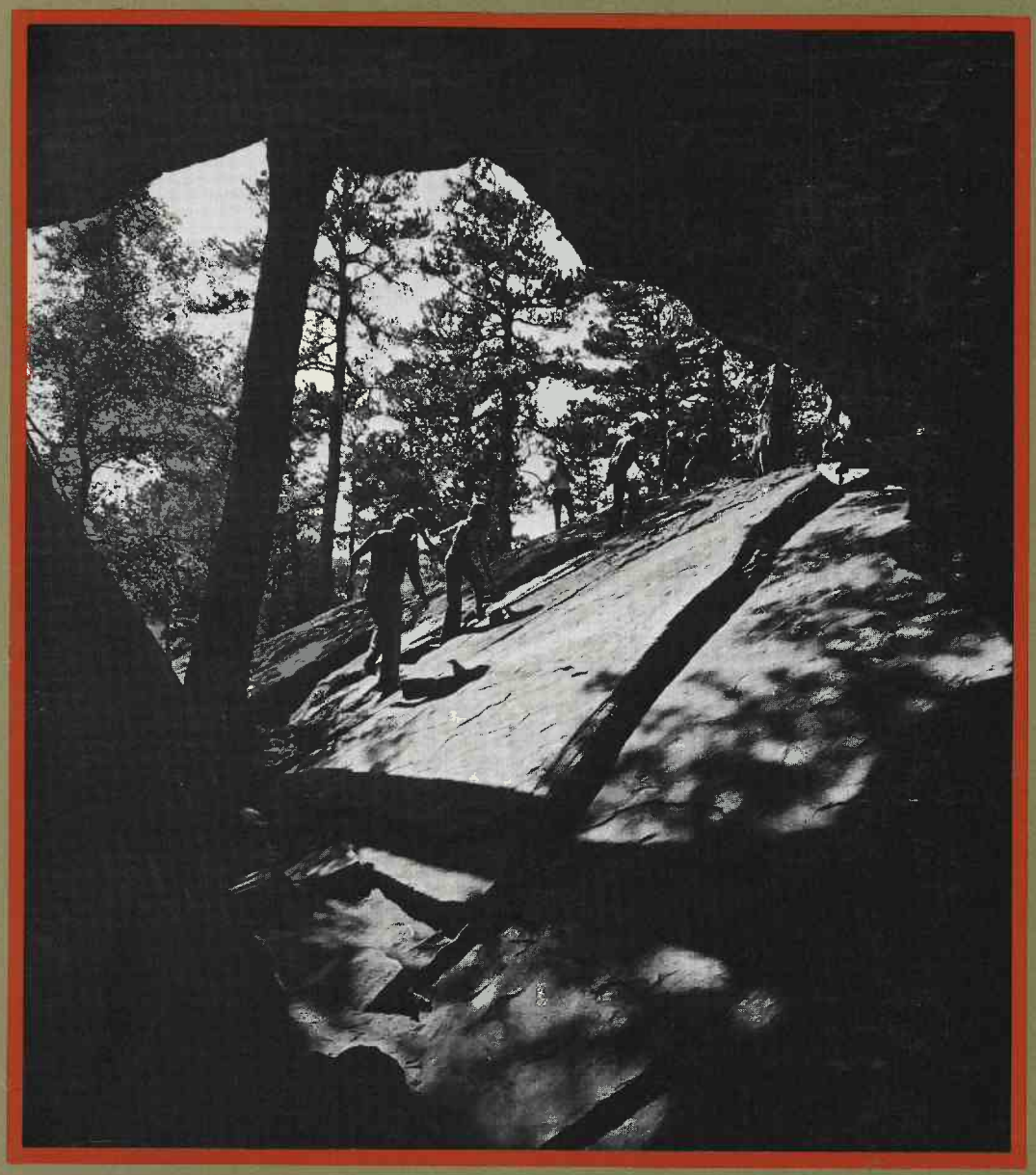
Oklahoma Geological Survey Guidebook 22



Guide to

Robbers Cave State Park

Arthur J. Myers, Dearl T. Russell
George J. Goodman, Cheryl A. Lawson

Oklahoma Geological Survey
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FOREWORD

An earlier edition of *Guide to Robbers Cave State Park* was published by the Oklahoma Geological Survey (OGS) in 1958 as Guidebook 7. It contained information on the geology and biology of Robbers Cave State Park and the surrounding area. The author of Guidebook 7, Dearl T. Russell, had studied and mapped northern Latimer County and submitted a thesis on his investigations for a Master of Science degree at the University of Oklahoma in 1958. He prepared Guidebook 7 to help Scouts at Camp Tom Hale and visitors to Robbers Cave enjoy and understand the natural history of the area.

The original material has been updated and expanded by Dr. Arthur J. Myers, Dr. George J. Goodman, and Dr. Cheryl A. Lawson, and is now being issued as Guidebook 22 by the OGS.

Myers retired from the OGS in 1984 after serving six years as a geomorphologist and aerial-photo interpreter. Before coming to the OGS, he had served on the faculty of the University of Oklahoma School of Geology and Geophysics for 33 years. Myers holds a B.A. in chemistry from Kalamazoo College, a B.S. and M.S. in geological engineering from Michigan Technological University, Houghton, and a Ph.D. in geology from the University of Michigan.

The botany section of this publication was prepared by Goodman and Lawson. Goodman, a recognized authority on the flora of Oklahoma, is a Regents Professor Emeritus of Botany at the University of Oklahoma and was formerly curator of the Bebb Herbarium there for more than 30 years. His current research is on the flora of Oklahoma and the botany and botanical history of the western United States.

Lawson graduated with distinction from the University of Oklahoma and from there received her Ph.D. in botany. She is a member of Phi Beta Kappa, and of many state, national, and international professional organizations. Her current research involves the botany of the Great Plains and the Rocky Mountains.

Cover Illustration
Robbers Cave

Leaf drawings by Roy D. Davis

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Geology of Robbers Cave State Park

Arthur J. Myers[1] and Dearl T. Russell[2]

Introduction

Robbers Cave State Park is in the wooded hills of southeastern Oklahoma. It is on the northern flank of the Ouachita Mountains, where sandstones of Pennsylvanian age, interbedded with shales, form rugged and picturesque landscapes. Figure 1 is a map showing the location of the park in northwestern Latimer County.

The park is a forested area that is refreshing and enjoyable, especially for persons from the grasslands of central and western Oklahoma. It offers recreational facilities of many kinds (fig. 2), including several hiking trails from which to observe trees, rocks, and wildlife. Some of the trails are short, but for energetic, adventuresome people there is a 12-mile hiking trail from Robbers Cave to the picnic area south of Lake Carlton.

Both Wayne Wallace Reservoir and Lake Carlton are formed by dams on Fourche Maline Creek and are picturesque bodies of water with high bluffs (formed by the Bluejacket Sandstone of Pennsylvanian age) on their far sides. As it flows through the park from Wayne Wallace Reservoir to Lake Carlton, Fourche Maline Creek has many interesting and scenic points. The water flowing over the dam at Lake Carlton is pretty, but even more important on a hot summer day, Lake Carlton boasts a swimming beach as well as a swimming pool.

Lodging facilities include cabins along the escarpment side of a cuesta with a lovely view of Coon Creek Valley and Coon Creek Lake. Trailer hookups are available in the Old Circle Campground area. Group-camp cabins are available as well, and there are three campgrounds where tents can be pitched. The park even has an equestrian campground. Many picnic shelters are available, along with a cafe and grocery store.

Of course, one of the main attractions of the park is Robbers Cave (fig. 3). From the parking area a path leads to the cave, which appears rather small and insignificant at first and may be an initial disappointment to some. But very few visitors leave the park without succumbing to the temptation to climb over the rocks and boulders to explore the cave.

Origin of Caves

Man has long been fascinated by caves. His first shelter was a cave, and the caves at Lascaux, France, contain some of the earliest works of art, the wall paintings that were made by Cro-Magnon man more than 20,000 years ago. The Dead Sea Scrolls reposed for centuries in the silent security of caves, which their ancient custodians recognized as suitable repositories for their preservation and eventual recovery. Caves are often tourist attractions; witness the popularity of Luray Cavern in Virginia, Mammoth Cave in Kentucky, Onondaga and

[1]Geologist (retired), Oklahoma Geological Survey.
[2]Deceased.

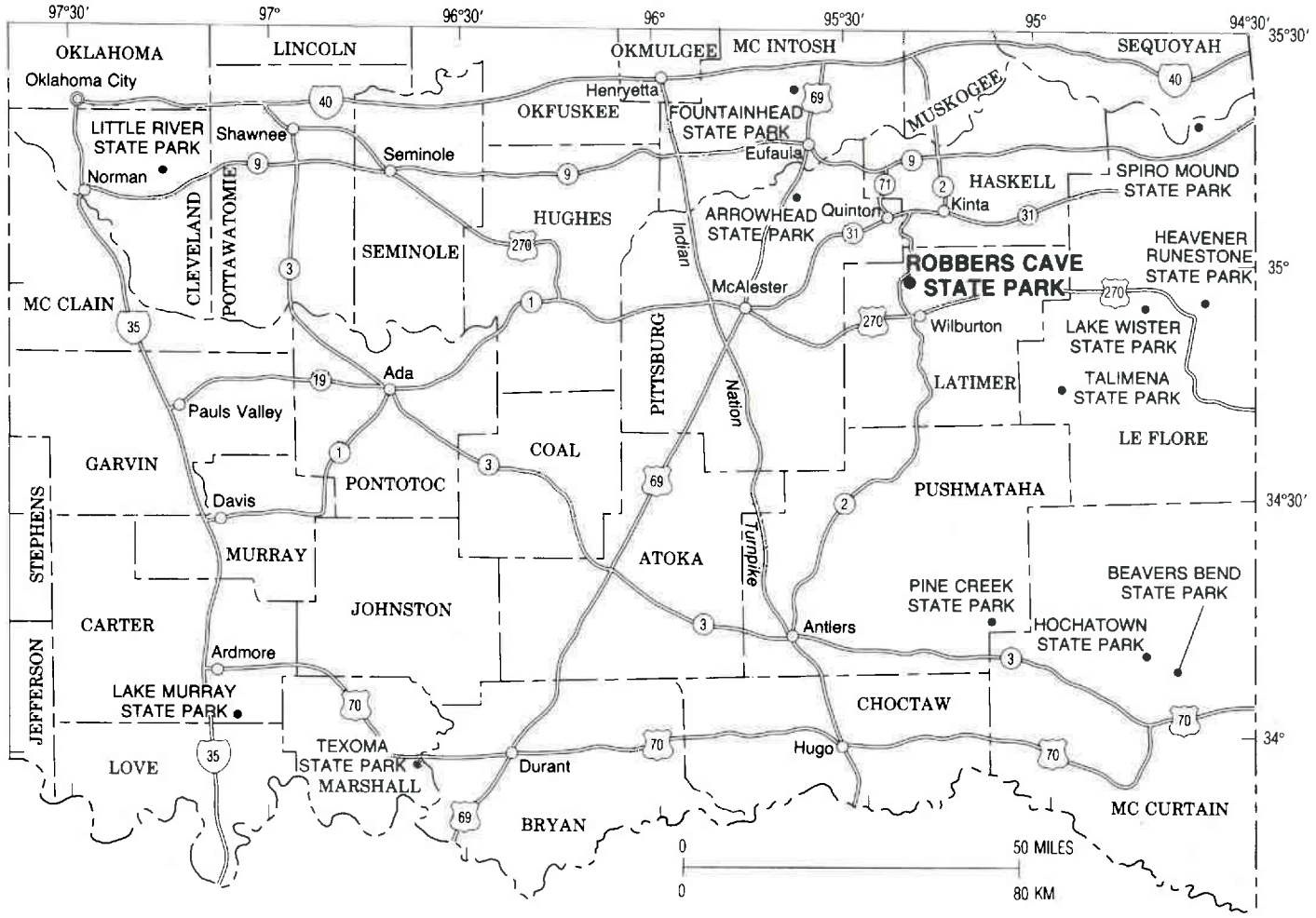


Figure 1. Map of southeastern Oklahoma, showing routes of major highways and location of Robbers Cave State Park and nearby State parks.

Meramec Caverns in Missouri, and Carlsbad Caverns in New Mexico.

Not everyone is in complete agreement about the detailed mechanics of cave formation. There is agreement that caves are formed when soluble rock is dissolved by subsurface water; although some scientists believe the dissolution takes place above the water table, some believe it is at the water table, and some believe that it is below the water table.

Most caves form in limestone, which is made up of the mineral calcite, whose chemical composition is calcium carbonate or $CaCO_3$. Carbonic acid, a weak acid that forms in water where there is decaying organic matter, reacts with the $CaCO_3$ to form a soluble bicarbonate. As a result, ground water moving along joints and bedding planes will dissolve the rock and form enlargements which, in time, become caves.

Gypsum is another rock that is soluble in water, and again, water moving along joints and bedding planes can dissolve the rock and form caves. Alabaster Cavern, in Woodward County, Oklahoma, was formed by this method in gypsum.

Robbers Cave formed in sandstone that is composed of the mineral quartz (SiO_2), which is relatively insoluble. However, the quartz grains have been cemented together by calcium carbonate so ground water can dissolve the calcium carbonate cement, and then the loosened quartz grains can be removed by the circulating ground water. The sandstone bluff (IPsv-11 on geologic map, pl. 1, in pocket) in which Robbers Cave has formed rises about 140 feet above the camp's parking area. The cave is approximately two-thirds of the way up the bluff, where it has formed along the junction of a bedding plane and a fault. This was a zone of weakness, and downward-percolating ground water moving along this zone gradually enlarged the opening to form the cave. As the cave became larger, blocks of rock were loosened by dissolution of the cement-

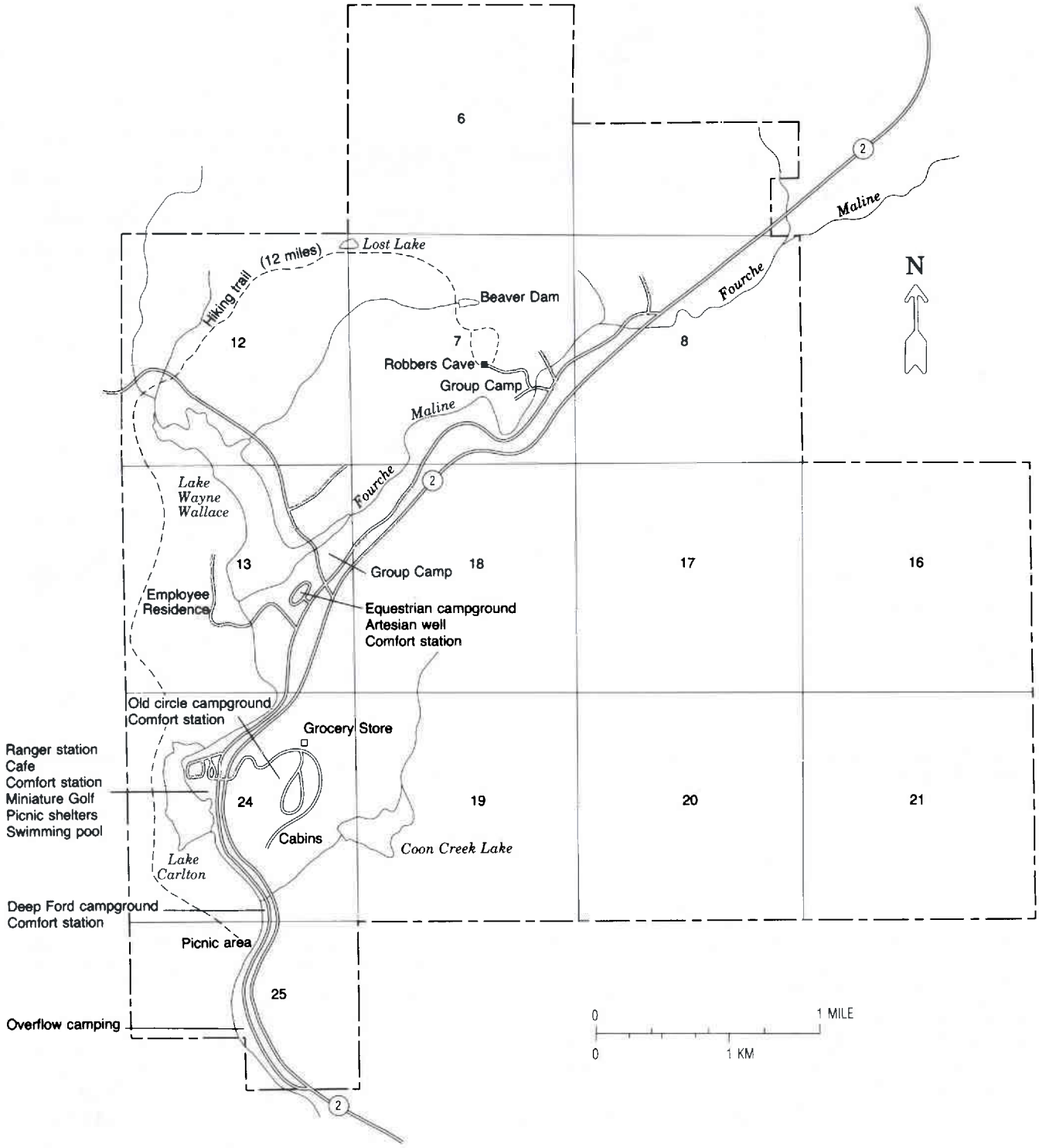


Figure 2. Map of Robbers Cave State Park, showing location of available facilities.

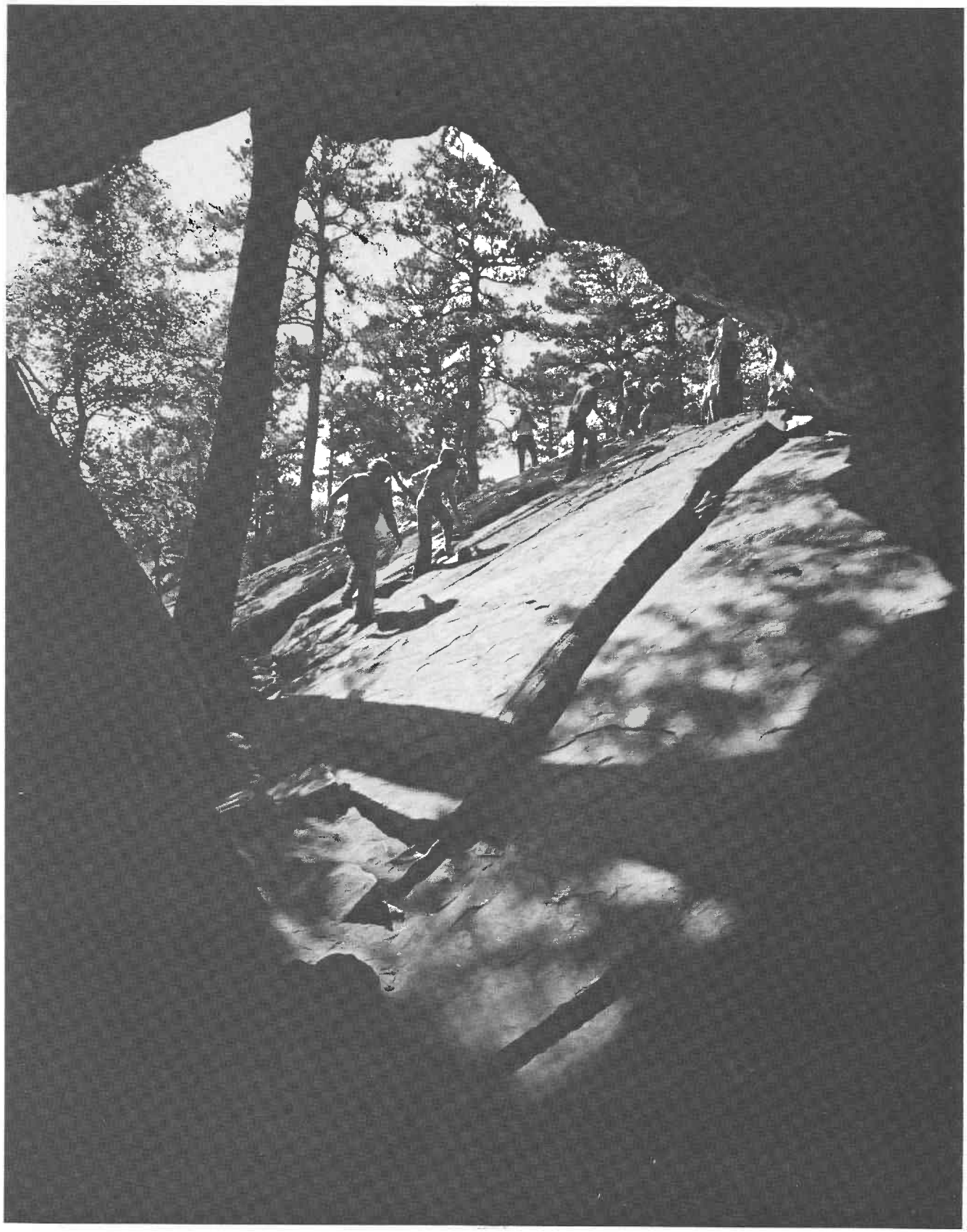


Figure 3. Robbers Cave: the floor is a bedding plane that dips from right to left; the steep slope on the left side represents a fault plane; the roof is irregular because of weathering and slumping. Erosion probably began along the junction of the bedding plane and the fault plane and was enlarged by weathering, slumping, and erosion.

ing material and subsequently fell to the floor of the cave. Some of these blocks were removed later by erosion.

Weathering of some of the minerals has stained many of the rocks shades of red, brown, and various other colors—making some beautiful abstract patterns. Weathering and erosion along bedding planes also has intensified the stratification. In many places a series of steps has formed along individual strata, making for an easy climb toward the top of the bluff. The top of the bluff is a wooded area with many large boulders and, at the edge of the large slump blocks, a spectacular view of the valley to the southeast.

Origin of Rocks

Rocks are classified as sedimentary (formed from the accumulation of sediments, either above or below sea level), igneous (formed from the cooling and solidification of molten material), or metamorphic (formed by alterations in the solid state of preexisting rock in response to changes in heat and (or) pressure below the zones of weathering or cementation). In Oklahoma, almost 99 percent of the outcropping rocks are sedimentary in origin; the rest are mainly igneous rocks in the Wichita and Arbuckle Mountains, with a small area of mildly metamorphosed rocks in the Ouachita Mountains southeast of Robbers Cave State Park.

At various times in the geologic past, parts of continents were flooded by shallow inland seas. Rivers flowing into these seas transported sand, silt, and dissolved mineral matter, which waves and currents then spread out in layers that are called strata or beds. Rocks formed in this manner from sediments are sedimentary rocks, and their most characteristic feature is the stratification. The tops and bottoms of strata are bedding planes. As originally deposited, the strata are essentially horizontal, and the first one deposited is at the bottom and is the oldest. Successive overlying strata are younger than the ones below. A unit of rock of the same rock type is called a formation, and within a formation there may be several strata. Formations are generally named for localities where they were first studied and described.

Sedimentary rocks are classified on the basis of texture (size of the mineral grains) and (or) mineral composition and are either clastic or nonclastic rocks. Clastic rocks consist of fragments derived from preexisting rocks that were broken down by weathering and subsequently transported and deposited in another environment. A sandstone is a sedimentary deposit composed of sand-sized (1/16 to 2 mm) quartz grains that have been lithified (made into a rock) by cementation of a secondary mineral (commonly calcite, chemical composition calcium carbonate or $CaCO_3$). Siltstone is a cemented sedimentary deposit composed of silt-sized (1/256 to 1/16 mm) quartz grains, and it generally contains impurities of clay minerals. Shale is a laminated sedimentary deposit containing clay-sized particles (less than 1/256 mm) that have been lithified, or changed to rock, most commonly by compaction. The sandstones and shales of Latimer County are primarily buff and brown colored because the mineral grains are coated with a thin covering of iron oxide; however, some rocks are gray because of a coating of organic matter.

Nonclastic sedimentary rocks form when dissolved mineral matter is precipitated on the sea floor. Limestone, composed of the mineral calcite, is the most abundant nonclastic sedimentary rock. Limestone is still being formed—in places such as in the seas around the Bahama Islands—by both physiochemical precipitation (direct precipitation from sea water) and biochemical precipitation (removal by marine organisms of dissolved mineral matter from sea water). Limestone formed in this manner can later be broken down by weathering and (or) erosion, then transported by rivers back to the sea, where it is redeposited by waves and currents. Since the material has been broken up and transported from its place of origin, it becomes a clastic limestone. When the loss of water by evaporation from the sea is greater than the amount of water brought to it by rivers, the dissolved mineral matter is precipitated on the sea floor. These deposits are called evaporites, and include gypsum and salt (the mineral halite). Although there are no evaporites in Latimer County, they are abundant in western Oklahoma. In fact, Alabaster Caverns State Park in Woodward County has a cave that is formed in gypsum. In Latimer County, only one thin limestone is in the Robbers Cave area, although a thick limestone bed forms a ridge south of Wilburton.

Coal is another type of sedimentary rock in Latimer County. It consists of compressed carbonaceous matter derived from the partial decomposition of plant life. Plant remains accumulated in swampy waters and were partially preserved in the stagnant waters of large fresh-water swamps. Subsequent burial by more sediments resulted in increased pressure and a rise in temperature that caused the organic plant remains to be transformed into bituminous coal. Coal beds in the park area are thin and low in

grade (level of purity); however, a high-grade bituminous coal is mined from surface pits near Wilburton.

Geologic History

Geology is centered around the history of the Earth and the study of the processes that produced the geologic features seen today. Less than 200 years ago many respected scientists believed that the Earth was only a few thousand years old. James Usher, an Irish archbishop, used genealogies in the Bible as a basis for publishing in "Anneles Veteris et Novi Testamenti" that the Earth was created in 4004 B.C. The vice-chancellor of Cambridge University refined the calculations and determined that the Earth was created at 9:00 a.m. on October 26, 4004 B.C. However, Charles Darwin (1809–1882), after his observations on the voyage of the Royal Navy's H.M.S. Beagle and with the publication of *The Origin of Species*, believed that the Earth had to be much older in order to account for the changes that had taken place. Today it is believed that the age of the Earth can be measured in billions of years and that the rocks at the surface are the products of a long and complex series of events.

In the late 18th century James Hutton, a Scottish geologist, proposed the classification of rocks into strata or layers. Later, William Smith, who collected fossils in England, noted that some strata contained fossils that were different from those in the strata above and below. This led to the designation of "index fossils" to be used as a basis for dating strata. Figure 4 shows the geologic time scale and compares it to a calendar year. Geologic time has been divided into eras, which are further subdivided into periods and then epochs. The oldest era is the Precambrian, which represents about 80 percent of the total age of the Earth. The Paleozoic (600 to 220 million years ago) is the age of ancient life; the Mesozoic (220 to 70 million years ago) is the age of middle life; and the Cenozoic (70 million years ago to the present) is the age of recent life. The Paleozoic Era has been divided into seven periods of varying lengths. The rocks in Robbers Cave State Park belong to the Pennsylvanian Period, which is toward the end of the Paleozoic Era.

The Pennsylvanian Period is named after the state of Pennsylvania, where rocks of that age contain large amounts of coal. The Pennsylvanian Period began about 320 million years ago and lasted 50 million years. Although periods of geologic time may seem to be phenomenally long, they are rather brief when compared to the total age of the Earth. When the 4.5-billion-year history of the Earth is compared with a 365-day year, the Pennsylvanian Period began about 26 days ago and lasted only about 4 days (fig. 4).

During the early part of the Pennsylvanian Period the Arkoma Basin (fig. 5), an area of east-central Oklahoma that extends into west-central Arkansas, gradually began to subside. At the same time the region to the south, which is now the Ouachita Mountain Uplift, slowly began to rise.

As these slow movements of the Earth's crustal blocks continued through millions of years, weathering was causing parts of the uplifted Ouachita Mountains to decompose and disintegrate. The sediments produced were carried by streams into the sinking Arkoma Basin, where they were deposited as horizontal layers of strata. After many layers had accumulated in the basin, the sediments were lithified into the solid rocks that can be seen in northern Latimer County and the park area. These sandstones and siltstones have many features similar to present-day delta deposits, such as those in the Mississippi River delta in the New Orleans area. Therefore, using the axiom "the present is the key to the past," geologists who have studied sediments in the park interpret them as being part of an ancient delta deposit.

From time to time during the Pennsylvanian, the Arkoma Basin area was flooded by the shallow marine seas that extended throughout much of the Midcontinent area. The climate during these times was apparently warm and humid, because abundant plant remains suggest that the landscape was covered by luxuriant vegetation. During periods of submergence, marine sediments were deposited, and during periods of emergence, nonmarine sediments were deposited. Thus, interbedded marine and nonmarine sediments extend throughout the basin.

By the end of Pennsylvanian time, more than 21,000 feet of clastic sediments had been deposited in the Arkoma Basin. Geologists believe that the land remained above sea level during the Permian, Triassic, Jurassic, and Cretaceous Periods, because there is no evidence that rocks of these ages were deposited in the Arkoma Basin. Erosion continued through the Tertiary, but alluvium was deposited by streams in the stream valleys during the Quaternary. Because we are still in the Quaternary Period, we can observe that erosion continues to modify the topography, changing features that first formed near the end of the Pennsylvanian Period.

Geologic Time Scale Compared to a Calendar Year

Geologic Era	Geologic Period	Beginning (Million Years Ago)	Comparative Date[1]			
				Day	Hr	Min
Cenozoic ("Recent life")	Quaternary	1	December	31	22	03
	Tertiary	70	December	26	7	44
Mesozoic ("Middle life")	Cretaceous	135	December	21	1	12
	Jurassic	180	December	17	9	36
	Triassic	220	December	14	3	44
Paleozoic ("Ancient life")	Permian	270	December	10	2	24
	Pennsylvanian	320	December	6	1	04
	Mississippian	350	December	3	14	40
	Devonian	400	November	29	13	20
	Silurian	430	November	27	2	56
	Ordovician	490	November	22	4	37
	Cambrian	600	November	13	16	00
Precambrian		4,500	January	1	0	00

[1]Determined by A. J. Myers.

Figure 4. Geologic time scale compared to a calendar year.

Stratigraphy

The branch of geology that deals with descriptions of sedimentary rock, or rock strata, is known as stratigraphy; and examining and describing rocks in the field is the first step for a geologist who is studying an area. The geologist records such things as rock type, color, thickness, orientation, and areal distribution; then from this information he compiles a detailed description of the formations that make up the stratigraphy of the area. From these findings, a geologic map of the area can be produced. Plate 1 (in pocket) is a geologic map of the Robbers Cave State Park area. It shows those parts of T. 6 N. that are present on the Quinton South and Wilburton 7½-minute topographic maps and includes the eastern part of R. 18 E. and most of R. 19 E.

Northern Latimer County was mapped by Dearl T. Russell for his master's thesis in 1958 for the School of Geology and Geophysics at the University of Oklahoma; and Oklahoma Geological Survey Circular 50, *Geology of Northern Latimer County, Oklahoma* (1960), is the published version of that thesis. The stratigraphy of northern Latimer County is summarized by the columnar section in figure 6 that contains the name of each rock unit, lithologic type, and average thickness.

The oldest formation exposed in northern Latimer County is the Atoka Formation. It was named for the town of Atoka in Atoka County, Oklahoma, and is composed of gray to brown silty shale and brown sandstone. The shale is easily eroded and forms valleys, whereas the resistant sandstone forms ridges and caps many hills in the southern part of Latimer County. The Atoka Formation is not exposed in the park or map area.

Overlying the Atoka Formation is the Hartshorne Formation, which is named for the town of Hartshorne in Pittsburg County, Oklahoma. The Hartshorne is gray to brown silty sandstone interbedded with thin, gray silty shales. The formation ranges in thickness from 84 to 316 feet. In the upper part is the upper Hartshorne coal, which is 4 to 6 feet thick and has been mined by surface mining. The Hartshorne Formation is not exposed in the park but is exposed in the extreme southwestern part of the geologic-map area (pl. 1).

The McAlester Formation overlies the Hartshorne Formation and was named for the town of McAlester in Pittsburg County, Oklahoma. It consists of in-

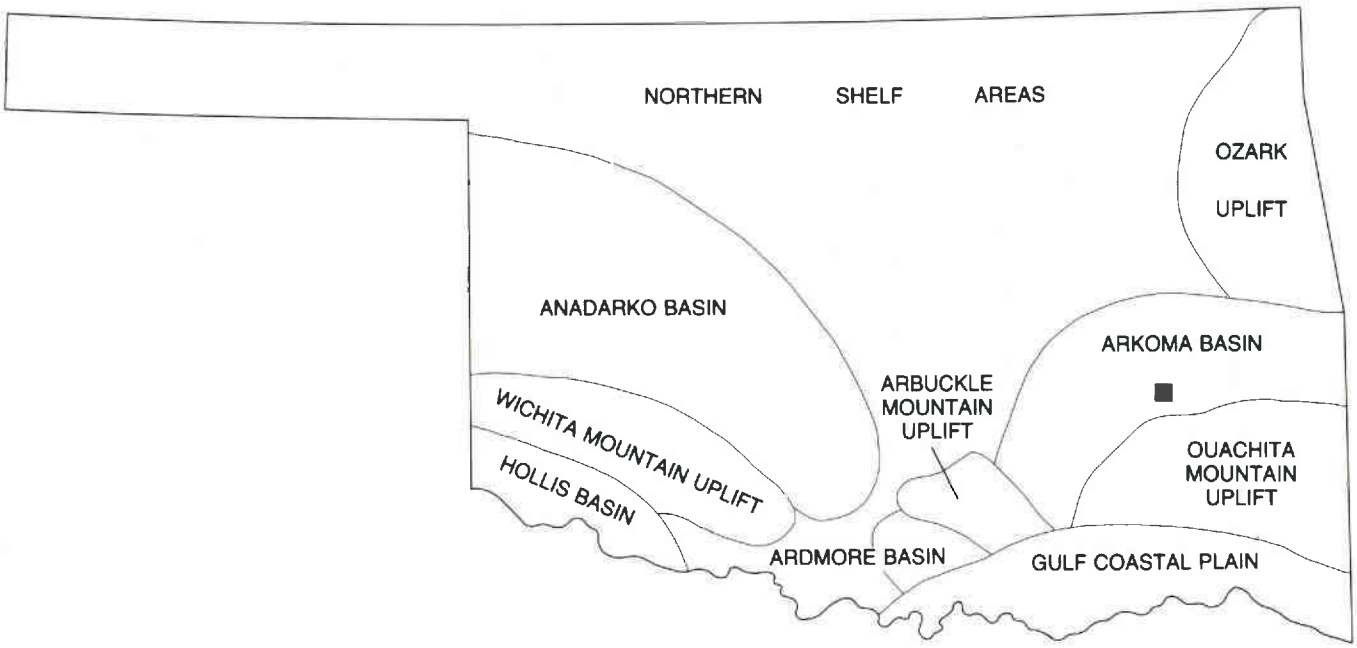


Figure 5. Map showing major geologic provinces of Oklahoma (from Johnson and others, 1972, p. 1). Solid square indicates location of Robbers Cave State Park.

terbedded sandstones and shales and has a total thickness of 2,134 feet. Exposures of the McAlester Formation are in the southwestern and south-central parts of the area mapped (pl. 1). Shales in the road cuts along State Highway 9 are part of the McAlester Formation, along with the coals which have been mined by surface mining. Some of the mines are shown in the south-central part of the map (pl. 1).

The Savanna Formation overlies the McAlester Formation and was named for the town of Savanna, which is also in Pittsburg County, Oklahoma. The Savanna consists of brown, fine-grained sandstone beds and siltstone beds interbedded with gray-green to dark silty shales. There are 14 mappable units in the formation (pl. 1). The sandstones are up to 200 feet thick, and the shales range in thickness from 200 to 550 feet. The total thickness in Latimer County ranges from 1,470 to 1,990 feet.

Most of the rock outcrops in the park are of the Savanna Formation, the most extensive formation in the map area, with many fine exposures in easily accessible road cuts along State Highway 2 and at various localities throughout the park area. Most of the ridges are capped by Savanna sandstones, whereas valleys have formed on the shales. As the shales weather and erode, the thick overlying sandstones form large slump blocks. Some are as much as 30 to 40 feet high. Robbers Cave has formed in sandstone unit IPsv-11 (pl. 1) that also forms the high bluff upon which cabins have been built. Rough Canyon to the west of Robbers Cave contains large boulders of Savanna sandstones. Shale at the top of the Savanna Formation is exposed along Lake Wayne Wallace and Lake Carlton.

Overlying the Savanna Formation is the Boggy Formation, named from exposures along Boggy Creek in Atoka and Coal Counties, Oklahoma. The Boggy Formation consists of brown to buff sandstones and siltstones interbedded with dark- to light-gray silty shales. There are eight mappable sandstone units with seven interbedded shales in the formation. The Boggy ranges in thickness from 700 feet in western Latimer County to 2,136 feet in eastern Latimer County. The basal sandstone is the Bluejacket Sandstone Member, which forms spectacular bluffs on the west side of Lake Carlton. The Secor coal lies just above the Bluejacket Sandstone. The Boggy Formation is present in the park only in the western part but is present also on the east side of the map area (pl. 1).

Paleontology

Paleontology, the study of life in the geologic past, relies on fossil plants and animals. The fossil

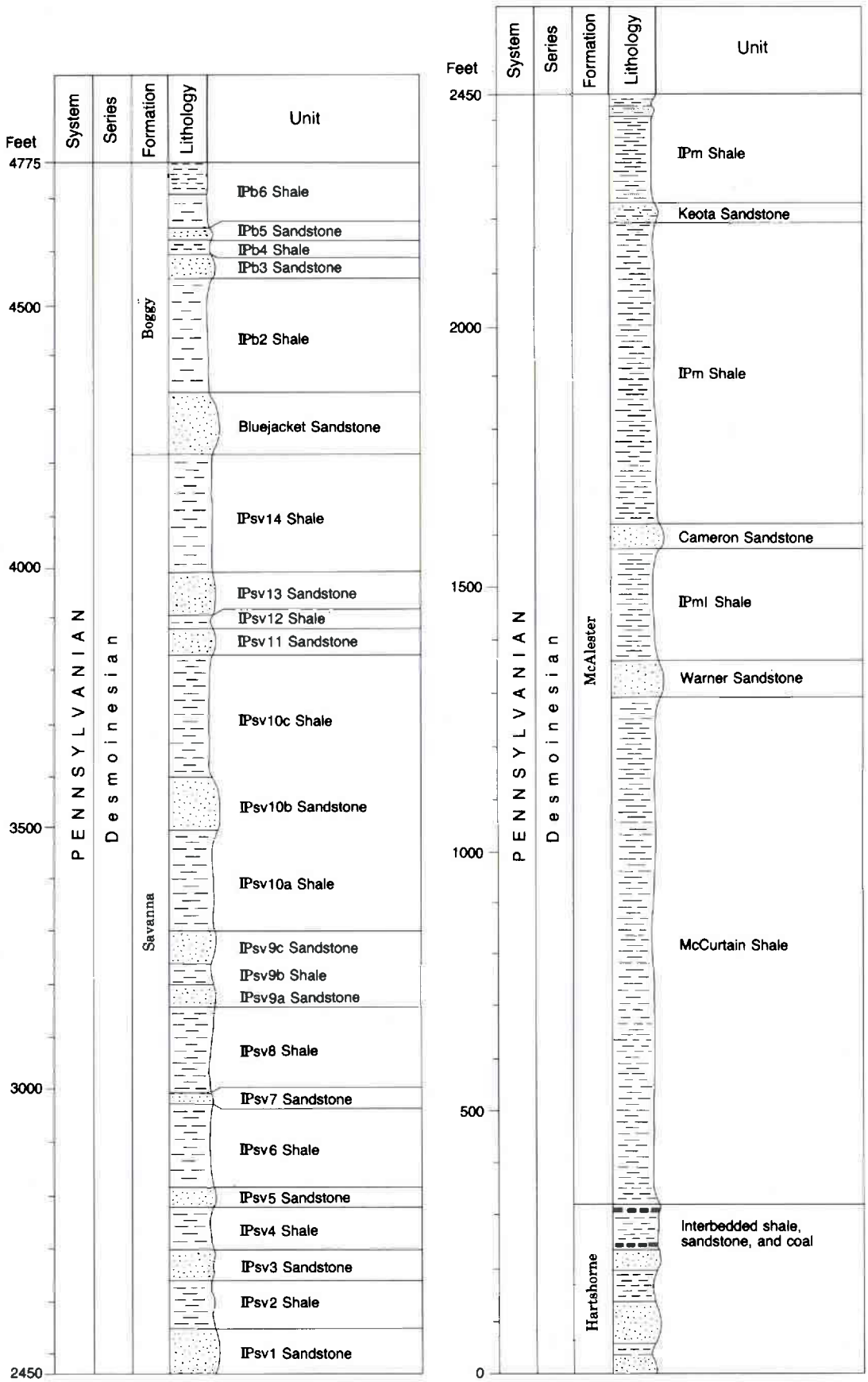


Figure 6. Composite columnar section of rocks in Robbers Cave State Park area. Modified from Russell (1958, pl. 1).

remains of many ancient plants are present in the rocks that crop out in northern Latimer County. Fossil remains of animals are rare, but they can be found with careful searching. Fossil tree stems, stumps, and trunks are common. Sandstone has replaced the original woody material, and imprints of plant leaves are also present in many of the shales—but they are difficult to find. Coal beds in this region nearly always contain the remains of leaves, stems, and spores of many plants.

The most common fossils in the region include *Stigmaria* (fig. 7) and *Calamites* (fig. 8). The two genera of scale trees most common are *Lepidodendron* and *Sigillaria* (fig. 9). In excavating for State Highway 2 many years ago, the thick sandstone layer IPsv-11 of the Savanna Formation (pl. 1), which forms the ridge underlying the park's tourist cabins, yielded the large stump of a scale tree. The road cut where it was found is north of Coon Creek and overlooks Lake Carlton. Specimens of *Stigmaria* are the fossil underground stems of scale trees, and they resemble cacti at first glance. They have been mistaken for the fossil remains of ancient snakes by those not familiar with paleobotany. Numerous *Stigmaria* specimens can be found in creek beds, where they have come to rest after having been eroded out of the strata. *Calamites* specimens, which are numerous, are fossils of a rush-like plant with vertical grooves up the trunk.

Studying fossil plants found in strata helps paleobotanists better understand the Earth's history, because fossils provide information about the conditions and the types of life that existed during the time that the enclosing strata were deposited. For example, plant fossils found in the region surrounding the park area are of plants similar to ones that now grow only in warm, humid climates. Therefore, the rock strata in which they are preserved must have been deposited during a period of warm, moist conditions.

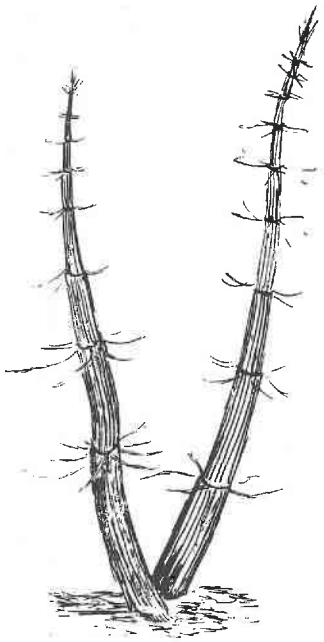


Figure 8. *Calamites.* Vertical grooves in the bark characterize this Pennsylvanian rush. Sand casts of this plant are numerous in the park area. From Russell (1958, fig. 10).

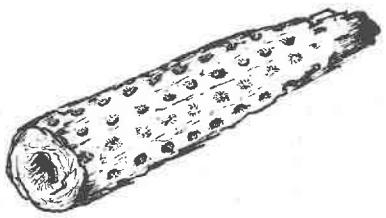


Figure 7. *Stigmaria.* Fossil underground stem of a scale tree. Pits are where rootlets were attached. These plants are common in the camp area and have been mistaken for fossil cacti or even fossil snakes. From Russell (1958, fig. 11).

Topography and Structural Geology

Topography refers to the shape of the Earth's surface. Robbers Cave State Park is in the Interior Highlands geomorphic province, which includes the Ozark Plateau in northeastern Oklahoma, southwestern Missouri, and northwestern Arkansas, and the Ouachita Mountains in southeastern Oklahoma and west-central Arkansas (fig. 10). The Sans Bois Mountains are in the northwestern part of the Ouachita Mountains, where the region is a submature-to-mature plateau with gently folded strong and weak strata.

The map showing geomorphic provinces of eastern Oklahoma (fig. 11) shows Robbers Cave State Park in the McAlester Marginal Hills Belt. This belt extends from northern Atoka County northeastward

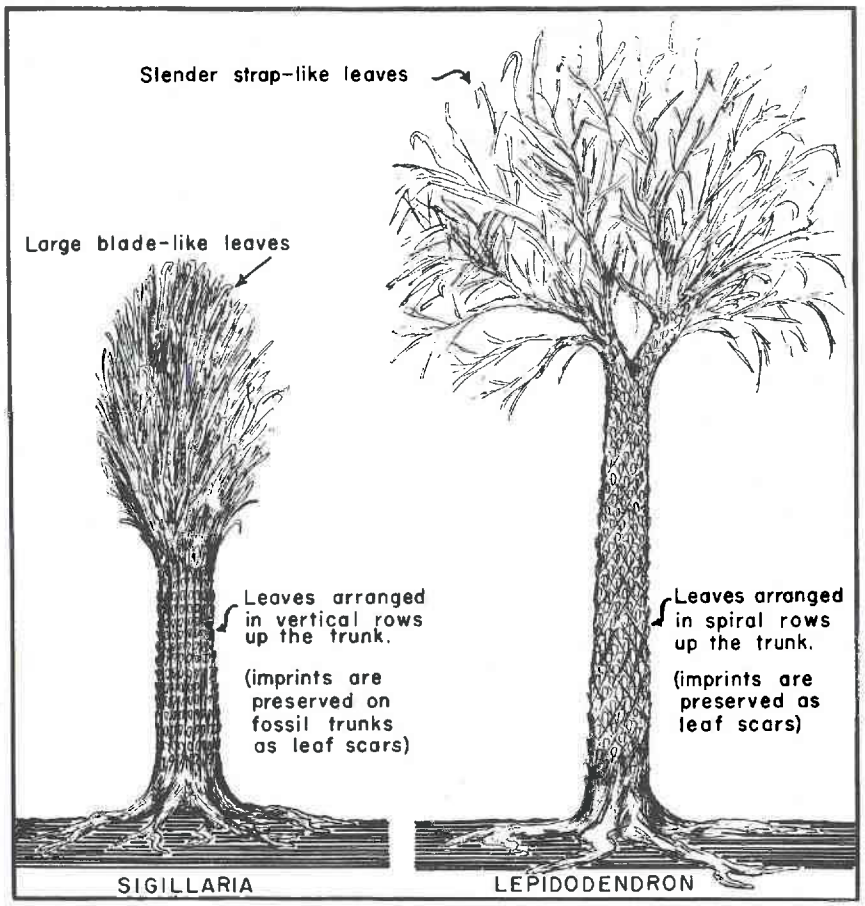


Figure 9. Scale trees. Sandstone casts of the trunks are abundant in the park area. From Russell (1958, fig. 8).

through parts of Coal, Pittsburg, Latimer, and Le Flore Counties. The area is one of resistant Pennsylvanian sandstones that cap broad hills and mountains, rising from 300 to almost 2,000 feet above wide hilly plains.

In the process of mountain building, rocks are often folded into an upward arch (called an anticline) and a downward arch (a syncline). If the deformation is too intense, the strata are broken and are offset as faults. Joints are cracks that form perpendicular to stratification in rocks; commonly two sets of joints occur, in many cases extending at right angles to one another. Weathering and erosion, which result in the removal of rock material, are greater along bedding planes, joints, and faults.

The major structural feature in northern Latimer County is the Sansbois Syncline (pl. 1). The linear extent, or axis, of the fold extends across the middle of the park, with Robbers Cave on the north flank and Old Circle Campground on the south flank, then continues in an east-west direction across the central part of the map area. The topographic highs occur along the axis of the fold. Even though synclines are downfolds of rock, as erosion continues they commonly form subsequent topographic highs. Figure 12 is a block diagram of a canoe-shaped synclinal mountain west of Robbers Cave State Park, along the axis of the fold. The dashed line is the park boundary.

The North Wilburton Fold (pl. 1) is an anticline shown in the north-central part of the map area. In the northwestern part of the area faults have cut isolated outcrops of the IPsv-11 sandstone member of the Savanna Formation.

The Sans Bois Mountains form the main mountain range between Sans Bois Creek (at an elevation of approximately 550 feet on the north) and Fourche Maline Creek (at an elevation of approximately 600 feet on the south). Blue Mountain in sec. 35, T. 7 N., R. 20 E., northeast of the map area, is the highest point in the Sans Bois Mountains. It is composed of the uppermost sandstone in the Boggy Formation, and the axis of the Sansbois Syncline passes through it. Tucker Knob, elevation 1,532 feet, is a picturesque, isolated, cone-shaped mountain half a mile east of State Highway 2, approximately 7 miles

south of Quinton and 3 miles north of the park (fig. 13). Both Tucker Knob and Panther Mountain, which is 2 miles west of the highway, are composed of the Bluejacket Sandstone, the basal unit of the Boggy Formation.

The topography of the park area consists of high, rugged escarpments or bluffs and enormous blocks of sandstone. The force of gravity has gradually pulled large blocks of sandstone downslope from their original position, and many slump blocks have formed interesting features. In some cases the gradual downslope movement resulted in sandstone layers sliding along smooth bedding planes and giving rise to features such as the steep crevice called Devils Slide.

The high sandstone ridges are separated by valleys that have been cut into the shale layers by streams. Thus the topography of the park area has resulted from selective erosion of rock strata. The height of topographic features is related to the dip (the slope of bedding planes), hardness, and thickness of rock strata. The thicker and more resistant layers form large hills and ridges. Ridges are formed by the folding of the strata forming the Sansbois Syncline, and they are called either hogbacks or cuestas, depending on the slope of the two sides. Hogbacks have slopes that are about the same on both sides; cuestas have one gentle slope and one slope that is much steeper because erosion has cut across the strata. Ridges are well illustrated on the block diagram in figure 12.

Robbers Cave has formed in one of the sandstones of the Savanna Formation (IPsv-11, pl. 1). The sandstone's resistance has caused it to form a cuesta that dips gently to the southwest, into the Sansbois Syncline. On the escarpment side of the cuesta a series of bluffs has formed, attaining a total height of approximately 140 feet (fig. 14). In addition to the folding, the sandstone contains joints and has been faulted. Weathering and erosion have enlarged some of the joints from a few inches to more than a foot (fig. 15). In some places intermittent streams have sculpted a rounded appearance near the bottom of enlarged joints. On top of the bluff, joints along the bedding plane have the appearance of a checkerboard. Some of the slump blocks have broken away along joint planes (fig. 16). Jointing is responsible for features like the Stone Corral (one of the popular tourist attractions in the park), and some of the narrow passes are also the result of enlarged joint planes.

The sandstone units contain several strata, and smaller cuestas have formed in places on the flanks of the main cuesta (fig. 17). One such cuesta can be seen from near the entrance to Robbers Cave.

The park's tourist cabins have been built along the same cuesta as Robbers Cave but are on the south side of the axis of the Sansbois Syncline, with beds dipping to the northwest. The erosion side of the ridge forms a steep cliff about 200 feet high that descends to Coon Creek, which has formed a valley in the underlying shale (IPsv-10, pl. 1).

The waters of Lake Carlton (fig. 18) cover mainly shale (IPsv-14, pl. 1), but the lake is dammed where Fourche Maline Creek cuts across the sandstone and flows south across other units. The high bluff along the west side of the lake is the erosion side of a cuesta in the Bluejacket Sandstone, which is the basal member of the Boggy Formation.

It is hoped that this guidebook will help visitors to Robbers Cave State Park appreciate the scenic points of interest by encouraging them to look at rocks more closely and to see their makeup. The visitor will gain an even better understanding of geology by thinking about the long period of time and varied environments in which the rocks were formed, and the intense forces that bent the rocks into folds and even caused them to break into faults.

The Earth's surface is not static, and even today dynamic processes are continuing to make changes in Robbers Cave State Park.

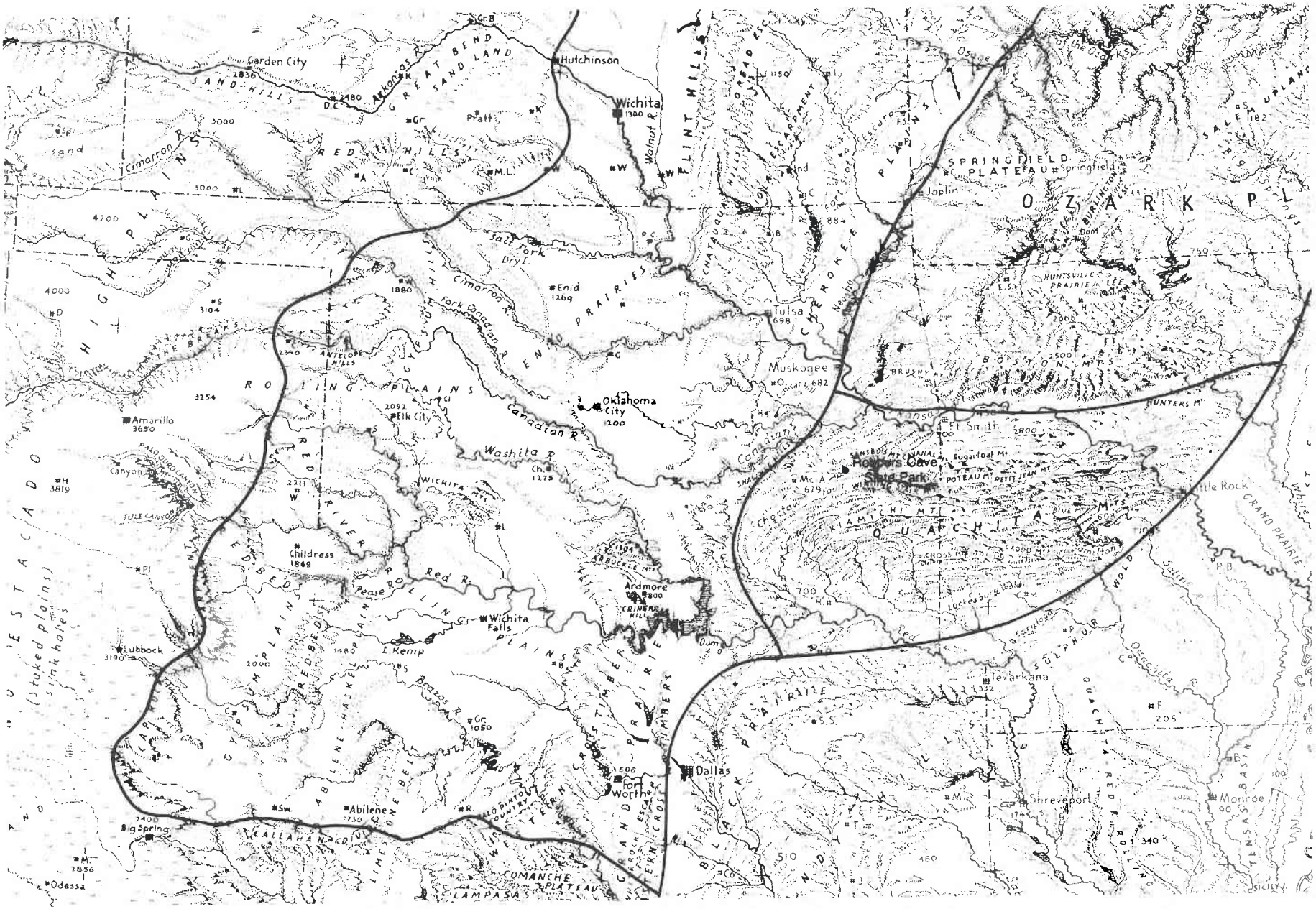
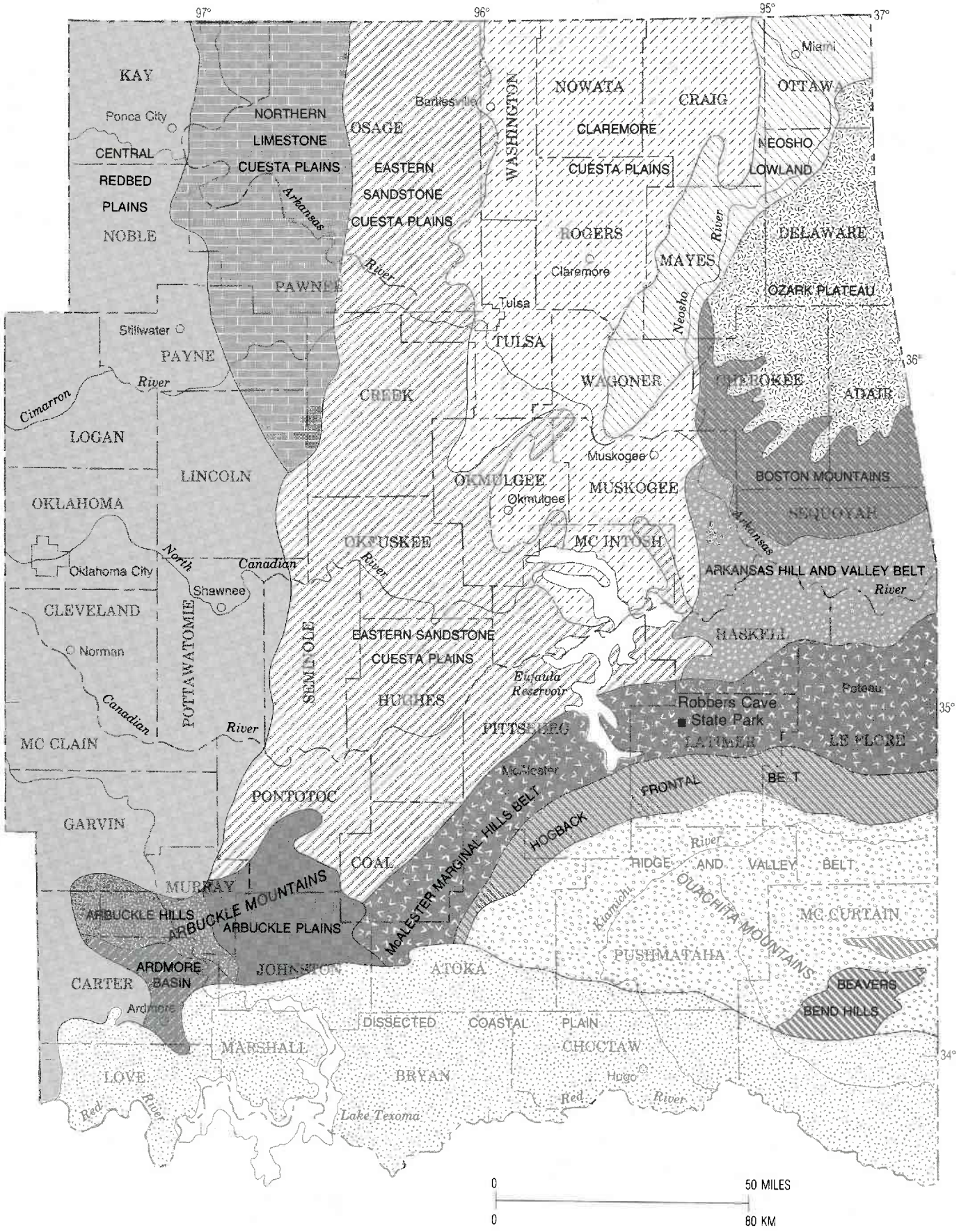


Figure 10. Map showing generalized geomorphic regions of Oklahoma and parts of surrounding states. Northeastern Oklahoma is part of the Ozark Plateau, southeastern Oklahoma is part of the Ouachita Mountains, the Panhandle is part of the High Plains, and the rest of the State is part of the Osage Plains of the Central Lowland. Modified from Raisz (1957).


97°
96°
95°
37°
36°
35°
34°
KAY
Ponca City
NORTHERN
LIMESTONE
CUESTA PLAINS
CENTRAL
REDBED
PLAINS
NOBLE
Arkansas
River
PAWNEE
OSAGE
EASTERN
SANDSTONE
CUESTA PLAINS
Barnsdall
WASHINGTON
NOWATA
CRAIG
CLAREMORE
CUESTA PLAINS
Miami
OTTAWA
NEOSHO
LOWLAND
ROGERS
Claremore
MAYES
DELAWARE
OZARK PLATEAU
Tulsa
TULSA
WAGONER
CHEROKEE
ADAIR
Stillwater
PAYNE
Cimarron
River
CREEK
LOGAN
LINCOLN
OKLAHOMA
Muskogee
OKMULGEE
Okmulgee
MUSKOGEE
BOSTON MOUNTAINS
SEQUOYAH
MC INTOSH
OKFUSKEE
North
Canadian
River
Oklahoma City
Shawnee
ARKANSAS HILL AND VALLEY BELT
CLEVELAND
POTTAWATOMIE
SEMINOLE
EASTERN SANDSTONE
CUESTA PLAINS
Norman
Eufaula
Reservoir
HUGHES
Robbers Cave
State Park
Canadian
River
PITTSBURG
LATIMER
LE FLORE
MC CLAIN
McAlester
FRONTAL
BELT
PONTOTOC
HOGBACK
GARVIN
COAL
RIDGE
AND
VALLEY
BELT
MURRAY
ARBUCKLE MOUNTAINS
ARBUCKLE HILLS
ARBUCKLE PLAINS
McALESTER MARGINAL HILLS BELT
Kiamichi
River
OUACHITA MOUNTAINS
MC CURTAIN
PUSHMATAHA
ARDMORE
BASIN
CARTER
Ardmore
JOHNSTON
ATOKA
BEAVERS
BEND HILLS
DISSECTED
COASTAL
PLAIN
MARSHALL
CHOCTAW
LOVE
BRYAN
Hugo
Red
River
Lake Texoma
0
50 MILES
0
80 KM

EXPLANATION

Arbuckle Mountain Province

Arbuckle Hills—Low to moderate hills chiefly of Cambrian to Mississippian limestones. Steeply dipping strata are complexly folded and faulted.

Arbuckle Plains—Gently rolling hills and plains developed on granites of Precambrian age and gently dipping limestones chiefly of Ordovician age.

Ouachita Mountain Province

Beavers Bend Hills—Moderate to high hills and ridges formed by tightly folded Ordovician through Mississippian sedimentary rocks.

Ridge and Valley Belt—Long and sinuous mountain ridges of broadly folded Mississippian and Pennsylvanian sandstones towering above subparallel shale valleys.

Hogback Frontal Belt—Thrust blocks of steeply dipping Pennsylvanian sandstones and limestones in hogback ridges rising 500 to 1,700 feet above adjacent valleys.

Other Provincess

Ardmore Basin—Lowland of folded Mississippian and Pennsylvanian shales and sandstones between Arbuckles and Dissected Coastal Plain.

Arkansas Hill and Valley Belt—Broad, gently rolling plains and valleys with scattered hills 100 to 300 feet high capped by Pennsylvanian sandstones.

Boston Mountains—Deeply dissected plateau capped by gently dipping Pennsylvanian sandstones.

Central Redbed Plains—Red Permian shales and sandstones forming gently rolling hills and broad, flat plains.

Claremore Cuesta Plains—Resistant Pennsylvanian sandstones and limestones dipping gently westward, forming cuestas between broad shale plains.

Dissected Coastal Plain—Soft, south-dipping Cretaceous sands, gravels, and clays of Gulf Coastal Plain, slightly dissected by streams.

Eastern Sandstone Cuesta Plains—West-dipping Pennsylvanian sandstones forming cuestas that overlook broad shale plains.

McAlester Marginal Hills Belt—Resistant Pennsylvanian sandstones capping broad hills and mountains that rise 300 to 2,000 feet above wide, hilly plains.

Neosho Lowland—Gently rolling shale lowlands with a few low escarpments and buttes capped by Pennsylvanian sandstones and Mississippian limestones.

Northern Limestone Cuesta Plains—Thin Permian limestones capping west-dipping cuestas that rise above broad shale plains.

Ozark Plateau—Deeply dissected plateau formed in gently dipping Mississippian limestones and cherts.

Figure 11. Map (opposite) showing geomorphic provinces in central and eastern Oklahoma. Solid square indicates location of Robbers Cave State Park. Map adapted from Curtis and Ham (1972).

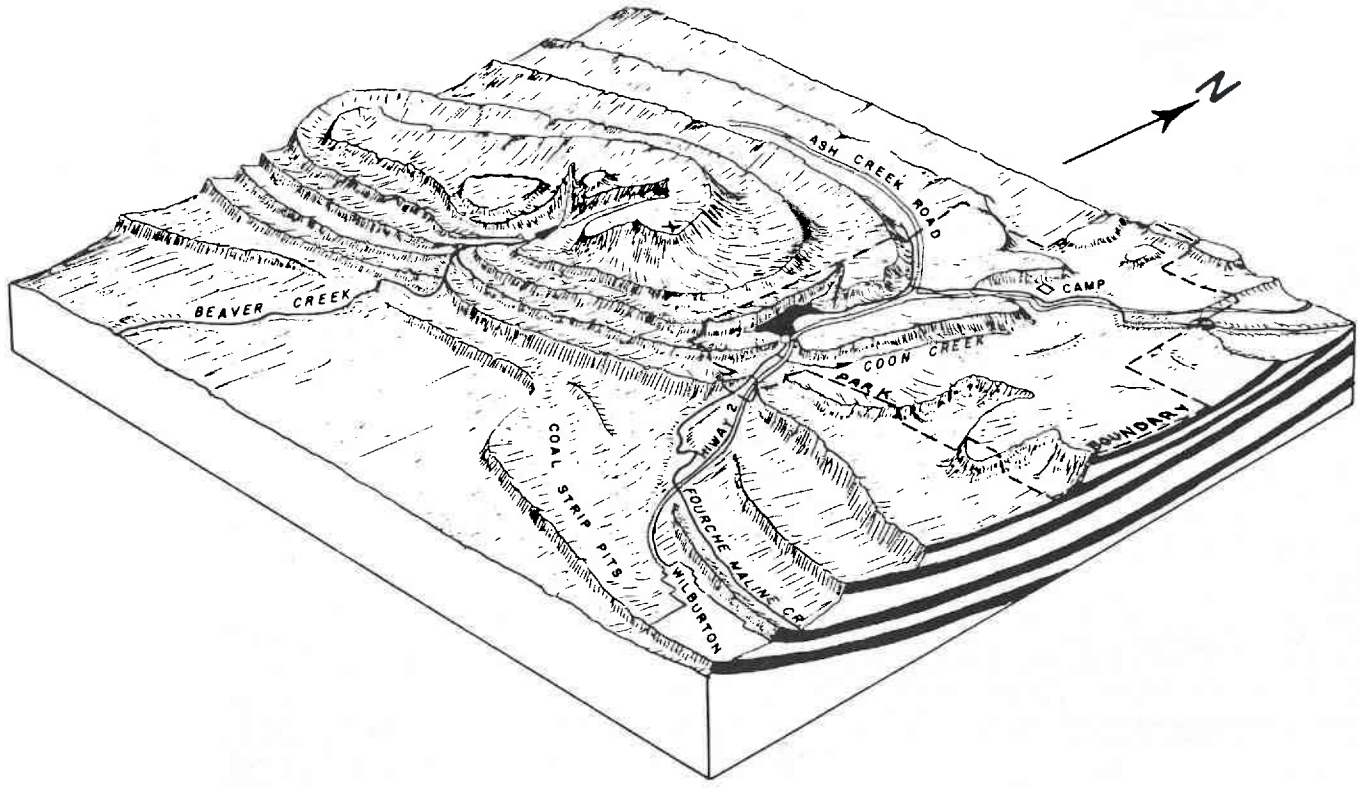


Figure 12. Schematic aerial view of the canoe-shaped synclinal mountain west of Robbers Cave State Park. The bow of the canoe extends into the park. Dashed line is park boundary. From Russell (1958, fig. 12).

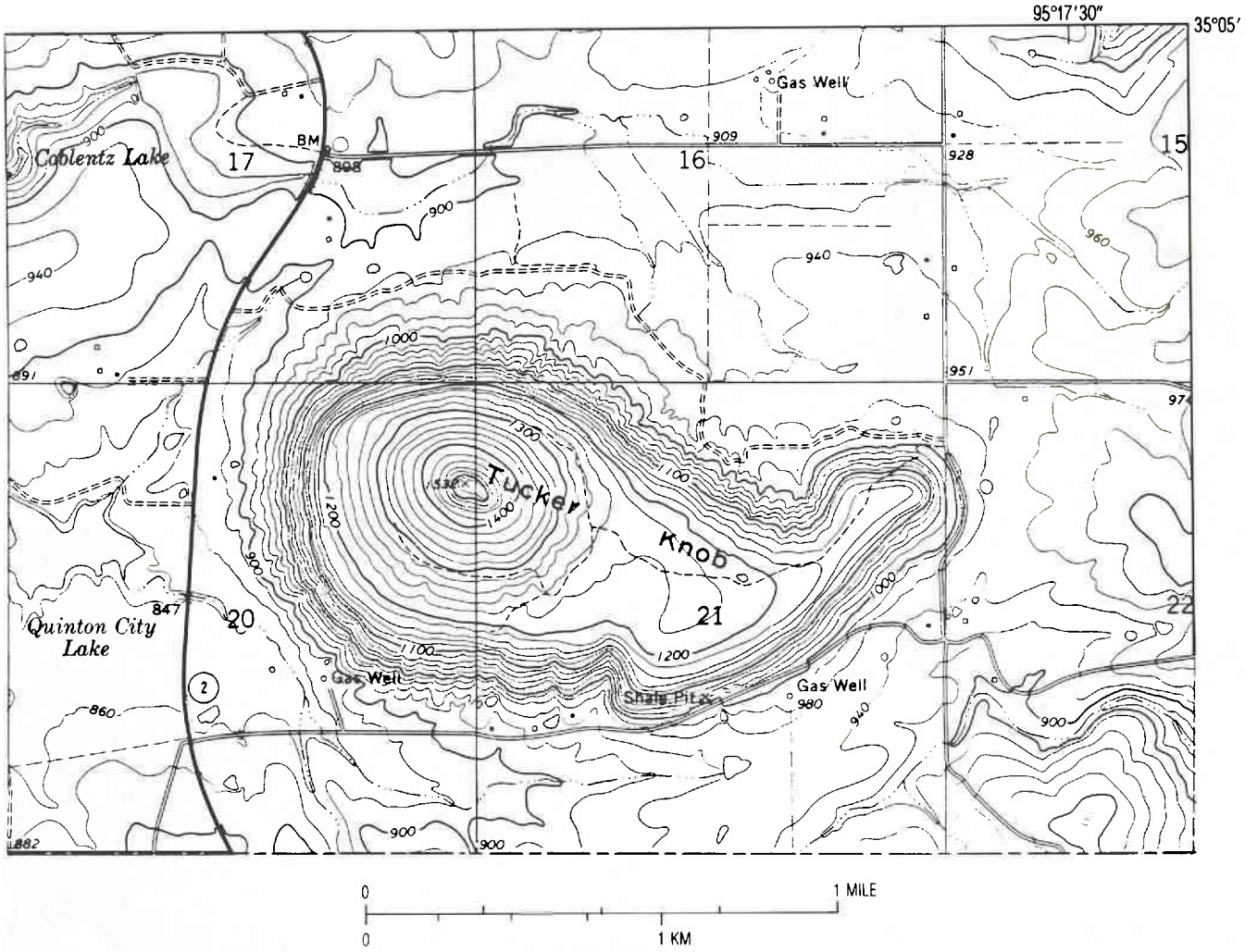


Figure 13a. Tucker Knob is a picturesque, cone-shaped mountain east of State Highway 2 between Quinton and Robbers Cave State Park. Map from U.S. Geological Survey 7½-minute-quadrangle map series: Quinton South, 1969.

Figure 13b. Photograph of Tucker Knob.

Figure 14 (above). Part of the high bluff at Robbers Cave, which is the erosion side of the cuesta formed in sandstone IPsv11 of the Savanna Formation.

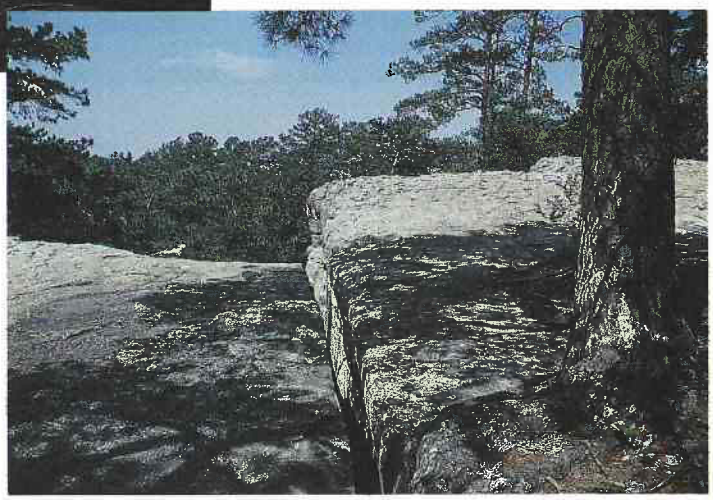


Figure 15 (right). One of the many joints that have been enlarged by erosion in sandstone IPsv11 of the Savanna Formation at Robbers Cave. View is at the top of the bluff, with the strata dipping toward the bottom.

Figure 16 (left). Slumped blocks of sandstone result in an almost vertical cliff approximately the size of a three-story building along a joint in the bluff at Robbers Cave.

Figure 17. A small cuesta on the flanks of the main cuesta that has formed in sandstone IPsv11 of the Savanna Formation in the Robbers Cave area. The bedding plane dips toward the left, and on the right is the steep erosional scarp that cuts across the strata.

Figure 18. Lake Carlton and part of the bluff on the erosion side of the cuesta formed by the Bluejacket Sandstone, the basal member of the Boggy Formation.

Botany of Robbers Cave State Park

George J. Goodman[1] and Cheryl A. Lawson[2]

Introduction

Your visit to Robbers Cave State Park brings you into one of Oklahoma's scenic forests, a forest that lies at the northwestern edge of the Ouachita Mountains and the southern edge of the Sans Bois Mountains. The towering trees, together with the shrubs, vines, and herbaceous plants on the forest floor, blend harmoniously, creating a natural setting for your enjoyment and a sanctuary for the abundant wildlife. The amount of rainfall, the soil type, and other environmental factors are well suited for the development of a forest. If the amount of rainfall were less and the soil different, as they are in central and western Oklahoma, a grassland or prairie would be expected. Even so, in the park there are variations in the makeup of the forest, which is dominated by oaks (*Quercus*) mixed with many hickories (*Carya*) and pines (*Pinus*). On some of the drier slopes and on poor soil, especially where erosion has occurred, the forest is limited to pines. On better soil, mixed with the pines, oaks, and hickories, are several other deciduous species. The most abundant oaks by far on these slopes are post oak (*Q. stellata*) and blackjack (*Q. marilandica*), with the hickories being primarily black (*C. texana*) and mockernut (*C. tomentosa*).

The plants you will find in the park will depend primarily on two factors: the season of your visit and your location in the park. The plants most varied by the season will, of course, be the herbaceous ones. For example, in the spring of the year the forest floor and forest openings may be covered with spring bloomers such as camass (*Camassia scilloides*), crow poison (*Nothoscordum bivalve*), yellow-eyed grass (*Hypoxis hirsuta*), spring beauty (*Claytonia virginica*), buttercups (*Ranunculus*), violet woodsorrel (*Oxalis violacea*), and blue-eyed grass (*Sisyrinchium campestre*), some of which flower before the leafy canopy of the trees develops and screens out the light. As the season progresses to late summer and fall, very different herbaceous plants will appear. Fewer plants will be seen on the forest floor; however, many will be quite conspicuous with their colors of yellow, blue, and white in the forest openings and along the roadsides. Likely finds are members of the sunflower family (Compositae), such as hairy sunflower (*Helianthus hirsutus*), aster (*Aster ericoides* and *A. sagittifolius*), ironweed (*Vernonia baldwinii*), gayfeather (*Liatris squarrosa*), broomweed (*Gutierrezia dracunculoides*), plains coreopsis (*Coreopsis tinctoria*), goldenrod (*Solidago*), and fragrant cudweed (*Gnaphalium obtusifolium*).

It is true, too, that certain trees and shrubs will be more conspicuous than others at certain times of the year. For example, flowering dogwood (*Cornus florida*) with its beautiful flower-like bracts and redbud (*Cercis canadensis*), our state tree, with its abundant pinkish-red flowers can be viewed easily in the early spring through what remains a predominantly dormant forest. In many parts of the park, French mulberry (*Callicarpa americana*) adds a splash of fall color with its wand-like stems covered in clusters of purple berries. This is one of Oklahoma's truly lovely shrubs.

Slopes, particularly north-facing ones, and protected ravines are more moist areas and better support the growth of plants requiring more moisture. The trees you may find in this area include chinquapin oak (*Q. muhlenbergii*), redbud (*Cercis*), flowering dogwood (*C. florida*), spotted oak (*Q. shumardii*), red maple (*Acer rubrum*), and winged elm (*Ulmus alata*). Occasional are hackberry (*Celtis*), willow oak (*Q. phellos*), black cherry (*Prunus serotina*), and chittamwood (*Bumelia lanuginosa*).

Likely shrubs to be found in these more moist areas are witch hazel (*Hamamelis vernalis*), black-

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berry (*Rubus*), prairie rose (*Rosa setigera*), dense St. Johns wort (*Hypericum densiflorum*), falseindigo (*Amorpha fruticosa*), and buttonbush (*Cephalanthus occidentalis*).

Along Fourche Maline Creek, black willow (*Salix nigra*), river birch (*Betula nigra*), American elm (*U. americana*), sycamore (*Platanus occidentalis*), and various oaks are characteristic. Mixed with the trees and shrubs in the summer are such herbs as brown-eyed Susan (*Rudbeckia triloba*) and mistflower (*Eupatorium coelestinum*).

At certain times of the year, Lake Carlton itself may support an abundance of aquatic plants, such as pondweed (*Potamogeton*), bulrush (*Scirpus*), Brazilian parrotfeather (*Myriophyllum brasiliense*), water-willow (*Justicia americana*), and water hyssop (*Bacopa rotundifolium*). Frequent on the lake borders are cat-tail (*Typha domingensis*), water hemlock (*Cicuta maculata*), small-spike falsenettle (*Boehmeria cylindrica*), and rush (*Juncus*).

Roadsides and prairie openings support the growth of many grasses along with tree huckleberry (*Vaccinium arboreum*); smooth, winged, and fragrant sumac (*Rhus glabra*, *R. copallina*, and *R. aromatica*); aster (*Aster*); goldenrod (*Solidago*); and bush-clover (*Lespedeza*). In the fall such grasses as silver bluestem (*Andropogon saccharoides*), big bluestem (*A. gerardii*), little bluestem (*A. scoparius*), long-spike tridens (*Tridens strictus*), Indian grass (*Sorghastrum nutans*), and Johnson grass (*Sorghum halapense*) can be expected in one or both of these areas. At the forest edge, coralberry (*Symphoricarpos orbiculatus*) occurs often.

Key to the Woody Plants

The following key to the woody plants of the park and adjacent areas is based almost entirely on leaf and twig characters. Hence, reasonably mature leaves should be used.

Meanings of terms, such as "opposite," "alternate," "simple," and "compound," can be ascertained from the illustrations in figures 19 and 20. A ruler is provided at the edge of the inside back cover for measurements needed in the key.

In using the key, you will find that there are always two choices. These are indicated both by indentation and by paired symbols (A and AA, B and BB, etc.). Generally, it is better to read both choices, then choose the better one. As an example, suppose we had a Spotted Oak (fig. 21) which we wish to identify. The leaves are not needle- or scale-like (as described at *A*), so we choose *AA*. The leaves are arranged alternately on the stem (one at a node), so we would choose *C* not *CC*, where the leaves are to be opposite (two at a node). The leaves are simple, so choose *D* rather than *DD*. But the leaves are not entire; instead they are lobed, so we pass *E* and go to *EE*, where it states that the leaves are toothed or lobed. The plant is not a vine but a tree, so choose *SS*. The leaves are lobed halfway or more to the middle, so we choose *V*. Soon you are at Spotted Oak. Good luck! Have fun!

A. Trees evergreen and with leaves either scale-like and small or needle-like.
  B. Leaves scale-like, most of them hardly an eighth of an inch long; fruits berry-like ..... Eastern red cedar (*Juniperus virginiana*)
  BB. Leaves needle-like, 2 inches or more long. ..... Short leaf pine (*Pinus echinata*; fig. 22)

AA. Trees, shrubs or vines, but not with leaves as above.
  C. Leaves alternate.
    D. Leaves simple.
      E. Leaves entire.
        F. Leaves about as long as wide, or at least less than twice as long as wide.
          G. Vines.
            H. Stems prickly. ..... Greenbrier (*Smilax*)
            HH. Stems not prickly. ..... Red berry moonseed (*Cocculus carolinus*)
          GG. Trees or shrubs.
            I. Veins 5 or more from the base of the heart-shaped leaf. ..... Redbud (*Cercis canadensis*; fig. 24)
            II. Veins 3 from the lop-sided leaf base. ..... Georgia hackberry (*Celtis tenuifolia*; fig. 25)
        FF. Leaves 2 or more times longer than wide.
          J. Woody vines. ..... Bama supplejack (*Berchemia scandens*)
          JJ. Trees or shrubs.
            K. Trees.
              L. Leaves tipped with a bristle an eighth of an inch or more long and the leaf stalk less than 0.5 inch long ..... Willow oak (*Quercus phellos*)
              LL. Leaves without bristle tips, or if bristle tipped, the leaf stalk an inch or more long.
                M. Leaves with 3 major veins (best seen from beneath) arising from the base of the lop-sided leaf. ..... Sugar hackberry (*Celtis laevigata*)
                MM. Leaves with several veins arising along the length of the midrib.
                  N. Larger leaf blades over 8 inches long ... Pawpaw (*Asimina triloba*)
                  NN. Leaf blades not over 4 inches long.
                    O. End of leaves rounded .. Chittamwood (*Bumelia lanuginosa*)
                    OO. End of leaves with a distinct point or tip.
                      P. Leaves glossy, the twigs often with thorns about 0.5 inch long ..... Osage orange (*Maclura pomifera*)
                      PP. Leaves not glossy and twigs without thorns ..... Persimmon (*Diospyros virginiana*)
                      &
                      Black tupelo (*Nyssa sylvatica*)
                      (These two are most easily separated by the fruits, those of persimmon being a nearly spherical berry often over an inch in diameter, and those of black tupelo being elongate fleshy fruits 0.5 inch long).
            KK. Shrubs.
              Q. Leaves glossy, thick and leathery; tall shrubs ..... Tree huckleberry (*Vaccinium arboreum*; fig 23)
              QQ. Leaves not glossy or thick; plants usually not over 4 feet tall.
                R. Leaves very often rounded at the base ..... Deerberry (*Vaccinium stamineum*)
                RR. Leaves tapering to the base; plants commonly not over 2 feet tall. ..... Blueridge blueberry (*Vaccinium vacillans*)
      EE. Leaves toothed or lobed (sometimes the lobes or teeth only near the end of the leaf).
        S. Vines.

T. Stems prickly ..... Greenbrier (*Smilax*)
TT. Stems not prickly.
U. Flower and fruit clusters longer than wide ..... Grape (*Vitis*)
UU. Flower and fruit clusters wider than long .... Heart leaf ampelopsis (*Ampelopsis cordata*)
SS. Trees or shrubs.
V. Leaves lobed half way or more to the middle.
W. Lobes ending in a slender bristle.
X. Under surface of leaves hairless..... Spotted oak (*Quercus shumardii*; fig. 21)
XX. Under surface of leaves short-hairy ..... Black oak (*Quercus velutina*)
WW. Lobes not ending in a bristle.
Y. Leaves with teeth as well as lobes; occasional leaves of .... Red Mulberry (*Morus rubra*; fig. 23)
YY. Leaves lobed but without teeth ..... Post oak (*Quercus stellata*; fig. 22)
VV. Leaves toothed or wavy margined but not deeply lobed.
Z. Leaves large (commonly 5 inches or more wide), about as broad as long, angularly lobed..... American sycamore (*Platanus occidentalis*; fig. 23)
ZZ. Leaves more nearly triangular, oval, or narrow or obviously broadest above the middle.
a. Leaves broadest above the middle.
b. Leaves mostly 3 to 4 inches long.
c. Widest portion of the leaves about 1.5 inches ..... Water oak (*Quercus nigra*; fig. 21)
cc. Widest portion of the leaves 2.5 inches or more ..... Blackjack oak (*Quercus marilandica*; fig. 21)
bb. Leaves mostly 2.5 inches or less long.
d. Leaves broadest well above the middle; twigs sometimes thorny; petals 5, in loose clusters at the end of branchlets; fruits with remaining flower parts at the top as in an apple .... Little hip hawthorne (*Crataegus spathulata*)
dd. Leaves broadest only slightly above the middle; twigs never thorny; petals 4, flowers mostly single or few in a cluster on short stalks along the stem; fruits with remaining flower parts, if any, at the stem end more nearly like a cherry ..... Possumhaw (*Ilex decidua*)
aa. Leaves broadest near the middle or below.
e. Leaves broadest near their lop-sided base; 3 major veins arising from the leaf base; leaves 2 to 4 or more inches long, alternating on but two sides of the twigs..... Hackberry (*Celtis occidentalis*)
ee. Leaves differing in one or more ways from the above.
f. Leaf stalks commonly 2 inches or more long, as long or longer than the triangular leaf ..... Eastern cottonwood (*Populus deltoides*; fig 25)
ff. Leaf stalks less than 2 inches long, never so long as the leaf.
g. Base of leaf on each side of midrib straight and parallel with the straight lateral veins ..... River birch (*Betula nigra*; fig. 22)
gg. Base of leaf rounded, tapering, or heartshaped, hence if lateral veins straight, then not parallel to the leaf base.
h. Leaves more than 3 inches long.
i. Leaves 0.5 inch or less wide ..... Black willow (*Salix nigra*; fig. 22)
ii. Leaves an inch or more wide.
j. Teeth over 20 on each edge of the leaf.
k. Veins on each side of the midrib fewer than 10..... Red mulberry (*Morus rubra*; fig. 23)
kk. Veins on each side of the midrib more than 10..... American elm (*Ulmus americana*; fig 24)
jj. Teeth fewer than 15 on each edge of the leaf; leaves sometimes appearing as wavy margined.
l. Veins about 10 on each side of the midrib ..... Chinquapin oak (*Quercus muhlenbergii*; fig. 21)
ll. Veins about 6 on each side of the midrib; leaves often but wavy margined ..... Ozark witch-hazel (*Hamamelis vernalis*; fig. 24)
hh. Leaves 3 inches or less long.
m. Leaves about as broad as long, broadly triangular to nearly round in outline, sharply toothed; twigs usually thorny ... Downy hawthorne (*Crataegus mollis*)

mm. Leaves at least twice as long as wide: twigs not thorny.
n. Shrubs not over 4 feet tall.
o. Leaves with 3 evident veins from the base.
p. Leaves at least 2 inches long ..... Jerseytea (*Ceanothus americanus*)
pp. Leaves less than 2 inches long ..... Inland ceanothus (*Ceanothus herbaceus*)
oo. Leaves with veins arising along the midrib; teeth on edges of the leaf very small ..... Blueridge blueberry (*Vaccinium vacillans*)
nn. Trees, or if shrubs, over 6 feet tall.
q. Leaf stalks less than 0.25 inch long; trees.
r. Leaves about 2 inches long; twigs usually winged ..... Winged elm (*Ulmus alata*; fig. 25)
rr. Leaves nearer 4 inches long; twigs not winged .....American elm (*Ulmus americana*; fig. 24)
qq. Leaf stalks at least 0.25 inch long, usually longer.
s. Leaves, at least mostly, less than an inch wide.
t. Leaves slender, 3 times or more as long as wide; often tree-sized shrubs with several trunks from the base ..... Black willow (*Salix nigra*; fig. 22)
tt. Leaves usually no more than twice as long as wide, widest at the middle or above ..... Possumhaw (*Ilex decidua*)
ss. Leaves, at least mostly, an inch or more wide.
u. Leaf bases rounded or tapering, leaf stalks rarely as much as 0.75 inch long, mostly with one or two glands near attachment to the leaf blade; remnants of the flower at the stem end of the fruit; flowers appearing with the leaves..... Black cherry (*Prunus serotina*)
uu. Leaf bases frequently heart-shaped, leaf stalks often 0.75 to 1 inch long and lacking glands; remnants of the flower at the top of the fruit as in an apple; flowers with their long, narrow (0.5 to 0.75 inch long) petals appearing before the leaves ..... Serviceberry (*Amelanchier arborea*)

DD. Leaves compound.
v. Leaflets 3 to 5, all, except sometimes the middle one, arising from one point.
w. Leaflets 5; a climbing, non-spiny vine ..... Virginia creeper (*Parthenocissus quinquefolia*)
ww. Leaflets 3, or if sometimes 5, the stems prickly; shrubs or vines.
x. Stems lacking spines or prickles.
y. Leaflets 2 to 3 inches long, margins toothed .... Fragrant sumac (*Rhus aromatica*; fig. 28)
yy. Leaflets to 4 inches long, margins nearly smooth to irregularly toothed..... Poison ivy (*Rhus radicans*; fig. 28)

xx. Stems spiny or prickly; shrubs.
z. Leaf stalks prickly. . . . . Blackberry & Dewberry (*Rubus*; fig. 26)
zz. Leaf stalks lacking prickles; leaflets mostly 3 . . . . . Prairie rose (*Rosa setigera*; fig. 27)

vv. Leaflets often more than 5, and not arising from one point.
1. Shrubs, usually not over 8 feet tall.
2. Midrib of the leaf winged. . . . . Winged sumac (*Rhus copallina*; fig. 28)
2′. Midrib of leaf wingless.
3. Leaflets toothed.
4. Stems prickly . . . . . Leafy rose (*Rosa foliolosa*)
4′. Stems not prickly. . . . . Smooth sumac (*Rhus glabra*; fig. 26)
3′. Leaflets entire or nearly so . . . . . Falseindigo (*Amorpha fruticosa*)
1′. Trees.
5. Leaflets 2 inches long or less, entire or minutely wavy margined.
6. Most of the leaflets more than 0.5 inch wide . . . . . Black locust (*Robinia pseudoacacia*)
6′. Most of the leaflets less than 0.5 inch wide. . . . . Honey locust (*Gleditsia triacanthos*)
5′. Leaflets over 2 inches long, toothed.
7. Leaflets 9 or fewer . . . . . Hickory (*Carya*; fig. 27)
7′. Leaflets 11 or more . . . . . Black walnut (*Juglans nigra*)

CC. Leaves opposite, (sometimes 3 to 4 at a node).
8. Leaves simple.
9. Leaves entire.
10. Vines.
11. Leaves whitish beneath . . . . . Yellow honeysuckle (*Lonicera flava*)
11′. Leaves green beneath. . . . . American starjasmine (*Trachelospermum difforme*)
10′. Upright trees or shrubs.
12. Leaves often 3 to 4 at a node; flowers and fruits in spherical clusters . . . . . Buttonbush (*Cephalanthus occidentalis*; fig. 29)
12′. Leaves 2 per node.
13. Shrubs usually less than 4 feet tall, or, if sometimes a little taller, the leaves no more than 2 inches long.
14. Leaves twice or less as long as wide . . . . . Coralberry (*Symphoricarpos orbiculatus*; fig. 29)
14′. Leaves more than twice as long as wide . . . . . Dense St. Johns wort (*Hypericum densiflorum*)
13′. Shrubs or small trees more than 4 feet tall.
15. Flowers and fruits in dense clusters; petal-like bracts which appear in the spring large and white or sometimes pink. . . . . Flowering dogwood (*Cornus florida*; fig. 29)
15′. Flowers and fruits in loose clusters often 2 or 3 inches wide and often as long.
16. Leaves 1.5 inches or more wide, lower surface only slightly paler green than the upper . . . . . Rough leaf dogwood (*Cornus drummondii*)
16′. Leaves frequently less than 1.5 inches wide, lower surface much paler green than the upper, appearing whitish . . . . . Silky dogwood (*Cornus obliqua*)

9′. Leaves toothed or lobed.
17. Leaves lobed and up to 2 inches long; plant a low shrub; young shoots of . . . . . Coralberry (*Symphoricarpos orbiculatus*; fig. 29)
17′. Leaves toothed and more than 2 inches long.
18. Leaves less than twice as long as wide . . . . . Red maple (*Acer rubrum*; fig. 29)
18′. Leaves more than twice as long as wide.
19. Leaves usually 4 to 6 inches long; flowers and fruits in clusters at the base of the leaves . . . . . French mulberry (*Callicarpa americana*; fig. 29)
19′. Leaves less than 4 inches long; flowers and fruits not arranged as in the preceding.
20. Leaves glossy, the leaf stalks very usually covered with rusty red hairs; flowers and fruits borne at the ends of the twigs . . . . . Southern blackhaw (*Viburnum rufidulum*)
20′. Leaves not glossy; flowers and fruits borne at the leaf bases on stalks an inch or more long . . . . . Eastern wahoo (*Euonymus atropurpureus*)

8′. Leaves compound.
21. Vines.
22. Leaflets toothed; stems woody; flowers red . . . . . Common trumpetvine (*Campsis radicans*)
22′. Leaflets entire or sometimes lobed; stems hardly woody; flowers bluish . . . . . Leatherflower (*Clematis pitcheri*)
21′. Upright trees or shrubs.
23. Leaflets 3, only occasionally 5 . . . . . Boxelder (*Acer negundo*)
23′. Leaflets 5 to 11.
24. Leaflets entire or with minute teeth; trees . . . . . Ash (*Fraxinus*)
24′. Leaflets sharply toothed; shrubs . . . . . American elder (*Sambucus canadensis*)

Leaf Organization

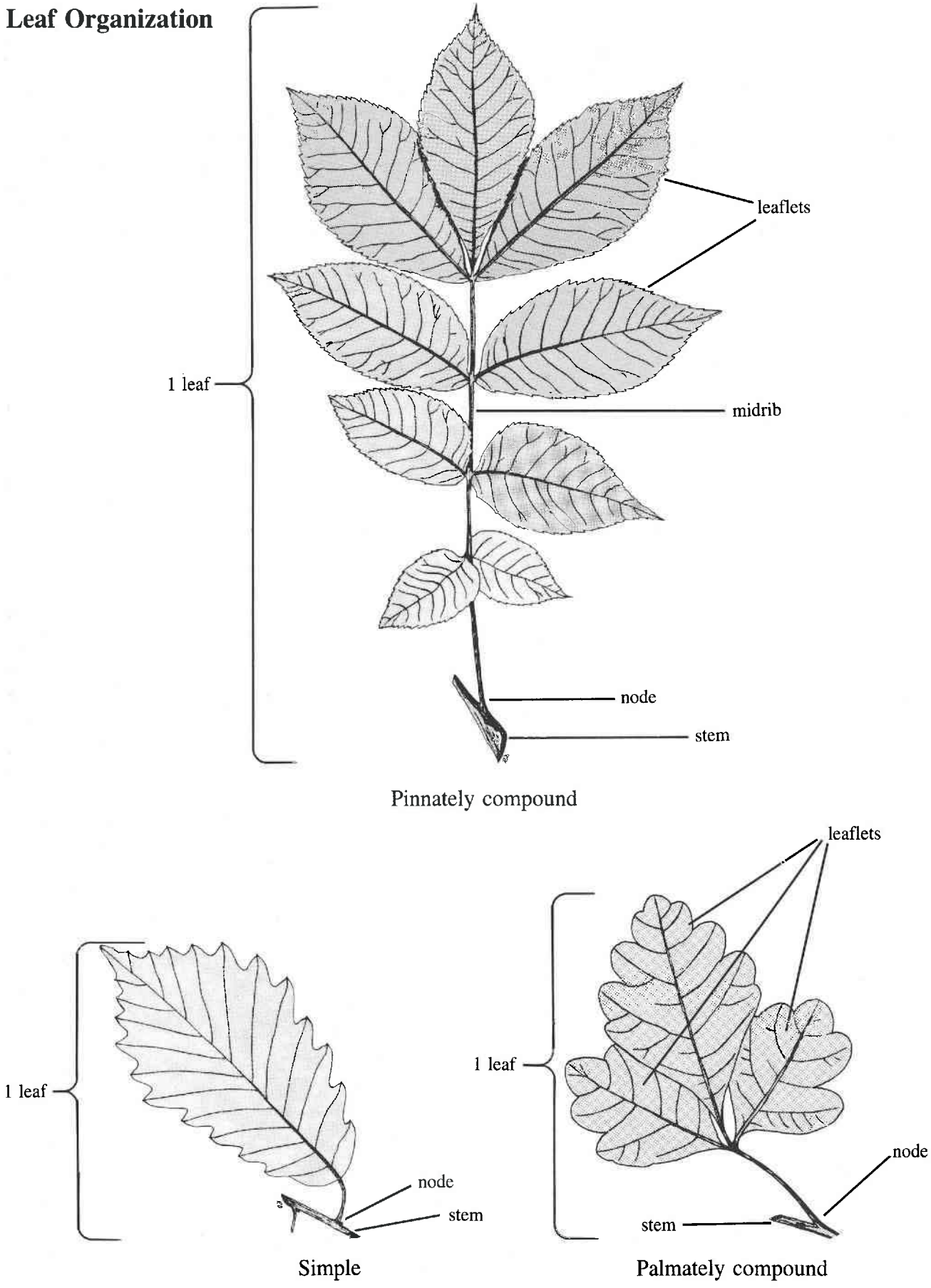
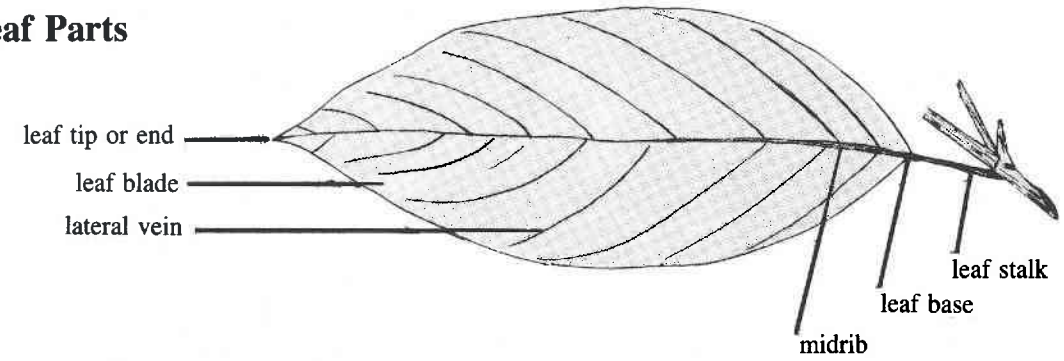
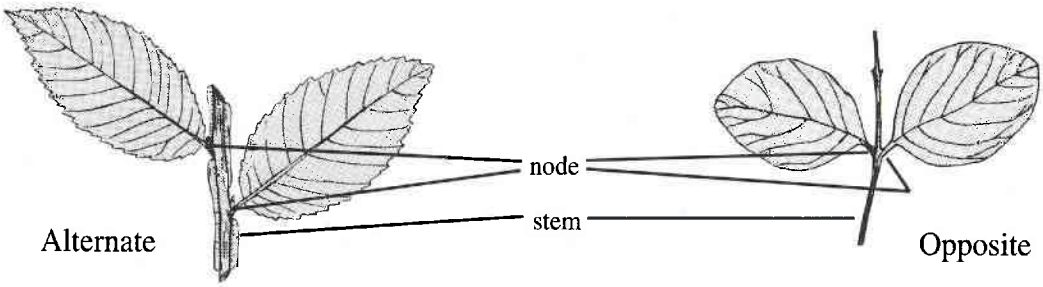


Figure 19. Illustrations showing leaf organization.

Leaf Parts



Leaf Position



Leaf Margins

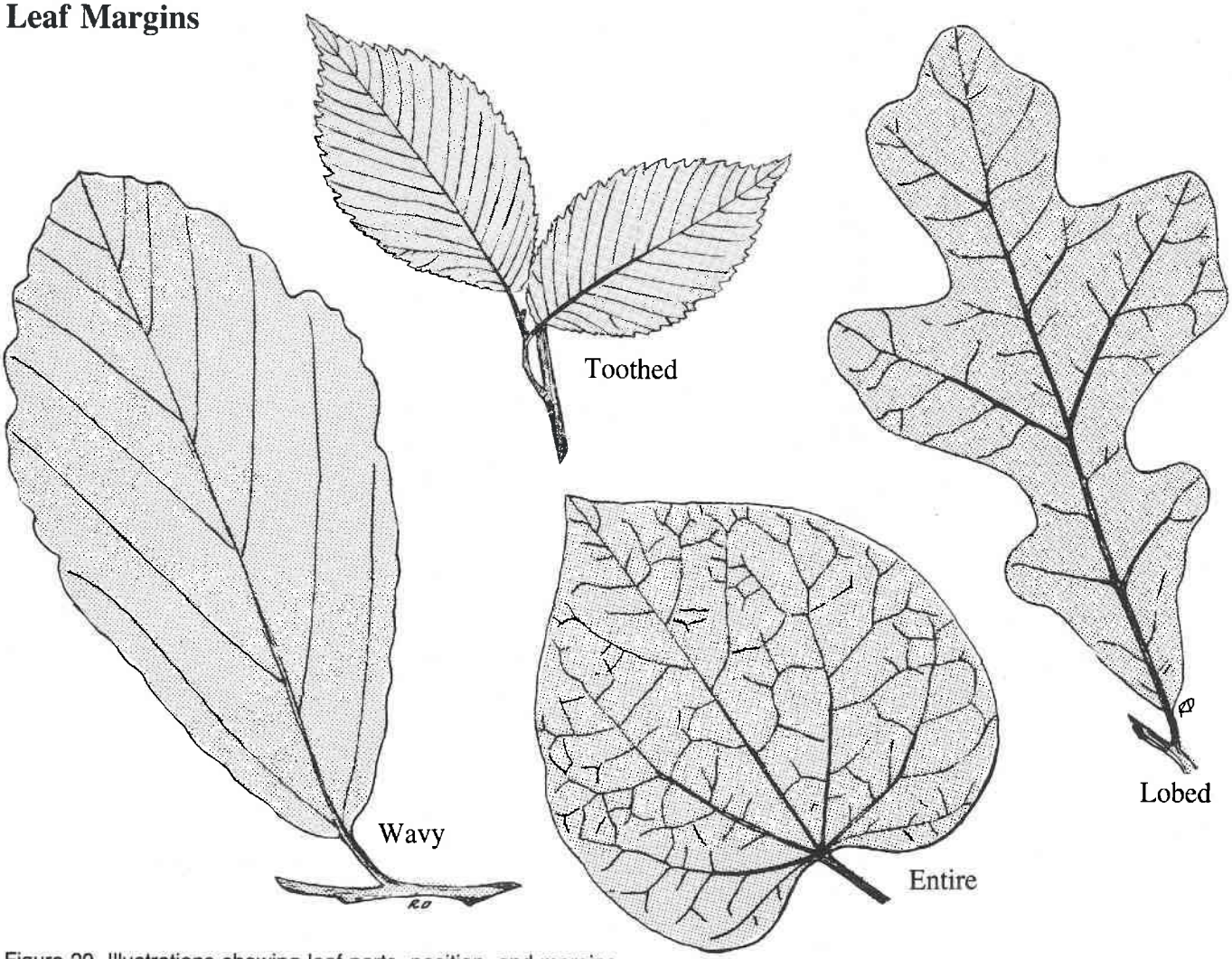
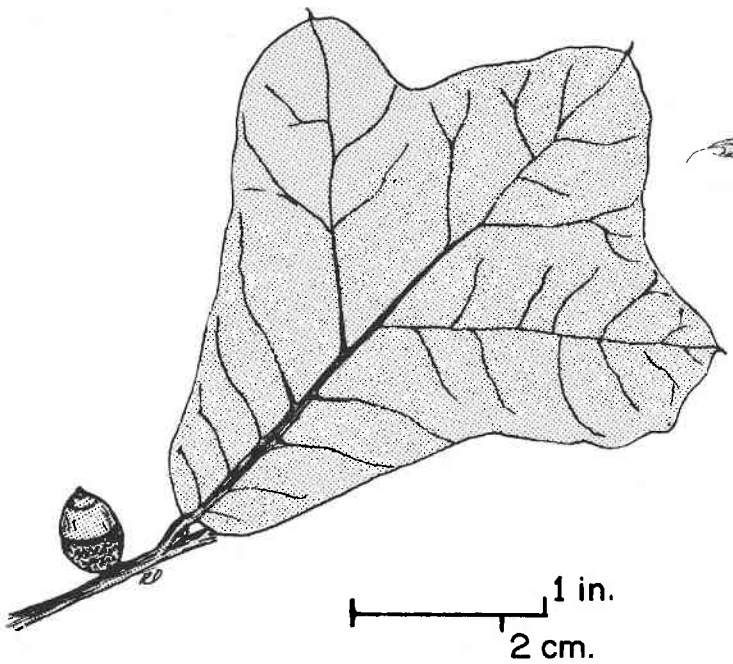
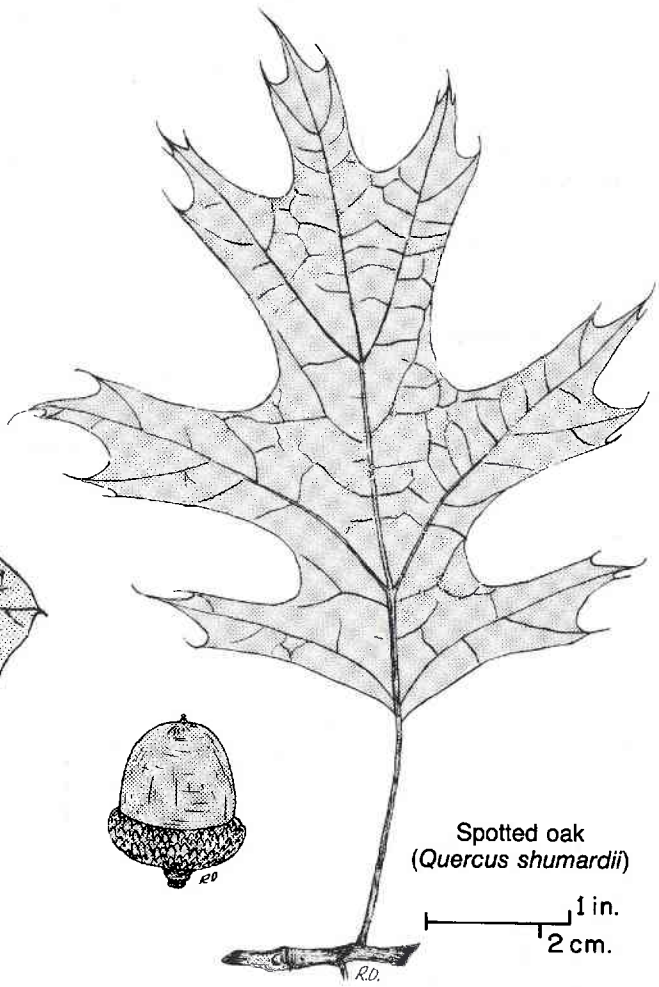
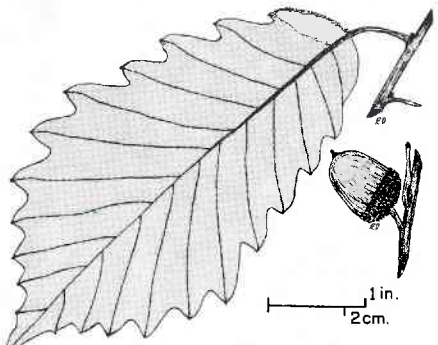


Figure 20. Illustrations showing leaf parts, position, and margins.

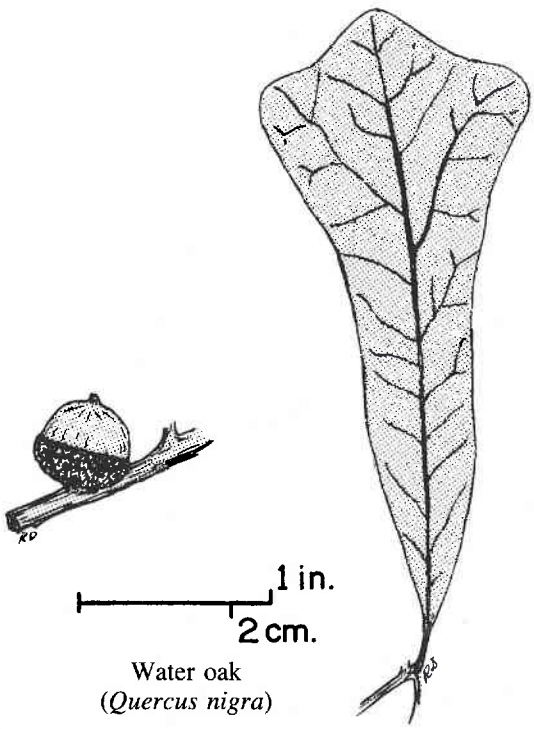


Blackjack oak
(*Quercus marilandica*)





Chinquapin oak
(*Quercus muhlenbergii*)



Water oak
(*Quercus nigra*)

Figure 21. Illustrations showing simple, alternate leaved species.

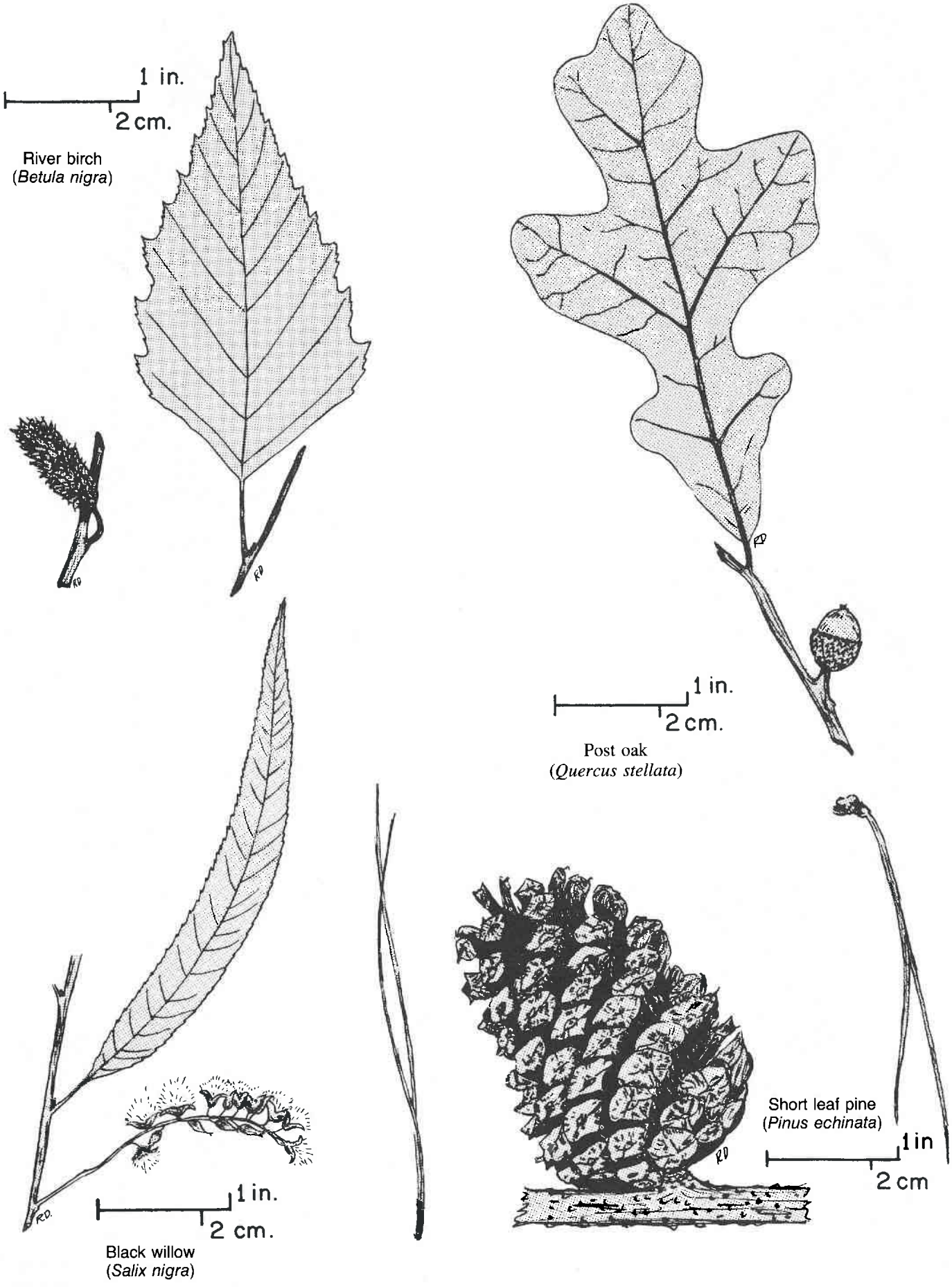


Figure 22. Illustrations showing simple, alternate leaved species.

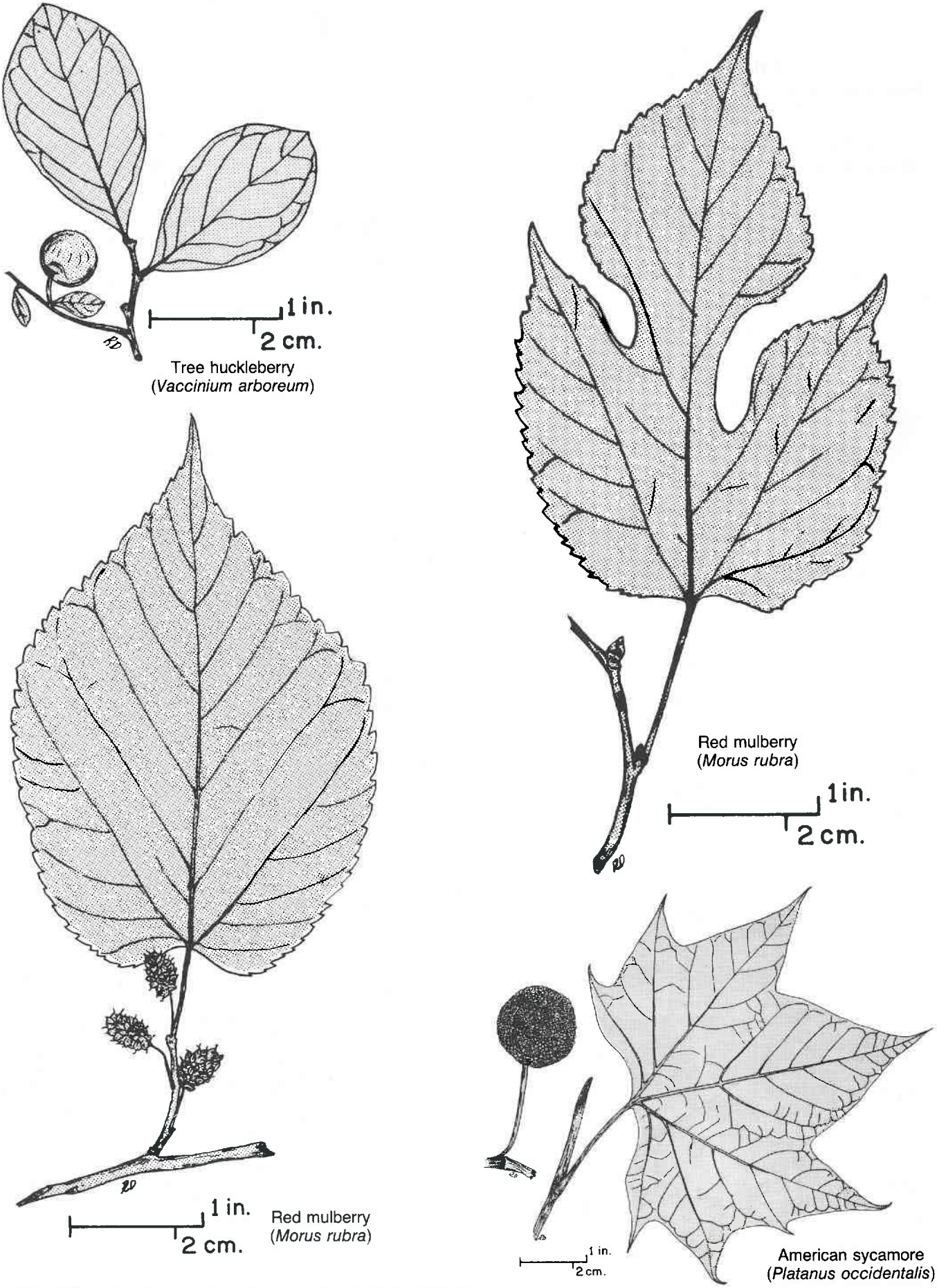


Figure 23. Illustrations showing simple, alternate leaved species.

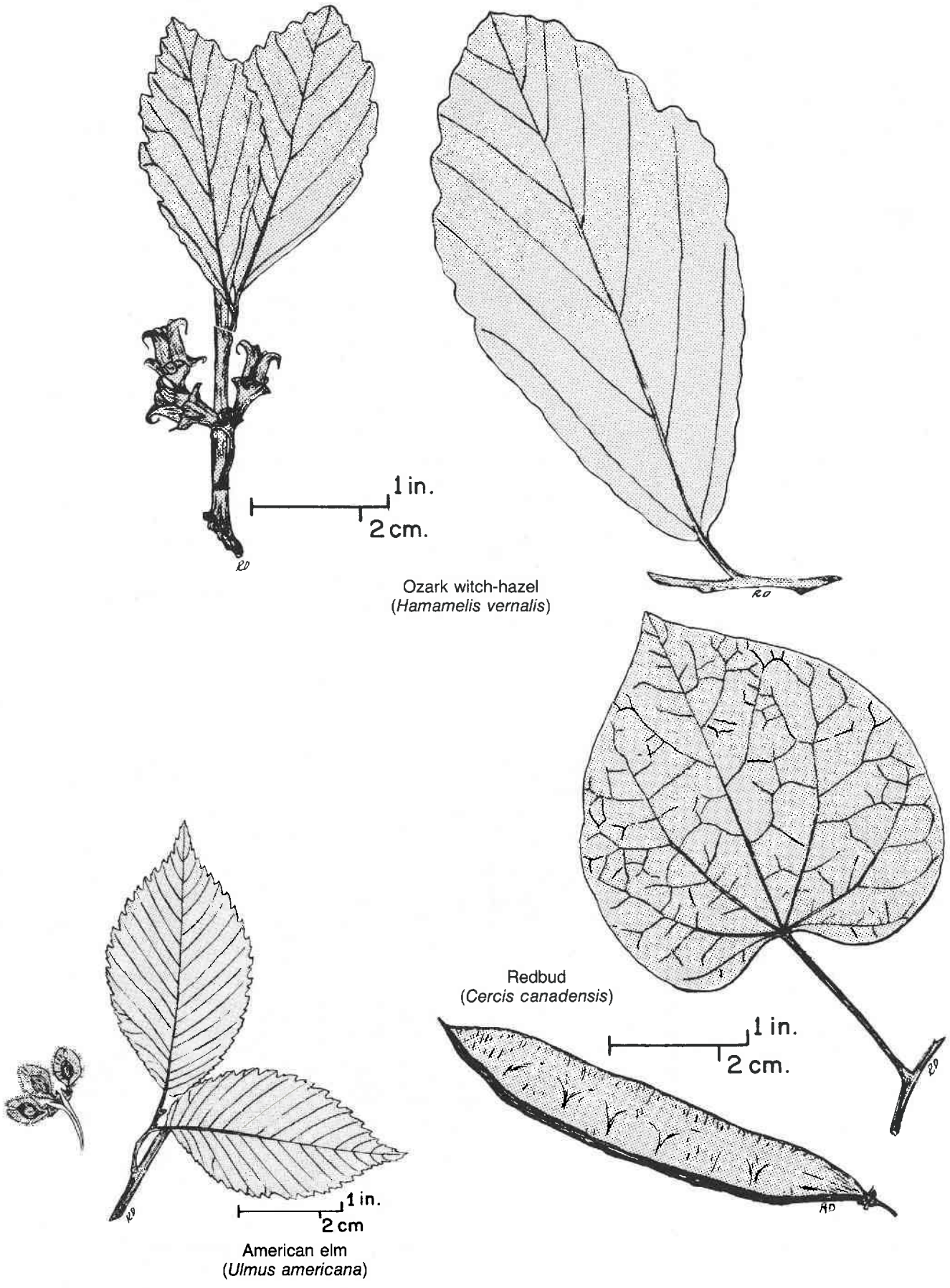


Figure 24. Illustrations showing simple, alternate leaved species.

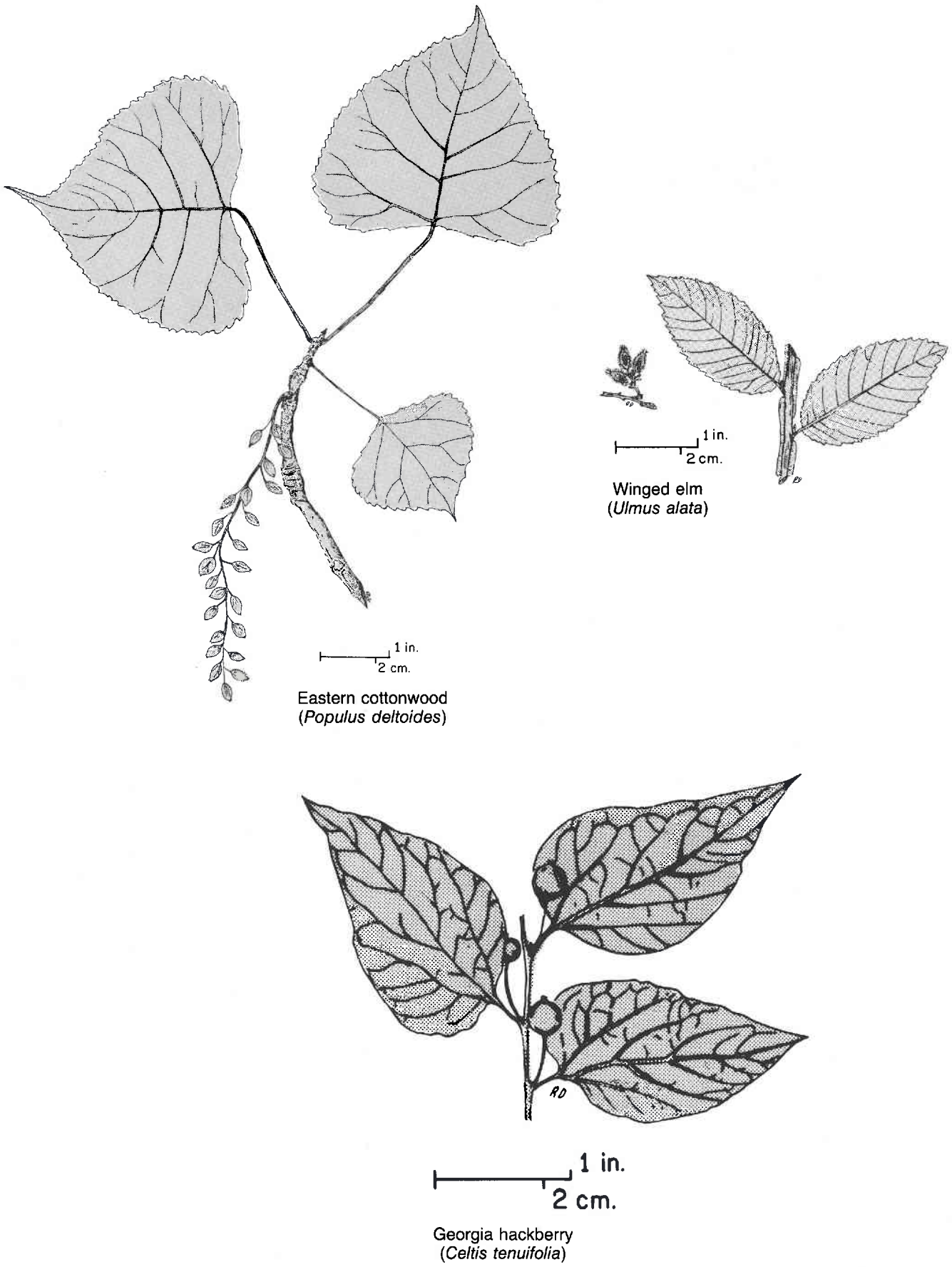


Figure 25. Illustrations showing simple, alternate leaved species.

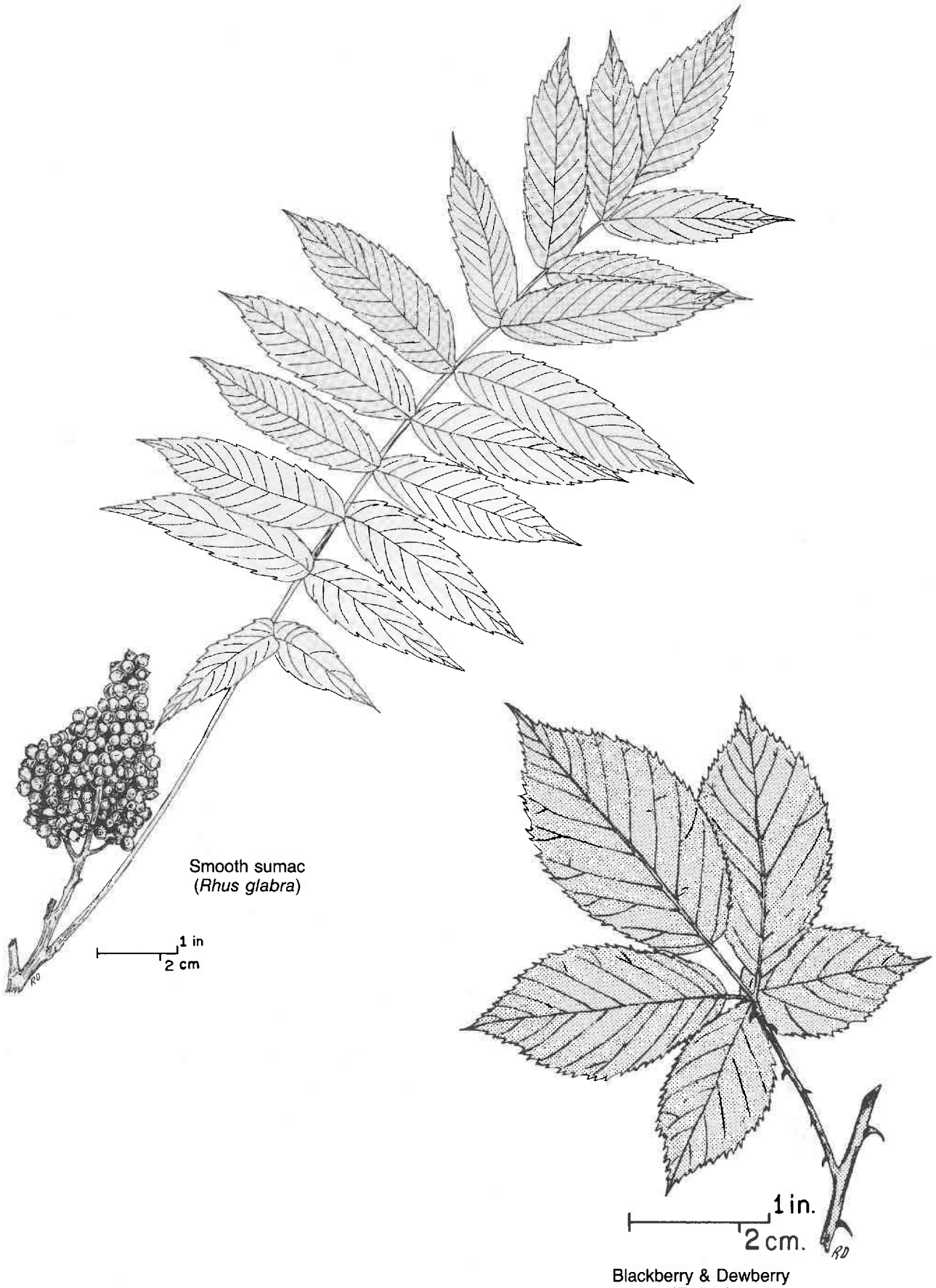


Figure 26. Illustrations showing compound, alternate leaved species.

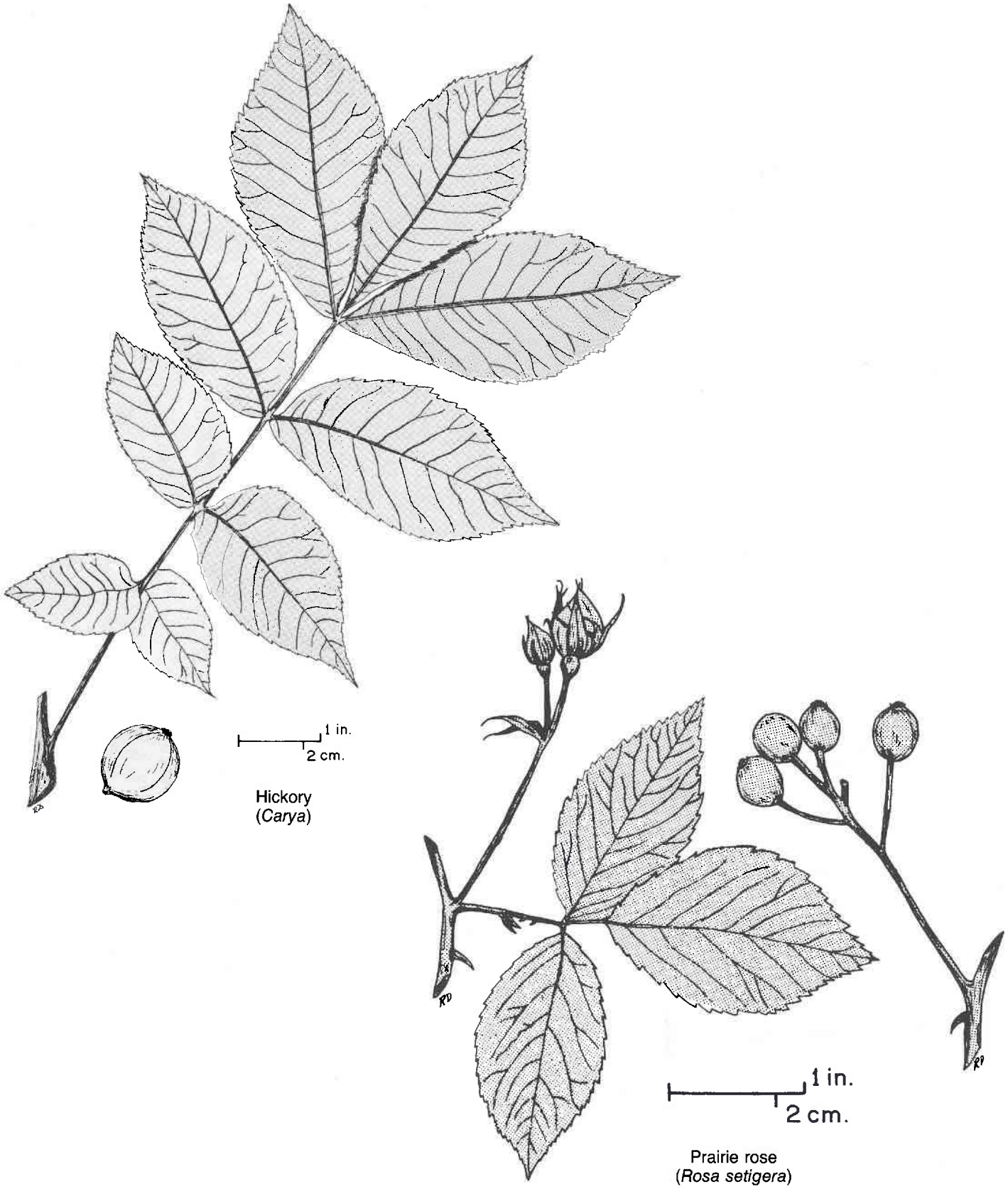


Figure 27. Illustrations showing compound, alternate leaved species.

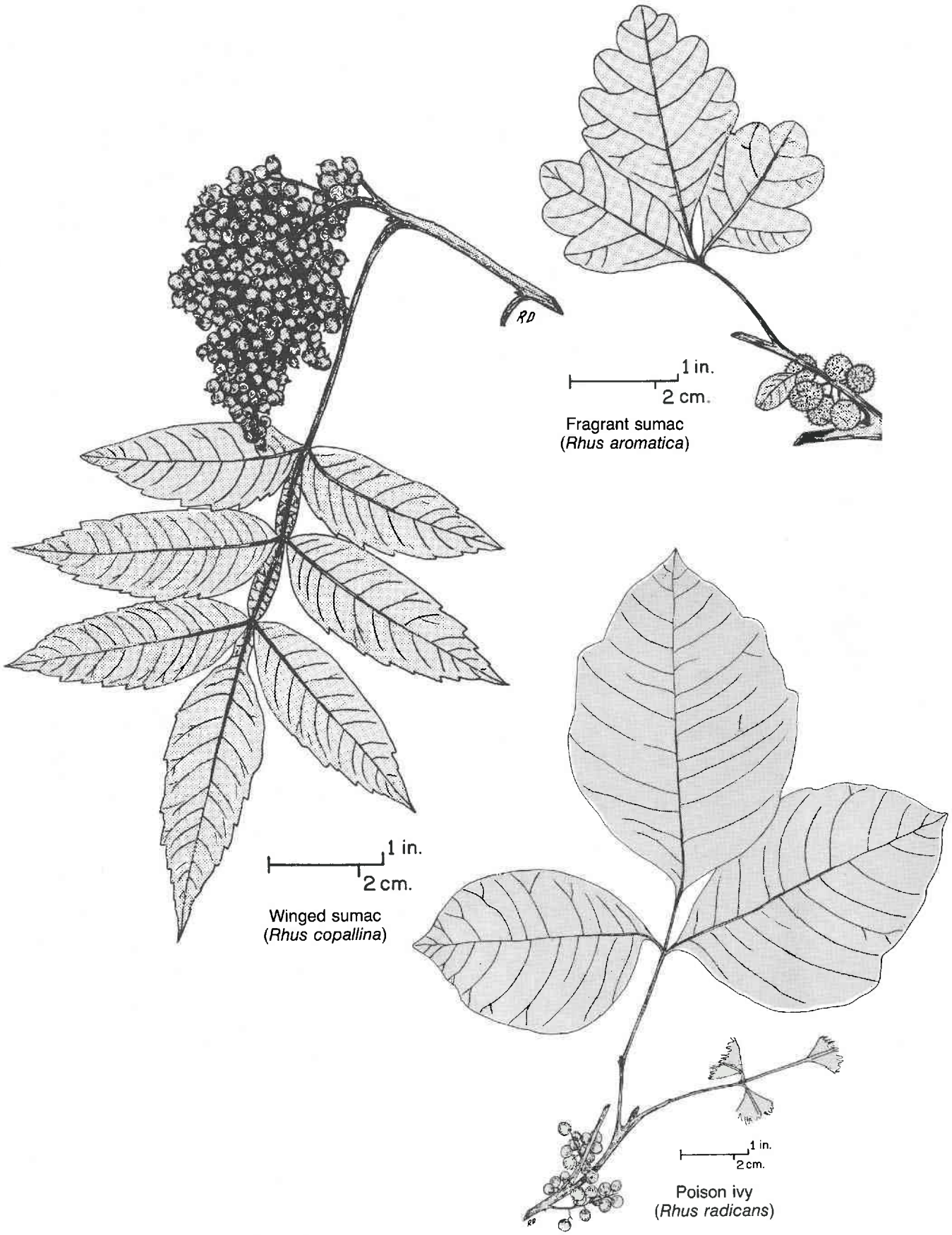


Figure 28. Illustrations showing compound, alternate leaved species.

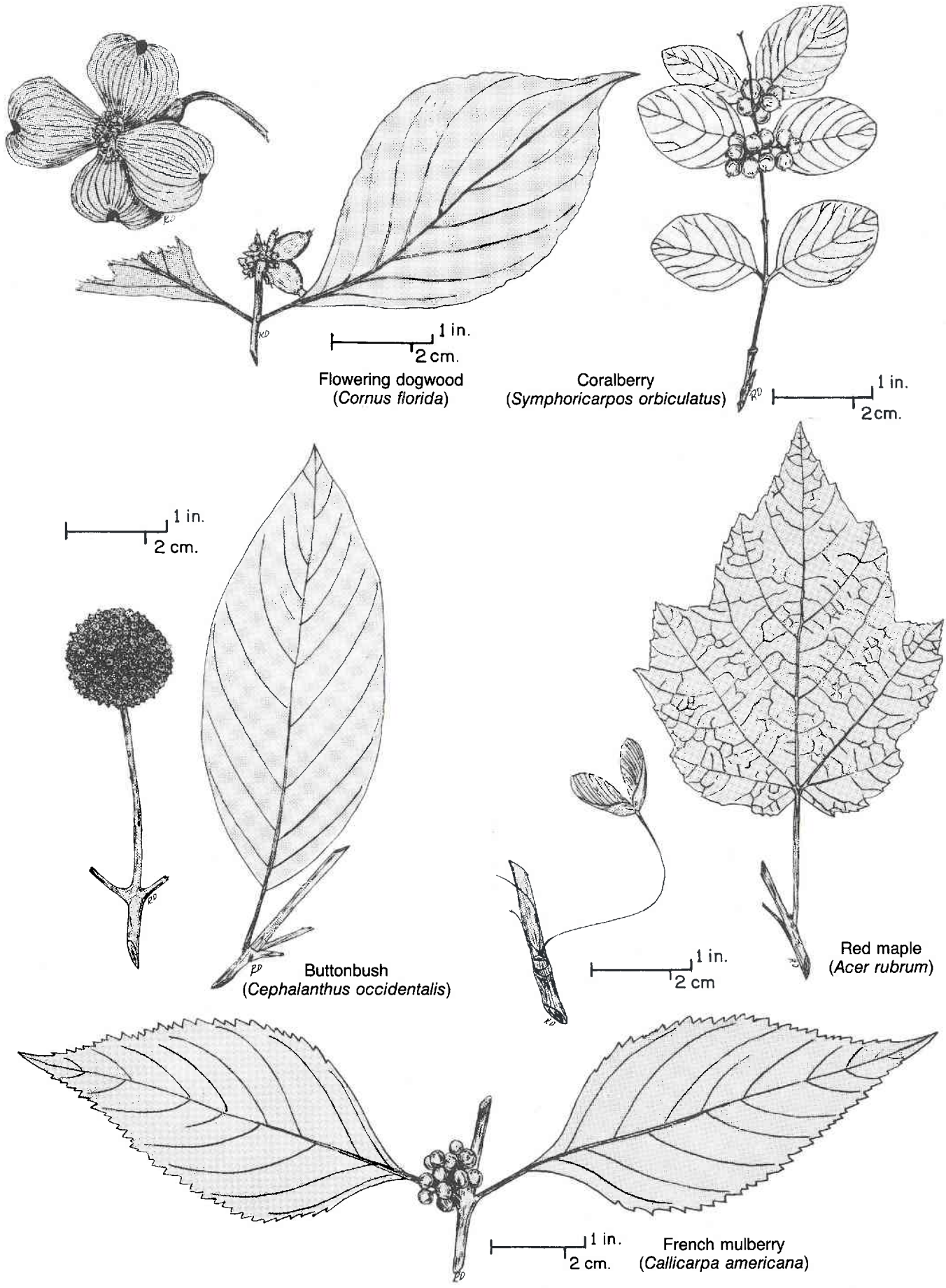


Figure 29. Illustrations showing simple, opposite leaved species

List of the Plants

The following is a list of plants from Robbers Cave State Park and the area surrounding it. Nearly all the plants on this list are to be expected within the park; however, only those marked with an asterisk have been recorded within its boundaries.

The names occurring on the left side of each column are the scientific names. The names to the right are the common names.

POLYPODIACEAE	FERN FAMILY
**Asplenium pinnatifidum*	Pinnatifid spleenwort
**Asplenium platyneuron*	Brown stem spleenwort
Cheilanthes lanosa	Hairy lipfern
**Cheilanthes tomentosa*	Woolly lipfern
Pellaea atropurpurea	Purple cliffbrake
**Polypodium polypodioides*	Resurrection fern
**Pteridium aquilinum*	Western bracken
Woodsia obtusa	Blunt lobe cliff fern
PINACEAE	PINE FAMILY
**Juniperus virginiana*	Eastern redcedar
**Pinus echinata*	Short leaf pine
TYPHACEAE	CAT-TAIL FAMILY
**Typha domingensis*	Narrow leaf cat-tail
POTAMOGETONACEAE	PONDWEED FAMILY
**Potamogeton*	Pondweed
ALISMACEAE	WATER-PLANTAIN FAMILY
Alisma subcordatum	Small flower water-plantain
Sagittaria ambigua	Arrowhead
GRAMINEAE	GRASS FAMILY
**Agrostis elliottiana*	Annual ticklegrass
**Andropogon gerardii*	Big bluestem
**Andropogon saccharoides*	Silver bluestem
**Andropogon scoparius*	Little bluestem
**Andropogon virginicus*	Yellow sedge bluestem
**Aristida oligantha*	Prairie threeawn
Arundinaria gigantea	Giant cane
**Bromus japonicus*	Japanese brome
**Bromus mollis*	Soft brome
**Cynodon dactylon*	Bermuda grass
**Digitaria sanguinalis*	Hairy crabgrass
**Elymus canadensis*	Canada wildrye
Eragrostis capillaris	Lacegrass
**Eragrostis spectabilis*	Purple lovegrass
Manisuris cylindrica	Carolina joint-tail
**Panicum anceps*	Beaked panicum
**Panicum dichotomum*	Forked panicum
Panicum hians	Gaping panicum
**Panicum lanuginosum* var. *fasciculatum*	Woolly panicum
**Panicum malacophyllum*	Soft leaf panicum
**Panicum oligosanthes* var. *scribnerianum*	Scribner panicum
Panicum sphaerocarpon	Round seed panicum
**Paspalum dilatatum*	Dallisgrass
**Paspalum floridanum* var. *floridanum*	Florida paspalum
**Setaria glauca*	Foxtail
**Sorghastrum nutans*	Indian grass
**Sorghum halapense*	Johnson grass
**Sphenopholis obtusata*	Prairie wedgescale
**Sporobolus asper*	Tall dropseed

GRAMINEAE (continued)	GRASS FAMILY (continued)
**Tridens flavus*	Purpletop
**Tridens strictus*	Long spike tridens
**Uniola latifolia*	Broad leaf spanglegrass
CYPERACEAE	SEDGE FAMILY
Carex annectens	Yellow fruit sedge
**Carex austrina*	Southern sedge
**Carex blanda*	Woodland sedge
**Carex bushii*	Bush sedge
Carex crus-corvi	Crowfoot sedge
**Carex emoryi*	Emory sedge
Carex frankii	Franks sedge
**Carex louisianica*	Louisiana sedge
Carex lupulina	Hop sedge
Carex lurida	Lurid sedge
Carex squarrosa	Squarrose sedge
Carex straminea	Straw sedge
Cyperus ovularis	Globe flatsedge
Cyperus strigosus	False nutgrass
Rhynchospora globularis var. *harveyi*	Globe beakrush
**Scirpus*	Bulrush
COMMELINACEAE	SPIDERWORT FAMILY
Commelina virginica	Virginia dayflower
Tradescantia ohiensis	Ohio spiderwort
JUNCACEAE	RUSH FAMILY
**Juncus acuminatus*	Knot leaf rush
Juncus brachycarpus	White root rush
Juncus diffusissimus	Slimpod rush
**Juncus effusus*	Soft rush
**Juncus interior*	Inland rush
**Juncus marginatus*	Grass leaf rush
Juncus validus	Round head rush
**Luzula campestris* var. *bulbosa*	Bulb woodrush
LILIACEAE	LILY FAMILY
**Camassia scilloides*	Eastern camass
**Nothoscordum bivalve*	Crow poison
**Smilax bona-nox*	Saw greenbrier
Smilax glauca	Cat greenbrier
Smilax tamnoides	Bristly greenbrier
**Zygadenus nuttallii*	Poison camass
AMARYLLIDACEAE	AMARYLLIS FAMILY
Agave lata	Agave
**Cooperia drummondii*	Evening star rainlily
**Hypoxis hirsuta*	Yellow-eyed grass
IRIDACEAE	IRIS FAMILY
**Sisyrinchium campestre*	Blue-eyed grass
ORCHIDACEAE	ORCHID FAMILY
**Spiranthes gracilis*	Slender ladiestresses
Spiranthes vernalis	Upland ladiestresses
SALICACEAE	WILLOW FAMILY
**Salix nigra*	Black willow
**Populus deltoides*	Eastern cottonwood
JUGLANDACEAE	WALNUT FAMILY
Carya cordiformis	Bitternut hickory
**Carya texana*	Black hickory
**Carya tomentosa*	Mockernut hickory
Juglans nigra	Black walnut

BETULACEAE	BIRCH FAMILY
**Alnus serrulata*	Alder
**Betula nigra*	River birch
FAGACEAE	BEECH FAMILY
Quercus alba	White oak
**Quercus borealis*	Northern red oak
Quercus falcata	Southern red oak
**Quercus lyrata*	Overcup oak
Quercus macrocarpa	Bur oak
**Quercus margaretta*	Dwarf post oak
**Quercus marilandica*	Blackjack oak
**Quercus muhlenbergii*	Chinquapin oak
**Quercus nigra*	Water oak
**Quercus phellos*	Willow oak
**Quercus shumardii*	Spotted oak
**Quercus stellata*	Post oak
**Quercus velutina*	Black oak
ULMACEAE	ELM FAMILY
Celtis laevigata	Sugar hackberry
Celtis occidentalis	Hackberry
**Celtis tenuifolia*	Georgia hackberry
**Ulmus alata*	Winged elm
**Ulmus americana*	American elm
**Ulmus crassifolia*	Cedar elm
Ulmus rubra	Red elm
MORACEAE	MULBERRY FAMILY
**Maclura pomifera*	Osage orange
**Morus alba*	White mulberry
**Morus rubra*	Red mulberry
URTICACEAE	NETTLE FAMILY
**Boehmeria cylindrica*	Small spike falsenettle
LORANTHACEAE	MISTLETOE FAMILY
**Phoradendron serotinum*	Christmas mistletoe
POLYGONACEAE	BUCKWHEAT FAMLIY
Polygonum bicorne	Smartweed
Polygonum convolvulus	Dull seed cornbind
Polygonum hydropiper	Smartweed
Polygonum opelousanum	Smartweed
**Polygonum pennsylvanicum*	Pennsylvania smartweed
Polygonum persicaria	Spotted smartweed
Polygonum tenue	Pleat leaf knotweed
Polygonum virginianum	Virginia knotweed
Rumex hastatulus	Heartwing sorrell
Rumex verticillatus	Swamp dock
NYCTAGINACEAE	FOUR-O'CLOCK FAMILY
**Mirabilis albida*	White four-o'clock
PHYTOLACCACEAE	POKEWEED FAMILY
**Phytolacca americana*	Pokeweed
AIZOACEAE	CARPETWEED FAMILY
Mollugo verticillata	Green carpetweed
PORTULACACEAE	PURSLANE FAMILY
**Claytonia virginica*	Spring beauty
CARYOPHYLLACEAE	PINK FAMILY
**Arenaria drummondii*	Drummond sandwort
**Arenaria patula* var. *robusta*	Pitcher sandwort
**Cerastium brachypodum*	Short stalk chickweed
**Cerastium vulgatum*	Big cerastium
Holosteum umbellatum	Jagged chickweed

**Silene antirrhina*	Sleepy catchfly
Silene stellata	Starry campion
RANUNCULACEAE	BUTTERCUP FAMILY
Clematis pitcheri	Leatherflower
Delphinium carolinianum	Blue larkspur
Delphinium virescens	Plains larkspur
**Ranunculus fascicularis*	Tufted buttercup
Ranunculus laxicaulis	Water plantain spearwort
**Ranunculus macranthus*	Showy buttercup
BERBERIDACEAE	BARBERRY FAMILY
**Podophyllum peltatum*	May-apple
MENISPERMACEAE	MOONSEED FAMILY
**Cocculus carolinus*	Red berry moonseed
**Menispermum canadense*	Canada moonseed
ANONACEAE	CUSTARD-APPLE FAMILY
Asimina triloba	Pawpaw
LAURACEAE	LAUREL FAMILY
Sassafras albidum var. *molle*	Sassafras
FUMARIACEAE	FUMATORY FAMILY
**Corydalis crystallina*	Mealy corydalis
CRUCIFERAE	MUSTARD FAMILY
**Arabis canadensis*	Sicklepod
**Brassica kaber*	Charlock
**Lepidium virginicum*	Poor man's pepper
**Sisymbrium officinale*	Hedgemustard
SAXIFRAGACEAE	SAXIFRAGE FAMILY
Penthorum sedoides	Virginia penthorum
HAMAMELIDACEAE	WITCH-HAZEL FAMILY
**Hamamelis vernalis*	Ozark witch-hazel
PLATANACEAE	PLANE-TREE FAMILY
**Platanus occidentalis*	American sycamore
ROSACEAE	ROSE FAMILY
**Amelanchier arborea*	Serviceberry
**Crataegus mollis*	Downy hawthorne
Crataegus spathulata	Little hip hawthorne
Fragaria virginiana var. *illinoensis*	Wild strawberry
Geum canadense	White avens
Gillenia stipulata	Indian physic
**Potentilla simplex*	Old field cinquefoil
**Prunus serotina*	Black cherry
Rosa carolina	Carolina rose
Rosa foliolosa	Leafy rose
**Rosa setigera*	Prairie rose
**Rubus ostryifolius*	High brush blackberry
**Rubus trivialis*	Southern dewberry
LEGUMINOSAE	BEAN FAMILY
**Amorpha fruticosa*	Falseindigo
**Apios americana*	American potatobean
Astragalus distortus	Bent pod milkvetch
**Astragalus mexicanus*	Ground plum
Baptisia leucantha	White falseindigo
**Baptisia leucophaea*	Plains wildindigo
**Baptisia sphaerocarpa*	Yellow wildindigo
**Cassia chamaecrista*	Prairie-senna
**Cercis canadensis*	Redbud
**Clitoria mariana*	Atlantic pigeon wings
Crotalaria sagittalis	Arrow crotalaria

Desmodium canescens	Hoary tickclover
**Desmodium ciliare*	Little leaf tickclover
Desmodium dillenii	Panicled tickclover
Desmodium rigidum	Stiff tickclover
Desmodium sessilifolium	Sessile leaf tickclover
**Galactia volubilis*	Downy milkpea
**Gleditsia triacanthos*	Honeylocust
Lathyrus pusillus	Low peavine
**Lespedeza cuneata*	Chinese bushclover
Lespedeza repens	Creeping bushclover
**Lespedeza stipulacea*	Korean bushclover
**Lespedeza stuevei*	Stueves bushclover
Lespedeza virginica	Slender bushclover
**Melilotus alba*	White sweetclover
Neptunia lutea	Yellow neptunia
**Petalostemon candidum*	White prairieclover
Psoralea floribunda	Many flower psoralea
**Psoralea psoralioides* var. *eglandulosa*	Sampson snakeroot
Rhynchosia latifolia	Broad leaf snoutbean
**Robinia pseudoacacia*	Black locust
**Schrankia nuttallii*	Nuttall sensitive-brier
**Strophostyles leiosperma*	Slick seed wildbean
**Strophostyles umbellata*	Perennial wildbean
**Stylosanthes biflora*	Pencil flower
**Tephrosia virginiana*	Devil's shoestring
Trifolium campestre	Low hop clover
**Trifolium carolinianum*	Carolina clover
**Trifolium dubium*	Shamrock
**Trifolium reflexum*	Buffalo clover
OXALIDACEAE	WOODSORREL FAMILY
**Oxalis corniculata*	Creeping oxalis
Oxalis stricta	Yellow oxalis
**Oxalis violacea*	Violet woodsorrel
POLYGALACEAE	MILKWORT FAMILY
**Polygala incarnata*	Pink milkwort
Polygala sanguinea	Blood milkwort
**Polygala verticillata* var. *dolichoptera*	Whorled milkwort
EUPHORBIACEAE	SPURGE FAMILY
**Acalypha gracilens* var. *monococca*	Slender copperleaf
Acalypha rhomboidea	Rhomboid copperleaf
Andrachne phyllanthoides	Missouri maidenbush
**Croton capitatus*	Woolly croton
**Croton monanthogynus*	Single fruit croton
Crotonopsis elliptica	Narrow leaf rushfoil
Euphorbia corollata	Flowering spurge
**Euphorbia dentata*	Toothed spurge
Euphorbia spathulata	Warty euphorbia
**Euphorbia supina*	Spotted euphorbia
**Tragia ramosa*	Noseburner
CALLITRICHACEAE	WATER-STARWORT FAMILY
**Callitriche heterophylla*	Water-starwort
ANACARDIACEAE	CASHEW FAMILY
**Rhus aromatica*	Fragrant sumac
**Rhus copallina*	Winged sumac
**Rhus glabra*	Smooth sumac
**Rhus radicans*	Poison ivy
**Rhus toxicodendron*	Poison oak

AQUIFOLIACEAE	HOLLY FAMILY
**Ilex decidua*	Possumhaw
CELASTRACEAE	STAFF-TREE FAMILY
Euonymus atropurpureus	Eastern wahoo
ACERACEAE	MAPLE FAMILY
Acer negundo	Boxelder
**Acer rubrum*	Red maple
Acer saccharinum	Silver maple
BALSAMINACEAE	TOUCH-ME-NOT FAMILY
Impatiens capensis	Spotted snapweed
RHAMNACEAE	BUCKTHORN FAMILY
Berchemia scandens	Bama supplejack
Ceanothus americanus var. *pitcheri*	Jerseytea
**Ceanothus herbaceus* var. *pubescens*	Inland ceanothus
**Rhamnus caroliniana*	Carolina buckthorn
VITACEAE	GRAPE FAMILY
Ampelopsis cordata	Heart leaf ampelopsis
**Cissus incisa*	Ivy treebine
**Parthenocissus quinquefolia*	Virginia creeper
**Vitis* sp.	Grape
MALVACEAE	MALLOW FAMILY
Callirhoe alcaeoides	Plains poppymallow
Sida spinosa	Prickly mallow
HYPERICACEAE	ST. JOHNS WORT FAMILY
**Ascyrum hypericoides* var. *multicaule*	St. Andrews cross
**Hypericum densiflorum*	Dense St. Johns wort
**Hypericum drummondii*	Drummond St. Johns wort
Hypericum mutilum	Dwarf St. Johns wort
**Hypericum punctatum*	Spotted St. Johns wort
CISTACEAE	ROCKROSE FAMILY
**Lechea tenuifolia*	Narrow leaf pinweed
VIOLACEAE	VIOLET FAMILY
Viola missouriensis	Missouri violet
**Viola pedata*	Birdsfoot violet
**Viola pensylvanica*	Smooth yellow violet
**Viola rafinesquii*	Field pansy
PASSIFLORACEAE	PASSION-FLOWER FAMILY
**Passiflora incarnata*	Maypop passion-flower
Passiflora lutea var. *glabriflora*	Yellow passion-flower
NYSSACEAE	SOUR GUM FAMILY
**Nyssa sylvatica*	Black tupelo
MELASTOMACEAE	MELASTOMA FAMILY
**Rhexia mariana* var. *interior*	Maryland meadow beauty
ONAGRACEAE	EVENING-PRIMROSE FAMILY
**Gaura longiflora*	Tall gaura
**Ludwigia alternifolia* var. *pubescens*	Rattlebox
Oenothera biennis	Evening-primrose
**Oenothera fruticosa* var. *Goodmanii*	Goodman sundrops
**Oenothera laciniata*	Cut leaf evening-primrose
Oenothera speciosa	Showy primrose
HALORAGIDACEAE	WATER-MILFOIL FAMILY
**Myriophyllum brasiliense*	Brazilian parrotfeather

UMBELLIFERAE	PARSLEY FAMILY
**Chaerophyllum procumbens*	Spreading chervil
**Chaerophyllum tainturieri*	Tainturier chervil
**Cicuta maculata*	Water hemlock
Eryngium yuccifolium	Button snakeroot
Polytaenia nuttallii	Prairie parsley
**Spermolepis divaricata*	Rough fruit spermolepis
**Torilis arvensis*	Hedge parsley
CORNACEAE	DOGWOOD FAMILY
**Cornus drummondii*	Rough leaf dogwood
**Cornus florida*	Flowering dogwood
**Cornus obliqua*	Silky dogwood
ERICACEAE	HEATH FAMILY
**Vaccinium arboreum*	Tree huckleberry
**Vaccinium stamineum*	Deerberry
**Vaccinium vacillans*	Blueridge blueberry
PRIMULACEAE	PRIMROSE FAMILY
**Dodecatheon meadia*	Shootingstar
SAPOTACEAE	SAPODILLA FAMILY
**Bumelia lanuginosa*	Chittamwood
EBENACEAE	EBONY FAMILY
**Diospyros virginiana*	Persimmon
OLEACEAE	OLIVE FAMILY
**Fraxinus americana* var. *americana*	White ash
Fraxinus pennsylvanica var. *subintegerrima*	Green ash
GENTIANACEAE	GENTIAN FAMILY
**Sabatia angularis*	Square stem rosegentian
Sabatia campestris	Prairie rosegentian
APOCYNACEAE	DOGBANE FAMILY
**Amsonia hubrichtii*	Hubricht bluestar
Amsonia tabernaemontana	Low slimpod
**Apocynum cannabinum* var. *pubescens*	Hemp dogbane
Trachelospermum difforme	American starjasmine
ASCLEPIADACEAE	MILKWEED FAMILY
**Asclepias quadrifolia*	Four leaf milkweed
**Asclepias tuberosa*	Butterfly milkweed
**Asclepias verticillata*	Whorled milkweed
**Asclepias viridis*	Green flower milkweed
CONVOLVULACEAE	CONVOLVULUS FAMILY
**Ipomoea pandurata*	Root morning-glory
Ipomoea purpurea	Morning-glory
POLEMONIACEAE	PHLOX FAMILY
Gilia rubra	Standing cypress
**Phlox pilosa* ssp. *ozarkana*	Ozark downy phlox
**Phlox pilosa* ssp. *pilosa*	Downy phlox
HYDROPHYLLACEAE	WATERLEAF FAMILY
Hydrolea ovata	Hairy hydrolea
Nemophila phacelioides	Large flower nemophila
Phacelia glabra	Smooth phacelia
**Phacelia hirsuta*	Hairy phacelia
BORAGINACEAE	BORAGE FAMILY
**Heliotropium indicum*	Turnsole
**Myosotis verna*	Early scorpiongrass

VERBENACEAE	VERVAIN FAMILY
**Callicarpa americana*	French mulberry
Verbena bracteata	Large bract vervain
**Verbena canadensis*	Rose vervain
**Verbena stricta*	Woolly vervain
**Verbena urticifolia*	White vervain
LABIATAE	MINT FAMILY
**Monarda russelliana*	Russell beebalm
Monarda citriodora	Lemon beebalm
**Monarda fistulosa*	Long flower horsemint
**Monarda virgata*	Branched beebalm
**Prunella vulgaris*	Selfheal
**Pycnanthemum tenuifolium*	Slender mountainmint
**Salvia azurea* var. *grandiflora*	Azure sage
**Salvia lyrata*	Lyre leaf sage
**Scutellaria ovata*	Egg leaf skullcap
Scutellaria parvula var. *australis*	Small skullcap
SOLANACEAE	NIGHTSHADE FAMILY
Physalis virginiana	Virginia groundcherry
Solanum americanum	Blue flower nightshade
**Solanum carolinense*	Horsenettle
Solanum elaeagnifolium	Silver leaf nightshade
**Solanum rostratum*	Buffalobur
SCROPHULARIACEAE	FIGWORT FAMILY
**Agalinis fasciculata*	Fascicled agalinis
**Agalinis heterophylla*	Prairie agalinis
**Agalinis tenuifolia*	Slender agalinis
**Aureolaria grandiflora*	False foxglove
**Bacopa rotundifolia*	Water hyssop
Buchnera americana	American bluehearts
Castilleja coccinea	Indian paintbrush
Castilleja indivisa	Texas paintbrush
**Collinsia violacea*	Violet collinsia
**Linaria canadensis* var. *texana*	Old field toadflax
Lindernia dubia	Yellow seed falsepimpernel
Mimulus alatus	Sharp wing monkeyflower
**Pedicularis canadensis*	Common lousewort
Penstemon digitalis	Beardtongue
Penstemon tubiflorus	Tube penstemon
**Verbascum blattaria* forma *albiflora*	Moth mullein
**Verbascum thapsus*	Flannel mullein
Veronica arvensis	Common speedwell
BIGNONIACEAE	BIGNONIA FAMILY
**Campsis radicans*	Common trumpetvine
**Catalpa speciosa*	Catalpa
ACANTHACEAE	ACANTHUS FAMILY
**Justicia americana*	American water-willow
**Ruellia humilis*	Wild petunia
Ruellia strepens forma *cleistantha*	Limestone ruellia
PLANTAGINACEAE	PLANTAIN FAMILY
**Plantago aristata*	Bracted plantain
**Plantago virginica*	Paleseed plantain
RUBIACEAE	MADDER FAMILY
**Cephalanthus occidentalis*	Buttonbush

Diodia teres	Rough buttonweed
**Diodia virginiana*	Large buttonweed
**Galium pilosum* var. *pilosum*	Hairy bedstraw
Hedyotis crassifolia	Small bluets
Hedyotis nigricans	Prairie bluets
Sherardia arvensis	Field madder
Spermacoce glabra	Smooth buttonplant
CAPRIFOLIACEAE	HONEYSUCKLE FAMILY
**Lonicera flava*	Yellow honeysuckle
**Lonicera japonica*	Japanese honeysuckle
**Sambucus canadensis*	American elder
**Symphoricarpos orbiculatus*	Coralberry
**Viburnum rufidulum*	Southern blackhaw
VALERIANACEAE	VALERIAN FAMILY
**Valerianella nuttallii*	Nuttall cornsalad
**Valerianella radiata*	Beaked cornsalad
CAMPANULACEAE	BLUEBELL FAMILY
**Lobelia cardinalis*	Cardinal flower
**Lobelia puberula*	Purple dewdrop
Triodanis lamprosperma	Venus lookingglass
Triodanis perfoliata	Clasping Venus lookingglass
COMPOSITAE	SUNFLOWER FAMILY
**Achillea millefolium* var. *lanulosa*	Yarrow
**Ambrosia bidentata*	Lance leaf ragweed
**Ambrosia psilostachya*	Western ragweed
**Antennaria plantaginifolia*	Plantain leaf pussytoes
Anthemis cotula	Mayweed camomile
Aster azureus	Sky-blue aster
**Aster ericoides* var. *ericoides*	Heath aster
**Aster lateriflorus* var. *flagellaris*	Calico aster
**Aster paludosus* var. *hemisphericus*	Single stem bog-aster
**Aster patens* var. *patentissimus*	Skydrop aster
**Aster sagittifolius*	Arrow aster
**Aster turbinellus*	Prairie aster
**Bidens polylepis*	Awnless beggarticks
**Boltonia diffusa*	Small head boltonia
Cacalia tuberosa	Indian plantain
Chaetopappa asteroides	Leastdaisy
**Chrysopsis pilosa*	Soft gold aster
Cirsium altissimum	Tall thistle
**Cirsium carolinianum*	Soft thistle
Cirsium iowense	Iowa thistle
**Conyza canadensis*	Canada fleabane
**Coreopsis grandiflora* var. *harveyana*	Cord leaf coreopsis
**Coreopsis tinctoria*	Plains coreopsis
Coreopsis tripteris	Atlantic coreopsis
Crepis pulchra	Showy hawksbeard
Dracopsis amplexicaulis	Clasping coneflower
Echinacea pallida	Pale echinacea
**Elephantopus carolinianus*	Leafy elephantfoot
**Erigeron strigosus*	Prairie fleabane
Erigeron tenuis	Slender fleabane
**Eupatorium coelestinum*	Mistflower
**Eupatorium rugosum*	White snakeroot

**Eupatorium serotinum*	Late flower thoroughwort
**Euthamia gymnospermoides*	Bushy goldenrod
**Gnaphalium obtusifolium*	Fragrant cudweed
**Gnaphalium purpureum*	Purple cudweed
Grindelia lanceolata	Gumweed
**Gutierrezia dracunculoides*	Broomweed
**Helenium amarum*	Bitterweed
Helenium flexuosum	Purple head sneezeweed
**Helianthus divaricatus*	Rough sunflower
**Helianthus hirsutus*	Hairy sunflower
Helianthus mollis	Ashy sunflower
**Heliopsis helianthoides* var. *scabra*	Rough heliopsis
Hieracium gronovii	Hairy hawkweed
**Krigia virginica*	Carolina dwarf dandelion
**Liatris asper* var. *intermedia*	Rough gayfeather
**Liatris elegans*	Pink scale gayfeather
**Liatris pycnostachya*	Hairy button snakeroot
**Liatris squarrosa* var. *hirsuta*	Scaly blazing star
**Pyrrhopappus carolinianus*	Carolina false dandelion
**Rudbeckia grandiflora*	Rough coneflower
**Rudbeckia hirta* var. *pulcherrima*	Black eyed Susan
**Rudbeckia subtomentosa*	Sweet coneflower
**Rudbeckia triloba*	Brown eyed Susan
Senecio glabellus	Butterweed
Senecio obovatus	Golden groundsel
**Serinia oppositifolia*	Weedy dwarf dandelion
Silphium asteriscus	Starry rosinweed
**Solidago canadensis* var. *scabra*	Canada goldenrod
Solidago gigantea var. *serotina*	Giant goldenrod
Solidago missouriensis	Missouri goldenrod
**Solidago petiolaris*	Downy goldenrod
**Solidago radula*	Rough goldenrod
**Verbesina virginica*	White crownbeard
**Vernonia baldwinii*	Baldwin ironweed
**Vernonia lettermanii*	Letterman ironweed

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Glossary of Geological Terms

anticline —An upfold of strata the center of which is the "axis." The strata dip away from the axis like the roof of a house. The core of the fold contains stratigraphically older rocks. The opposite of a syncline.

bedding plane —A characteristic of sedimentary rocks. Bedding planes are subparallel planes along which individual beds may separate.

clastic rock —Sedimentary rock consisting of fragments derived from preexisting rocks that were broken down and then transported to another place of deposition.

columnar section—A drawing or graphic representation showing in a vertical column the sequence of rock units found in a specified area.

cuesta—A ridge with one slope long and gentle and the other slope steep. *Cuesta* is a Spanish word meaning flank or slope of a hill. Cuestas are caused by dipping rock strata.

dip —The angle at which a rock stratum or fault surface is inclined from the horizontal. Dip is always at right angles (90°) to the strike of a stratum.

epoch—Subdivision of a period of time. Rocks formed during an epoch constitute a series.

era—Greatest of all geologic time divisions. Consists of two or more geologic periods.

erosion—The natural process of weathering, disintegration, dissolution, and removal of rock and earth material, mainly by water and wind.

fault—A fracture or a zone of fractures in rock with displacement of the sides relative to one another either horizontally, vertically, or both.

flood plain—A relatively flat area close to a stream. It is made of sediment carried over the stream banks during times of flood.

fold—A curve or bend in rock strata, usually as a result of deformation.

formation—The fundamental stratigraphic unit used for geologic mapping. It may include several rock types. Formations sometimes are divided into members and beds.

fossil—The remains or traces of an animal or plant that have been preserved by natural causes in the Earth's crustal rocks. The term does not include an organism that has been buried during historic time.

geologic time—History of the Earth divided into eras, periods, and epochs.

group —Two or more formations with similar characteristics or other affinities.

hogback—The outcropping edge of a cuesta. Its slopes are roughly equal.

igneous rock—Rock formed by cooling and solidification of hot molten material called magma. Magma that flows onto the surface of the earth (lava) cools rapidly to form fine-grained rocks, whereas magma that solidifies several miles beneath the surface cools slowly to form coarser grained rocks.

joint—A fracture in rock along which no displacement has occurred.

marine —Of or belonging to the sea.

member—*see* formation

metamorphic rock—Rock that has been changed through intense heat, high pressure, or contact with chemically active fluids from magma. Slate and phyllite are examples of metamorphosed shale, quartzite metamorphosed sandstone, and marble metamorphosed limestone.

nonclastic rock—A sedimentary rock whose deposition was caused by chemical or biological action.

organic deposits—Deposits formed from the remains of living matter such as plants and animals.

orogeny—A movement or movements of the Earth's crust (folding and faulting) that cause mountains to form.

paleobotany—The science of fossil plants.

paleontology—The science of fossils, both plant and animal.

paleozoology—The science of fossil animals. Its two divisions are vertebrate and invertebrate paleozoology.

period—Subdivision of an era. Rocks formed during a period constitute a system.

sediment—Bits of rock, often the result of weathering, that accumulate in layers. Sand, gravel, silt, and mud are some examples of sediment, which can be transported or deposited by air, water, or ice.

sedimentary rock—Rock formed by the compaction and cementing of sediments deposited in water or from air. Sediments may consist of rock or mineral fragments of various sizes (mud, sand, gravel), the remains of animals or plants, the products of chemical action or evaporation, or mixtures of these materials. Sedimentary rocks typically have a layered structure known as bedding or stratification.

series—*see* epoch

slump —A mass of rock or unconsolidated material of any size that has slipped downward by gravity from its original position.

stratum—A single sedimentary bed or layer. The plural form is strata.

strike —The direction or trend of a rock stratum or fault surface as it intersects the horizontal.

structural geology—Study of the structural features of rocks (folds and faults) and the causes of their deformation.

syncline—A fold in rock layers in which the strata dip inward from both sides toward the axis. A downfold. The core of the fold contains stratigraphically younger rocks. The opposite of an anticline.

system—*see* period

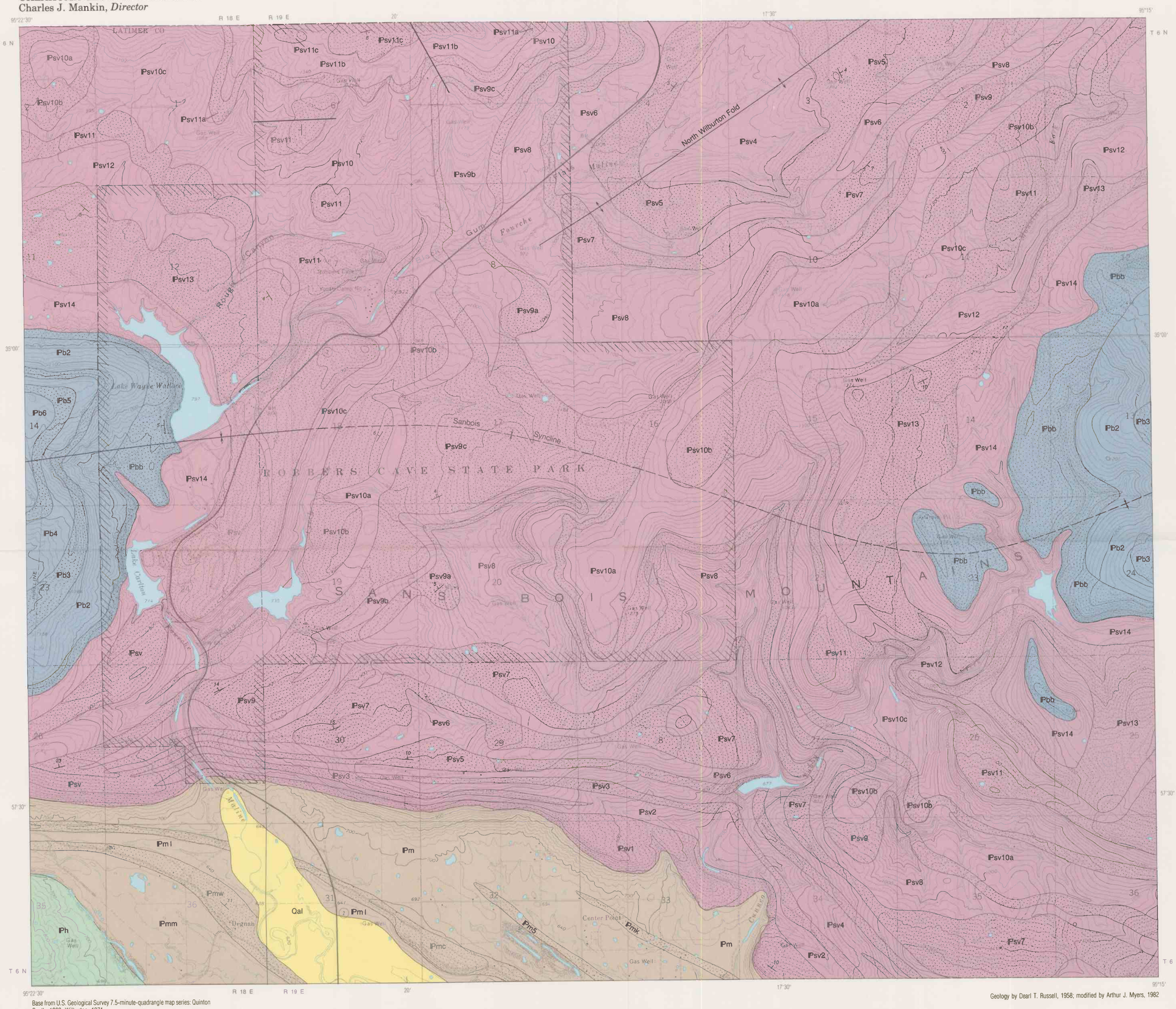
terrestrial—Consisting of or pertaining to land as distinct from water. Examples of terrestrial deposits are flood plains of streams and rivers. These clastic sediments are deposited by flood waters.

topography—The physical features of a region; the shape of the land's surface.

water table—The upper limit of the portion of the ground that is wholly saturated with water.

weathering—The group of processes—such as the chemical action of water and air and of plants and bacteria, and the mechanical action of changes of temperature—whereby rocks exposed to the weather change in character, decay, and finally crumble into soil.

OKLAHOMA GEOLOGICAL SURVEY
Charles J. Mankin, *Director*



Base from U.S. Geological Survey 7.5-minute-quadrangle map series: Quinton South, 1969; Wilburton, 1971

Geology by Dearl T. Russell, 1958; modified by Arthur J. Myers, 1982

GEOLOGIC MAP OF ROBBERS CAVE STATE PARK AREA

By

Dearl T. Russell and Arthur J. Myers

1985

EXPLANATION

QUATERNARY

Alluvium

Qal — Sand, silt, and clay on flood plains of present streams

PENNSYLVANIAN

Boggy Formation

IPb6, IPb5, IPb4, IPb3, IPb2 — Odd-numbered units (IPb3, IPb5) are prominent sandstones; even-numbered units (IPb2, IPb4, IPb6) are shales
Brown to buff sandstones, siltstones, and dark- to-light-gray silty shales
Only lower part of formation crops out in map area

IPbb — Bluejacket Sandstone Member (IPbb)

Savanna Formation

IPsv14, IPsv13, IPsv12, IPsv11 (c, b, a), IPsv10 (c, b, a), IPsv9 (c, b, a), IPsv8, IPsv7, IPsv6, IPsv5, IPsv4, IPsv3, IPsv2, IPsv1

Odd-numbered units (IPsv1, IPsv3, IPsv5, IPsv7, IPsv9, IPsv11, IPsv13) are prominent sandstones; even-numbered units (IPsv2, IPsv4, IPsv6, IPsv8, IPsv10, IPsv12, IPsv14) are shales
Brown, fine-grained sandstone and siltstone beds and gray-green to dark silty shales
Thickness: 1,470 to 1,990 feet
IPsv11 locally consists of lower (IPsv11a) and upper (IPsv11c) sandstone beds separated by a thin middle shale (IPsv11b)
IPsv10 locally consists of lower (IPsv10a) and upper (IPsv10c) shale beds separated by a middle sandstone (IPsv10b).
IPsv9 locally consists of lower (IPsv9a) and upper (IPsv9c) sandstone beds separated by a middle shale (IPsv9b).

McAlester Formation

IPmk — Keota Sandstone Member (IPmk): brown, fine-grained, thin-bedded
IPm — Unnamed shale (IPm): dark, blocky; contains clay-ironstone
IPm5 — Tamaha Sandstone Member (IPm5): brown, fine-grained, thin-bedded
IPmc — Cameron Sandstone Member (IPmc)
IPml — Unnamed shale (IPml): dark, blocky; contains clay-ironstone concretions
IPmw — Warner Sandstone Member (IPmw)
IPmm — McCurtain Shale Member (IPmm)

Hartshorne Formation

Ph — Brown to gray silty sandstone, interbedded with silty shale; only upper part is present in mapped area

Contact

Fault

Anticline, showing trace of crestal plane

Syncline, showing trace of trough plane; dashed where approximately located

10 — Strike and dip of beds

Outline of park area

SCALE 1:24 000

1 0 1 MILE
1000 0 1000 2000 3000 4000 5000 6000 7000 FEET
1 5 0 1 KILOMETER

CONTOUR INTERVAL 20 FEET
DATUM IS MEAN SEA LEVEL

STUDY AREA

UTM GRID AND 1971 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET