gradually since that time, and prairie vegetation replaced the desert plants. Grasses are adapted to a climate which is too dry for trees and too moist for desert, so when our climate moderated enough for these conditions to exist, the areas which had been desert became grassland. When settlers arrived, they associated the mounds with prairie, so they called them "prairie" pimples but they might more appropriately be called "desert" pimples instead.

Though the pimples were generally associated with prairie, they are often to be seen in forests as well. The climate of the state has continued to get moister and as it has done so, trees have gradually overgrown the prairies. Man has hurried the process by plowing the prairies and even leveling off the pimples.

The largest prairie in the state at the time of settlement was the half-million acre Grand Prairie which extended from Lonoke to Arkansas Post. Now, because of the pressures of rice cultivation, virtually all evidence of its prairie history have been obliterated. Elsewhere in the state, prairie and the pimples have fared somewhat better. If you want to see prairie pimples look around Fayetteville and along the terrace land in the Arkansas River Valley, expecially around Ft. Smith and Conway. Look along the terraces from Jonesboro to Brinkley, from Bald Knob to Searcy and from Monticello to Crossett and look from Arkadelphia to Hope. They occur elsewhere too, but you might have to look closer to find them.



SURFACE GEOLOGY

SURFACE GEOLOGY

Area 1

The surface rocks of the Salem Plateau are the oldest of the Ozark Highlands, younger ones having been removed by erosion. They are largely Ordovician in age, and predominantly dolomote and limestone with some sandstone and shale.

Area 2

Here, limestone and chert of Lower Mississippian age, is the surface rock. Weathering more easily reduces the limestone, leaving large pieces of chert which are especially prominent on hillsides where the finer materials have been eroded away. The limestone is quarried in many localities. Outliers of the Boston Mountains are especially common in the western part of the region.

Area 3

The Boston Mountains and the eastern part of the Arkansas Valley are surfaced in sandstone and shale of Pennsylvanian age. The massive Atoka formation, over 1,500 feet thick, is the most prominent. The Atoka sandstone forms the rimrock at the top of the Boston Mountains.

Area 4

The western part of the Arkansas Valley is surfaced in Upper Pennsylvanian sandstone and shale. Coal is important in the shales, much of it accessible by strip-mining. There are numerous natural gas fields in this region.

Area 5

Mississippian sandstone and shale surface most of the Fourche Mountains and the Athens Plateau of the Ouachitas.

Area 6

The Central Ouachitas are closely folded ridges and valleys of Ordovician and Silurian sandstone and shale.

Area 7

Arkansas novaculite is exposed along the outer edge of the Central Ouachitas, sometimes referred to as the Novaculite Uplift. The novaculite is very hard, fine-grained rock of silica, used as an abrasive stone and as a silica source in manufacturing.

Area 8

Recent alluvium and terrace deposits cover much of the lowlands in the southeastern half of the state. Particularly, they provide the surface materials in the Mississippi Alluvial Valley and along the rivers of the Gulf Coastal Plain. The recent alluvium has been deposited by flood waters of the streams and consists of a variety of water-washed material such as silt.

Area 9

The edge of Crowley's Ridge and a large area of the Gulf Coastal Plain are surfaced with formations of Eocene age. The Coastal Plain in interrupted by the more recent alluvial deposits of the major rivers, the Saline, Ouachita, and Red. Generally, the surface materials are sand and clay. There are scattered deposits of lignite.

Area 10

Scattered Cretaceous formations occupy the inner edge of the Gulf Coastal Plain from the Oklahoma line to Clark County. Most of the beds are course sand, clay, or gravel.

Area 11

Loess caps the higher portions of Crowley's Ridge. This is a fine, wind-blown silt derived from the alluvial deposits around the ridge. The winds picked up the dried alluvium which was deposited mainly during the Pleistocene. The bluffs on the east side of the Mississippi Valley, from Cairo, Illinois, southward are also capped with loess.

Area 12

Alluvial terraces of Quaternary age occur in the northern Delta and in the Coastal Plain along the Red, Ouachita and Saline rivers. They are higher than the adjacent Recent floodplains. They are former floodplains below which streams have now cut. The terraces in the Delta and on the eastern edge of the Coastal Plain are capped by thin layers of loess.

Question: Where are the oldest rocks in Arkansas (two places) and how old are they? To answer this question, pick out the geological period in the descriptions of the rock types and find its age in the Table of Geological History in "HOW ARKANSAS GOT TO BE".

CLIMATE

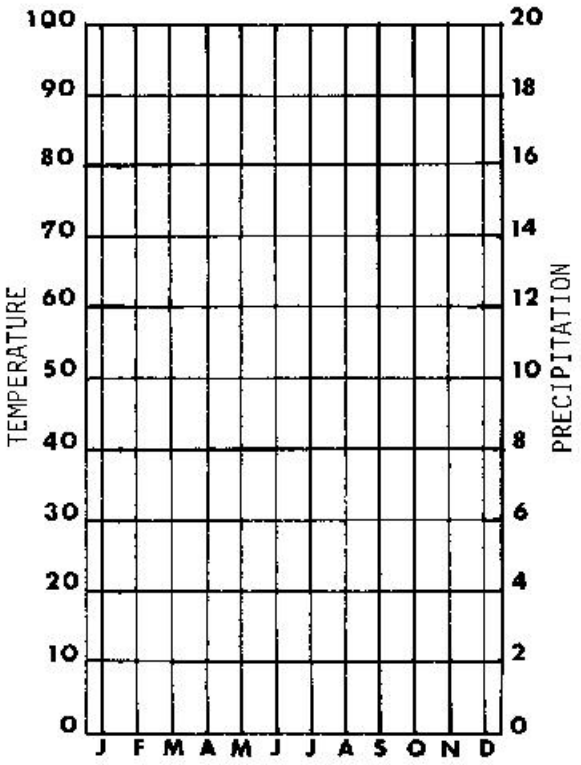
These figures for Little Rock may be considered "average" for Arkansas. Maps on the next several pages illustrate the variation in climate around the state.

AVERAGE MONTHLY TEMPERATURE, PRECIPITATION & SNOWFALL
Little Rock 1935 - 1975

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Ann.
Temperature (°F)	41.7	44.8	52.9	62.5	70.1	78.2	81.3	80.5	74.2	63.8	51.9	43.9	62.2
*Precipitation (In.)	4.69	3.93	4.62	5.13	4.91	3.66	3.43	3.35	3.32	2.90	4.11	4.18	48.23
Snowfall (in)	2.2	1.3	0.5	T	0.0	0.0	0.0	0.0	0.0	0.0	0.2	1.0	5.2

*Includes all liquid precipitation plus the liquid equivalent of all frozen precipitation (sleet, snow, etc.).

Plot these monthly temperature and precipitation averages on the climatic graph below. Notice that temperatures are listed on the left-hand side of the chart and rainfall amounts on the right so both may be plotted on the same chart.



Which month has the:

Highest temperature? _____

Lowest temperature? _____

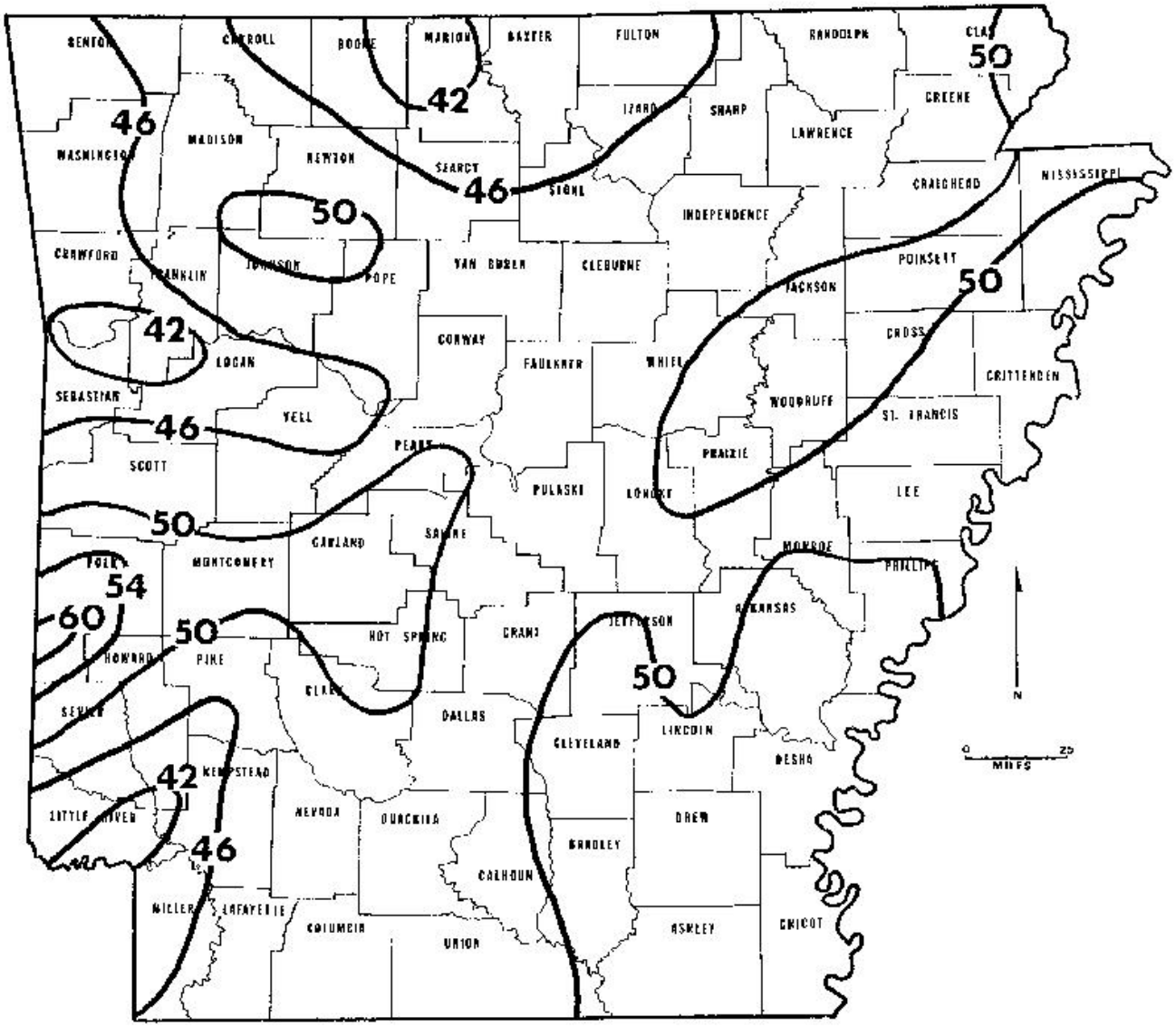
Greatest precipitation? _____

Least precipitation? _____

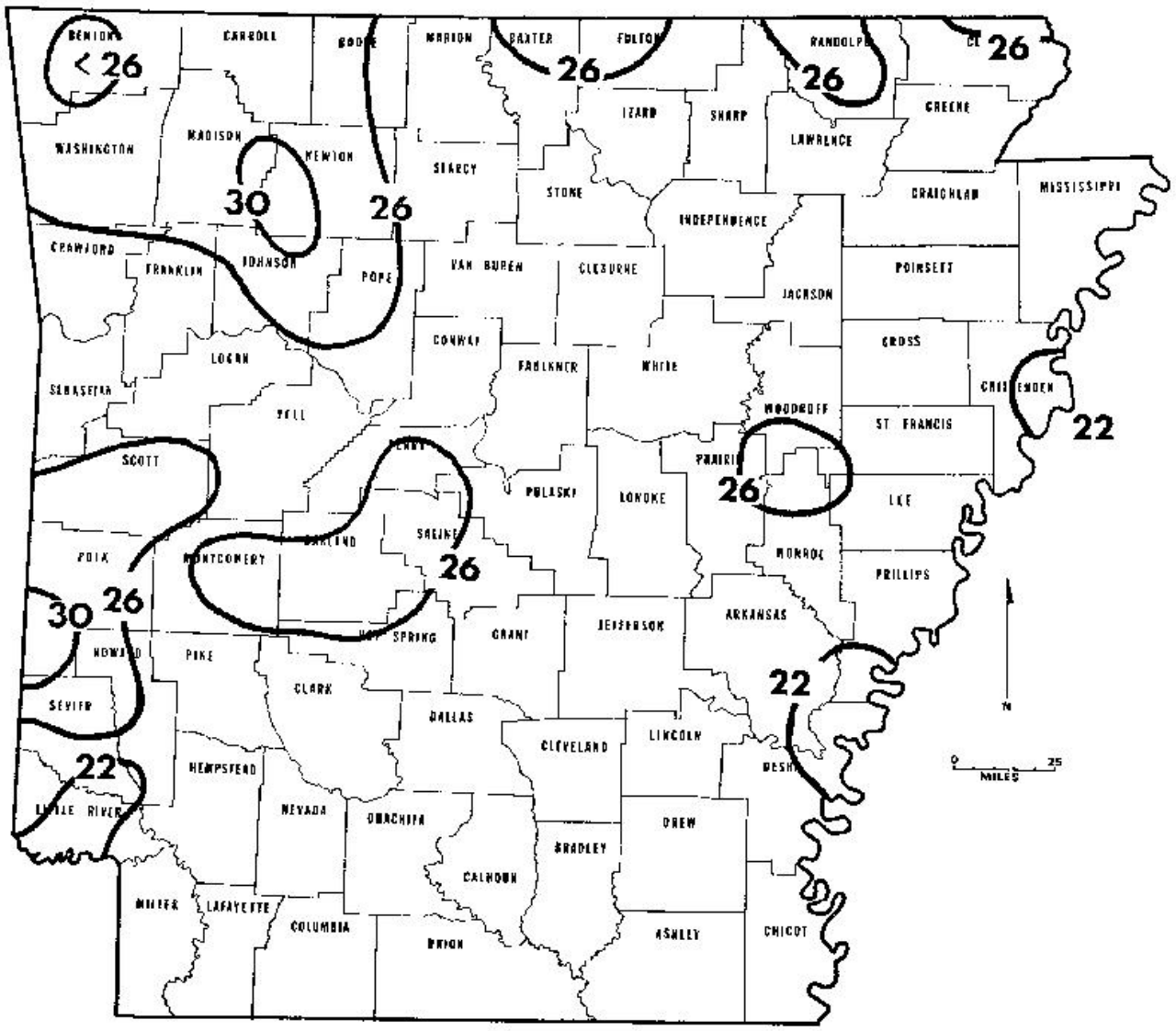
What is the range (difference between highest and lowest month) of:

Temperature? ____

Precipitation? ____



MEAN ANNUAL PRECIPITATION



MEAN PRECIPITATION

APRIL TO SEPTEMBER

QUESTIONS ON MEAN ANNUAL PRECIPITATION

What is the "average" annual precipitation for Arkansas? _____

Which county has the greatest annual precipitation? _____

Which counties have the least annual precipitation? _____

In general, does northern or southern Arkansas have greater annual precipitation? _____

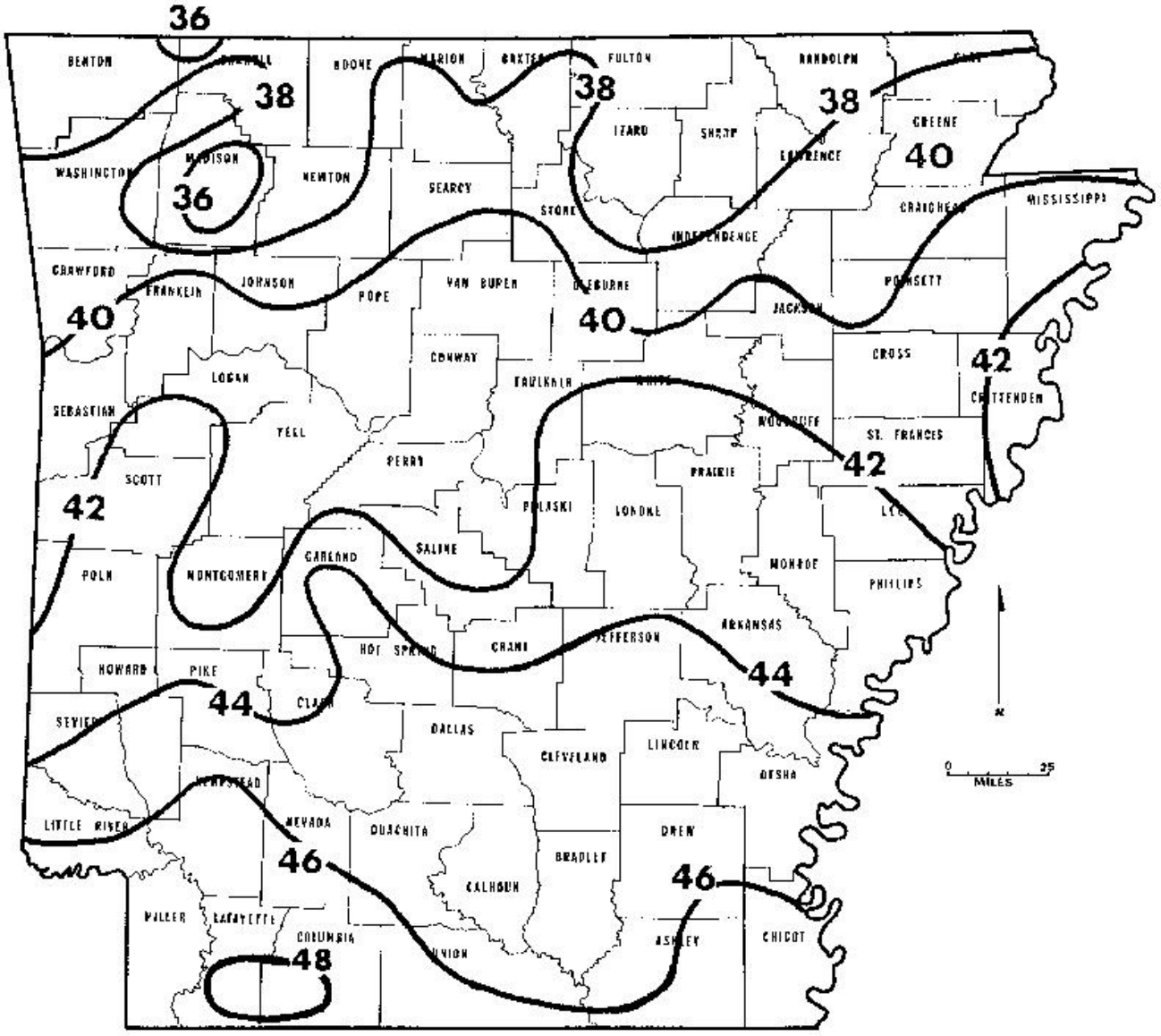
QUESTIONS ON APRIL TO SEPTEMBER PRECIPITATION

Why is the amount of precipitation from April to September particularly important? _____

What is the "average" April to September precipitation for Arkansas? _____

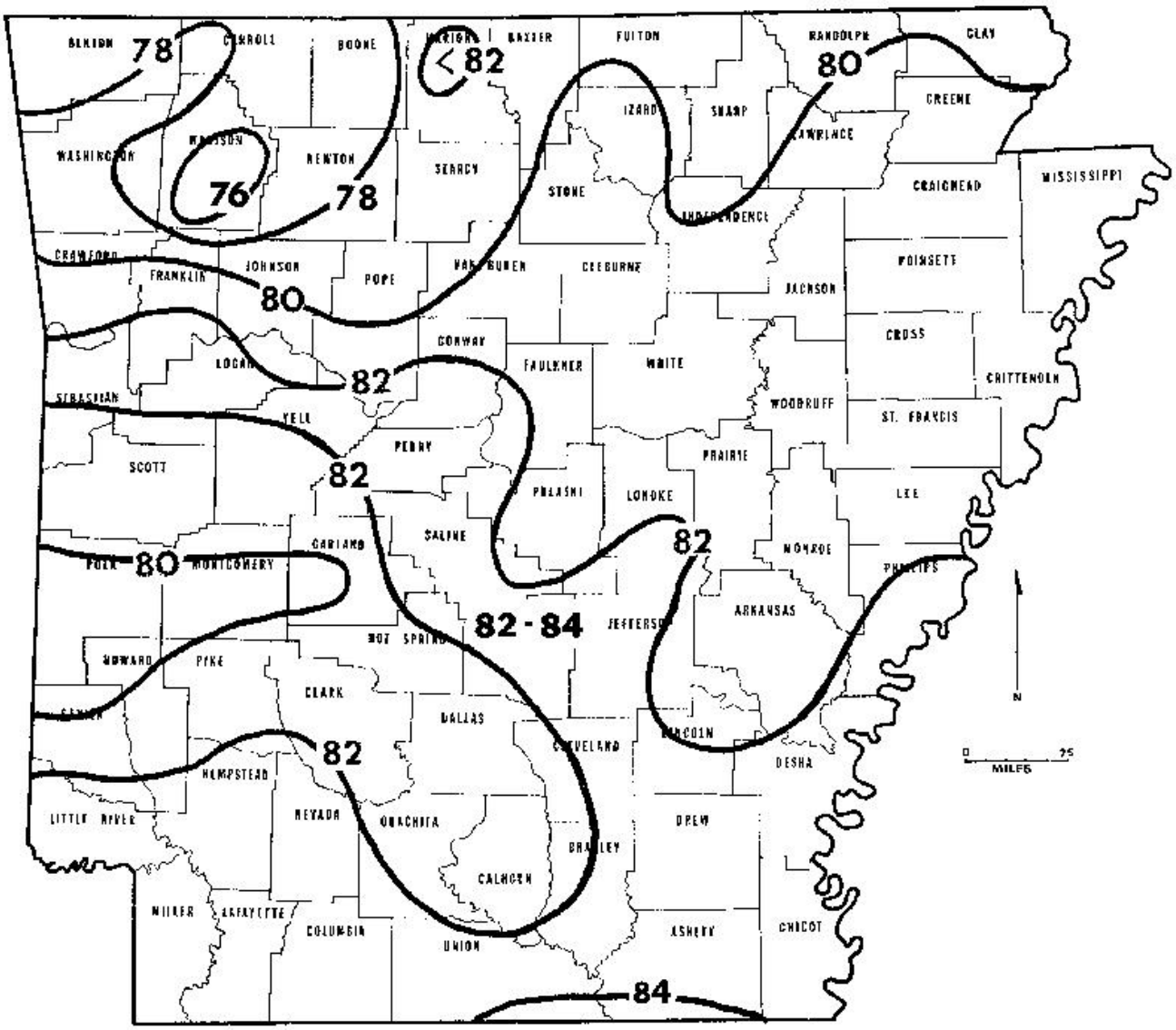
Which counties have the greatest precipitation during this period? _____

In general, does northern or southern Arkansas have greater precipitation during this period? _____



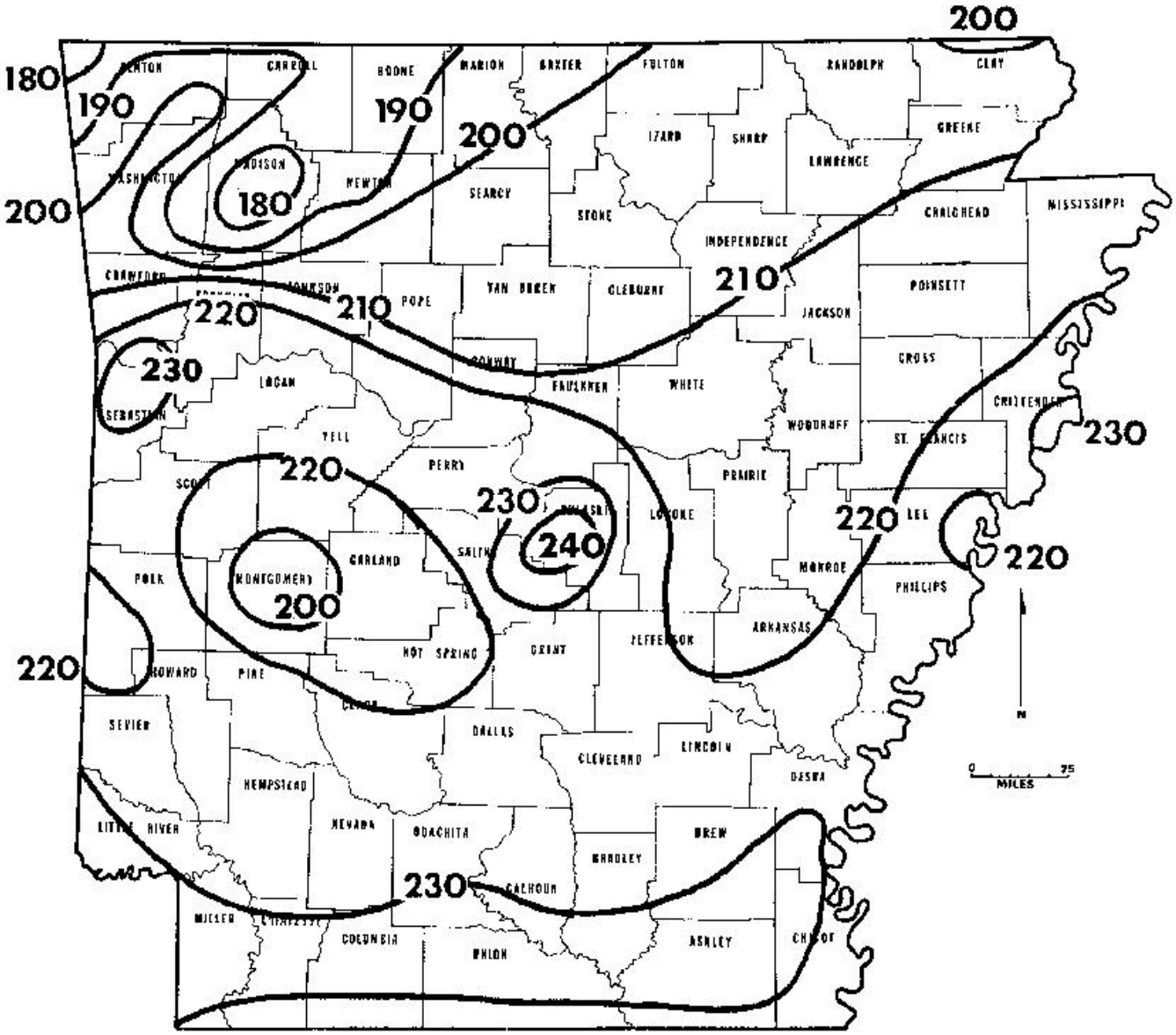
MEAN JANUARY TEMPERATURE

IN DEGREES F.



MEAN JULY TEMPERATURE

IN DEGREES F.



MEAN DURATION OF GROWING SEASON IN DAYS

QUESTIONS ON TEMPERATURE AND GROWING SEASON

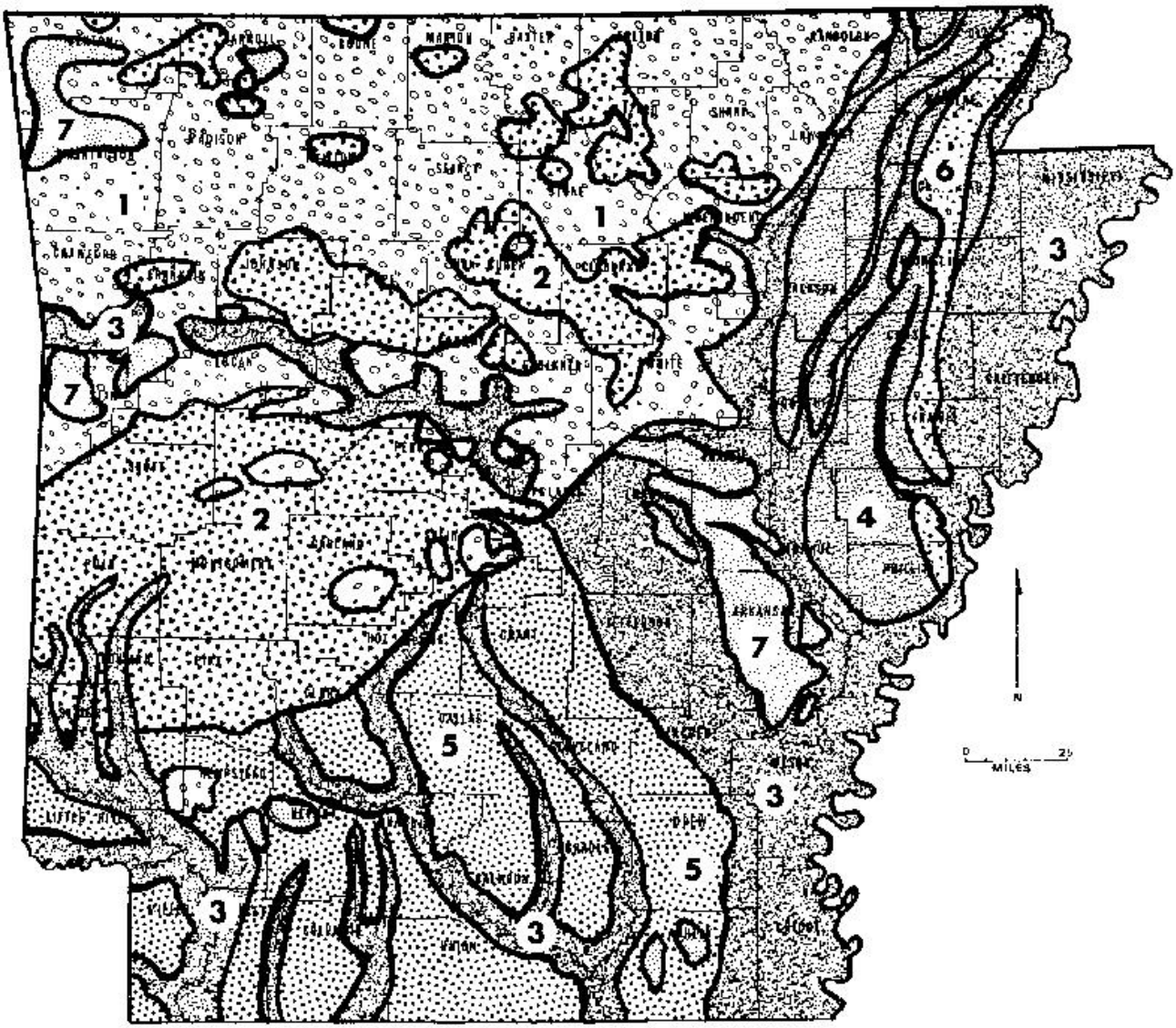
How many degrees is northern Arkansas cooler than southern Arkansas:

During July? _____

During January? _____

The length of the growing season is the amount of time between the last frost in spring and the first frost in fall. Name two factors which influence the length. _____

_____



PLANT COMMUNITIES

PLANT COMMUNITIES

Area 1

Upland Hardwood Forest. The dominant species here are oaks and hickories which are adapted to the relatively thin, dry soils of the mountains. Typical species include:

very dry sites - blackjack oak, post oak

dry sites - black oak, black hickory

moist sites - southern red oak, white oak, mockernut hickory

very moist sites - northern red oak, beech, sugar maple

Area 2

Upland Pine Forest. The characteristic species of this type is the shortleaf pine. The soils of this forest are formed in chert, novaculite or sandstone. Because of that, they are more acid than equivalent sites occupied only by upland hardwoods. The sites may be "very dry", "dry" or "moist", and upland hardwoods appropriate to those conditions (listed above) will be present. Within the area mapped as Upland Pine Type, pine does not usually occur on "very moist" sites.

Area 3

Bottomland Hardwood Forest. The dominant species of this type are oaks and hickories which are adapted to intervals of flooding. Typical species include:

permanently or usually flooded - baldcypress, tupelo

very frequently flooded - overcup oak, nuttall oak, water hickory

frequently flooded - sweetgum, pecan, cherrybark oak

sometimes flooded - willow oak, water oak, sugarberry

Area 4

Terrace Hardwood Forest. This forest type occurs on sites which seldom flood but may be poorly drained because they are flat and their soils are clayey. Typical associations of species include those of the "sometimes flooded" bottomland hardwood forest, along with those communities of the upland hardwood forest which occur on "moist", "dry" or "very dry" sites.

Area 5

Lowland Pine Forest. The characteristic species of this forest type is the loblolly pine. It occurs on sites similar to the Terrace Hardwood Forest and with terrace hardwood species appropriate to those sites. Lowland Pine sites are usually more rolling, sandier and better drained than Terrace Hardwood sites. Shortleaf pine is found along with, or instead of, loblolly pine in some areas mapped as Lowland Pine Forest, particularly on the quaternary terrace along the eastern edge of the Coastal Plain (see the geology map), and dry, steep areas elsewhere.

Area 6

Crowley's Ridge Upland Hardwood Forest. This type is similar to the Upland Hardwood type except that "very moist" and "moist" sites are far more common on Crowley's Ridge than in the Ozarks and Ouachitas. Also, some species such as the tulip tree are found in Arkansas only in the Crowley's Ridge type and others, such as the white walnut, are found most commonly in this forest. Shortleaf pine is found on the northern half of the ridge.

Area 7

Prairie. This is the one major plant community of Arkansas which is not dominated by trees, but rather by native grasses. Dominant species include big bluestem, indiangrass and switchgrass on moister sites and little bluestem on drier sites. There are four major kinds of prairie in Arkansas:

(a) The "Grand Prairie" type of the Delta and eastern Coastal Plain,

(b) The Blackland Prairie type of the Coastal Plain,

(c) The Cherokee Prairie type of the western Arkansas River Valley, and

(d) The Osage Prairie type of the Ozarks.

These differ from each other in minor, but recognizable ways such as the presence of unique species and different relative abundance of common species.

The Prairie comminity type merges with the "very dry" and "dry" upland forest communities to form savanna, where oaks and pines are scattered among the native grasses.

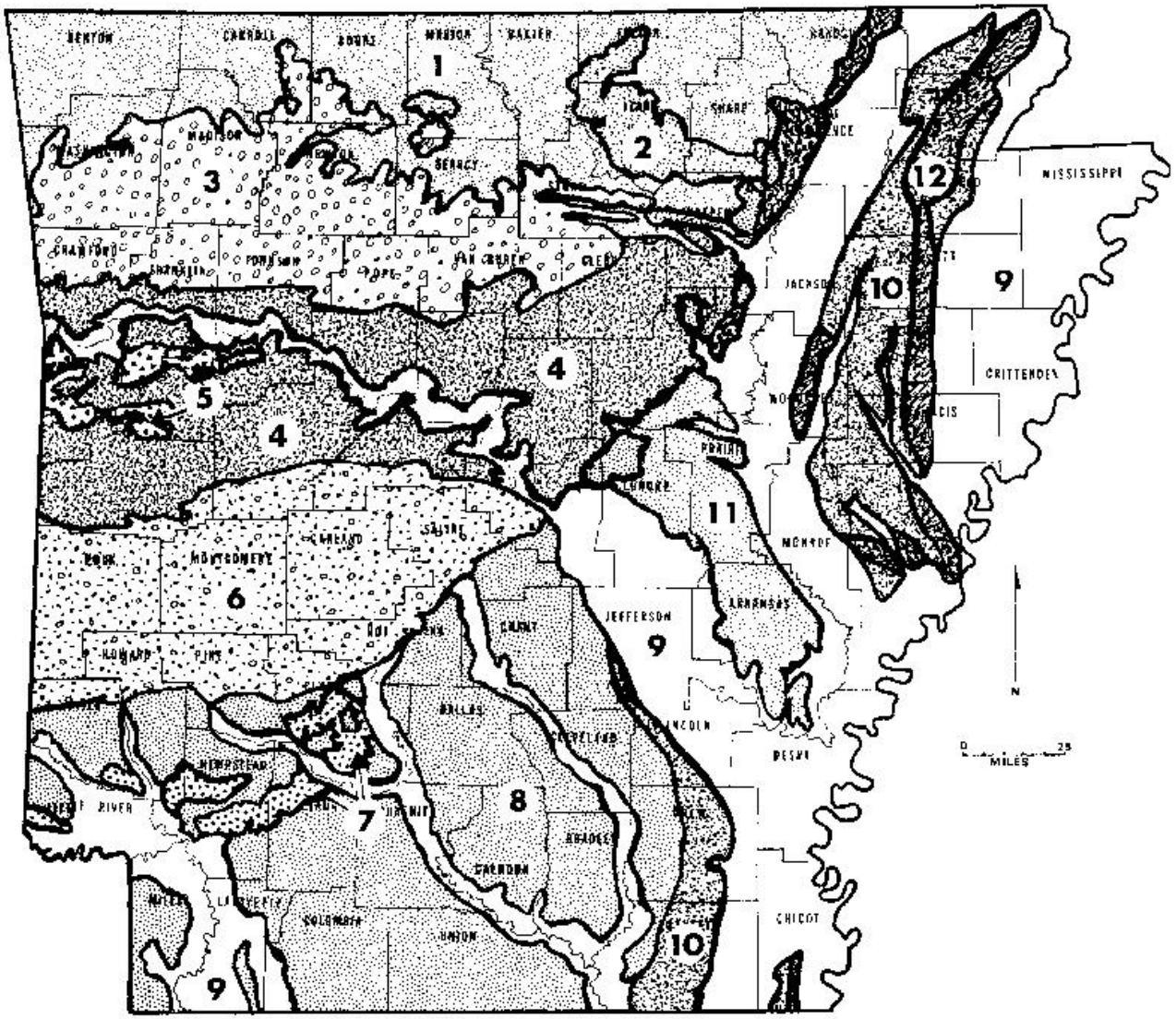
QUESTIONS ON PLANT COMMUNITIES

Name the division or divisions where there is no upland hardwood forest.

Which three divisions have the most bottomland hardwood forest?

In which two divisions is no prairie shown on the map?

List, in detail, the associations of species found in "Area 4".



SOIL ASSOCIATIONS

SOIL ASSOCIATIONS

Area 1

Ozark Highland Limestone Soils. These soils have developed chiefly on the limestones of the Springfield and Salem palteaus. Elevations range between 500 and 1,500 feet and most of the land is sloped. Terrain varies from the relatively flat areas in parts of Washington and Benton counties to the very rugged hills of Carroll County. Subsoils are slowly to moderately permeable clays. Soils are mainly silty loam, relatively deep in the valleys and on flatter areas but very thin on the steeper hillsides.

Area 2

Ozark Highland Sandstone-Limestone Soils. This is a small area found mainly in Izard, Fulton and Sharp counties. The hills and valleys are eroded from sandstone and limestone on the Salem Plateau. Clay and sandy loam subsoils are overlain by loamy soils.

Area 3

Boston Mountain Soils. The Boston Mountains range generally from 1,500 to 2,300 feet elevation. Much of the area is very rugged and several sections have over 1,000 feet local relief. Relatively level land is confined to ridge tops which are remnants of the old plateau surface and the valley floors. The soils are sandy loams and clay loams, medium textured, and generally well drained.

Area 4

Arkansas Valley Soils. Sandstone and shale are the parent materials for soils found on the narrow ridges and in the wide valleys of the Arkansas Valley section of the Ouachitas. The valleys stand at 300 to 500 feet and ridges rise 1,000 to 2,000 feet above them. Soil conditions vary considerably from valley floor to hillside but most soils are slowly to moderately permeable and of medium texture: sandy, silty, and clay loams.

Area 5

Cherokee Prairie Soils. These occupy scattered areas in the western Arkansas Valley, developing over sandstone and shale and under prairie. The soils are deep and of medium texture.

Area 6

Ouachita Mountain Soils. The soils are of medium texture and are of moderate permeability formed from shale, sandstone, novaculite, and quartzite. Soils are mainly silty clay and silty loam, deep in the valleys and very stony on the ridge tops.

Area 7

Blackland Prairie Soils. In southwestern Arkansas, scattered prairies occupied areas of chalk and calcareous marls. Gray clay subsoils are overlain by deep, dark clay and silt loam soils.

Area 8

Forested Coastal Plain Soils. Central south Arkansas consists of a sandy coastal plain of rolling terrain broken by stream valleys. Most subsoils are sandy or silty clay loams, relatively deep. Soils are largely sandy loams with some silt and clay loams.

Area 9

Bottomland and Terrace Soils. This soil association is found along all major streams. The deep alluvial material varies from coarse to fine texture and thus from rapid to slow permeability. The land is level to only gently undulating and there is much wet land.

Area 10

Loessial Plain Soils. In some areas of eastern Arkansas, especially on the west side of Crowley's Ridge, are broad alluvial plains capped with wind-deposited silt. Most of the soils are deep, medium textured, and slowly permeable. The subsoils are mainly clay and often compact.

Area 11

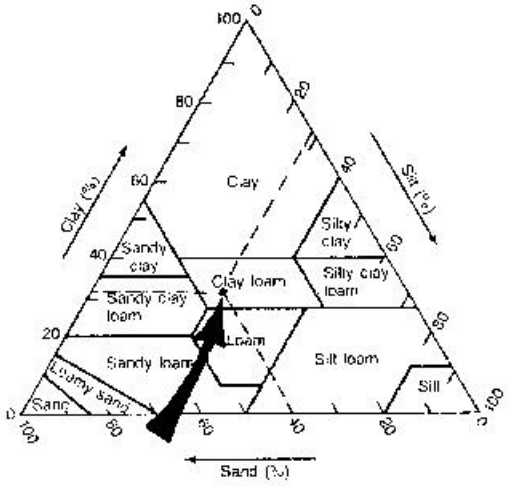
Eastern Prairie Soils. The prairies of eastern Arkansas are mainly in Arkansas and Prairie counties; the largest is called the Grand Prairie. The terrain is nearly level. The clay subsoils are generally compact.

Area 12

Loessial Hill Soils. Crowley's Ridge and smaller ridges of eastern Arkansas are capped with wind-blown silt varying in depth from a few to as much as seventy feet. The area is in moderate slope and there has been much soil erosion. The largely silt loam soils are deep, of medium texture, and are moderately permeable.

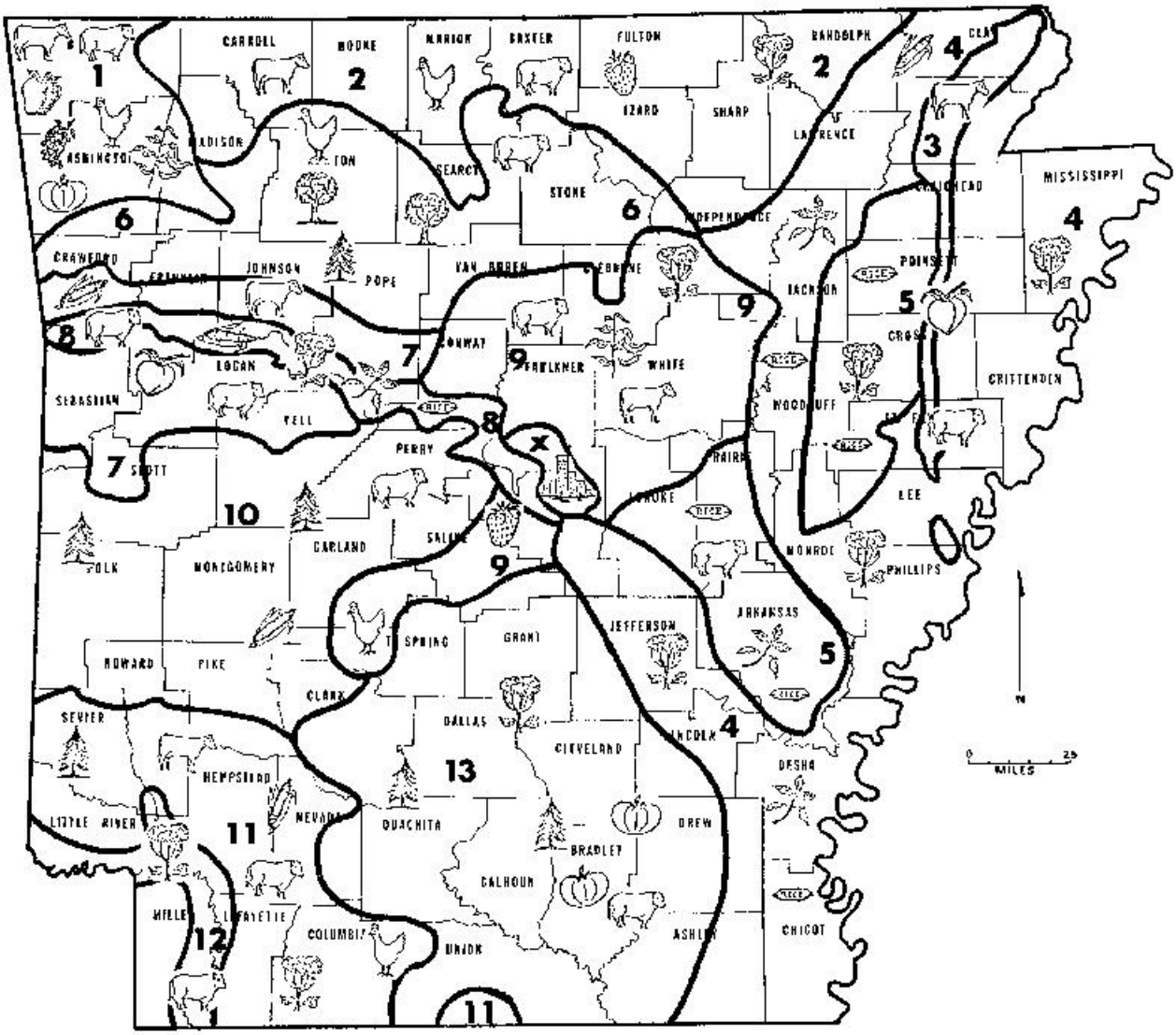
SOIL CLASSIFICATION

Soils are classified according to the size of the mineral particles which comprise them. The smallest of these particles is clay, which has a diameter of less than two thousandths of a millimeter (.002 mm). Particles with diameters between two thousandths and five hundreths of a millimeter (.002 mm-.05 mm) are called silt. The next largest particles are called sand with diameters from .05 mm to 2.0 mm. Larger particles are called gravel. The figure below illustrates the classification of soils with varying proportions of these particles.



Example: A soil with 40% sand, 32% clay and 28% silt is classified as clay loam.

Problem: Classify (name) a soil which is composed of 60% sand, 30% silt and 10% clay. _____



TYPE - OF - FARMING REGIONS

TYPE-OF-FARMING-REGIONS

Type-of-farming regions are the result of many complex natural and human factors interacting. Basically, the natural factors offer certain possibilities for the use of the land; they may also present obstacles to other uses. Terrain, with respect to slope and relief as they affect drainage, erosion, and the use of machinery, is a major influence. The most rugged parts of the Ozarks and Ouachitas are ill-suited for cropping. Along the major streams in eastern Arkansas there are extensive wet lands. The soils generally are low in natural fertility but respond well to commercial fertilization and other scientific farming practices. The compact subsoil in some areas favors irrigated rice and the sandy coastal plain soils favor the growth of pines. Climate throughout the state makes possible a wide variety of agricultural activities, yet the uplands in the north do not have a sufficiently long growing season for cotton to be economically feasible. Man himself, working with what Nature provides and occasionally improving upon it, is influenced in his decisions on land use by capital, market, tradition, availability of land, and government aids and controls.

Region 1

This area is primarily on the Springfield Plateau, extending into the Boston Mountains. Poultry, especially broilers, dairy cattle, and beef cattle are the major agricultural interests. Fruits, particularly grapes and apples, and vegetables, dominated by tomatoes and green beans, are important. Pasture acreage exceeds cropland, which is greater than the woodland. Many farm families supplement their farm income with work in the towns of this region.

Region 2

The Salem Plateau and eastern area of the Springfield Plateau comprise this region. Woodland, cropland, and pasture are nearly balanced in acreage. Beef cattle and dairying predominate. Variations exist within such a large area, especially in the importance of poultry and various crops. Cotton is significant in the eastern part of the region, vegetables and strawberries in the center, and poultry in the west.

Region 3

Crowley's Ridge is the location of this region and many of the farm units include significant acreage on the Alluvial Plain. General farming predominates, with cotton and fruit declining and beef cattle and dairying increasing in importance.

Region 4

Much of the Mississippi Alluvial Plain is in this region, extending from Missouri to Louisiana in eastern Arkansas. Cotton and cash grain, especially

soybeans, corn, and rice in certain areas, dominate the agriculture. Livestock are increasing in importance but are generally less significant than in other parts of the state. This area has the highest tenancy rate within the state and the size of farm unit is smaller here than elsewhere, empahsizing the commercial nature of the agriculture and the land values.

Region 5

Certain areas within the Mississippi Alluvial Plain emphasize rice production to such a degree that they comprise a distinct region. The rice area just north of the Arkansas River is the older, with soybeans, cotton, and beef cattle also important. The rice area to the west of Crowley's Ridge is newer and has greater emphasis upon cotton. Subsoil and available irrigation water are significant factors.

Region 6

The Boston Mountains constitute most of this region. Rough terrain and the large acreage in national forest seriously limit the extent of agriculture. General farming prevails, with emphasis upon livestock, especially beef cattle, hogs, and chickens. Non-commercial farms are common. The hardwood forest covers much of the area but produces limited cash income.

Region 7

The western half of the Arkansas Valley, excluding the bottomlands, has a varied agriculture. Diversified agriculture prevails, featuring beef and dairy cattle, corn, pasture, and a wide variety of vegetable and fruit crops. Cotton has decreased in importance in recent years, especially in the western part of this region. Adjacent to the major towns, many farmers work off the farms.

Region 8

The very narrow alluvial lands along the Arkansas River from Ft. Smith to Little Rock comprise this region. Part of the original floodplain is now under the waters of the Arkansas River Navigation Project. Most of the land here is part of farms in Region 7. Cattle occupy the terrace lands while the lower lands are used mainly for crops. Soybeans, corn, and oats are major grains. There is considerable emphasis upon commercial vegetables in the western portion of the region and rice is of increasing importance in the eastern part where cotton also is found.

Region 9

The central agricultural region is situated largely in the highlands but extends into the lowlands. The metropolitan population is a major influence not generally felt elsewhere in the state. Dairying and general farming predominate, with cotton, beef cattle, poultry, and a variety of vegetables and small fruits in significant proportions.

Region 10

The bulk of the Ouachita Mountain area is quite similar in economic development to the Boston Mountains, Region 6. Rough terrain and the large acreage of the Ouachita National Forest emphasize the extent of woodland and the limited cropland. Much land is in pasture and hay is the major crop, followed by corn. General farming concentrates on livestock production.

Region 11

This region is on the Gulf Coastal Plain in the southwestern part of the state. Cotton is the outstanding crop and corn is widely grown but the trend is away from row crops and to more pasture. Beef cattle usually rank high, but dairying and broilers are significant in certain areas. Vegetables and fruit are locally quite important. Near cities and around the timber and oil industries, many farm people are employed off of the farm.

Region 12

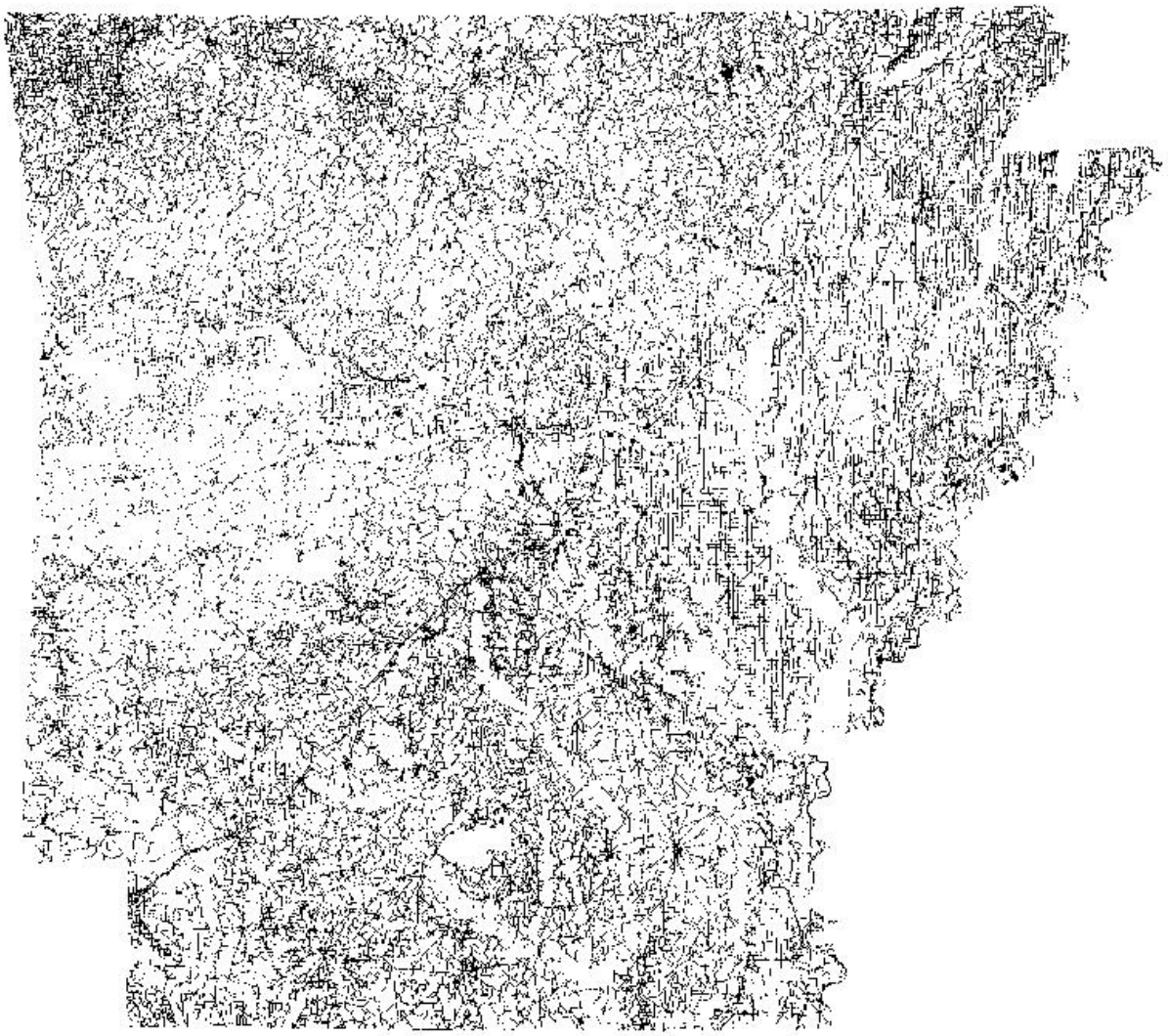
This is another of the narrow bottomland areas, along the Red and Little rivers. Cotton is very important, with beef cattle the other major source of farm income.

Region 13

Central southern Arkansas is also on the Gulf Coastal Plain which is heavily forested. Timber and mineral industries compete successfully with agriculture for labor. General farming is the most widespread with beef cattle and cotton the major commercial products. Locally, vegetables and forest products from the farm are commercially important. There are many non-farm forest holdings in this area.

Region X

This is a non-agricultural region, devoted to the Little Rock-North Little Rock metropolitan area.



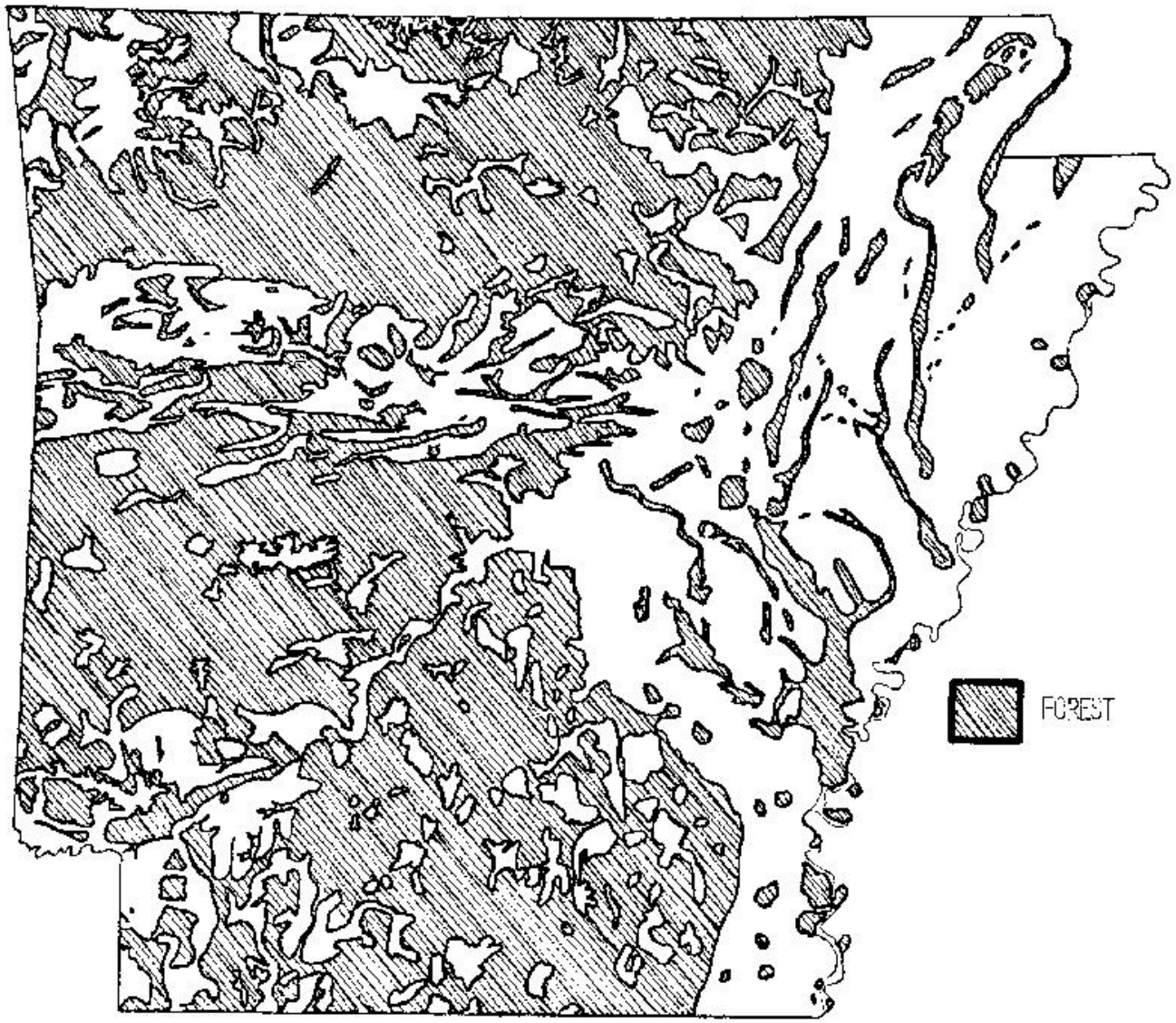
ALL ROADS

QUESTIONS ON ROAD PATTERNS

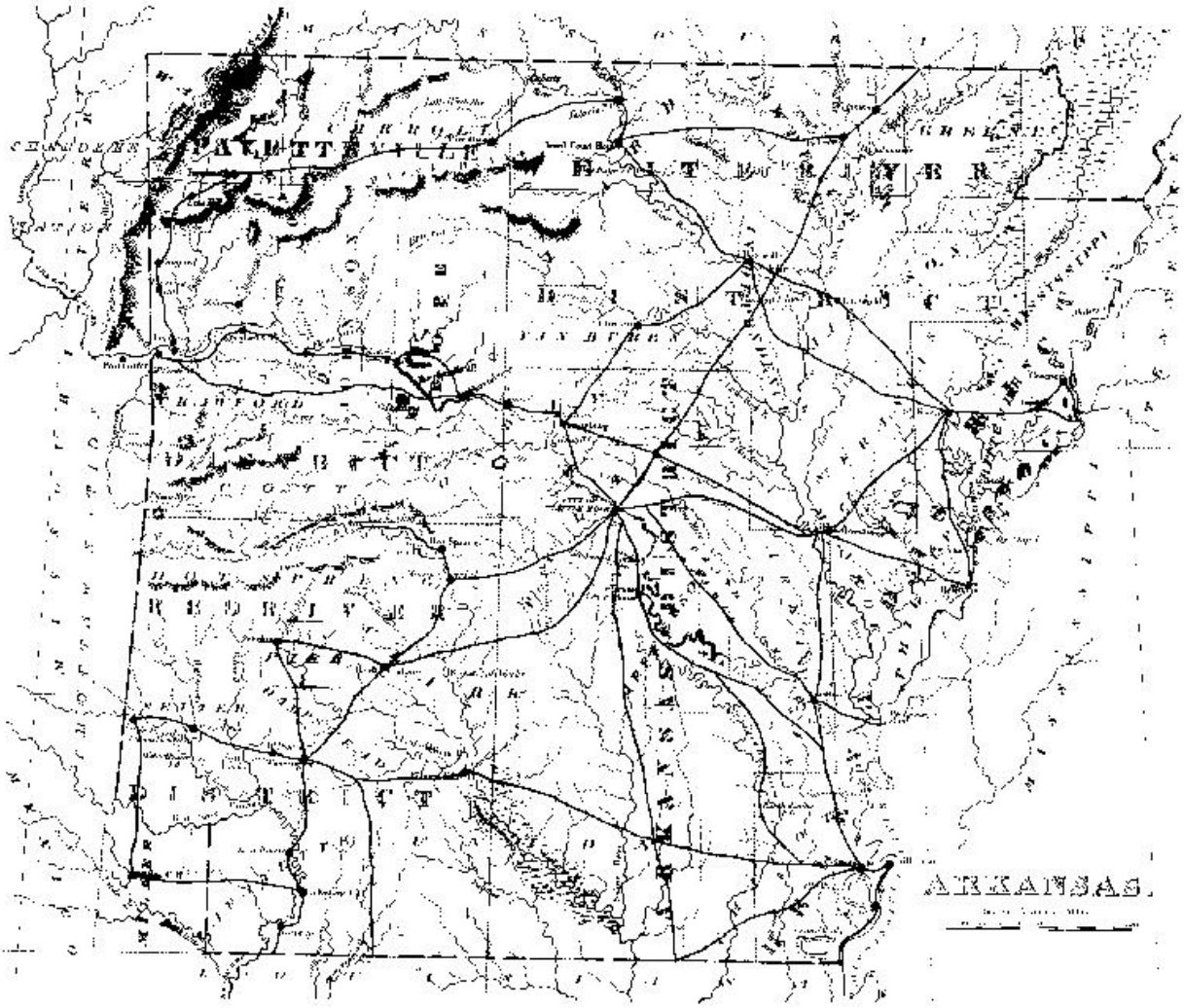
Can you tell the difference between flat, rolling and rugged areas? How?

Can you tell where rivers run? How?

How can you tell the difference between densely populated and sparsley populated areas?



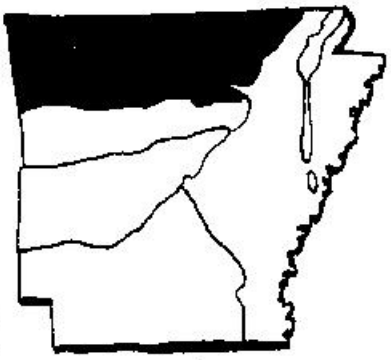
FOREST COVER



ARKANSAS CIRCA 1834

Present Boundaries Shown

THE OZARK MOUNTAINS



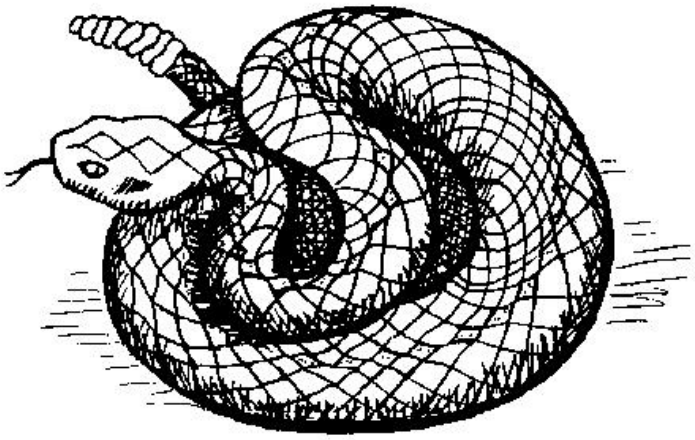
The Ozarks have a special mountainous topography. Although the mountains are quite rugged in places, the tops tend to be flat and at the same height. This has resulted from the geologic history of these mountains. The Ozarks were formed when the bedrock was uplifted into high plateaus which were then eroded down into the present rugged shape. (see "How Arkansas Got To Be").

In a stream or road cut you can get a feeling for the geology of the area. The rocks that make up the Ozarks were deposited at the bottom of an ocean that covered Arkansas 300 million years ago. When the limey-shelled creatures of the ocean died, their shells were compressed into limestone. This limestone makes the Ozarks a rich fossil-hunting area. Also, limestone is easily dissolved by water, so caves such as Blanchard Caverns have been formed by streams flowing through cracks in the limestone. Water flowing through cracks in limestone is not purified or filtered, so polluted water that enters a cave may very easily appear miles away as a polluted spring. A well drilled into the underground stream will also be polluted. Small wonder that the water from most wells and springs in the Ozarks is unsafe, including the "healing" water at Eureka Springs.

The streams of the Ozarks are usually small and quite beautiful. As they have carved mountains out of plateaus, they have made bluffs, waterfalls, and even a natural dam. The larger streams like the Buffalo and White rivers are well known by canoe and innertube pilots. Some of the larger streams are crossed by man-made dams which form beautiful impoundments like Beaver, Bull Shoals and Norfork Lakes. It should be remembered though, that under these lakes were rivers that were themselves scenic and recreational resources.

The trees of the upland hardwood, oak-hickory forest of the Ozarks are suited to the thin soil and steep slopes of the mountains. In the spring the forest floor is covered with wildflowers of all sorts while the fall colors of the changing leaves give the forest a special sort of beauty.

The Ozarks abound in wildlife (though not as much as the bottomlands). There are minks along the streams, rattlesnakes under the rocks and butterflies resting and feeding on the sandbars along the streams. Some of the most interesting plants and animals of the Ozarks are found in the bare rock outcrops



called cedar glades. Look closely and you will see that these rocks are not bare but covered with lichens and mosses. These lichens produce acids which are the first step in breaking down rocks into soil. The collared lizard, known as the "Mountain Boomer", is at home in the glades and you may overlook an interesting camoflaged grasshopper that is colored to match the pattern of the lichens.

The first residents of the Ozarks were pre-historic Indians known as bluff dwellers. They are called that because they often took shelter under overhanging bluffs. Their belongings and decorations can still be seen in many of the bluff shelters.

By the time the first white people arrived in the Ozark Mountains the bluff dwellers had been replaced by the Osage Indians. The Osage lived the wandering life that the bluff dwellers had before them and were very warlike. The first white men in this area adopted the same lifestyle, but eventually they settled down and became farmers.

The few places in the stream valleys and on the flat tops of the mountains where the soil was deep enough for farming were far apart. The isolation that resulted helped to develop the unique Ozark Mountaineer or Hillbilly lifestyle. This lifestyle, characterized by independence, suspicion of strangers and a very special mountain music, is one we are very conscious of in Arkansas today. Sometimes we're proud, sometimes we're ashamed, but always we're aware of our hillbilly heritage.

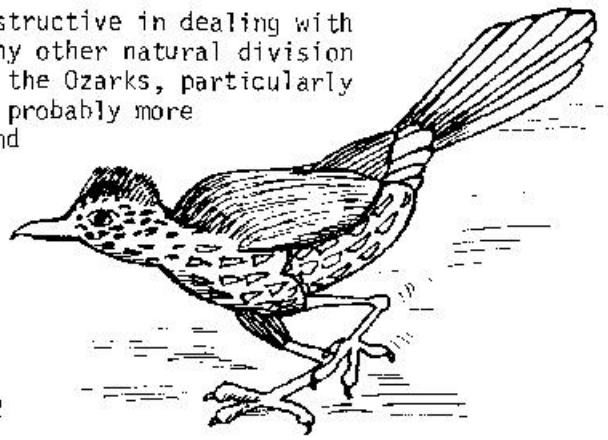
Between World War I and World War II, their subsistence lifestyle became less and less acceptable to these people. Growing enough corn to eat (or sometimes maybe drink) was no longer enough. They wanted cash to buy kerosene and canned food. Some tried to grow cotton on the hillsides and when their topsoil eroded away they left the mountains. Other folks simply moved out.

Now people are moving back into the hills to enjoy what may be their greatest natural resource, the scenery. But the water supply in the Ozarks is limited and the natural system is delicate. In an attempt to escape the problems of the city many people are relocating in the mountains only to find new problems. The small, high-quality streams are limited in the amount of sewage that they can carry. Here sewage must be highly and expensively treated to avoid the destruction of strem quality. The people here must ask themselves how much they are willing to spend to protect the environmental quality that brought them in the first place.

The Ozarks now support several industries, each with its own special environmental considerations. The poultry industry is perhaps the largest but care must be taken to keep chicken litter out of streams and underground channels. With beef prices rising, more land is being cleared for cattle grazing. This is often done with potentially dangerous chemicals. Also, overgrazing of pasture will lead to erosion and the loss of soil as well as water quality.

The timber industry of the Ozarks is not large but much of it involves public land where intensive timber management practices may interfere with other valid uses of the forest.

People have probably been less destructive in dealing with the natural system of the Ozarks than any other natural division of Arkansas. Yet the natural system of the Ozarks, particularly the cave-spring-stream water system, is probably more delicate than any other in the state, and is such a valuable resource that it must be given extreme protection.



QUESTIONS ON THE OZARKS

When were the rocks of the Ozarks laid down (use the SURFACE GEOLOGY map and the TABLE OF GEOLOGICAL HISTORY in "HOW ARKANSAS GOT TO BE)? List time period and years before the present.

PERIOD YEARS BEFORE PRESENT

What was the area like at that time (refer to "HOW ARKANSAS GOT TO BE")?

_____

_____

Approximately what is the average annual precipitation? _____

April-September precipitation _____

July temperature _____

January temperature _____

What plant communities are found in the Ozarks (refer to the PLANT COMMUNITIES map)? _____

What elevations are found there (refer to SOIL ASSOCIATIONS map)? ____

What major soil associations are found there? _____

_____

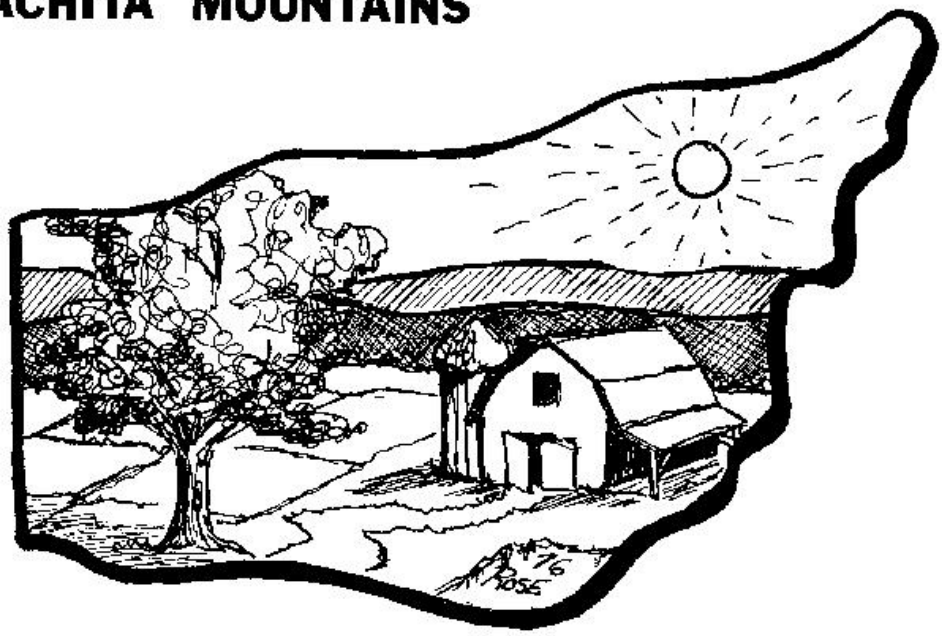
What are the primary agricultural products of the area (refer to TYPE OF FARMING REGIONS map)? _____

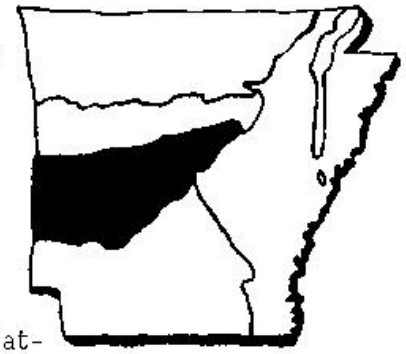
_____

Where are the two most level parts of the Ozarks and what cities are found there (refer to the ALL ROADS map and to the ARKANSAS GEOGRAPHY map)?

_____

THE OUACHITA MOUNTAINS





The best way to understand the Ouachitas is to compare them to the Ozarks. Contrary to what many people think, the Ouachitas differ from the Ozarks in significant ways.

An important difference may be seen in a road cut: the layers of rock are almost always tilted. In the Ozarks, the rock layers are almost always horizontal. These differences result from the different geological histories of the two systems. In the Ozarks, bedrock was pushed up into rugged, flat-topped mountains. However, in the Ouachitas, a belt of land about 120 miles wide was "squeezed together" until it was only half that wide. When that happened, the rock did what might be expected, it wrinkled up.

The mountains of the Ouachitas are big wrinkles in the earth's crust: long east-west trending, sharp-pointed ridges that may be a couple of miles wide and over a hundred miles long.

The most common rocks of the Ouachitas are sandstone and shale rather than the limestone and dolomite which are so common in the Ozarks.

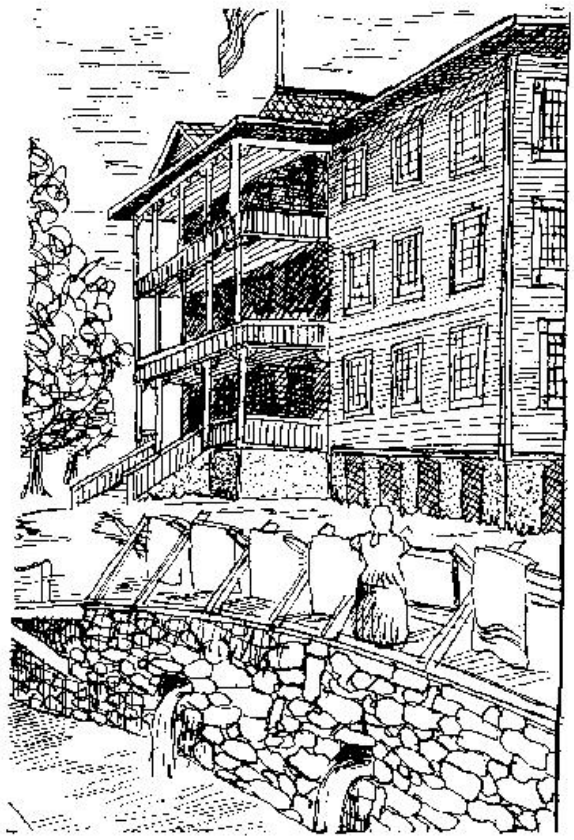
Sandstone weathers into a sandy soil, and sandy soil is favorable to the growth of pine. It's not surprising then that pine forest is more widespread in the Ouachitas than the Ozarks. The largest populations of wild turkey in Arkansas live in this forest.

The valleys of the Ouachitas tend to be much wider than the valleys of the Ozarks: up to 20 or 30 miles wide . That has been important to people from the beginning, because there is a fairly deep soil in those valleys.

The first people we know about in the Ouachitas were the Caddo Indians. They wandered the hills, hunting and fishing, but tney were also able to live in settled villages made possible by the agricultural crops which thrived in the relatively deep soils of the wide Ouachita valleys.

Early settlers continued clearing the valleys for farms. Many of them grew into large plantations where the planters lived an elegant "Old South" lifestyle. Up on the ridges, though, folks lived a rugged pioneer life, like that of the Ozark Mountaineer. In the Ouachitas, then, there was a blend of lifestyles, with rich planter and poor mountaineer living close together.

An interesting point about the history of the Ouachitas is that there is hardly any, except for the Hot Springs area. The area has been almost untouched by historians and unnoticed by the general public.



Hot Springs has the most interesting history of any part of the Ouachitas. It was widely known amoung the Indians, both as a source of high-grade novaculite for arrowheads and for the healing value of the springs.

It was first described by an exploring party led by Dunbar and Hunter in 1804. They had been sent out to describe the springs by Thomas Jefferson after his purchase of Louisiana. Later, they were visited by virtually every explorer or traveler who wrote about Arkansas.

The value of the springs was officially recognized in 1832 when the United States Congress formally withdrew the land around the springs from homestead or private purchase. This was the first time in history that the U.S. Government had reserved land for public use.

The dominant public use of the springs has been therapeutic bathing. Bathhouses were built and in 1921,

government land surrounding the springs was declared a National Park.

The development of the springs area is a fascinating part of its history. Originally, the 45 to 70 springs flowed from the lower slopes of Hot Springs Mountain into Hot Springs Creek. At that point the valley through which the creek flowed was too narrow for large bathhouses to be built. In 1883 a rock vault was built over the stream and the valley was filled to a depth of 20 feet or more. That made a wide enough flat place to build the present bathhouses and private buildings along Central Avenue.

Today the upper end of the vault, near the fountain, and the lower end, near the railroad station, are visible. In between, the stream, with riffles and pools intact, is flowing through the vault under the street or under the porches of the bathhouses. It can be traced by the manholes and drains which lead to it.

The vault was designed to be large enough to accommodate flood flows, but turned out to be too small. Whenever flow is too great, water backs up at the upper end of the vault until it is high enough to flow down the street, sometimes three feet deep.

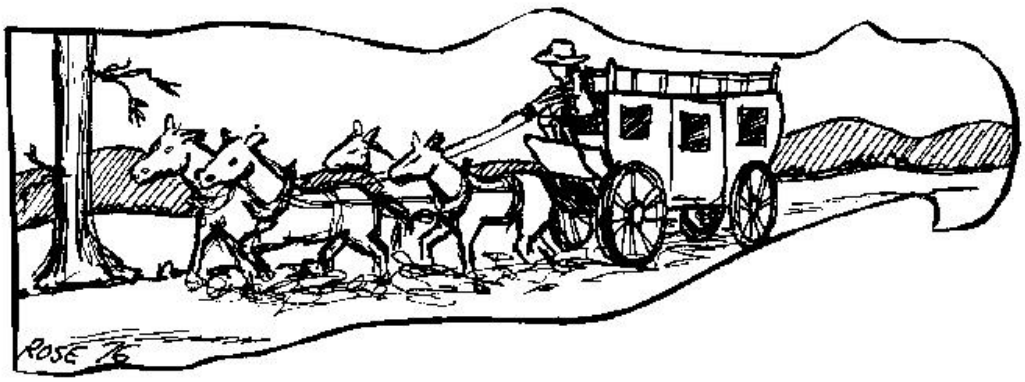
All but two of the springs have been covered over, with pipes now carrying their water to a central distribution center. With both stream and springs covered, it's no wonder that Hot Springs National Park has an identity crisis. The most common comment on the visitor register is "Where is Hot Springs National Park?".

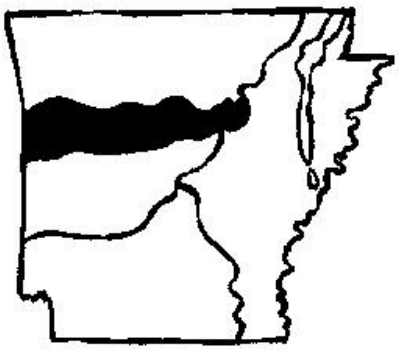
There a couple of major uses of land in the Ouachitas, both of which are different from the major land-uses of the Ozarks. One is forestry. The timber sites are good enough that much of the Ouachita Mountain Division has been purchased by the National Forest Service and private timber companies. That land today is managed intensively for timber production. Associated with that use of land are a variety of controversial practices, such as clearcutting and aerial spraying of herbicides,which the people of the Ouachitas will have to deal with in the future. Another major use of land in the Ouachitas is mining of valuable minerals such as barite, novaculite, and quartz, which are formed during mountain-building. Mining can cause several environmental problems, such as destruction of plants and animals by acid water which drains from mines into a stream. Also, if a mine is not reclaimed, the productivity of that land is lost. Mining, then, is a land-use which is important to the economy of Arkansas, but must be done carefully.

By looking at the land of the Ouachitas- its geology, plants, animals, soil - and its people - their use of the land, history, culture, and land-use problems - it is apparent that the Ouachita Mountain Division is a unique area different in many ways from the Ozarks.

EXERCISE: Complete the table you began after reading "A BRIEF LOOK AT THE NATURAL DIVISIONS". This time, use all the information you have access to.

THE ARKANSAS RIVER VALLEY





The Arkansas River Valley, as the term is used here, is not just the lowlands along the Arkansas River but rather it is the trough that is up to forty miles wide between the mountains to the north and south. Within the Valley are flat-topped mountains, like those that are typical of the Ozarks, and folded ridges, like those of the Ouachitas. Some of the rocks have flat strata typical of the Ozarks and others have tilted layers like those of the Ouachitas.

However, there are also unique features to the Valley, like high, isolated, flat-topped mesas, buttes, or monadnocks such as Mt. Nebo and Petit Jean Mountain. These monadnocks were at one time connected to the Ozarks and their structure is very similar to the southern Ozarks. They're capped by massive sandstone which helps to keep them from eroding away, and there are layers of shale below the sandstone.

Under the sandstone ledges there are bluff shelters like those found in the Ozarks. These bluff shelters were first used by the bluff dwellers, those ancient Indians who also lived in the Ozarks. Later, other folks sought refuge in the bluff shelters. One of these was Belle Star, a colorful Fort Smith outlaw. She walled in the front of a bluff shelter along Rock Creek to make it into a fortress.

The streams of the Valley meander across the shale that is its typical rock. As they do, they expose the soil that has formed in the Valley by the weathering of this shale over millions of years. Along the Arkansas River and other major streams that cross the Valley there are found deep alluvial soils that have been deposited by the rivers. They are the most productive crop lands of the Valley. The Arkansas River has a tremendous effect on both the wildlife and the people of the Valley. Along the river, in the wintertime, are found hundreds of thousands of ducks. On the river sandbars there are eagles which come to fish and sometimes prey on sick or crippled ducks.

Also, the River is a much-used migration corridor for birds. Along it, "sea gulls," such as the ring-billed gull, are common. These gulls nest in the far north and spend their winters on the gulf coast or further south. As they pass through Arkansas they often fly along the Arkansas River. Other migratory birds do the same.

The general nature of the Valley is that it is a rolling upland, and that's what has been most important to people. The first settlers in the Valley lived a rugged pioneer life, but the rolling nature of the Valley allowed people to quickly clear large farms. Most of the Valley has remained cleared and in agricultural production since. Today, there is pasture on the rolling areas and row-crops along the River.

Because of the rolling nature of the Valley and the presence of the Arkansas River, the Valley became a communications and transportation corridor through the mountains. The River itself was the first transportation corridor for flat-boats, keel boats and eventually steam boats. Then, land transportation became more common. The Butterfield stage line ran over the rolling country of the Valley in preference to the rugged mountains on either side. Stage houses were built along the line to provide resting stations for the horses and riders. Around these way-stations, small towns appeared which grew into larger cities. As a result, there are today a number of urban areas in the Arkansas River Valley such as Ft. Smith, Clarksville, Ozark, Russellville, Morrilton, and Searcy.

The largest of these cities is Fort Smith, which has a rich history. In 1818 Major Stephen Long of the U. S. Army was sent up the Arkansas River to locate the site for a fort which was to be the last outpost on the western frontier. The fort would also serve to keep peace between the Indians and the settlers who were moving into the territory. As Long neared the site of present day Fort Smith, he saw the prairies becoming larger and more numerous with their western plants and animals. He picked out a likely looking hill overlooking the Arkansas River at the mouth of the Poteau River, Belle Point, for the site of the first Fort Smith.

Later, Fort Smith was abandoned by the Army when there was no longer a need for an Indian outpost this far east. One of the fort buildings was turned over to Federal Judge Issac Parker who was assigned to Arkansas. His responsibilities included all major crimes committed in Indian Territory to the west. Indian Territory was a notorious refuge for outlaws. In order to discourage crime, Judge Parker built gallows which were capable of hanging six people at once. Because of this he was known as the "Hanging Judge."

Today the Arkansas River Valley is still a major transportation and communications corridor. Within the Valley are the Arkansas River Navigation System, an interstate highway, two major railroads, and many other highways, pipelines, and powerlines. The Valley is scenic and offers easy access to the even nicer scenery of the mountains to the north and south. With all of these attractions, we can probably expect that in the future a great deal of the population growth and industrial development of Arkansas will occur in the Arkansas River Valley. Along with that growth will come problems like air and water pollution.

There is another problem of particular interest to the Valley and that is water supply. There are not really very good water supplies in the Arkansas River Valley and when growth and development take place, people must look for new and enlarged water supplies. When they do, they very often look to the streams that flow out of the Ozark mountains to the north. However, these streams are valuable scenic and recreational resources themselves. Consequently, the people of the Arkansas River Valley are going to be faced with some very difficult trade-offs between preserving these streams as a scenic and recreational resource or developing them as water supply reservoirs.

EXERCISE: Compare the natural systems of the three upland divisions. Specifically, list the ways all three divisions are alike, the ways the Ozarks and Arkansas River Valley are alike (and different from the Ouachitas), the ways the Ouachitas and Arkansas River Valley are alike (and different from the Ozarks) and the ways the Arkansas River Valley is different from the other two.

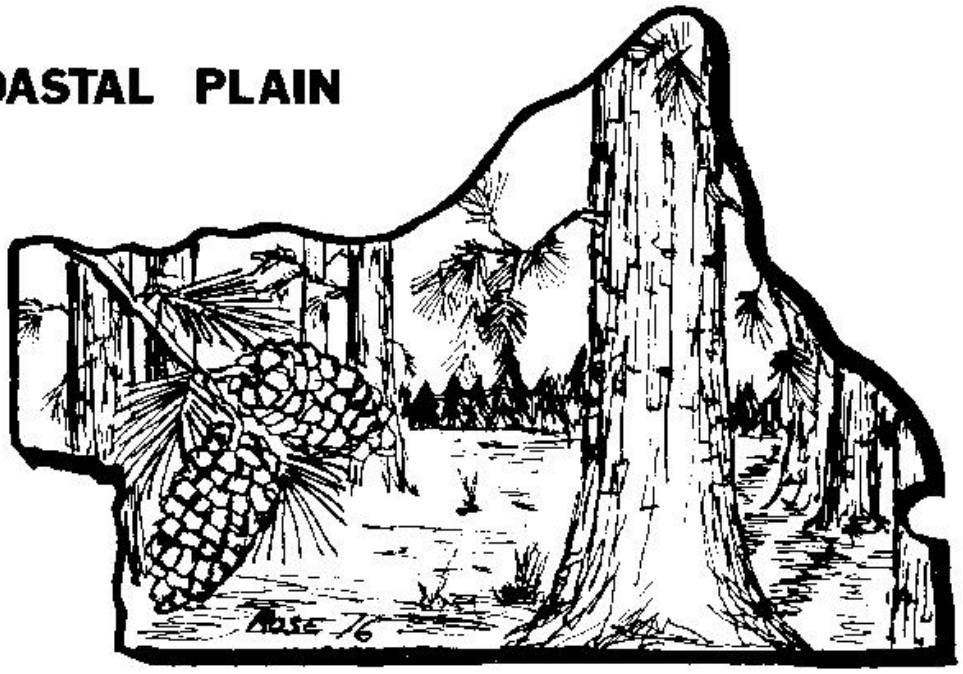
ALL DIVISIONS ALIKE

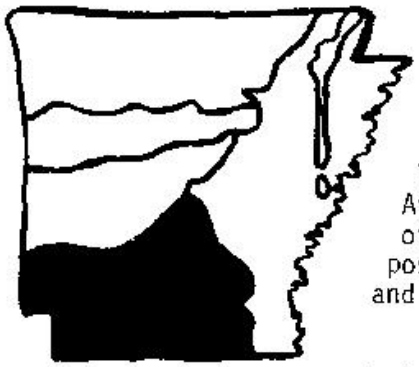
OZARKS AND ARKANSAS RIVER VALLEY DIFFERENT FROM OUACHITAS

OUACHITAS AND ARKANSAS RIVER VALLEY DIFFERENT FROM OZARKS

ARKANSAS RIVER VALLEY DIFFERENT FROM OZARKS AND OUACHITAS

THE COASTAL PLAIN

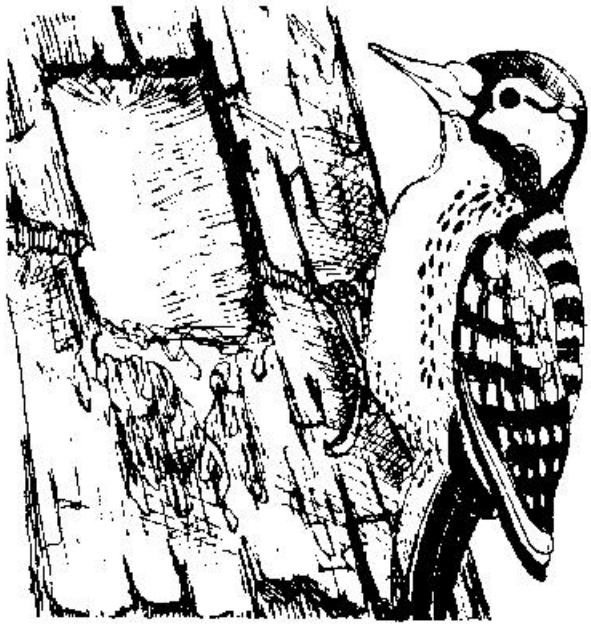




The Coastal Plain covers the southern fourth of Arkansas. Its principal cities include Texarkana, Hope, El Dorado, Magnolia, Monticello, Pine Bluff and Little Rock. It is a rolling lowland, and along with the rest of southern and eastern Arkansas, was once covered by the waters of the Gulf of Mexico. When the Gulf retreated to its present position it left exposed in the Coastal Plain the sands and gravels that had made up its bottom and beaches.

With sandy soil and abundant water the forest of the Coastal Plain is dominated by pines. In these pine forests it is possible to see typical pine-land bird species like the Pine Siskin or the endangered Red-cockaded Woodpecker.

There are also some wide river-bottoms in the Coastal Plain and along these river-bottoms the typical forest is a bottomland hardwood forest. Sometimes the rivers widen out into swamps and in those swamps are found Cypress and Tupelo and other swamp plants. There are interesting animals there too, like the Common Gallinule, the alligator and the Green Heron. Prairies were common in the Coastal Plain in the early days with their abundant flowers and grasses.



One of the most interesting portions of the Coastal Plain is extreme southwestern Arkansas. Southwestern Arkansas has wide river bottoms with deep soil along the Red River and the Ouachita River. Also in this area are the blackland prairies, very special prairies that were found in a belt from Arkadelphia down to Texarkana and then extending on into Texas. These blackland prairies, along with the Red River bottomland, were known in the early days to be the most fertile lands in Arkansas.

When you look beneath the surface of the blackland prairies, though, you can see that only the top foot or so is black and below that the soil is white. It is actually chalk and when you look closely you see that the black color of the surface comes from the richness of the soil which has allowed an abundance of organic material to accumulate. Deeper in the soil is chalk and usually abundant oyster shells and other shells that accumulated when this was the bottom of the Gulf of Mexico. In some places this chalk accumulated over a hundred feet thick and that tremendous thickness of chalk is exposed along the Little River in a place called White Cliffs. White Cliffs is the same sort of formation as the White Cliffs of Dover and was formed at the same time.

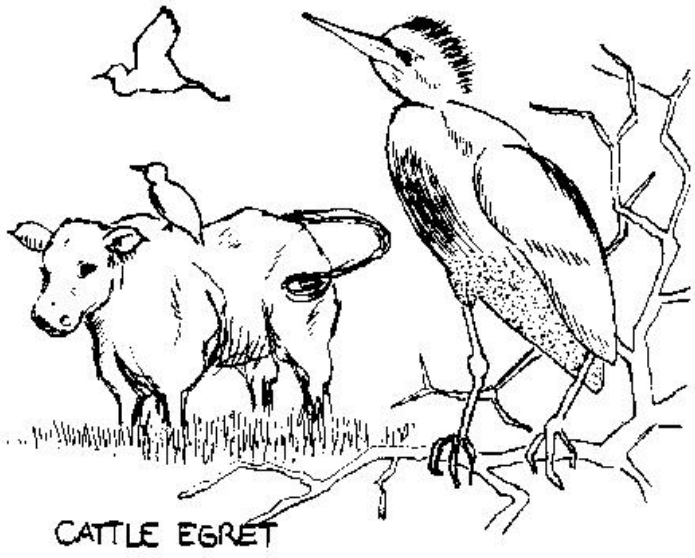
Indians took advantage of the fertile soils of the Red River bottom and the blackland prairies in southwestern Arkansas. The Caddo Indians had their major population centers there even though they roamed up into the Ouachitas. They lived in large villages depending on agriculture based on the fertile soils of the area. Often these villages had mounds that were used in their religious ceremonies. They gathered salt at salt springs along the Ouachita

River (one of the earliest industries in Arkansas was the production of salt at Arkadelphia).

As settlers moved into Arkansas they were attracted to the fertile lands in the Red River bottoms and the blackland prairies. There they built one of the oldest towns in Arkansas, the city of Washington. A number of the old buildings of Washington now make up Old Washington State Park. Old Washington has one of the most interesting histories of any town in Arkansas. Here people lived on plantations and lived a very elegant "Old South" life-style. However, their attention was directed across the Red River to Texas, a dozen miles away. In fact, you might say with some accuracy that a great deal of the early history of Texas started right in the town of Washington. The Austin family lived there for a while and speculated in land, Jim Bowie had his famous Bowie knife invented there, Sam Houston was known to hang out in the saloon, plotting his takeover of Texas and Davy Crockett received a hero's welcome there on his way to the Alamo.

The prairies of the Coastal Plain played a part in the Civil War in Arkansas. Prescott, on Prairie De Ann, was the site of one of the most significant battles. The Union General Steele had marched out of Little Rock on his way to wipe out the confederate forces and he met them on the prairie. There the Confederates won a stirring victory. The Confederate forces withdrew to Washington and Steele withdrew to Camden. While he was based at Camden a number of other smaller battles were fought which eventually convinced him that he couldn't beat the Confederates so he began a retreat back toward Little Rock and on the way was attacked again at Jenkins Ferry, in the lowlands along the Saline River.

The pine forest of the Coastal Plain has played an important role in its history and its present industry. During the latter part of the 19th century folks in Chicago had cut over all of the nearby forest and they began looking for new sources of timber for expansion of their cities and the railroads. They sent their rails here and began to cut over the whole state (not just the Coastal Plain). The type of logging practiced in those days is often referred to as "cut and run" logging: buy the land, cut it over and then abandon the land and let it go back to the state for failure to pay taxes. Settlers tried to move into these cutover lands and turn those sandy hillsides into productive farmlands. However, they found out that the land would simply not do a good job of growing cotton or any other cash crop. At the same time the timber industry realized that there was no longer any virgin forest nearby for them to cut over. They realized that it was in their best interest to buy the land and hold on to it permanently, harvest the trees, let the trees grow again, harvest them again and thereby carry on "sustained yield" timber management. Much of the Coastal Plain today is owned by the timber industry which carries on intensive timber management of that land. Many of these timber management practices are very controversial, like spraying herbicides and clear-cutting the forest. These are problems that the people of the Coastal Plain will have to deal with in the future.

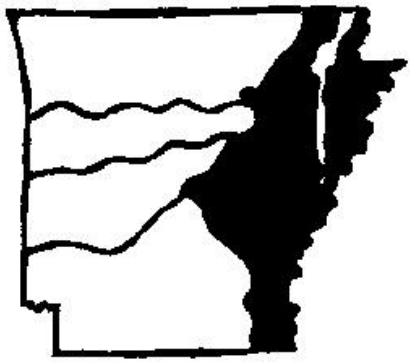


A major use of land today in the Coastal Plain is for pasture. In recent years we've seen the appearance in Arkansas of a new species of bird in these pastures, the cattle egret. Cattle egrets are African birds which are typically found on the plains of East Africa. Somehow they got to South America, maybe on cattle boats, and have since thrived and expanded their range into the southern United States. They can sometimes be seen in the pastures around cattle and occasionally even perched on their backs.

Another important use of land in the Coastal Plain today is mining. There is mining of granite or nepheline syenite near Little Rock and also bauxite in the same area. The problems with mining can be very serious. If acid water is allowed to flow out of the mine it can destroy the quality of nearby streams and if the mine is not properly reclaimed, the productivity of the land is more or less permanently lost. Mining may become even more significant in the future of the Coastal Plain since it has large deposits of lignite. Lignite is a form of coal, often called brown coal, which many people think may be the answer to our state's energy problems. There are large quanities of it in the Coastal Plain and it has never been mined because of its relativity low heat content. With the energy crisis reaching the proportions it has, we are looking to any conceivable source of energy and lignite looks like a promising alternative to the oil and natural gas we depend on today. So, in the future, we may well see a great deal of mining in the Coastal Plain of lignite.

EXERCISE: By now you should be able to investigate the natural system of an area such as the Coastal Plain on your own. Remember to study all the maps and information available, and to relate each bit of information to all the rest. Use this page for notes.

THE DELTA



The Mississippi Alluvial Plain, or Delta, covers the eastern third of Arkansas. It is a unique part of Arkansas which has made major contributions to our heritage and economy. Its major cities include Stuttgart, Lake Village and Blytheville.

The area once was covered by the Gulf of Mexico until its waters receded. When it did, it left behind the sands and gravels that had made up its bottom and beaches like it did in the Coastal Plain.

But then rivers like White River, the Mississippi River, the Arkansas River and even the Ohio River flowed through the Delta, sweeping away the old ocean-bottom sands and gravels, replacing them with sand, silt and clay that the rivers themselves carried.

Lakes have played an important role in the character of the Delta, too. They are formed when a river abandons its channel and leaves its old course isolated as still water. Sometimes the lakes are very shallow and cypress trees grow across them to form beautiful swamps which are a notable feature of eastern Arkansas.

These lakes and rivers have been responsible for depositing the tremendously rich and deep soil which is Arkansas' most valuable natural resource, since we are an agricultural state.

With abundant water and deep soil, the forest trees of the Delta grow to an enormous size. This forest has been an important part of Arkansas' economy throughout this century. It produces oak for railroad ties and barrel staves and it produces persimmon for the finest golf club heads. Pecan trees grew naturally in this bottomland forest and are now cultivated in orchards. Even cypress knees make for beautiful lamp bases.

However, not all of the Delta was covered by the forest. At least a half-million acres from Arkansas Post to Lonoke were covered by six-foot tall prairie grasses and flowers. Even though most of the prairie has been plowed up it is still called the Grand Prairie and is today the center of rice production in the state.

The Delta was a wildlife paradise when the settlers arrived. It was home to ducks, deer, bison, and elk. There were beavers with lodges that sometimes were 6 feet high. One of the most "historic" animals of the Delta is found on the Grand Prairie. It is the Willow Flycatcher that was discovered and painted by John James Audubon in 1821 at Arkansas Post on the Grand Prairie.

The first explorers in Arkansas, led by Desoto in 1541, described the early inhabitants of the Delta as Indians who carried on large-scale

agriculture and lived in large and numerous villages.

Chiefs ruled over several villages. In the central village there was often a mound used in religious ceremonies. From their habit of building these mounds, these Indians are usually called mound builders.

One hundred and thirty years later, explorers found the mound builders had disappeared, leaving the Delta occupied by a few thousand Quapaw and, occasionally, the Osage Indians rode across its prairies.

The first settlers found it to be an inhospitable place. The rivers shaped this land through floods which were dangerous and inconvenient to people. They also created breeding areas for malaria-carrying mosquitos. However, those same floods deposited an extremely rich and deep soil offering settlers an incentive to stay and grow cotton.

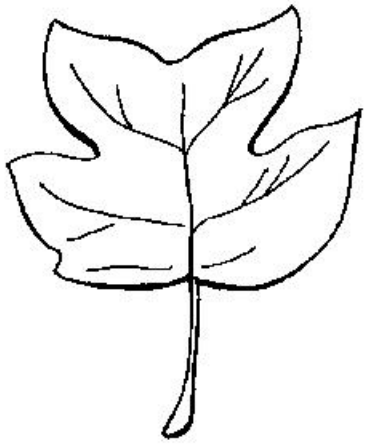
They built an empire on "King" cotton and created an "Old South" culture unique to this country's history. This culture was both romantic and corrupt in that the elegant life the planters led was dependent on the labor of slaves.

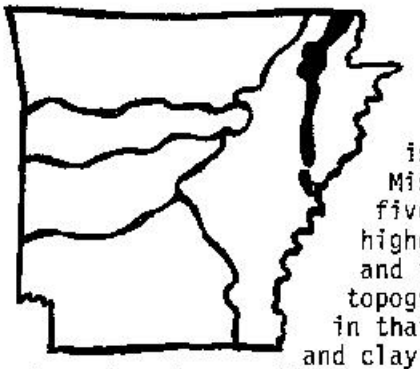
After the Civil War, people continued clearing the forests of the Delta, channeling its rivers and draining its swamps to create more agricultural land. Today, the Delta is the heart of Arkansas' agricultural economy, but 90% of its forest has been cleared and its streams are polluted by silt and pesticides. The only animals that seem to thrive here these days are the blackbirds which number in the millions during the winter.

The most important question that Delta people will have to answer in the future is whether all of the bottomland forest must be cleared and every stream polluted and ditched in order to help feed this hungry world.

EXERCISE: In your detailed investigation of the Delta system, pay particular attention to the importance of rivers. Specifically determine how rivers have affected the Delta's geology, soil, plants, animals, land-use, history, culture and environmental problems.

CROWLEY'S RIDGE





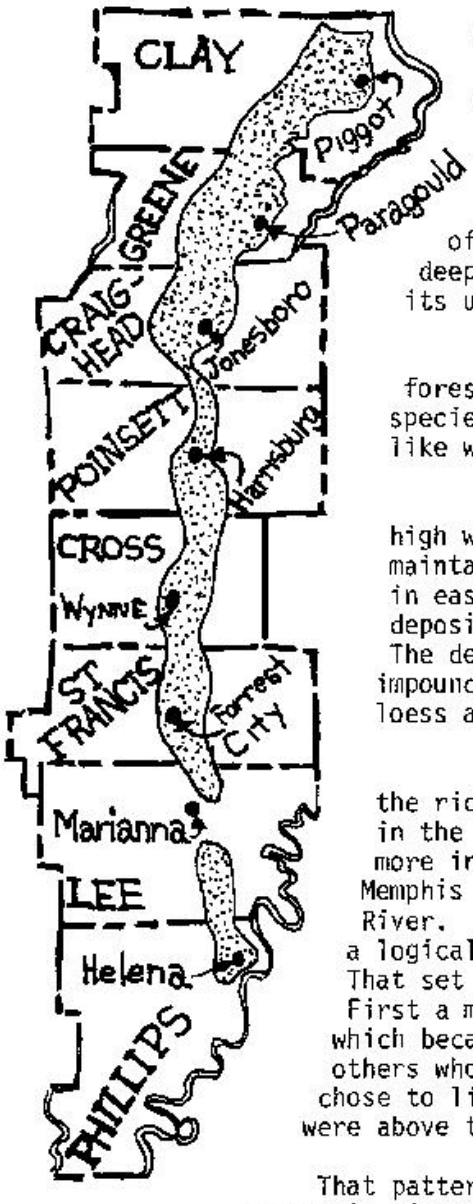
The smallest of Arkansas' Natural Divisions is Crowley's Ridge. It extends from southeastern Missouri to Helena (about 150 miles) and is one to five miles wide. The ridge stands about 200 feet higher than the Delta cotton fields which surround it and its steep slopes contrast with the flat Delta topography. Its geology is also different from the Delta in that the ridge is composed of ocean-bottom sand, gravel and clay capped with wind-blown dust or loess. The river-deposited soils which make up the Delta are not found on the ridge.

These differences result from the unique geological history of the ridge. Like all of eastern and southern Arkansas, the ridge was covered by the waters of the Gulf of Mexico until about 50 million years ago. When the shore of the gulf retreated to its present position, it left exposed its bottom and beaches which make up the sandy rolling hills of the Coastal Plain today.

In the Delta the rolling hills were carved away by large rivers, primarily the Mississippi and Ohio, which deposited a deep alluvial soil of sand, silt and clay which the rivers carried.

At one time the Ohio River was flowing where the St. Francis and Mississippi now flow along the eastern border of Arkansas, and the Mississippi was flowing far to the westward, about where the Black and White Rivers now flow. (see "How Arkansas Got To Be") As they carved out their valleys, they left a narrow strip of ocean-bottom material between them which became the base of Crowley's Ridge. Then, about 20,000 years ago, as the last glaciers began their retreat, the rivers deposted glacier-ground rock in their floodplains.

When the silt dried out and was picked up by the wind, Crowley's Ridge was tall enough to act like a "drift fence" and caused dust to pile up 50 feet deep on the southern half, and the ridge took on its final shape.



As a result of that geological history, marine fossils such as shark's teeth may be found in the clays at the base of the ridge. Gravel is also common in these marine sediments. Since the rivers which formed the Delta did not deposit much gravel, it is one of the most valuable mineral resources of the ridge. The top of the ridge, at least at the southern end, is covered with a blanket of loess up to 50 feet thick. This loess forms a deep soil which has helped to give the ridge several of its unique features.

One of the unique features of the ridge is its forest. It is an upland hardwood forest but contains species which are rare or absent elsewhere in the state, like white walnut and tulip tree.

Streams on the ridge are typically small and have high water quality. Because the water quality has been maintained, some support aquatic life found nowhere else in eastern Arkansas. As they cut through the marine deposits, the streams sometimes form pure sand beaches. The deep valleys of these streams provide the best impoundment sites in eastern Arkansas, but sometimes the loess and underlying sand fail to hold water well.

A road from Memphis to Little Rock which crosses the ridge north of Forrest City was one of the earliest in the state. In places it has been eroded 50 feet or more into the ridge. Westward bound travelers from Memphis first had to cross the swamps along the St. Francis River. Then, they climbed onto the drier ridge, which was a logical place to rest before crossing the swamps ahead. That set the stage for much of later history of the ridge. First a man by the name of Strong built a way-station which became one of the state's earliest settlements. Later, others who made their living farming the nearby Delta land chose to live on the ridge. It offered house sites which were above the floods and on scenic hills.

That pattern has continued today. Seven counties straddle Crowley's Ridge and the largest town and county seat of each one is located on or next to it. Cities like Paragould, Jonesboro, Forrest City and Helena, which most people think of as Delta towns, are actually Crowley's Ridge towns.

Urbanization, then, is an important use of land on Crowley's Ridge.

The Ridge also played a part in the Civil War in Arkansas. At Helena, Federal troops placed cannon on the ridge, which commanded a view of the Mississippi River. From that vantage any rebel boat trying to move upstream or down could be destroyed.

Besides urbanization, the uses of land on Crowley's Ridge today are varied. Within a small area can be found productive forests, mines, peach orchards and row-crops. All of these uses of land must beware of one potential problem and that is erosion. The loess which caps the ridge is uniquely susceptible to erosion, because its physical and chemical structure cause it to maintain a vertical slope. However, the slope literally melts when it gets wet and can cause disastrous land-slides.

In many cases, people have attempted to stabilize slopes with an imported vine, kudzu, but sometimes the cure is as bad as the disease, because kudzu can overgrow and kill other plants, even trees.

Because of the unusual geology, forest and land-use problems of Crowley's Ridge it is often considered the most unique of Arkansas' natural divisions.

QUESTION: Describe in more detail the features which cause Crowley's Ridge to be "often considered the most unique of Arkansas' natural divisions."

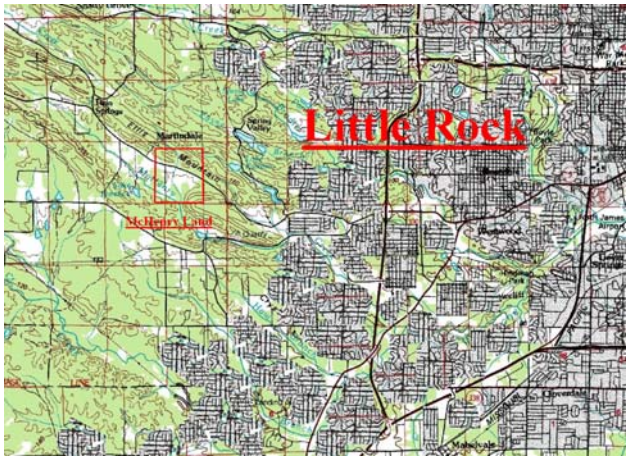
Central Arkansas Land-use Simulation

Purpose

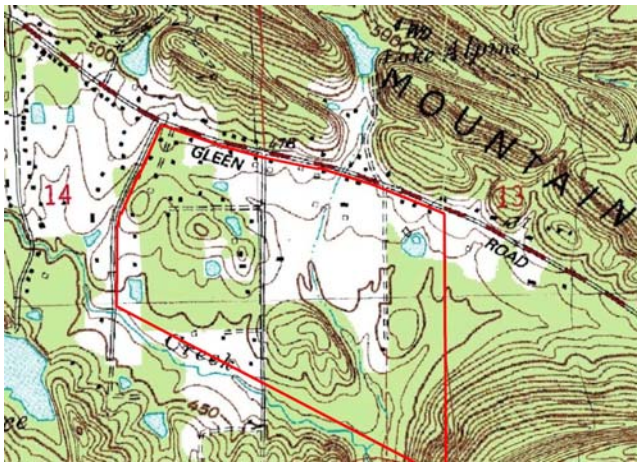
The purpose of this activity is to familiarize students with the understanding of the political, economical, social, and environmental factors involved in land-use decision making. This simulation is loosely based on the U.S Forest Service's *Land-Use Simulation: Investigating Your Environment.* However this activity uses real land located in Central Arkansas (its donation is fiction) but will be based on real data taken from that land. The activity will make an excellent capstone for a geology or environmental science course.

Background

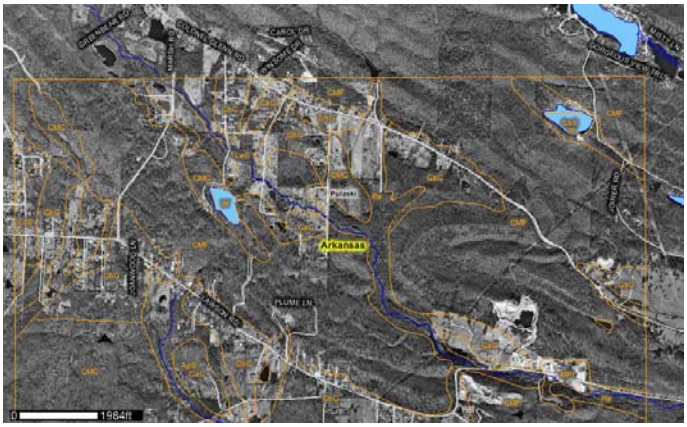
It is the year 2012, and the city of Little Rock has grown past I-640 to the west. A small piece of farmland on McHenry Creek near Colonel Glen Road has been donated to the city if an appropriate land-use can be found for the property. The land is less than 10 miles from I-640. Appropriate use was not defined in the donation statement.



The land is hemmed in the north and south by Ouachita east-west running ridges composed of sandstone and shale.

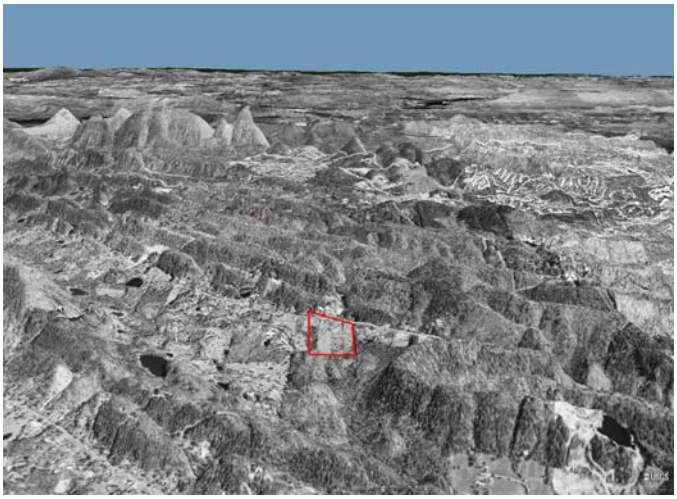


The surface geology is of Womble Shale which produces deep, well drained, slowly permeable upland soils of Pennsylvanian age.



The soil types are gravelly silt loam with a gentle undulating slope and deeper alluvial soils near the creek.

An aerial view shows much of the land has been cleared with the exceptions of the higher elevations.



The lower angle view has been exaggerated to show the Ouachita ridges.

Correlations to 2005 Arkansas Environmental Science Framework

SP.3.ES.5	Evaluate the impact of different points of view on health, population, resource, and environmental issues: • governmental • economic • societal
SP.3.ES.6	Research how political systems influence environmental decisions
SP.3.ES.8	Compare and contrast man-made environments and natural environments
SP.3.ES.9	Evaluate personal and societal benefits when examining health, population, resource, and environmental issues
SP.3.ES.10	Predict the long-term societal impact of specific health, population, resource, and environmental issues
SP.3.ES.11	Investigate the effect of public policy decisions on health, population, resource, and environmental issues
SP.3.ES.12	Explain the impact of factors such as birth rate, death rate, and migration rate on population changes
SP.3.ES.13	Distinguish between developed and developing countries
NS.4.ES.1	Collect and analyze scientific data using appropriate mathematical calculations, figures and tables
NS.4.ES.2	Use appropriate equipment and technology as tools for solving problems (e.g., microscopes, centrifuges, flexible arm cameras, computer software and hardware)
NS.4.ES.3	Utilize technology to communicate research findings

Correlations to Geology Framework

Strand 2: The student will develop map interpretation skills for topographic and geologic

features.

G.2.1 Determine latitude and longitude of specific map points.
G.2.2 Determine scaled map distances.
G.2.3 Determine elevations of specific points from a topographic map.
G.2.4 Recognize basic topographic map symbols from a legend/key.
G.2.6 Construct a profile from a topographic map.
G.2.7 Identify landforms and direction of stream flow using a topographic map.
G.2.8 Interpret basic rock types, time periods, and faults from geologic maps.
G.2.9 Determine and measure compass readings from selected sites.
G.2.10 Identify practical applications for map interpretation skills.
G.2.11 Investigate methods of remote sensing for measuring and monitoring the earth's crust.

Suggested Times and Procedure

Students are given the information in the appendix with the homework of individually assessing the land data given in the handouts. They are to write down all possible land-uses for the land.

The next day as a group, they are to list all possible land uses. Then as a group, they are to place the land uses into a few categories (5 minutes).

The class should divide themselves into categories (the teacher may make these divisions for the best interaction) and the students develop their plan to be presented to the city board the following day. The next hour or class period one member from each land-use category is selected to serve on the city board. This is not mentioned to the group until the last minute (this means that the Board will be made up of members who initially are influence by the group they belonged to as a member of a land use category). They must leave the room and develop a rubric on which to judge the presentations (30 minutes). The groups continue on their plans.

Each land-use category is given 10 minutes to present their land-use plan to the city board. After the presentations, the city board leaves the room to decide on the most appropriate land use for the land. If a board decision cannot be reached, the land remains farmland until an approved plan can be developed.

Materials Needed

Poster paper, Tape, Markers, Printed Materials, and a stop-watch will be needed.

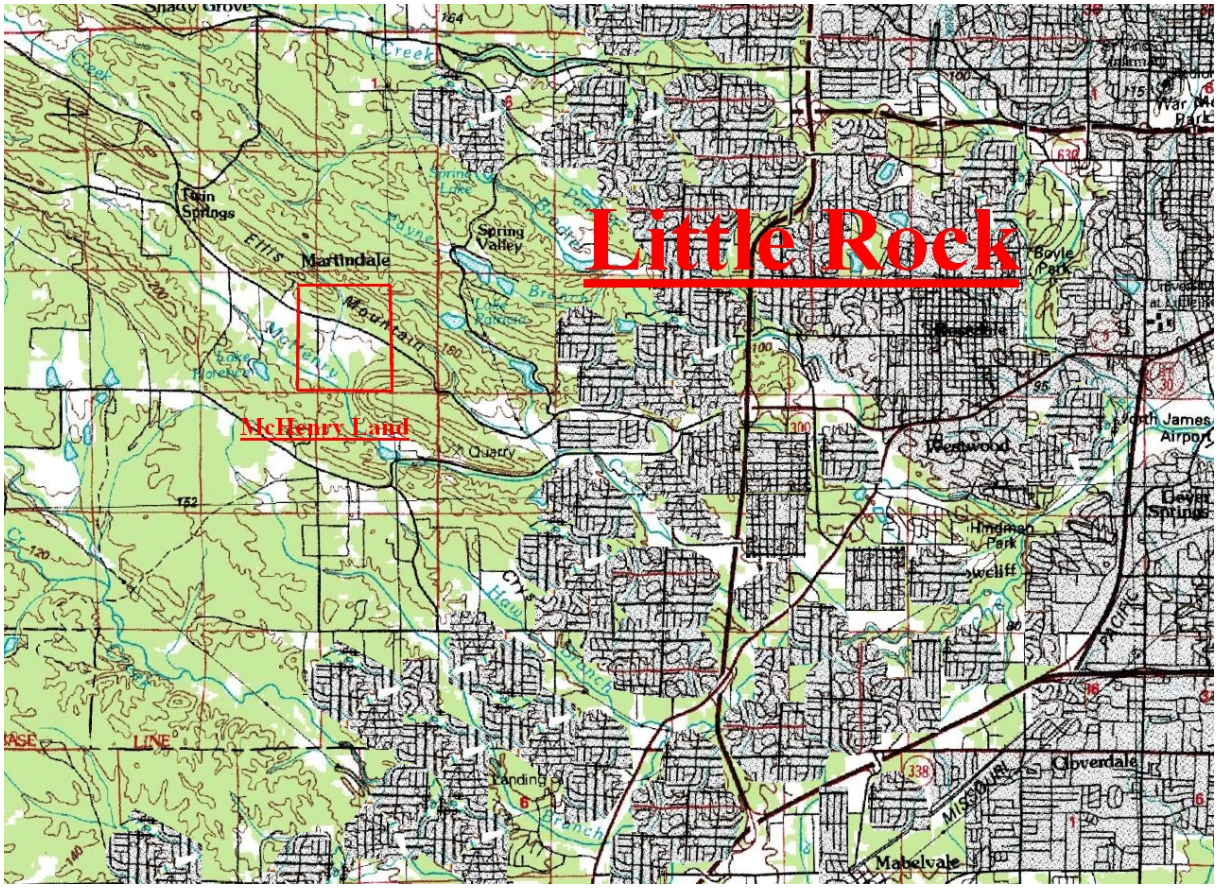
Internet Resources

NASA World Wind http://worldwind.arc.nasa.gov/download.html
Google Earth http://earth.google.com/download-earth.html
NRSC, Soils http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx
Geostor 5 http://www.geostor.arkansas.gov/Portal/index.jsp

Print Resources

Appendix – Printed material on land use for donated land.

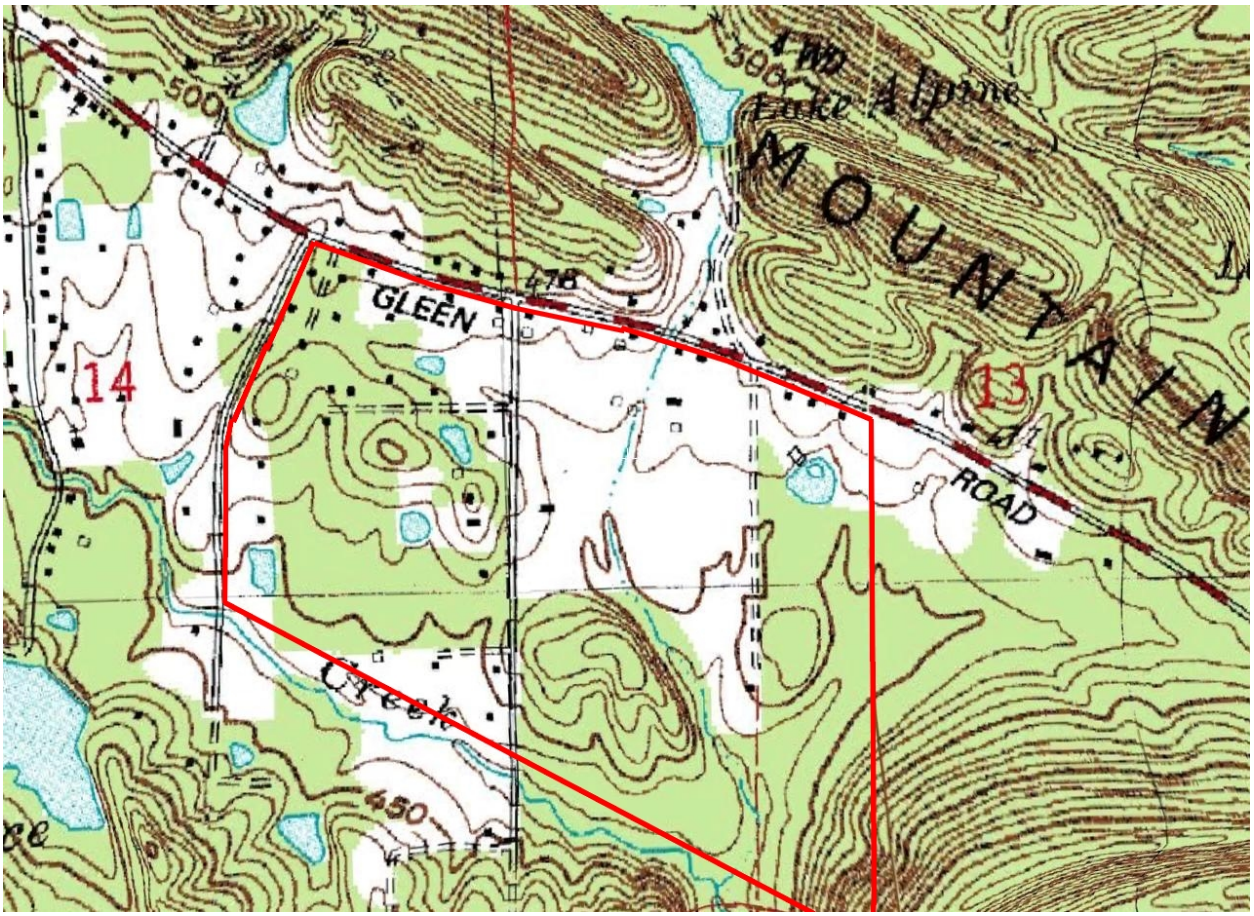
Appendix - Handouts
Donated Land in Western Pulaski Country



It is the year 2012 and the city of Little Rock has grown past I-640. A small piece of farmland McHenry Creek near Colonel Glen Road has been donated to the city if an appropriate land-use can be found the property. The land is less than 10 miles from I-640. Appropriate use was not defined in the donation statement by the present land holders.

You are to read the following materials and come up with several possible land usages (as an individual) for this land for tomorrow's class or for the next hour. The land sits on McHenry Creek just off of Colonel Glen Road. The land was a very old pasture and house site until recently.

Topographic Map of Site

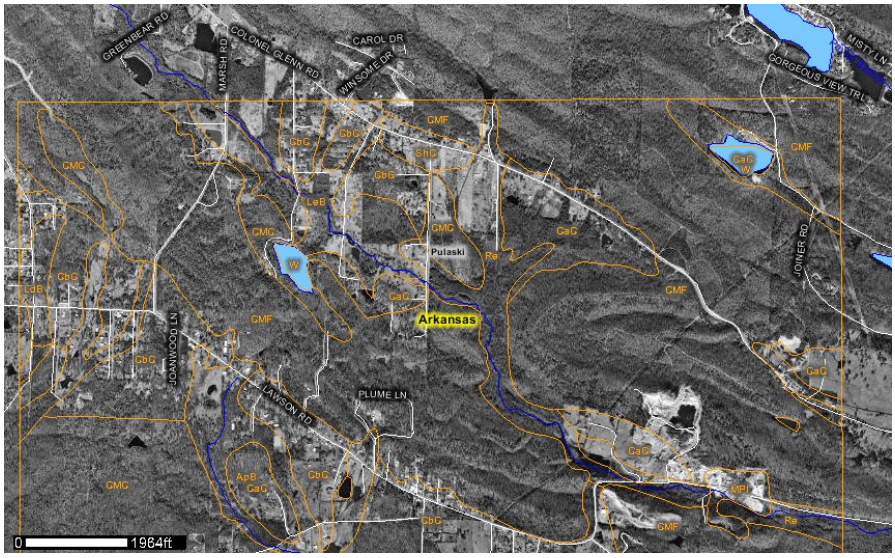


The donated land sits on one of the first wide valleys as you travel west on Colonel Glen Road. A few unoccupied old home places are located on the property.

Most of the land sits on a 1-3 % slope with the exceptions of three small hills in the western part of the site and the larger hill in the southern part of the site. The hills have over an 8 % slope. A small portion of the land in the southwest part of the site has over a 12 % slope. The pH of the soils ranges from 5.8 to 6.8 in various locations. Presently the back of the property floods in heavy rains. A small creek runs through the middle of the property from north to the south. This creek acts as a spillway for Lake Alpine to the north of Colonel Glen Road.

The land is bound by Colonel Glen Road on the north. Please note the spelling of Glen Road on the map.

Soils Map



The **Carnasaw** series consists of deep, well drained, slowly permeable upland soils. These soils formed in residuum weathered from shale of Pennsylvanian age.
CaC – Carnasaw soils (gravelly silt loam), 3-8 % slopes, pH of 6-7, fertile soil.

CMC – Carnasaw-Mountainburg soils association, undulating slope

CbC – Carnasaw-Urban land complex, 3-8 % slope, shallow soil.

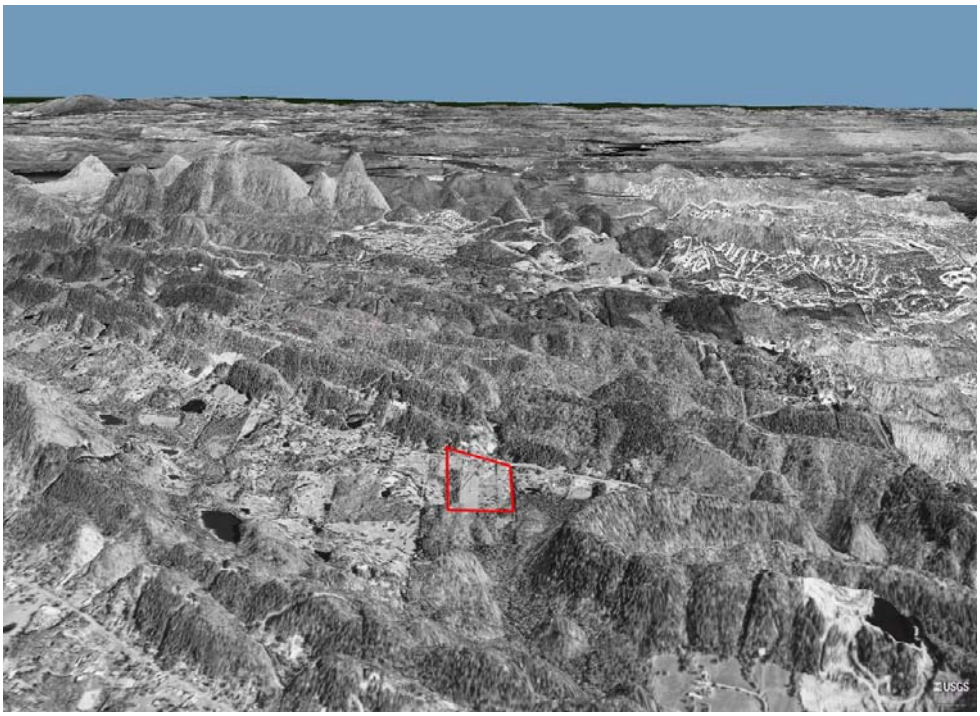
The **Sallisaw** series consists of deep, well drained, moderately permeable soil that formed in loamy and gravelly alluvium or valley-fill.
ShC – Sallisaw-Urban land complex, 3-8 % slope

The **Rexor** series consists of very deep, moderately well drained, moderately permeable soils that formed in loamy alluvium, pH 7, fertile soil.

Re – Rexor soils (silt loam) frequently flooded.

Soil Name and Numbered Map Area	Building Site Development				Sanitary Fac.	Construction Materials		Rec. Dev.
	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local Roads and Street	Septic Tank Absorption Fields	Roadfill	Topsoil	Paths and trails
Carnasaw and Sallisaw:	Severe (shrink-swell, low strength)	Severe (shrink-swell, low strength)	Severe (shrink-swell, low strength)	Severe (shrink-swell, low strength)	Severe (percs slowly)	Poor (shrink-swell, low strength)	Fair (thin layer, small stones)	Slight to Severe

Aerial View of Site



The elevation in the view above is exaggerated to show the Ouachita ridges.

Land Use Data Tables

AGRICULTURAL USES

Directions: Circle the item in each of the five columns below that best describes each of the five soil factors in the soil you studied. The most limiting soil factor will determine the best agricultural use of the land. A limiting soil factor can be defined as something that will restrict the use of land for desired activities. The most limiting factor indicates the most appropriate agricultural use.

SOIL FACTORS					Agricultural Uses
Slope (1%)	Erosion Hazard	Soil Depth	Drainage	Texture	
0-3	None	Deep	Good	Loam or silt loam*	Farm crops -- cultivation good soil management practices
3-20	Slight to moderate	Mod. deep	Somewhat poor	Sandy, loam or silty clay	Farm crops—few to several special cultivation practices
20-30	Severe	Shallow	Poor	Sand or Clay	Occasional cultivation, many special practices
0-2	None to slight	Deep	Good to poor	Stony	Pasture-woodland cultivation; no machinery can be used
30-90	Very severe	Deep to shallow	Good to poor	Sandy, loam, clayey or rocky	Pasture, timber growing, woodland, wildlife, no cultivation machinery
all	None to extreme	Deep to shallow	Excessive to poor	Rockland, river wash, sand dunes	Wildlife, recreation

*Loam is a combination of sand, silt, and clay particles.

Occupancy land uses

Select the most limiting factor for each land use and record the overall limitation (slight, moderate or severe) on Task F.

Land Uses and Factors Affecting That Use	Slight Limitation	Moderate Limitation	Severe Limitation
Roads and Streets			
Slopes	0-12%	12-30%	Over 30%
Depth	Over 40 in.	20-4-in. (50.8-101.6 cm)	Less than 20 in.
Water Table	Over 20 in.	10-20 in. (25.4-50.8 cm)	Less than 10 in.
Building Sites			
Slopes	0-12%	12-20%	Over 20%
Depth	Over 40 in.	20-40 in. (50.8-101.6 cm)	Less than 20 in.
Water Table	Over 30 in.	20-30 in. (50.8-76.2 cm)	Less than 20 in.
Septic Tank Filter Fields			
Slope	0-7%	7-12%	Over 12%
Depth	Over 6 ft.	4-6ft. (121.9-182.9 cm)	Less than 4 in.
Water Table depth below trench	Over 4 ft.	2-4ft. (61.0-121.9cm)	Less than 2 ft.
Picnic and Camp Areas			
Slope	0-7%	7-15%	Over 15%
Stones	0-20%	20-50%	Over 50%
Water Table during season of use	Over 30 in.	20-30 in. (50.8-76.2 cm)	Less than 20 in.

Possible Land Uses for Donated Land
(Do this as an Individual Before the Activity Begins)

List as many land uses as you can that fit the land, based on the data you were given. Be creative!

As a Group Develop, a Land Use Plan for the Donated Land Based on Data.

As a City Board, Develop a Plan (Scoring Rubric) for Judging Each Land Use Proposal

Do you agree with the City Board Findings on the Use of this Donated Land?

(Done After the Board Rules)

As an individual support your arguments (pro or con) with data and site references.

Common Arkansas Plants, Animals, Rocks and Environmental Chemistry Students Should Know

Pines, Red and White Oaks, Maples, Cedars, Hickories, Dogwoods, Sweetgum, American Sycamore, Poision Ivy, Virgina Creeper, Wild Roses, Sunflowers, Violets, Asters, Irises, Wild Carrot, Ferns
Copperhead, Cotton-mouth, Rattlesnakes, Hognosed, Earth, Garter, Green, Ground, King, Black Racer, Rat, and Water Snakes
Three-toes Box Turtle, Red-eared Slider, Soft-shelled, and Snapping Turtles
Basses, Crappe, Sun-Fish, Perch, Catfish, Trout, Walleye, Gar,
Eagles, Vultures, Hawks, Owls, English sparrows, blackbirds, starlings, crows, Wood Duck, Mallard, Raccoon, squirrels, Opossum, Eastern Cottontail, Swamp Rabbit, Skunks, Beaver, Coyote, Red and Gray Fox, Mountain Lion, Black Bear, white-tailed Deer
Rocks – Sandstone, limestone, Dolomite stone, Shale

pH
This is a measure of the activity of hydrogen ions (H^+) in a solution and, therefore, its acidity.
>8.5 strongly alkaline, 7.9-8.5 moderately alkaline, 7.3-7.9 slightly alkaline, 6.7-7.3 neutral, 6.2-6.7 moderately acid, 3.0-5.6 strongly acid

Dissolved Oxygen
Aquatic animals need dissolved oxygen (DO) to live. The amount of oxygen that can be dissolved in the water is reduced with increased temperature.

DO levels < 5-3 ppm are moderately stressful to stressful to aquatic organism
DO levels < 3 ppm are stressful to most aquatic organisms.
DO levels < 2 ppm will not support fish.
DO = 5-6 ppm is required for growth and activity of most aquatic organisms.

Nitrate-Nitrogen
Nitrogen is essential for plant growth, but the presence of excessive amounts in water supplies presents a major pollution problem. Nitrate in drinking water must be less than 10 ppm. Natural waters:
3 mg/L = Oligotrophic, 0.3 - 0.5mg/L = Mesotrophic, 0.5 - 1.5mg/L = Eutrophic, >1.5 = Hypereutrophic

Turbidity
Cloudiness in water, is caused by suspended materials that scatter light passing through the water.
Drinking water < 0.5 NTUs, Typical groundwater < 1.0 NTUs

Iron
Iron in water stains fixtures and may have an odor or taste. Values of 0-0.5 are acceptable.

Phosphates
They accelerate the growth of algae and aquatic plants. Total P > 0.03 ppm will increase plant growth and eutrophication.

Alkalinity
Alkalinity is the amount of buffering material in the water. Good range is 100 – 120 mg/L

Water Temperature above 27^o C

Coliform Counts
>1 colonies per 100 ml of water is unfit for drinking water
>200 colonies per 100ml of water is dangerous for swimmers

References

Websites are included throughout this document for the following references:
Arkansas Environmental Science Framework
Arkansas Science Teachers Association
Ecology Tutorial, an Environmental Systems Term Project
The Tragedy of the Commons, Dr. Barry Commoner
IPAT Equation, Sustainable Scale Project
Principles of Ecology by Van Waffle for Suite 101
2006 Index of Leading Environmental Indicators American Enterprise Institute for Public Policy Research
Earthwatch Lesson Plans
NAAEE Lesson Plans
NAAEE High School Guidelines
Elsflow Lesson Plans
Online Environmental Course
Science Spot EE Lessons
Oklahoma Biota
NatureDeficit Disorder, The National Environmental Education and Training Foundation
The Globe Program
Soil Testing Lesson Institute of Soil and Environmental Quality
Louisiana Leaf Key
Kansas Wildflower and Grasses
Index of Native Arkansas Wild Flowers
Tennessee Wildflower Key
Missouri Wildflower Key
Natural Diversity of Arkansas by Tom Foti
Soil Test Interpretations, Northern New Mexico State
Common Arkansas Wildlife, Arkansas Game and Fish Commission
Fifty Common Tree Key, About.com
Western U.P. Center for Science, Math and Environmental Education at Michigan Technological University
EPA Website
USGS Website
Google Earth
NASA World Wind
GeoStor 5.0 for Arkansas
Atlas of Population and Environment, AAAS
Ecology Laws or Principles, Netwalk
Environmental Literacy Council's Labs
Labs by Benjamin Nowak, AP Environmental Science/Geosystems Teacher, Centreville H.S., Fairfax County Virginia
McHenry Creek and Colonel Glen Road exist, but the donated land is fiction based on data
Investigating Your Environment, U S Forest Service