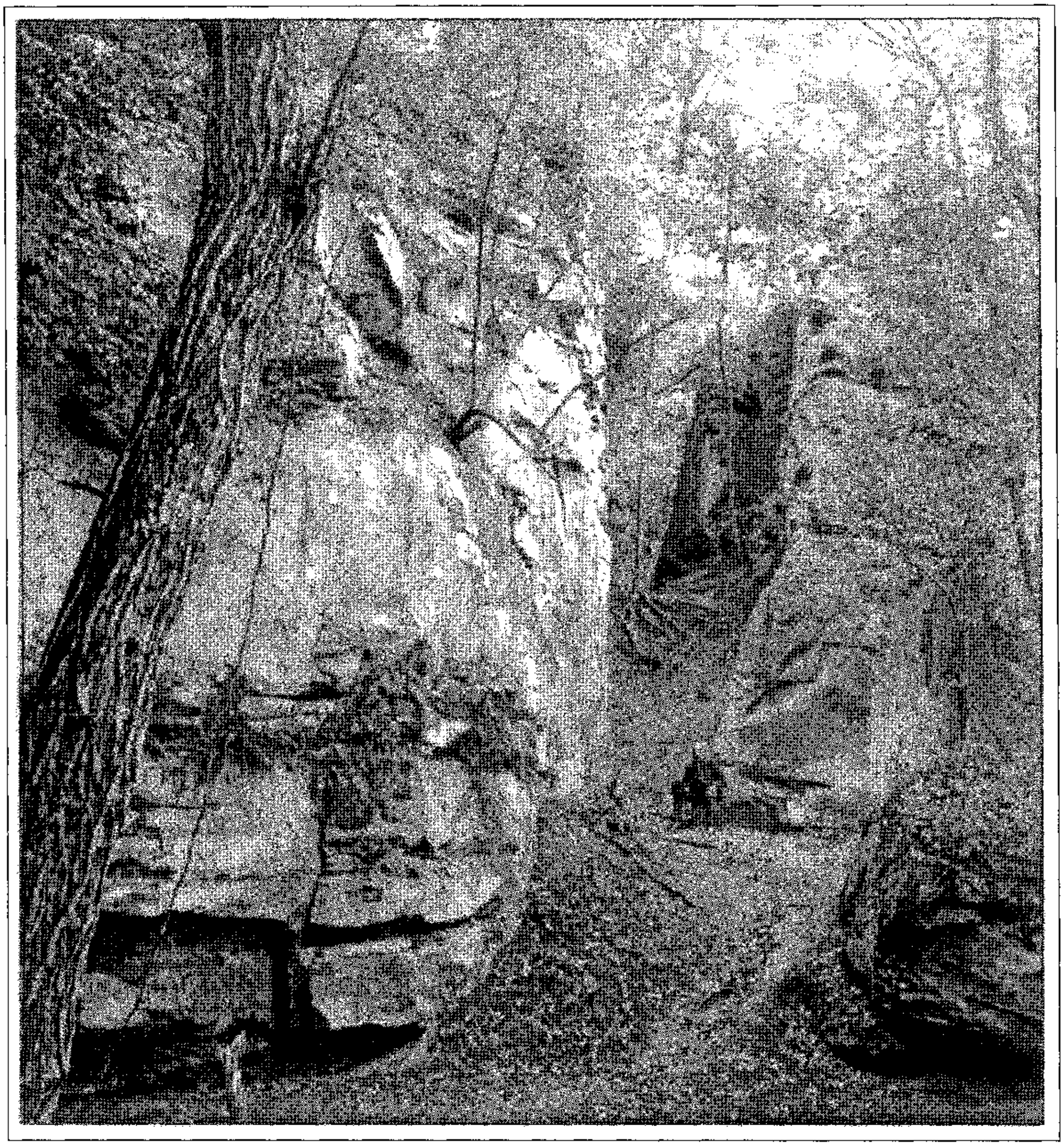
THE NATURAL HISTORY OF WILDCAT DEN STATE PARK

edited by Raymond R. Anderson and Bill J. Bunker



J.A. UDDEN AT THE "DEVIL'S LANE." PHOTO BY S. CALVIN,1898

Geological Society of Iowa

November 1, 1997 Guidebook 64

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Wildcat Den State Park, one of the most unique parks in Iowa, lies 12 miles from Muscatine and 18 miles from Davenport. Located in an area of rugged terrain and rock exposures about one mile north of the Mississippi River, the 417 acres of the park offers a variety of attractions, including some interesting and unique natural resources. Most of the park's natural resources are accessible via its trail system, which leads to such fascinating sites as *Steamboat Rock*, *Fat Man's Squeeze*, the *Devil's Punch Bowl*, and *Horseshoe Bend*. In addition the spectacular bluffs provide excellent views of this beautiful area and Pine Creek.

Rocks of Devonian and Pennsylvanian age are exposed in Wildcat Den State Park. The Caseyville Shale is the oldest Pennsylvanian unit found in the state of Iowa. Additionally, three Quaternary terrace levels in the park tell the story of major changes in the course of the nearby Mississippi River.

The park is also notable for its tree, shrub, and plant communities. As many as 25 varieties of ferns have been found in Wildcat Den, as well as numerous types of flowers and shrubs. It is not uncommon to see a variety of wildlife in the park, including white-tailed deer and many species of songbirds.

One of the first settlers in Muscatine County, Benjamin Nye, is credited for having built the county's first store and post office in 1838. In 1848 Nye built the old grist mill on Pine Creek, now the focal point of the park. The Pine Creek Grist Mill is one of the finest examples of mid-nineteenth century mills left in the country. The Iowa Department of Natural Resources is working to slowly restore the mill to its original condition. The Pine Creek Grist Mill has been placed on the National Register of Historic Places. A restored "turn of the century" schoolhouse is located near the mill and offers park visitors another glimpse of Iowa's past.

This field trip will provide participants with an opportunity to observe the various aspects of the natural and cultural history of Wildcat Den State Park and discuss them with experts in the fields of geology, botany, ecology, archaeology, and history. These trip leaders include, from the Iowa Department of Natural Resources, Wildcat Den State Park Ranger Ken Hyman, ecologist and botanist John Pearson from the Division of Parks and Preserves, geologists Brian Witzke, Art Bettis, Greg Ludvigson, Bill Bunker, Robert McKay, and Ray Anderson from the Geological Survey Bureau, and from the Office of the State Archaeologist Susan Snow. I hope that you enjoy the trip.

WILDCAT DEN STATE PARK:
A HISTORICAL PERSPECTIVE

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Introduction

The area now known as Wildcat Den State Park (Fig. 1) has had an interesting history since the time of European settlement. In the centuries before Europeans arrived, the area was inhabited by various Indian tribes, but the pace of change was slow. In the approximately 150 years since the time of settlement, there have been immense changes. Logging and milling industries were established, most of the forest covering the future area of the park was cut down, several farms were established, and much of the park land was cropped or grazed. Slowly, however, the forest has grown back, the farm houses have disappeared and eventually a park was established.

Figure 1. Wildcat Den State Park, the forested ridge as viewed from the north.

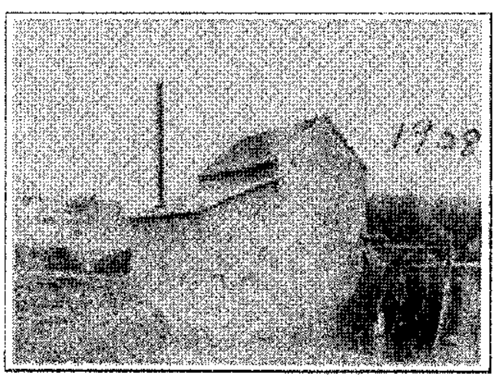
Early History of the Area

In the early 1800's, the eastern portion of Iowa was inhabited by the Sauk and Fox Indians. This area was ceded by the Indians to the United States at the conclusion of the Blackhawk war. The treaty, which became known as the Blackhawk Purchase, was signed on September 21, 1832. The treaty called for the Indians to give up possession on June 1, 1833. This treaty and further treaties in 1836 and 1837 opened the lands of eastern Iowa for settlement by European people.

In the spring of 1834 Benjamin Nye, Muscatine County's first white settler, arrived and built a cabin on Pine Creek, just below what is now Wildcat Den State Park. Nye went to St. Louis to purchase a supply of goods to open a store at the mouth of Pine Creek, where he traded primarily with Indians. In the fall of 1834, having built a place to live and established a business, Nye returned to Ohio to bring his wife and two daughters to Pine Creek.

Benjamin Nye was only the first of many settlers and the area quickly filled with pioneers. In the next few years, Nye was busy building mills. The first mill he built was a sawmill located about one half mile below the present day boundary of the park. The mill, however, was built too close to the Mississippi River and whenever there was high water on the river, the water would back up on his dam and prevent sufficient fall to turn the mill wheel. To cure this problem, Nye moved his sawmill to a location that is thought to be just upstream from the present mill and within the boundaries of the present day park. Much of the original forest covering the park land was cut to supply logs to the sawmill. Most of the large oak trees that now grow in the park sprouted after this episode of logging. In 1837 Ben Nye built his first grist mill to grind the crops grown by the burgeoning tide of settlers. It is believed this grist mill was built across from the sawmill.

As the settlers cleared more land and began breaking the prairie, there was increased demand for milling. Nye's first grist mill was outgrown and in 1848 he built a larger mill with three runs of burr stones. This larger mill was built just downstream from his earlier grist mill and sawmill. This larger mill built in 1848 is the mill that is preserved today in Wildcat Den State Park, and has become known as the Pine Creek Grist Mill. The two earlier mills are gone; and without an archaeological search, it is impossible to pinpoint their exact location. From the time of its construction until early in this century, the Pine Creek Grist Mill was the center of the local farming community. It was the destination of the crops raised and also a social center of the community. Through the years from 1850 to 1900, the various owners of the mill installed more and newer milling equipment. The water wheel was replaced with a turbine and a steam engine



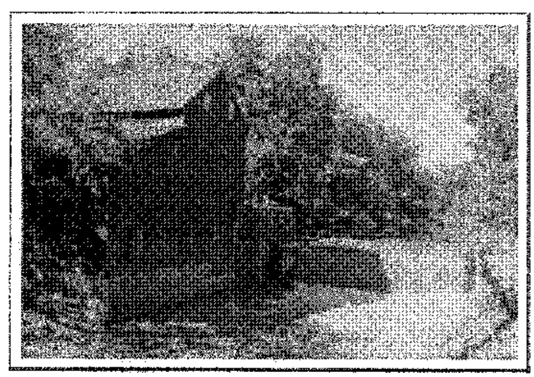


Figure 2. Views of the Pine Creek Grist Mill in 1908 (left) and today (right).

was installed for use during periods of low water. By 1900 the mill (see Fig. 2) enclosed an example of various milling equipment from the stone milling era to the modern steel roller milling era. But with increasing ease of transportation from the railroads towards the end of the nineteenth century, the water powered mill was slowly displaced by giant industrialized milling concentrated in larger cities. The Pine Creek Grist Mill slowly lost business until by 1923 the business was dissolved. The structure and surrounding land was purchased by the State of Iowa in 1927 as part of Wildcat Den State Park. This purchase effectively preserved the mill and its equipment.

Formation of the Park

The early park movement in Iowa had a strong scientific base. The park system was conceived as a system of preserves for areas of botanical, scenic and historic interest, without much in the way of recreational development. This concept perfectly fit the area of Wildcat Den State Park, and the area was on all the early lists of places to be included in the state park system. The botanical richness of the site had long been recognized and the old grist mill fit the concepts of historical value that were in use at that time. However, there was not enough money to directly buy a system of parks. What parks were and were not created was the result of a complex mix of politics, local interest, scientific value of the area and the availability of money, either donated or appropriated. The history leading to the creation of Wildcat Den State Park is detailed in an excerpt from a short article written by Ernest A. Lack and contained in the dedication brochure of the park.

> Long before the area known as Wild Cat Den was acquired as a public conservation project, it was popular as a picnic ground. However, its value as a haunt for many varieties of trees and flowers was unappreciated by most of the earlier visitors, except when occasionally a botanist or a geologist and their classes came to study the flora and geological formations.
>
> In order to preserve the beauty and natural resources of Wild Cat Den until it could be properly administered as a conservation and recreation sanctuary, two sisters, Miss Emma and Miss Clara Brandt purchased the area in 1905. At their own expense they maintained a watchman to prevent vandalism and destruction. At one time they had considered giving their portion of the present park to the Garden Club of America. However, in 1918 the Greater Muscatine Committee became interested and together with the Brandt sisters sought to have the Iowa State Board of Conservation acquire adjoining lands for a conservation project. It was not until 1927 that their plans were realized.
>
> To the Brandt sisters' gift of 67 acres the Board of Conservation added 141 acres including historic Pine Mill. This mill was built in 1848 by Benjamin Nye, Muscatine County's first settler. During the past summer the Emma and Clara Brandt homestead of 70 acres was added to the park. Wild Cat Den State Park is now a place of recreation for thousands of people annually, made possible by the zeal for conservation and the generosity of these sisters.

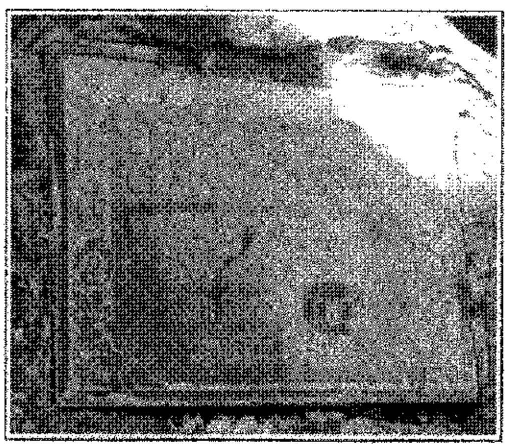


Figure 3. A bronze plaque honoring the Brandt sisters for their gift of the land for Wildcat Den State Park.

As can be seen from this article, the park resulted from a combination of botanical and geological interest, local pressure, and the donation of the park core area by two concerned citizens. The park was formally dedicated by the Governor of Iowa, Hon. Clyde L. Herring, at a ceremony in the park on Sept. 27. 1935. Since that time there have been additional land purchases to bring the total park acreage to 417 acres.

In the 1930's men working under the Works Progress Administration worked in the park constructing boundary fences, planting trees, building trails and working on the preservation of the Pine Creek Grist Mill. Also in the Depression Era, the National Youth Administration build an open shelter in the main picnic area. Since that time the park staff has worked to slowly improve the trail system, add an additional open shelter, pave the roads, and maintain the park. Sometime in the 1960's the Melpine Country School was moved to the park for preservation. In 1979 the Pine Creek Grist Mill was placed on the National Register of Historic Places.

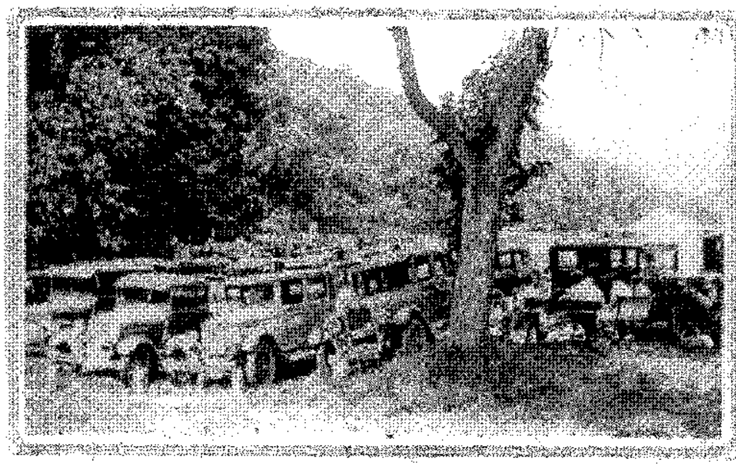


Figure 4. 1931 family reunion at what is now the Wildcat Den lower picnic area. Photo donated by Emery Law.

The Park at the Present Time

During the last twelve years, the park staff has rehabilitated the system of trails in Wildcat Den State Park. Several hundred steps, four overlooks, and a stairway have been constructed to control trail erosion and make the trails more accessible. Before this effort was started, the trail system was rapidly degrading into eroded gullies and barren strips across hillsides. This was having a strong negative impact on the vegetation and soils of the park. The use of trail structures attempted to control the negative impacts of intense recreational use while even allowing for increased use.

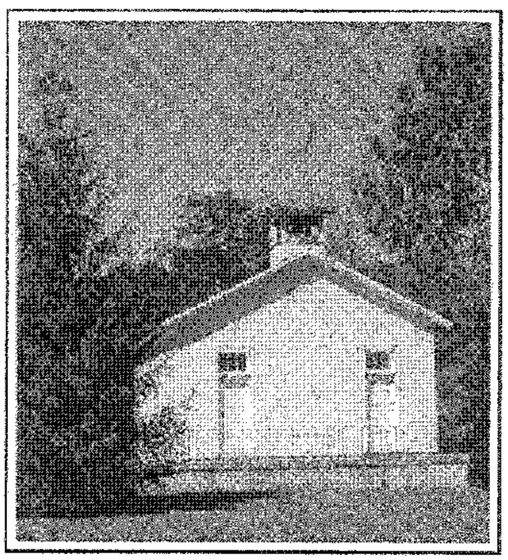


Figure 5. Melpine Country School located near the Pine Creek Grist Mill

The park also contains two historical structures: the Melpine Country School (Fig. 5) and the Pine Creek Grist Mill, which preserves a unique example of the pioneer milling industry and the transformation of the industry from stone milling to modern steel roller milling. The park staff has undertaken an attempt to develop these historical resources into a regionally significant interpretive site. In 1996 two volunteer groups were organized to help with this effort. The Friends of Melpine School were organized to restore the Melpine Country School. The Friends of Pine Creek Grist Mill were organized to restore the old mill. The goal of this effort is to develop the two historic structures into living history sites, while preserving an important part of the heritage of Iowa.

Another initiative was recently undertaken. An ecosystem management plan was developed utilizing the professional expertise of botanists, wildlife biologist, foresters, and park management, together with public input, to develop a long-term plan, primarily for management of the park vegetation. Because the state parks of Iowa, including Wildcat Den State Park, contain endangered species and some of the rarest ecosystems in the state, it was realized that active management was required to preserve these areas. A plan was developed for Wildcat Den State Park and implementation of that plan was begun in 1997.

Conclusion

The area encompassed by the park has a long and interesting history. Since the time of European settlement the area has attracted recreational use, as well as being the site of farming, logging, milling and other consumptive uses. The original park was envisioned as a scientific, botanical preserve; however, throughout most of the park's history the recreational use of the park has received the most emphasis. At the present time the hope is to manage the park for a number of different goals: outdoor recreational use, botanical and zoological management, and interpretive development of the cultural heritage preserved in the park.

THE DEMISE OF BENJAMIN NYE

The area encompassing Wildcat Den State Park has seen a number of interesting historical people. The story of the person, Benjamin Nye, who began the European settlement and developed the early industry in the area is a memorable story. Benjamin Nye built the Pine Creek Grist Mill which is preserved in the park. Four years after building the mill he was killed in a fight with his son-in-law and is now interred in the Nye Cemetery (Fig. 1).

The following is an account from the March 6, 1852 issue of the ***Iowa Democratic Enquirer.***

A fatal story occurred near the residence of Wm. Chambers, in this county, on Wednesday afternoon last, the particulars of which we chronicle with pain and horror. The tragedy, and the facts which led to it, are, indeed, a painful commentary upon the frailty of our nature, and the feeble tenure by which our passions permit us to hold to happiness and honor.

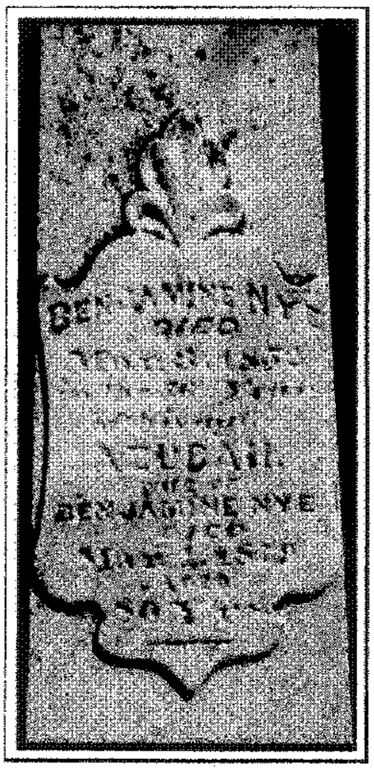


Figure 1. Headstone above the grave of Benjamine Nye and his wife Azudah in the Nye Cemetery near the south- east corner of Wildcat Den Park

Three years ago, Mr. Geo. McCoy, at that time a citizen of Cedar Co., left for California, fully imbued with the fever of the times - thirst for gold. He left a wife and five children behind him to await the result of his desperate venture and problematical return. His wife, with her children, after he left, sought the protection of her father, Mr. Benj. Nye, an old and worthy citizen, living at the mouth of Pine River, in this county. After he reached the land of gold, Mr. McCoy wrote frequently to his wife, and forwarded her considerable sums of money - the letters and money passing through the hands of one in whom Mr. McCoy had every confidence as a man of honor and a friend. But how he erred and how deeply he was betrayed, and his honor, his hopes and the fair name of his children blasted, has become a familiar tale, here where these events occurred. The wife forgot her vow, and in a moment of passion sacrificed her children, her husband, and herself irredeemably for this world, in the embraces of the false and traitorous friend of the absent husband. On his return from California, having been successful in his quest of wealth, and his bosom swelling with fond thoughts of those he left behind him, whom he was now to meet again, the husband and father was met by this tale of damming infamy.

He met his wife, however, and found in her arms the fruits of her guilt - but not all the fruits - they have multiplied in bitterness, and increased in anguish, until this last sad and bloody affray has resulted, and even yet the harvest of sorrow is not ended.

The scene between the heart-broken husband, the shame-covered wife, and the group of trembling, tearful and wondering children has been touchingly described to us by an eye-witness. Mr. McCoy, his mind soured by suspicion and the stern realities of his situation, selected from among the little group of five, one whom he rejected --declaring it was no child of his-- that like the one at her breast, it was the child of crime. After this scene Mr. McCoy removed his children (four) from their mother for a short time--but subsequently consented that they should remain with her at their grand-father's (Mr. Nye) until he left for California in April next. This was about two months ago.

On Wednesday last, McCoy came form Cedar County for his children. He stopped at Mr. Chambers and requested permission to bring them there that night--which was granted. He then went to Mr. Nye's in a wagon, got the four children he claimed, and started on his return to Mr. Chambers'. What occurred at Mr. Nye's we are not advised. On approaching Mr. Chambers' as he returned, accompanied by his children and a Mr. Long, he was overtaken by Mr. Nye, his father-in-law, and Mr. Patterson, also a son-in-law to Mr. Nye. They drove in advance of McCoy so as to intercept his wagon. Mr. Nye got down, and approached the wagon containing McCoy and company. (Illegible)...did so, some remark, which the eyewitness could not hear, except that it ...(illegible). McCoy stood up in his wagon, and warned Nye not to approach---Nye continued to advance, however---McCoy drew a revolving pistol and repeated the warning - Nye still advanced, and attempted to, perhaps did get hold of one of the children, when McCoy fired. The ball took effect in the right shoulder, making a slight would. Nye then stooped for a club - McCoy shot the second time, the ball striking in the back, but only penetrating the clothing. Nye then advanced with his club, McCoy shot the third and fourth time, with but little effect. He was knocked or pushed from the rear of the wagon. While recovering his feet dropped his pistol. Patterson then laid hold of McCoy behind, as if to hold him - Nye came at McCoy with his club again, saying unto Patterson, "kill him, &c." McCoy releasing himself from Patterson threw the latter in front of him, when Nye's blow took effect on P. breaking his collar bone, McCoy had drawn a Bowie knife, and on Nye again advancing, sprung at him, and avoiding his club, stabbed Nye in the breast. Nye still affected ... strike, he stabbed him the second time, and the third. The third stab was to the heart, and Mr. Nye fell dead at his feet. There were several witnesses to the whole affray, but so soon was it over that no effectual intervention could be made. McCoy gave himself up and is now awaiting his examination ... will take place as soon as Mr. Patterson is sufficiently recovered to ... stand. The body of Mr. Nye was interred on yesterday.

DEVONIAN ROCKS OF WILDCAT DEN STATE PARK

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Introduction

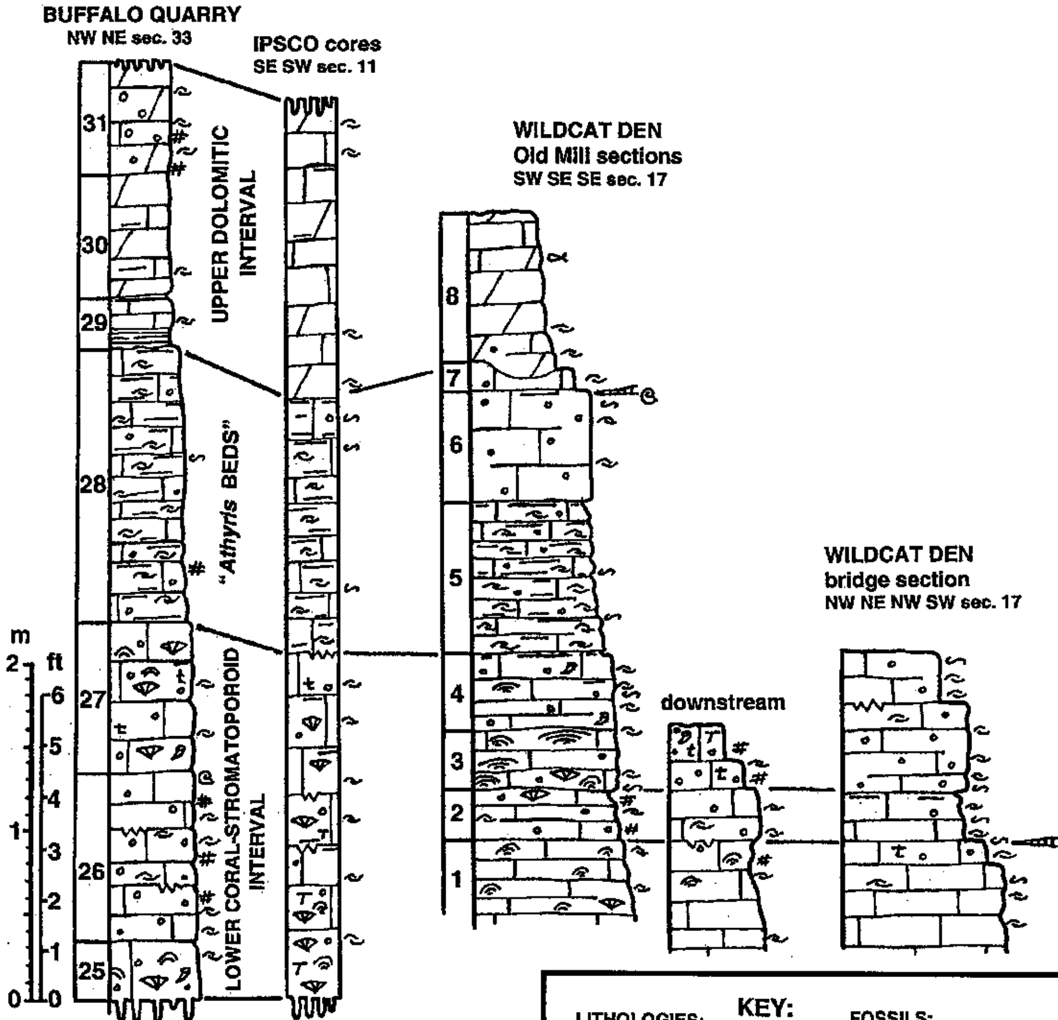
Wildcat Den State Park in Muscatine County, Iowa, is best known for its spectacular exposures of Pennsylvanian sandstone along the valley walls and adjoining tributary ravines of Pine Creek. However, interesting exposures of Devonian limestone can be seen at the lowest elevations in the park at a few places along the banks of Pine Creek, best shown near the Old Mill. These Devonian strata primarily belong to the Cedar Valley Group, a sequence of limestone and dolomite beds that crops out across a broad region stretching from southern Minnesota across eastern Iowa into western Illinois. Numerous quarries are developed in these strata across the outcrop belt, primarily to produce high-quality aggregate resources, and locally for cement production (as at the nearby quarry at Buffalo, Iowa). Strata of the Cedar Valley Group are buried beneath younger strata over an even broader region and are recognized in the subsurface of northeast Kansas and eastern Nebraska, most of Iowa and northern Missouri, and eastward to central Illinois.

The "Cedar Valley limestone" was originally named for characteristic exposures along the Cedar River in eastern Iowa (Owen, 1852; McGee, 1891), and the term has achieved widespread usage for the interval of fossiliferous limestone and dolomite strata above Middle Devonian rocks of the Wapsipinicon Group and below Upper Devonian shale strata of the Lime Creek and Sweetland Creek formations. Long considered a formation, the Cedar Valley was elevated to group status (the Cedar Valley Group) by Witzke, Bunker, and Rogers (1988) to include four constituent formations, in ascending order: the Little Cedar, Coralville, Lithograph City, and Shell Rock formations. Strata of the Coralville and Lithograph City formations can be seen in the area of Wildcat Den State Park. In addition, thin remnants of an Upper Devonian shale, the Sweetland Creek Shale, are also exposed in the area.

In general, each formation of the Cedar Valley Group represents a transgressive-regressive cycle of marine sedimentation, that is, a depositional pattern marked by initial deepening of the seaway followed by progressive shallowing. The shallowing phases of sedimentation culminated in mudflat facies and subaerial exposure in northern Iowa, but in the area of Wildcat Den and across southeast Iowa each depositional cycle of the Cedar Valley Group remained entirely subtidal (i.e., under seawater) for its duration. In other words, southeast Iowa occupied a deeper water and more offshore region (which we term the "middle shelf") during Cedar Valley deposition than did northern Iowa (which we characterize as the "inner shelf"). A similar pattern holds true for the Upper Devonian shale sequence of eastern Iowa (Witzke and Bunker, 1996).

The most complete succession of Cedar Valley strata in the area can be seen about 8 miles east of Wildcat Den at Buffalo, Iowa, in the huge quarry of Lafarge Corporation (Witzke et al., 1985). In addition, rock cores of Devonian strata (stored at the Geological Survey Bureau) recently drilled at the newly constructed IPSCO Steel Plant a few miles east of Wildcat Den provide convenient comparisons with the Devonian rocks of Wildcat Den (Fig. 1). Finally, numerous natural and quarried exposures of Devonian strata are also found in eastern Muscatine County (Udden, 1899), which compare directly with equivalent beds at Wildcat Den.

A brief discussion of each of the three Devonian formations exposed at Wildcat Den State Park follows. We will examine Devonian strata exposed along Pine Creek as part of this field trip. Please be



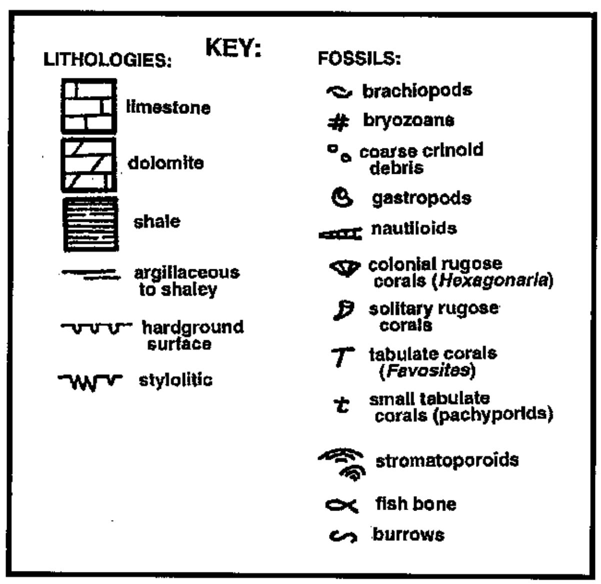


Figure 1. Graphic sections of Coralville Formation strata in Wildcat Den State Park compared with equivalent strata from the nearby IPSCO Steel Plant cores (stored at Iowa DNR-GSB) and Buffalo Quarry (Lafarge Corporation, Scott County). Unit numbers at Old Mill section keyed to written description that accompanies text. Unit numbers for the Buffalo Quarry correspond to descriptive intervals given by Witzke, Bunker, and Klapper (1985).

advised that collecting of rocks and fossils is not permitted in our state parks. These rocks were deposited in ancient seas that covered the region between about 368 and 375 million years ago.

Coralville Formation

The main exposures of Devonian strata in Wildcat Den State Park belong to the Coralville Formation, the second formation of the Cedar Valley Group. The Coralville overlies the Little Cedar Formation, the first formation of the Cedar Valley Group, and the contact is marked by a prominent burrowed discontinuity surface or "hardground" (a submarine lithified surface) in the area. This contact is not seen in the state park, but apparently lies only a short distance below the base of the Coralville exposures at the Old Mill and bridge sections (Fig. 1), probably within the streambed of Pine Creek.

The Coralville Formation derives its name from the type locality at the Conklin Quarry in Coralville, Johnson County, Iowa (Keyes, 1912; Stainbrook, 1941). Originally defined as a member within the Cedar Valley, it was elevated to formational status and subdivided into several members by Witzke, Bunker, and Rogers (1988). The entire interval of the Coralville Formation in southeast Iowa is included within the Cou Falls Member (ibid.). Based on the brachiopod and conodont faunas (ibid.; Day, 1992; Witzke and Bunker, 1997), the Coralville Formation is of late Middle Devonian age (upper *subterminus* Fauna; late Givetian).

The Coralville Formation in Muscatine County and the Quad Cities area can be subdivided into three general intervals each characterized by distinctive lithologies and fossils, which are informally labeled in ascending order (Fig. 1): the "lower coral-stromatoporoid interval," the "*Athyris* beds," and an "upper dolomitic interval." These strata were first described under different names by Udden (1899): the "*Strombodes* ledges," the "*Cystodictya*" and "*Gomphoceras* ledges", and the "main dolomite."

Lower Coral-Stromatoporoid Interval

The lower coral-stromatoporoid interval is characterized by scattered to abundant fossil corals and stromatoporoids (extinct sponge-like colonial organisms superficially resembling corals) which locally form tabular reef-like accumlations called "biostromes." The limestone matrix is a fine- to coarse-grained skeletal packstone (a rock composed primarily of fragmented shells of marine organisms). Udden (1899) described these as breccia-like accumulations of corals and stromatoporoids (which he referred to "*Strombodes*"). At the Old Mill section, the stromatoporoids display hemispherical and tabular forms, most less than 15 cm across, but a few ranging upward to 1 meter in diameter. Coral fossils include colonial forms (especially the distinctive *Hexagonaria* and the so-called honeycomb coral, *Favosites*) as well as solitary corals (horn corals). The abundance of corals and stromatoporoids varies significantly over short distances, and in some sections (e.g., see accompanying description of Wildcat Den Bridge Section) they are locally rare to absent. Coral faunas display lateral changes, with certain forms present only locally, especially branching pachyporid tabulate corals (as seen at the small exposure downstream from the Mill; Fig. 1).

The fossils in this interval are abundant and diverse, and include a variety and abundance of brachiopods, corals, stromatoporoids, crinoid material, and others (see fossil list in accompanying Table). The brachiopods are variably abraded to whole-shell, commonly concentrated into thin stringers or lenses. A variety of brachiopods are noted (see Table), but *Pseudoatrypa* and *Strophodonta* are most characteristic (the "*Strophodonta* Fauna" of Day, 1992, 1994). Crinoid material is conspicuous, primarily disarticulated stem segments and columnals, some exceptionally large (including columnals to 2 cm diameter). Bryozoan material occurs, but not as abundantly as the brachiopods or crinoids. Molluscs are rare, but nautiloids, gastropods, bivalves, and rostroconchs can be seen. This is the only interval of the Coralville Formation in the area that has produced trilobite material, but these are only occasionally seen. Interesting burrow forms, including horizontal burrow traces and larger subhorizontal burrow prods, attest to sediment reworking by worms and other burrowing infauna.

Table 1. Fossils of the Coralville Formation, Muscatine and Scott Counties, Iowa

FOSSIL	Units 1,2	Units 3,4	Unit 5	Units 6,7	Unit 8	Unit 31
BRACHIOPODA						
Inarticulata						
Petrocrania famelica		x				
Spiriferida						
Atrypidina						
Pseudoatrypa minor	x	x	x	x	x	
Indenpendatrypa randalia	x	x			x	x
Seratrpa rotunda	x	x	x			
Neatrypa waterlooensis	x					
Athyrididina						
Athyris vittata	x	x	x			x
Spiriferidina						
Cyrtina triquetra	x	x				
Cyrtina umbonata		x	x			
Tylothyris subvaricosa		x	x	x		x
Orthospirifer euruteines	x	x	x			
Eosyringothyris aspera		x	x			
Strophomenida						
Strophodonta randalia	x	x	x	x		x
Strophodonta parva	x	x	x	x	x	x
Schuchertella iowensis?					x	
Pentamerida						
Pentamerella laeviscula	x					
Orthida						
Schizophoria laudoni	x					
Terebratulida						
Cranaena iowensis	x					
Cranaena subovata	x					
Rhynchonellida						
Atribonium subovata	x					
BRYOZOA						
Trepostomata						
trepostome spp.	x					
Cryptostomata						
fenestellid spp.	x	x				x
cystodictyonid spp.	x	x	x			x
CNIDARIA						
Anthozoa						
Rugosa						
Hexagonaria thomasi	x	x				
Tabulophyllum traversensis	x	x				
indet. solitary rugosan spp.	x	x				
Tabulata						
Favosites sp.	x	x				
alveolitid sp.		x				
pachyporid spp.		x				
STROMATOPOROIDEA (PORIFERA)						
massive/hemispher. stromatoporoid spp.	x	x				
laminar stromatoporoid spp.	x	x				
MOLLUSCA						
Bivalvia						
indet. bivalve spp.	x					x
Gastropoda						
planispiral gastropod sp.				x		

FOSSIL	Units 1,2	Units 3,4	Unit 5	Units 6,7	Unit 8	Unit 31
conispiral gastropod spp.		x				
Rostroconchia						
Conocardium sp.	x					
Cephalopoda						
"*Acleistoceras*" spp.				x		
orthoconic nautiloid spp.	x			x		
ECHINODERMATA						
Crinoidea						
indet. crinoid spp. (stems, plates)	x	x	x	x	x	x
ARTHROPODA						
Trilobita						
Crassiproetus searighti	x					
Dechenella sp. C	x					
indet proetid sp.	x					
CONODONTA						
Icriodus subterminus	x	x	x	x	x	x
Mehlina gradata	x	x	x	x	x	x
Polygnathus xylus xylus					x	x
Polygnathus angustidiscus						x
Polygnathus sp.	x		x		x	x
TRACE FOSSILS						
horizontal burrow forms	x	x	x	x		
subvertical burrows/burrow prods	x	x		x		
VERTEBRATA						
Placodermi						
ptyctodontid sp.					x	
indet. placoderm bones/plates	x					

Athyris Beds

Udden (1899, p. 459) described an argillaceous (clay-rich) limestone unit "abounding in *Athyris vittata.*" This interval is informally termed the "*Athyris* beds" after the characteristic smooth-shelled brachiopod (the contained "*Athyris-Cyrtina* Fauna" of Day, 1992, 1994). At Wildcat Den, the interval includes a basal shaley recessive unit (Unit 5, Fig. 1) and upper ledges of more resistant limestone (units 6-7; probably the "*Gomphoceras* ledges" of Udden, 1899). The abundant brachiopods, mostly whole-shells, are commonly preserved in lenses and stringers. Crinoid debris is also scattered to common. Unlike the underlying strata, no corals or stromatoporoids are known from this interval. Horizontal burrows are scattered, and bryozoans are rare to absent.

The upper ledges are notably less fossiliferous and less argillaceous. Nautiloids and gastropods are seen near the top of the main ledge. The upper surface of these ledges (unit 7) is irregular and displays up to 30 cm of relief. This surface is interpreted as evidence of submarine erosion, possibly related to storm currents on the seafloor. An abrupt change in rock type is seen above this surface, with overlying strata dominated by dolomitic lithologies.

Upper Dolomitic Interval

The highest strata of the Cedar Valley Group exposed at the Old Mill section are dominated by calcitic dolomite and dolomitic limestone. This interval comprises the lower part of the "Main Dolomite" unit of Udden (1899) and the lower part of the "Upper Dolomitic Unit" of Witzke et al. (1985). This dolomitic interval was originally misidentified as a "sandstone" by several of the early workers in the area of Pine Creek, including Hall (1858; "sandstones" of the "Chemung group"), Calvin (1889; Middle

Deovnian "sandstone"), and Keyes (1894; "Montpelier sandstone"). To Udden's credit, he correctly recognized that these strata are not "sandstone" at all, but carbonate rock. In defense of the earlier misidentifications, this interval commonly disintegrates into sand-like accumulations of dolomite fragments in many weathered exposures and superficially resembles a sandstone. Fortunately, the Old Mill exposure at Wildcat Den State Park displays this interval as coherent ledges of dolomite.

This interval is only sparingly fossiliferous in the state park, with scattered fossils (brachiopods, crinoid debris) most common in the lower beds. A distinctive fragment of a ptyctdontid fish bone can be seen in the upper part at the mill section. Lithologies include both dolomite (calcitic to varying degrees) and dolomitic limestone These strata are erosionally truncated beneath Quaternary alluvium at the mill, but elsewhere in the region higher strata in the uppermost Coralville Formation (e.g., unit 31 from Buffalo Quarry and IPSCO cores; see Fig. 1) can be seen. These uppermost strata are notably more fossiliferous, including an abundance of brachiopods, crinoid debris, and bryozoans (see Table). The top of the Coralville Formation is marked by a regionally persistent hardground surface, locally bored or encrusted by corals.

Coralville Deposition

Carbonate sediments accumulated across a shallow-marine shelf of a broad subtropical seaway that flooded much of the continental interior of North America during the Middle Devonian. Coralville sedimentation was initiated in Muscatine County as the seaway deepened, and a rich fauna of marine organisms flourished across the shelf. Bottom conditions were episodically disrupted by storm-generated currents, producing abrasion and transport of the skeletal grains. In general, the environments progressively shallowed during subsequent deposition of the Coralville Formation. Changes in the bottom-dwelling faunas accompanied this shallowing, marked by an upward loss of certain organisms (especially corals and bryozoans) and a significant decline in brachiopod diversity. These changes suggest increasing environmental restriction associated with shallowing (Witzke and Bunker, 1997). At least one minor deepening episode interrupted this general shallowing pattern. Farther to the north and west, the shallowing phase of Coralville deposition was characterized by the progradation of extensive mudflat environments across the region, but Muscatine County remained in a submarine setting through the duration of this shallowing phase. The seaway again deepened during the subsequent depositional cycle of the Lithograph City Formation, which initiated a new episode of carbonate deposition above a lithified hardground surface at the top of the Coralville Formation.

Structure at the Old Mill Exposure

The exposure of Coralville rocks at the Old Mill and dam site displays strata that appear to have been disrupted by small-scale structural movements. Although bedrock strata at most exposures in eastern Iowa are generally horizontal (or virtually so), the exposures at the mill site dip slightly as a consequence of ancient structural movements. The section is faulted at the north end of a small anticlinal (domed) feature, with about 65 cm of offset observed. It is down-dropped on the north side. These features were earlier observed by Udden (1899, p. 278) "just below the dam at Pine Creek Mills"; he noted that the limestone strata there were offset "along a line of some small dislocation." Such small-scale faults and folds are not especially unusual, and comparable features have been observed at many bedrock exposures at various localities in Iowa. These structures are evidence of tectonic movements that affected the region over the considerable span of geologic time. Although the precise timing of these movements at the state park is unknown, many similar features elsewhere in Iowa appear to relate to Late Mississippian-Early Pennsylvanian stresses that propagated northward during uplift of the Ouachita Mountains in Arkansas.

Lithograph City Formation

Upper strata of the Cedar Valley Group in east-central and southeast Iowa are assigned to the Lithograph City Formation. The name was proposed by Witzke, Bunker, and Rogers (1988) for typical exposures at the former site of Lithograph City in northern Iowa where stone for lithographic engraving was quarried during World War I. The formation in southeast Iowa primarily incorporates the Andalusia Member, named for Andalusia Slough on the Mississippi River (ibid.) not far from Wildcat Den State Park. These strata in Muscatine and Scott counties are comprised primarily of fossiliferous dolomite and dolomitic limestone, with shaley beds in the lower part (ibid.; Witzke et al., 1985 "Upper Dolomitic Unit"). It reaches maximum thickness to about 9 m (30 ft) in the area. The highest beds of the formation at the Buffalo Quarry, which are bounded by hardground surfaces, have been separated from the Andalusia Member and will be named as a separate member of the formation ("Buffalo Heights Member," Day, 1997, pers. comm.). The contact between the Coralville and Lithograph City formations is marked by a prominent bored to encrusted hardground surface in the area, and is now drawn at the position indicated by Day (1992, 1994). The Middle-Upper Devonian boundary occurs within the Lithograph City Formation, and upper strata of the formation contain conodonts and brachiopods indicative of the lower portions of the Upper Devonian (lower Frasnian).

Although strata of the Lithograph City Formation are not well represented within Wildcat Den State Park, numerous exposures are known along the Pine Creek drainage in the area, with additional exposures stretching along the Mississippi River and its stream tributaries between Buffalo and Muscatine (Udden, 1899). As noted above, weathered exposures of these dolomitic strata had earlier been confused with "sandstone." In general, the sequence of strata in the area is marked, in ascending order, by (Witzke et al., 1985; Day, 1992, 1994): (1) shale with dolomitic beds containing an abundant brachiopod fauna, (2) fossiliferous argillaceous to shaley dolomitic beds, (3) vuggy dolomite with scattered fossil molds, (4) a biostromal dolomitic bed with abundant horn corals, (5) vuggy dolomitic beds with scattered to abundant laminar stromatoporoids (the "*Stromatopora* breccia" of Udden, 1899), and (6) an upper brachiopod-bearing dolomite bounded by hardgrounds.

A weathered exposure which encompasses part of the Lithograph City Formation occurs within Wildcat Den State Park about "ten rods" (i.e., 165 feet) above the mill site dam on the left bank of Pine Creek, "almost in a vertical wall," as noted by Udden (1899, p. 278). The lower strata of this exposure belong to the Coralville Formation. The upper portions of this exposure are characterized by "eroded ledges" and "high disintegrated dolomitic limestone" containing stromatoporoids in the upper part (ibid.). These stromatoporoid-bearing strata should logically be included within the Lithograph City Formation, as upper Coralville strata in the area are not known to contain stromatoporoids.

Depositional conditions during sedimentation of the Lithograph City Formation closely paralleled those seen in the Coralville Formation (Witzke, Bunker, and Rogers, 1988; Witzke and Bunker, 1996). The Lithograph City Formation was deposited during a general transgressive-regressive (deepening-shallowing) cycle, interrupted by one or more minor deepening episodes. The seas completely withdrew from eastern Iowa at the close of Cedar Valley deposition, and a period of subaerial erosion ensued.

Sweetland Creek Shale

Udden (1899) named the Sweetland Creek Shale for exposures along the lower reaches of Sweetland Creek in Muscatine County about 4 miles southwest of Wildcat Den State Park. These shale strata are characterized by a relatively thin interval of green-gray to gray calcareous shale and green-gray siltstone, reaching maximum thickness to about 14 feet (4.3 m). Additional exposures of the Sweetland Creek Shale are known along the streams that drain into the Mississippi River between Montpelier and Muscatine (East Hill), many of which are unconformably capped by Pennsylvanian shale or sandstone. Skeletal macrofossils are typically absent in the Sweetland Creek Shale, although abundant conodonts (microfossils) are present (Klapper and Furnish, 1962), and megaspores are common in the basal part. The Sweetland Creek Shale is an Upper Devonian formation (upper Frasnian).

The Sweetland Creek Shale overlies a major regional erosional unconformity developed on the Cedar Valley Group. The seas had completely withdrawn from the area at the close of Cedar Valley deposition, and upper Cedar Valley strata were erosionally truncated. Karst was developed at that time, with karstic systems locally penetrating through Devonian and Silurian strata in east-central Iowa. An erosional depression (possibly karstic) on Cedar Valley limestone strata can be seen in Wildcat Den State Park at the bridge section (see section description) which preserves remnants of green-gray and gray shale and siltstone characteristic of the Sweetland Creek Shale. Additional thin shale remnants of the Sweetland Creek Shale have been noted along Pine Creek in the state park (Fitzgerald, 1985), and some scattered thin shale exposures along the small stream which drains the northern portion of the park may also belong to the Sweetland Creek Shale.

Although Udden (1899) included an interval of dark gray to black shale above the dominantly green-gray shale sequence in his original definition of the Sweetland Creek Shale, these upper darker shale strata were excluded from the formation by Collinson (1968, p. 960) and assigned to the Grassy Creek Shale (a unit first defined in northeastern Missouri). This proposal is followed by the Geological Survey Bureau, as these upper shale strata are separated from the Sweetland Creek by a regional disconformity and are lithologically distinct. The Grassy Creek is a younger Upper Devonian shale unit (Famennian) which does not apparently crop out in the state park.

The Sweetland Creek Shale is a relatively deep-water offshore marine shale unit that was deposited beneath a low-oxygen water mass (Witzke, 1987). The low-oxygen bottom environments were generally inhospitable for bottom dwelling organisms, explaining the general absence of shelly fossils in the shale. The Sweetland Creek Shale is correlative with the richly-fossiliferous Lime Creek Formation of northern and central Iowa which was deposited in shallower well-oxygenated conditions. The Lime Creek Formation reaches thicknesses in excess of 15 times that of the much thinner and relatively condensed Sweetland Creek Shale (Witzke and Bunker, 1996).

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PENNSYLVANIAN ROCK STRATA AT WILDCAT DEN STATE PARK, MUSCATINE COUNTY, IOWA

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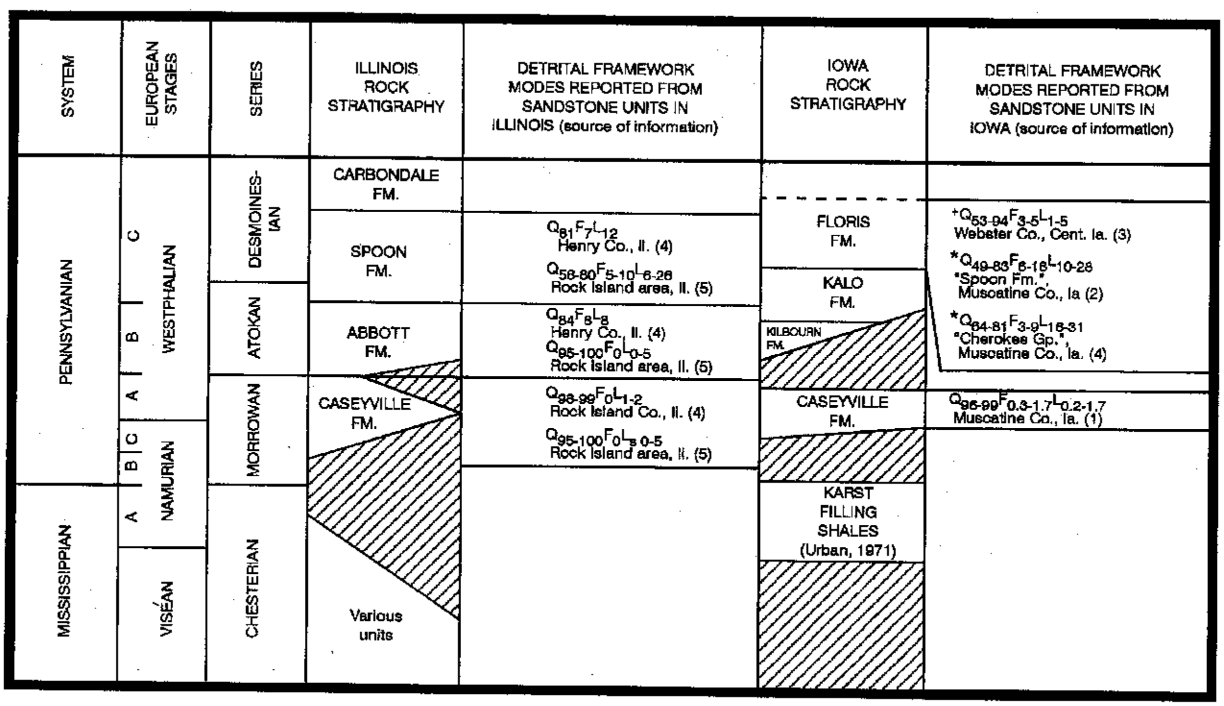
The Pennsylvanian sedimentary rocks exposed in Wildcat State Park consist of two different units, the carbonaceous mudrocks of the Lower Pennsylvanian (Morrowan) Caseyville Formation, and overlying sandstones of the Middle Pennsylvanian (Atokan [?] or Desmoinesian [?]) Cherokee Group, which have also been referred to as the Spoon Formation of Illinois (Fig. 1). Pennsylvanian strata at Wildcat Den, and other nearby exposures in Muscatine County, notably at Wyoming Hill on State Highway 22, have been the subject of many earlier geological field trips (e.g. Anderson et al., 1982; Hammer et al., 1985; Ludvigson and Swett, 1987), and an extensive published technical literature is available regarding these rocks.



Sources of information on detrital framework modes:

1) Fitzgerald, 1977, p. 35
2) Fitzgerald, 1977, p. 48
3) Burrgraf, *et al.*, 1981, p. 43
4) Anderson *et al.*, 1982, p. 16-17
5) Isbell *et al.*, 1984, p. 490

+Correlation suggested in Ravn et al., 1984, p. 28
*Correlation suggested in Ravn et al., 1984, p. 7

Figure 1. Stratigraphy of the basal Pennsylvanian rocks in Iowa and Illinois, with QFL serial designations (after Dickinson, 1970) based on petrographic studies in Iowa and Illinois. Lithostratigraphic and time-stratigraphic relationships are after Ravn and Fitzgerald (1982) and Ravn et al. (1984). From Ludvigson (1985).

Caseyville Formation

The Caseyville Formation is the oldest Pennsylvanian unit in the Upper Mississippi Valley region. Thicknesses of up to 30 meters of Caseyville strata are known from the Quad Cities region (Hopkins and Simon, 1975), and the 29 meters exposed at Wyoming Hill (see Ludvigson and Swett, 1987) represents the most complete section known in the area. The type section of the Caseyville was designated in the southern portion of the Illinois Basin in western Kentucky, and the unit is overlapped northward by younger Pennsylvanian rocks in Illinois. The Caseyville exposures in Muscatine County and the Quad Cities area represent a northern outlier of the formation. Caseyville strata in Wildcat Den State Park consist exclusively of carbonaceous shales and coals, both with abundant fossil plant material (Fitzgerald, 1977,1985). Most of the plant material is unidentifiable, but specimens of *Sigillaria*, *Lepidophlois*, and *Mariopteris* are known from the park (Figtzgerald, 1985). Elsewhere in the area, the Caseyville Formation has produced an abundant and diverse fossil flora (ibid.; Leary and Trask, 1985; Leary, 1994).

Two named coal beds have been recognized within the Caseyville Formation of Muscatine County. These are the lower Wildcat Den Coal Member, and the upper Wyoming Hill Coal Member (Ravn et al., 1984). Although both coals are exposed at the Wyoming Hill section (ibid., Hammer et al., 1985), illustrations of the type section of the Wildcat Den Coal Member (Ravn et al., 1984, p. 8) show the coal exposed near the base of a 7 meter-thick section. During our recent visits to the park, all of the Caseyville sections along Pine Creek have been actively landsliding, with coal beds only accessible as float in landslide deposits. The easternmost section near the park headquarters appears to extend upwards from Pine Creek for about 10 meters, and coal float is abundant just below the contact with the overlying sandstones of the Cherokee Group (see composite stratigraphic section for the park on page 24). This suggests that a yet stratigraphically higher coal than the Wildcat Den is also present in the state park, possibly the Wyoming Hill Coal.

The recognition of Lower Pennsylvanian rocks in this area is firmly established on palynologic (Ravn and Fitzgerald, 1982; Isbell, 1985), paleobotanic (Leary and Trask, 1985; Schabilion et al., 1987; Leary, 1994), and lithologic grounds (Fitzgerald, 1977; Isbell, 1985; Hammer et al., 1985). The Morrowan (Early Pennnsylvanian) rocks of the Quad Cities area are physically separated from their correlates in southern Illinois by more than 275 km, and the geographic isolation of this basin in the has been the subject of much speculation. Bunker et al., (1985) and Ludvigson (1985) considered that all the Morrowan strata in this area are of non-marine origin, and related their preservation to regional tectonic activity. Palynologic studies of other Pennsylvanian outliers in eastern Iowa (Nations, 1988; Ludvigson and Nations, 1989) have since shown that Morrowan deposits are more widely distributed across the area that was previously realized. Leary (1987, pers. comm. to Ludvigson) reported that Caseyville strata in the Quad Cities area of Illinois have produced lingulid brachiopods, indicating deposition in marginal marine environments. A drill core in Caseyville strata at the nearby IPSCO steel plant (core BD-94-39; at 118' depth, described by B.J. Witzke and B.J. Bunker) has also produced lingulid brachiopods, corroborating the earlier observations of Leary.

Sedimentologic evidence for marginal marine deposition of the Caseyville has also recently been developed at the Wyoming Hill section. As documented by Hammer et al. (1985, p. 15-18), the Wildcat Den Coal is immediately overlain by a finely-laminated white siltstone unit (Unit 6 of Hammer et al., 1985, p. 18) containing carbonized plant fossils and marcasite nodules. This unit buries upright *Lepidodendron* trees that were rooted in the underlying Wildcat Den Coal. Analysis of rhythmic variations in the thickness of sub-millimeter-scale laminae from Unit 6 have shown the unit to be tidally influenced (Archer et al., 1992), and in view of the rapid sedimentation recorded by burial of upright logs rooted in the underlying coal, the unit is now interpreted as an estuarine fill that recorded transgressive flooding of a river valley (ibid.).

Sandstone units are not included in any of the Caseyville exposures within Wildcat Den State Park; however they are present in the nearby exposures at Wyoming Hill, and other sections in the Quad Cities area (Fitzgerald, 1977; Anderson et al., 1982; Isbell, 1985). Unlike the sandstones of younger Pennsylvanian units in the area, Caseyville sandstones are quartz arenites, with only negligible quantities of feldspar and lithic grains (Fig. 1). Quartz sand grains in these rocks are characteristically well-rounded monocrystalline types, and many authors have suggested that they were derived from the sedimentary recycling of older sedimentary rocks (Fitzgerald, 1977, 1985; Isbell, 1985; Ludvigson, 1985; Ludvigson and Swett, 1987; Scal, 1990).

Cherokee Group

The sandstone cliffs of the Middle Pennsylvanian Cherokee Group (Fig. 2) are the most noteworthy landscape features at Wildcat Den State Park. The sandstones overlying the Caseyville Formation in Muscatine County, Iowa have traditionally been referred to the DesMoinesian Spoon Formation of Illinois, an inference based of their framework grain compositions and stratigraphic architecture, although no data are currently available to confirm the correlation of these units. These sandstones are notably micaceous, and petrographic analyses have shown that they are feldspathic litharenites, with rock fragments of sedimentary, metamorphic, and igneous derivation (Fitzgerald, 1977, 1985; Isbell, 1985; Ludvigson and Swett, 1987). Compositional characters like these are certainly consistent with data from the Desmoinesian Spoon Formation, and its Iowa correlate the Floris Formation (Fig. 1). However, the studies of Isbell (1985) and Scal (1990) showed that these compositional traits first appeared earlier in the Atokan stage, within the Abbott Formation of Illinois and the Kilbourn Formation of Iowa. Comparisons between the multi-storied channel sandstone bodies (Fig. 3) at Wildcat Den to the well-documented episode of Desmoinesian erosional incision, with backfilling by multi-storied channel sandstones of the Floris Formation (Ravn et al., 1984) have bolstered tentative correlations of these rocks with Desmoinesian Spoon/Floris strata (Ludvigson and Swett, 1987). Nevertheless, it must be acknowledged that there are no data that actually constrain the exact correlation of these Pennsylvanian sandstones.

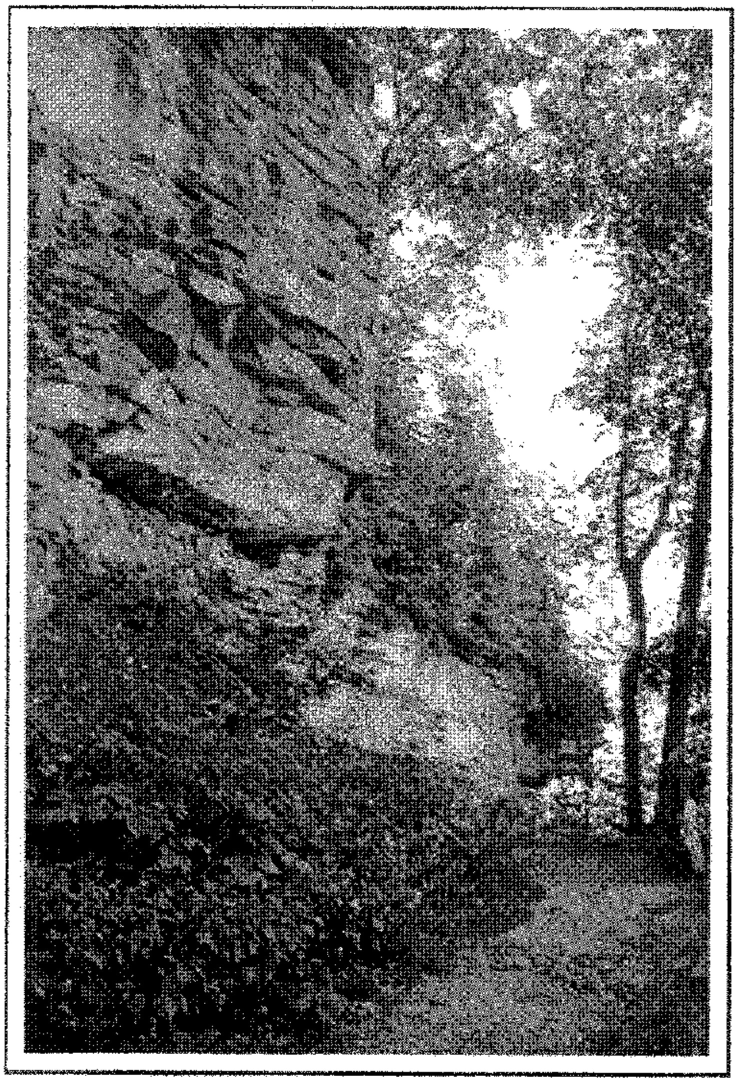


Figure 2. Sandstone cliff, Cherokee Group rock strata near Steamboat Rock, Wildcat Den State Park. Geologist Bob McKay for scale on walking trail to lower right.

Udden (1898, p 309) noted that the sandstone cliffs exposed along Pine Creek appear to be overlain by a mined coal seam, in turn overlain by a black, partly concretionary limestone containing chonetid, spiriferid, derbyid, and productid brachiopods, and pelecypods; both units exposed on the southernmost ridge top of the western bluff line of Pine Creek at its confluence with the Mississippi River (about 1 mile southeast of the park). He also suggested (ibid.) correlation of that coal with the Rock Island (No 1)

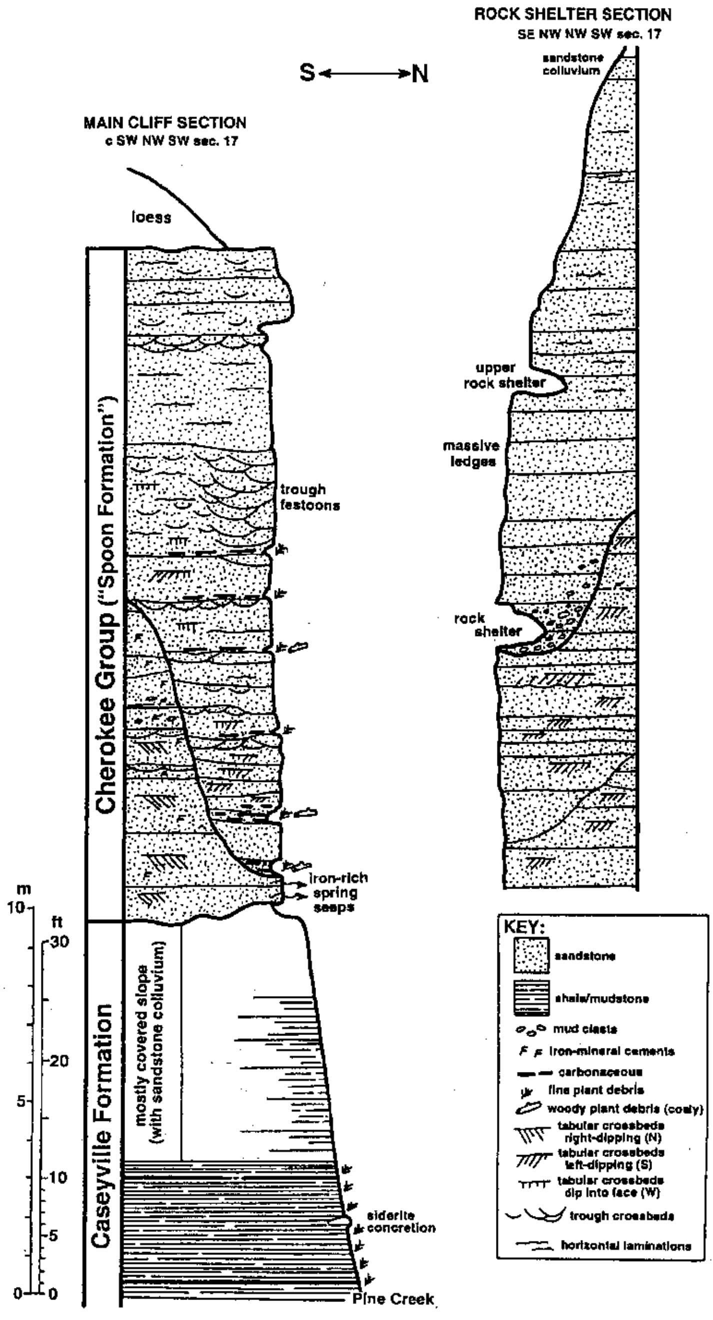


Figure 3. Measured stratigraphic sections of Pennsylvanian rocks at Wildcat Den State Park. Upper reaches of the rock shelter section are accessible to the north, and the upper reaches of the main cliff section are accessible in the Devil's Lane.

Coal Member (Spoon Formation) of Illinois, and by inference, correlation of the limestone to a unit now known as the Seville Limestone Member of the Spoon Formation (Hopkins and Simon, 1975). Ravn et al. (1984) reported, however, that the Rock Island (No. 1) Coal of Illinois correlates to the Cliffland Coal Member of the Kalo Formation in Iowa, and that Desmoinesian limestones in various stratigraphic positions in Iowa have been miscorrelated with the Seville. More work is needed to determine the stratigraphic context of these exposures.

The preceding discussion is intended to show that the precise stratigraphic position of the sandstone cliffs at Wildcat Den State Park is not known with certainty at this time. Since they might be of either Atokan or Desmoinesian age, assignment to the Middle Pennsylvanian Cherokee Group accommodates the full range of all these uncertainties.

Iron-rich spring seeps that issue from the basal Cherokee Group sandstones, just above the contact with underlying mudrocks of the Caseyville Formation, are a noteworthy feature along the walking trails at the foot of the cliffs in Wildcat Den State Park (Fig. 3). Carbonaceous plant debris and pyrite cements are abundant in some of these basal sandstone units, and the abundance of iron precipitation in these springs indicates that reduced anoxic groundwaters in the sandstones are discharging dissolved reduced ferrous iron (Fe^{2+}) that is rapidly oxidizing to insoluble ferric oxides (Fe^{3+}) on contact with the atmosphere.

Sandstone exposures at the Rock Shelter section (near the Brandt memorial plaque) and along the extensive cliff sections to the south provide an exceptional example of multi-storied channel deposition by an aggrading large river system. Major episodes of fluvial channel incision into underlying sedimentary deposits, with local relief of up to 25 m, is recorded by reactivation surfaces which truncate underlying strata (Fig. 3). The development of the main overhanging rock shelter is related to one of these surfaces, where a swale along a reactivation surface is immediately overlain by a deposit of mud-clast conglomerate that weathered out preferentially in relation to the enclosing pure sandstone strata. To the north of the main rock shelter is a smaller sandstone cave in a higher stratigraphic position. This feature appears to have developed by preferential weathering along two inclined rock fracture surfaces.

Cross bedding and other sedimentary structures are very well displayed in the sandstone exposures of the park. These have served as the basis for paleocurrent studies, which consistently have shown southwestward sedimentary transport directions (Fitzgerald, 1977, 1985; Anderson et al., 1982).

Stratigraphic changes in sedimentary style are evident, with decimeter to meter-scale planar cross bedding dominating the lower portions of the section. These include several stacked sets of meter-scale tabular crossbeds capped by shallow decimeter-scale trough cross-bedding. Exposures of this part of the section, viewed in and near the Devil's Punchbowl, display tabular cross beds with convolute and overturned laminae. Care must be taken in this area to distinguish between iron-cemented cross bedding and iron-cemented liesegang banding that cross-cuts bedding at high angles. Above the major channel-bounding reactivation surfaces at both the main cliff and the rock shelter sections, tabular cross bedding sets pass vertically into meter-scale trough festoons that are best observed in the upper reaches of the Devil's Lane. Higher yet, plane-bedded sandstones with very low-angle cross laminae are very common in the uppermost parts of the sandstone section.

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QUATERNARY GEOLOGIC HISTORY OF WILDCAT DEN STATE PARK

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Pre-Illinoian

The portion of eastern Iowa in which Wildcat Den State Park is located has a long and varied Quaternary history, only the latest of which is discernible in outcrops and landscape features. Continental glaciers advanced across this area many times during the pre-Illinoian period between about 2.2 and one-half million years ago (Hallberg et al., 1980). During these advances the bedrock was eroded and glacial till and associated sand and gravel were deposited. Exposures of pre-Illinoian glacial and interglacial deposits are not known in the park, but are well documented in surrounding areas (Anderson et al., 1982; Hallberg et al, 1980; Udden, 1898).

Illinoian

The last glaciation to directly affect this part of eastern Iowa was the Illinoian which occurred about 302,000 years ago (Johnson, 1986). The glacier advanced from the northeast out of the Lake Michigan Basin and reached its eastern terminal position in western Muscatine and Louisa counties, completely overriding the Wildcat Den area. As it advanced the glacier displaced the ancestral Mississippi River from its interglacial course in the Princeton Bedrock Valley of Illinois eastward to the Cleona Channel between Dixon and Wilton in eastern Iowa (Anderson, 1968; Bettis, 1987; Bettis and Autin, 1997). Following the Illinoian glaciation the ancestral Mississippi River resumed its previous southeasterly course through the Princeton Bedrock Valley where it remained during the ensuing Sangamon Interglacial and into the late Wisconsin.

This drainage realignment was one in a long history of the development of major drainage lines in southeastern Iowa. Evidence for other pre-Wisconsin drainage lines is evident in the distribution of valleys cut deep into the bedrock surface. In Muscatine county the most prominent bedrock valley is the Cleona Channel, which trends southwesterly across the western part of the county. The Cleona Channel joins the Udden Channel in Louisa County (Hansen, 1972). Both these bedrock valleys contain pre-Illinoian tills and multiple buried valley fills (Bettis, 1994a; Bettis and Autin, 1997). The Udden Channel was buried by the Illinoian glacial advance, but the Cleona Channel remained ice-marginal and carried the flow of the diverted Mississippi during the Illinoian advance. Today neither the Cleona nor the Udden channels are occupied by a large stream. Both, however contain important local sources of groundwater in their buried valley fills.

Sanamon Interglacial

During the Sangamon Interglacial, from the end of the Illinoian glaciation until about 55,000 years ago, the drainage network of southeastern Iowa continued to develop by down-cutting and headward extension, and soils developed on stable uplands and valley surfaces. Many of these soils were at the land surface for extended periods of time and attained strongly expressed morphologies, including thick clayey Bt horizons. Today these well-expressed soils of the last interglacial are known as the Sangamon Geosol, and form one of the Midcontinent's most widespread soil stratigraphic (pedostratigraphic) units.

Middle Wisconsinan

About 55,000 years ago loess began to slowly bury uplands and high terraces adjacent to large valleys in the Midcontinent (Leigh and Knox, 1994). This loess, the Roxana Silt, accumulated over a relatively long period of time between about 55,000 and 28,000 years ago. Following its accumulation the Farmdale Geosol formed in the upper part of the loess. The Farmdale was the surface soil from about 28,000 years ago until it was buried by Peoria Loess about 21,000 years ago.

Late Wisconsinan

About 21,000 years ago glacial ice of the Lake Michigan Lobe blocked the Ancestral Mississippi River flowing through the Princeton Bedrock Valley in central Illinois. Water ponded behind the blockage formed Glacial Lake Milan in what is now the Green River Lowland of northeastern Illinois (Shaffer, 1954; Anderson, 1968). Lake Milan deepened until its level reached the elevation of a low divide to the Ancestral Iowa/Cedar River near Andalusia, Illinois and an outlet channel began to develop. The outlet continued to deepen forming the Andalusia Gorge between Rock Island and Muscatine. Lake Milan eventually drained through the Andalusia Gorge, and the Mississippi River changed course to its present route through the Andalusia Gorge and south through the Ancestral Iowa/Cedar Valley to St. Louis, where it joins the pre-Wisconsin course of the Mississippi Valley.

At about the same time that the Andalusia Gorge formed and Lake Milan drained, Peoria Loess began to accumulate on the uplands and high terraces of the Upper Midwest. This deposit consists of silt blown from valleys that carried meltwater from glaciers to the north. In southeastern Iowa the Mississippi Valley was the primary loess source, but other valleys such as the Iowa/Cedar also were important local sources of loess. The loess accumulated episodically between about 21,000 and 12,000 B.P.* forming a silty blanket that mantled the existing topography. The loess thus forms a convenient marker that helps identify landforms and underlying deposits that are older than 12,000 years (loess-mantled) from those that are younger and have no loess cover.

Southeastern Iowa witnessed periglacial conditions between 20,000 and 16,000 B.P. during the early phase of Peoria Loess deposition (Bettis and Kemmis, 1992; Bettis, 1994b; Schwert et al., 1997). During this period uplands and slopes were severely eroded by solifluction and sheetwash, and thick, sandy and gravelly alluvial fills accumulated in valleys. Many of the colluvial slopes underlain by blocky sandstone colluvium in the park developed during this period of intense cold and effective frost action. As the climate ameliorated after 16,500 years ago, loess mantled the eroded landscape and coarse-grained alluvial fills. Today these loess-mantled terraces are included in the St. Charles Terrace Family of Mississippi Valley terraces (Hajic et al., 1991).

Outwash from glaciers in the northern part of the Mississippi basin and the Lake Michigan Basin aggraded the Mississippi Valley from 21,000 to 11,000 B.P. In the valley reach between Rock Island and Burlington the aggradation was punctuated by a down-cutting event at about 13,000 B.P. The result is two late glacial terraces, an older, higher level, known as the Savanna Terrace, and a younger, lower level, the Kingston Terrace (usually referred to in past discussions as the Mankato and Late Mankato terraces respectively (Trowbridge, 1954; Edmund and Anderson, 1967).

The Savanna Terrace is the oldest terrace lacking a loess cover in the Upper Mississippi Valley (Flock, 1983; Hajic et al, 1991; Bettis et al, 1992). Deposits comprising the Savanna Terrace in tributary valleys north of the Des Moines River junction accumulated during drowning of the lower reaches of tributaries as the Mississippi floodplain aggraded between 21,0000 and about 13,000 B.P. During this period floods produced by glacial lake outbursts, or during the spring and summer melt season, passed down the valley, back-flooded lower reaches of the tributaries and formed sediment dams at the tributary

* B.P refers to radiocarbon years before present. Radiocarbon years, as determined by the amount of radioactive carbon remaining in a sample of carbon, do not correspond to calendar years for a number of reasons including variations in the production rate of radioactive carbon in the atmosphere through time

mouths. Floods originating from the Lake Superior Basin carried distinctive reddish brown clay derived from the Upper Keweenan Fon du Lac Formation, whereas floodwaters from other sources did not. Most of the fill comprising this terrace consists of gray and grayish brown silt, loam and sand that is a combination of non-Superior-source flood sediment and locally-derived tributary alluvium.

A down-cutting episode formed the Savanna Terrace about 13,000 B.P. Outwash continued to accumulate and the Mississippi floodplain aggraded until about 10,500 B.P. when glacial meltwater was no longer directly discharged into the Upper Mississippi Valley. The youngest late glacial aggradation episode reached an elevation about nine meters lower than the elevation of the Savanna Terrace in the vicinity of Wild Cat Den State Park. About 10,500 B.P. another down-cutting episode isolated the latest glacial floodplain and formed the Kingston Terrace. The cause of this down-cutting event may have been the opening of the southern outlet of Glacial Lake Agassiz and the discharge of large volumes of sediment-free lake water into the Mississippi system.

Holocene

After this final late glacial down-cutting event the Mississippi River underwent a fundamental channel pattern change from a braided pattern that dominated during the periods of late glacial meltwater input to an island braided pattern that has continued throughout the Holocene. During the last 10,000 years Pine Creek has maintained a meandering pattern and deposited alluvium of the DeForest Formation (Bettis et al, 1992). The most significant geologic change to affect this area during the Holocene was the extreme upland and slope erosion and concomitant stream channel changes and sedimentation resulting from clearing and cultivation in the mid to late 1800's and early 1900's (Baker et al, 1993).

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ARCHAEOLOGY OF WILDCAT DEN STATE PARK, MUSCATINE COUNTY, IOWA

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Introduction

Archaeology provides information on the people who have lived in Iowa from ca. 12,000 years ago to the recent past. Over 17,000 archaeological sites have been recorded in the state. These sites range from the very earliest Paleo-Indian peoples' campsites to World War II training grounds. The known sites represent only a small portion of all of the archaeological sites within the state. Many archaeological sites are under extreme pressure from activities such as farming, erosion, and development. State parks and preserves provide protection for archaeological sites within their boundaries. This protection makes state parks unique areas to study these archaeological sites within their original environments with minimal disturbance.

Archaeological investigations in southeast Iowa have focused on areas along the Mississippi River and the major tributaries. Many studies are guided by cultural resource studies for road construction. In Muscatine County, 210 sites have been recorded, most of which are small prehistoric camps or habitation sites. Recent studies also have recorded historic-era artifact scatters and farmstead locations (e.g. Artz 1992). The Pine Creek drainage, which flows into the Mississippi River just east of Wildcat Den State Park, has received little archaeological study. Three prehistoric campsites were recorded north of Wildcat Den State Park near the former Melpine School location along Pine Creek (13MC107, 13MC114, and 13MC117). Just southeast of the park, lies the Nye Cemetery, 13MC45, which is associated with the Pine Creek Grist Mill (13MC210) (Neumann 1978). Also south of the park is the Pine Creek Mound Group, 13MC44, which was excavated in the 1800s and early 1900s (Dewys-VanHecke 1990; Hodges 1989). The mounds were built during the Middle Woodland period, ca. A.D. 100. These mounds were subsequently bulldozed by the landowner (Iowa Site Records 1975) (Fig. 1).

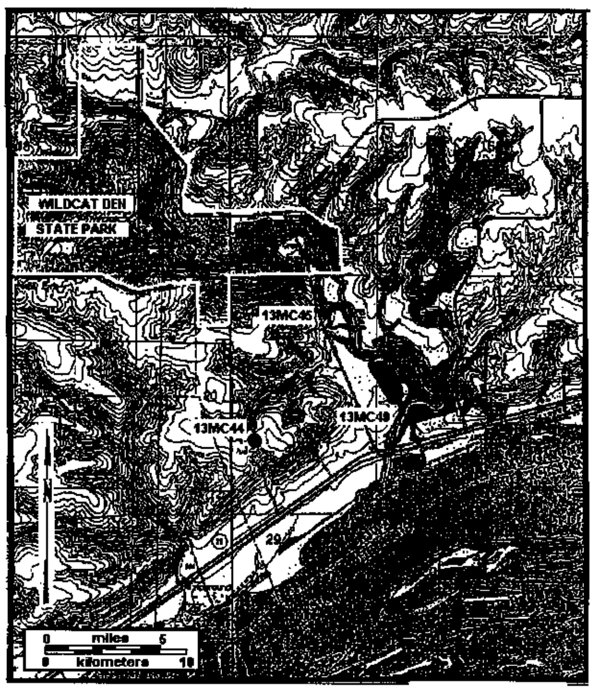

Figure 1. Archaeological Sites in Vicinity of Wildcat Den State Park.

Archaeological sites

Little archaeological research has been conducted within the boundaries of Wildcat Den State Park. Only one site is currently recorded within the park boundaries, the archaeological component of the Pine Creek Grist Mill, site 13MC210. The grounds surrounding the mill were the subject of an intensive survey in 1997. The study found the original house foundation, barn foundation, remnants of the original road cut and loading platform, and two additional foundations for outbuildings, one on either side of Pine Creek (Fig. 2). The site of the Pine Creek Grist Mill was claimed by the first Euro-American settler of Muscatine County, Benjamin Nye who arrived ca. 1834. He reportedly built three mills along Pine Creek (Acme 1889; Neumann 1978; Richman 1910, Western Historical 1879). The extant grist mill was built between 1837 and 1850 (Acme 1889; Clemens ca. 1930; General Land Office 1838; Neumann 1978; Richman 1910; Western Historical 1879). There are conflicting accounts as to the exact location and chronology of Nye's grist mills. Recollections of an early settler indicate that an Indian trail may have passed near the location of the extant mill (Clemens ca. 1930).

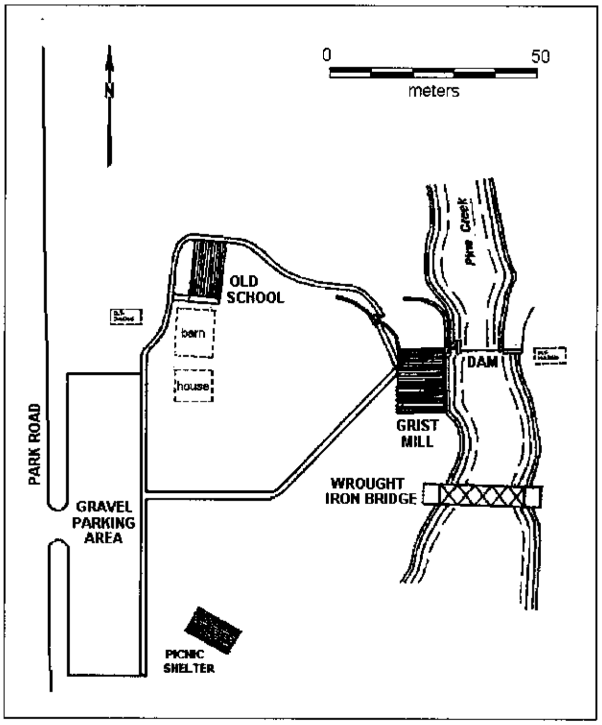

Figure 2. Sketch map of Pine Creek Grist Mill area.

In addition to the early historic remnants of Nye's mill, some evidence of Native American occupation was also identified within the area of the grist mill. Moline, Wassonville, and Keokuk chert flakes were recovered as well as a small fragment of grit-tempered Woodland pottery. Wassonville chert outcrops are found in southeast Iowa in Washington, Louisa, and Des Moines counties. Keokuk chert is also found in extreme southeastern Iowa, while sources of Moline chert can be found in western Illinois (Morrow 1994). All of these cherts are found regularly in southeast Iowa sites. No prehistoric features were identified. No additional prehistoric sites have been recorded in Wildcat Den State Park. A hike through the trails of the park indicates high potential for prehistoric sites on the ridge tops above the steeply sloping ravines. Two caves located in the vicinity of the Brandt Memorial, and Steamboat Rock may have been utilized by Native Americans, although no investigation for artifacts has been undertaken. The presence of mounds just outside of the park area (13MC44) suggests that mounds and other prehistoric features might also be identified.

The presence of mounds just outside of the park area (13MC44) suggests that mounds and other prehistoric features might also be identified.

The sandstone formations of Steamboat Rock and Fat Man's Squeeze, in particular, as well as the other sandstone cliffs at the park have been subject to almost 150 years of "name carving" or graffiti (Fig. 3). The carvings date as early 1861 and some of the earliest inscriptions may have been buried by erosional deposits along the trail which leads to these formations. Finally, as one of the original state parks dedicated in the early twentieth century, the park offers archaeological evidence of its own evolution: old roads and trails, maintenance, manhole systems for drainage, campground construction, etc.

Conclusion

Although a significant amount of archaeological research has not been conducted at Wildcat Den State Park, limited investigations suggest that the park offer many avenues for productive research on past human lifeways. Archaeological data are being integrated into the long term planning goals for the

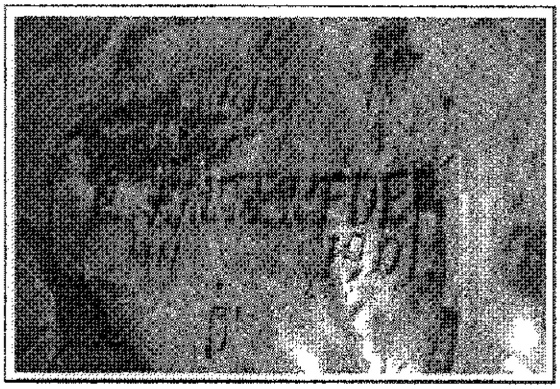

Figure 3. Graffiti carved in 1901 in the sandstone bluff near the current location of the Brandt Monument (Stop 1).

restoration and development of the Pine Creek Grist Mill area of the park. Caves and other geological formations within the park may have been utilized as rock shelters. Evidence of Woodland peoples within the grist mill area suggest that other locations along Pine Creek and on the ridges above Pine Creek may have been utilized by prehistoric peoples. The history of the park as a recreational space is reflected in the historic name carving and park construction. A comprehensive and systematic survey of the park area could shed new light on the uses of this area in the past. Coordinated archaeological, geomorphological and historical research will add significantly to knowledge of human occupation and adaptation. Wildcat Den State Park plays an important role in the preservation of these resources for future enjoyment and study.

Acknowledgements

Many thanks to Julie Plummer, member of the Friends of the Mill, for her help with archival information as well as being my guide through the trails at the park.

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THE VEGETATION OF WILDCAT DEN STATE PARK

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Wildcat Den State Park is a 400-acre area in eastern Muscatine County located along the contact between the Southern Iowa Drift Plain and the Mississippi Alluvial Plain. In Scott, Muscatine, and Louisa counties, the contact between these two landform regions is manifested as a 30-mile long, semi-forested bluffline extending westward from Davenport to Muscatine, then southward toward Toolesboro. Between Muscatine and Davenport, this bluffline rises about 150 feet in relief and extends for 1 to 2 miles inland from the Mississippi River floodplain. Wildcat Den is located in a highly dissected portion of this bluffline along Pine Creek approximately one mile upstream of its confluence with the Mississippi.

A composite view of the township plat maps drawn in 1837 by General Land Office surveyors (Fig. 1) indicates that the vegetation of Muscatine County was predominantly tallgrass prairie on the broad uplands between major drainageways while forests occupied the stream valleys and slopes bordering the Mississippi River floodplain. Within the area of eastern Muscatine County along the above-mentioned bluffline, Wildcat Den itself was located within a wide belt of "timber." In sharp contrast, a 1985 land cover map based on aerial photography (Fig. 2) shows only about fifteen patches of forest in this same area. In the 150 years following EuroAmerican settlement, the forest resource has been greatly reduced in area and broken into scattered fragments. Wildcat Den State Park today preserves a portion of one of those fragments.

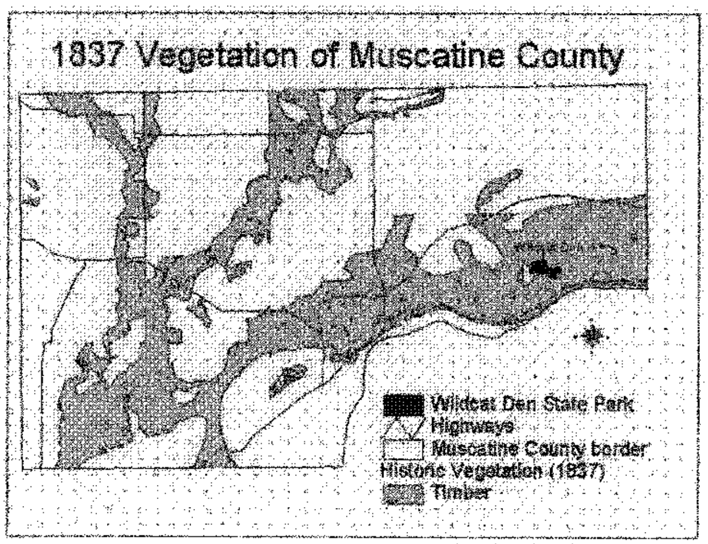


Figure 1. Forest cover in Muscatine County in 1837.

Most of the park contains natural forest covering a landscape with a surprising diversity of topography and substrate. Gently rolling uplands mantled with deep loess supporting dry forests are found in the western half of the park while level alluvial deposits along Pine Creek supporting bottomland forest prevail over much of the eastern half. Weaving between these landforms along the west bank of Pine Creek and its tributary ravines is a belt of steep slopes supporting a mesophytic forest community. The steeply sloping land in the park contains several additional features that create special habitats for many plants, including sandstone bluffs, slumps, and thin-soil hillcrests. Together, the diverse landforms in the park support a wide variety of plant communities and an exceptionally rich flora of over 300 species.

Dry forest communities dominated by mature white oak (*Quercus alba*) and red oak (*Q. borealis*) trees prevail on most of the rolling uplands in the park. Good examples of this community-type can be seen north of the upper picnic area and south of New Era Road in the extreme southern part of the park. Relatively young black oaks (*Q. velutina* and *Q. ellipsoidalis*) and ironwood (*Ostrya virginiana*) trees predominate on uplands in the northwestern part of the park which were subjected to heavy grazing and logging as late as the 1970's; interestingly, a rare orchid, oval ladies'-tresses (*Spiranthes ovalis*) occurs in Wildcat Den State Park only in a stand of disturbed upland woods in the "youngest" tract of land in the park. Black locust (*Robinia psuedoacacia*) is a dominant species on much of the ridge traversed by New Era Road and on the hillside west of the park office. In the early 1900's, this area was an open field used as a hayfield, pasture, and farmstead, but was heavily invaded by locust trees following the cessation of agricultural activity when these tracts became part of the park in 1927 and 1935. This opening is clearly visible on a 1938 aerial photograph of the park.

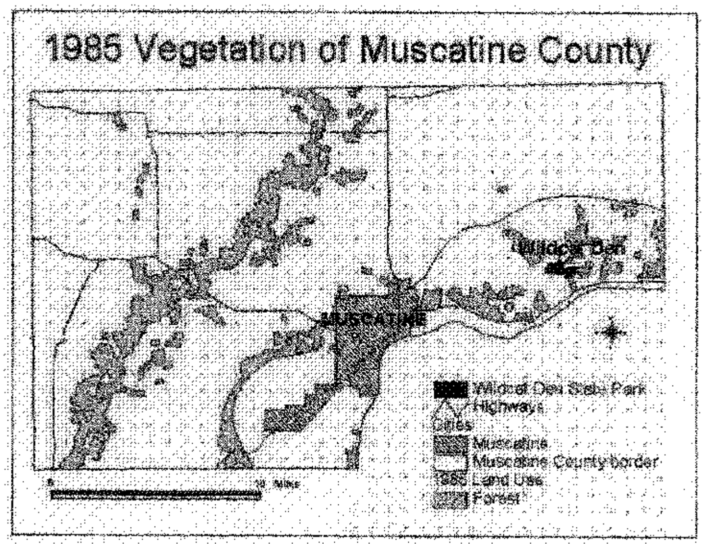


Figure 2. Forest cover in Muscatine County in 1985.

Mesophytic forest communities dominated by red oak, basswood (*Tilia americana*), and sugar maple (*Acer saccharum*) are found on the steep slopes in the park, especially where the aspect is north- or east-facing. The slopes and bluffs along Pine Creek and in the Devil's Punchbowl contain good examples of mature, mesic forest; in April and May, these areas are known for their showy display of spring wild-flowers. Additionally, these steep slopes support other, highly distinctive plant communities. The sandstone bluffs provide ideal habitat for the growth of many species of ferns, including walking fern (*Asplenium rhizophyllus*), polypody fern (*Polypodium virginianum*), cliff fern (*Woodsia obtusa*), and Goldie's fern (*Dryopteris goldiana*). Shining clubmoss (*Lycopodium lucidulum*) is another species that is restricted to the sandstone bluffs, but has not been reported since 1976. A rare plant associated with the slope forests is the forked aster (*Aster furcatus*).

The general appearance of the forest along the bluffs of Pine Creek photographed by Samuel Calvin in the 1890's is similar to the present-day forest (Fig. 3), suggesting that at least this portion of the park's forest has existed in a mature and undisturbed condition for over 100 years. Dr. Louis Pammel noted in 1919 that the previous owners had protectively managed the bluffland along Pine Creek:

> *"Wild Cat Den occupies an area of about 200 acres, belonging to the two Brandt sisters (Miss Clara and Miss Emma), Mr. Otto Fitchner, and Mr. Julius Welch. These people are to be highly commended for keeping the place in such fine condition. The wild plants have had an opportunity here to grow and the wild life has also been protected. In many of the scenic places I have visited in Iowa, much destruction has occurred, over-pasturing, cutting of timber, which has destroyed the beauty of the natural surroundings. However, in the case of Wild Cat Den in Muscatine County, the owners have protected the area in such a way that the original conditions still exist."*

The Brandt, Fitchner, and Welch tracts were acquired as the core of Wildcat Den State Park in 1926 and 1927 and remain one of the most interesting and most visited portions of the park today. A plaque commemorating the Brandt sisters can be viewed on the sandstone cliff adjacent to the "Wild Cat Cave" west of the lower picnic area.

Other special plant communities unique to the steep slopes include those developed on thin soils and on slumps. Colonies of eastern white pine (*Pinus strobus*) are frequent along the rim of the Devil's

Punchbowl where a high level of ambient light and exposed mineral soil favor the germination and growth of this shade-intolerant species. This species, which reaches its extreme southern limit in Iowa at Wildcat Den, is also the namesake of Pine Creek, which flows through the park. Rattlesnake plantain (*Goodyera pubescens*), an uncommon species of orchid, also occurs frequently on the forest floor beneath the white pines where matted pine needles create acidic soil conditions. A narrow ridge bordering the Devil's Punchbowl with thin gravelly soil supports another rare plant, black huckleberry (*Gaylussacia baccata*). Historical records suggest that this ridge also once supported a population of a plant species now extirpated from Iowa, grass pink (*Calopogon tuberosa*), last observed in the park in 1891.

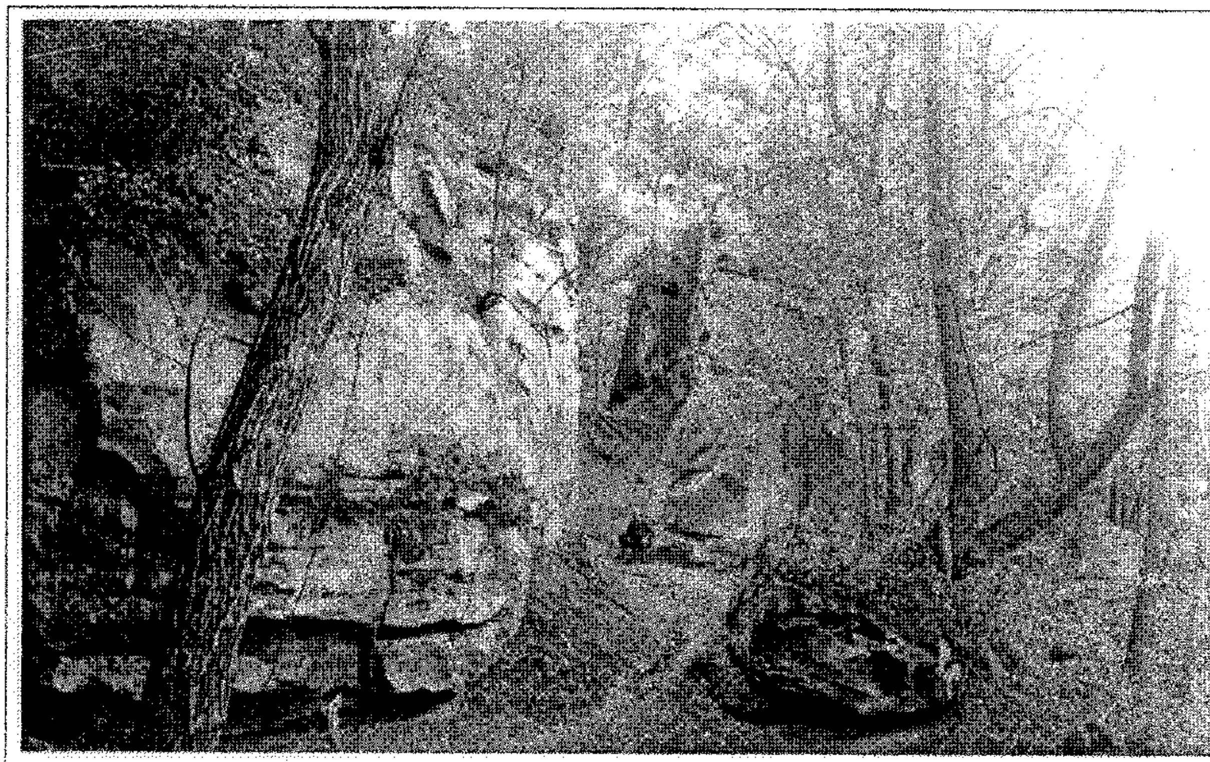


Figure 3. Typical vegetation in Wildcat Den near Steamboat Rock in 1898.

Many steep slopes in the park are unstable and have collapsed during extended periods of very heavy precipitation. The largest of these is located above Pine Creek between the park office and the Devil's Punchbowl. At this site, the sandstone bedrock is underlain by a shale and is actively undercut by a meander of Pine Creek. A large portion of the hillside slumped during a 10-inch rainfall event in 1990 and destroyed the mature forest previously occupying the site; the vegetation is now in very early stages of natural succession. This site can be viewed from the overlook along the trail immediately north of New Era Road.

The bottomland forests along Pine Creek are comprised of a heterogeneous mixture of tree species, including walnut (*Juglans nigra*), elms (*Ulmus americana* and *U. rubra*), hackberry (*Celtis occidentalis*), green ash (*Fraxinus pennsylvanicus*), cottonwood (*Populus deltoides*), and bur oak (*Quercus macrocarpa*).

The ecological management plan for Wildcat Den State Park is based upon an appreciation of the rich natural and cultural features of the park. A variety of active and non-intensive management activities are prescribed for different parts of the park. The mesophytic forests along the steep slopes and bluffs and the bottomland forests along Pine Creek will be managed primarily with a traditional, non-intensive ("passive") approach that permits natural succession to occur. In contrast, the white pine groves and related canyon rim habitats will be monitored to insure that the pine and huckleberry stands continue to thrive; although populations of these species seem adequate at the present time, removal of competing trees may be conducted if these species decline in the future due to natural successional trends. Although some stands will remain undisturbed, the overall management goal for the upland forest zone is to maintain or restore a forest community dominated by white oak, red oak, and associated species. Prescribed fire and thinning will be used to maintain the forest in an open condition representative of historic oak woodlands and savanna as well as to create conditions favorable for oak regeneration.

WILDLIFE AT WILDCAT DEN STATE PARK

Adapted from Wildcat Den State Park Ecosystem Management Plan
Iowa Department of Natural Resources
1996
Larry J. Wilson, Director

Introduction

Because of its size and natural diversity, Wildcat Den offers visitors opportunities to view a wide variety of wildlife. Birds that may be seen include several species of woodpeckers, including crow-sized pileated, warblers, vireos and summer nesting species such as eastern phoebes, wood thrushes, ovenbirds, and scarlet tanagers. The Iowa Wildlife Viewing Guide notes that "in May, as many as 20 species of warblers can be seen on a good day" and "in summer, nesting birds along the (interpretive) trail include eastern phoebes, wood thrushes, ovenbirds, and scarlet tanagers." Birds of prey include red-tailed hawks, great horned owls, screech owls, Cooper's hawks, and rough-wing hawks.

Wild turkeys provide park visitors with frequent viewing opportunities. Mammals include white-tailed deer, coyotes, raccoons, possums, red and gray fox, gray and fox squirrels, and rabbits. Amphibians include the American toad, tiger salamander, cricket frog, and the leopard frog. Other species that might be seen occasionally as they migrate through the area include the bald eagle, turkey vulture, and a variety of songbirds. Interesting species that may not be seen at all because of their habits are the flying squirrel and the bobcat. The Fairport area does not support as wide a variety of wildlife as the park proper. However, bald eagles are fairly frequent visitors to the Fairport vicinity.

Rare Animal Species

Rare animal species observed in the park include the Southern Bog Lemming (*Synaptomys cooperi*) and the Grass Pickerel (*Esox americanus*). The lemming is a special concern species last observed in "grassy fields" in the park in 1952. The Grass Pickerel is presently classified as a state-threatened fish species and was last observed in Pine Creek in 1981.

Wildlife Management Plan

State parks offer unique opportunities to demonstrate management activities that enhance wildlife diversity and provide for public viewing of a variety of wildlife species such as wild turkey, white-tailed deer, songbirds, and woodland mammals, as well as many of the smaller and inconspicuous, but no less interesting "critters" such as frogs, turtles, and snakes. At Wildcat Den, the management goal of restoring original upland forest species composition and subsequent management activities to achieve that goal will largely determine wildlife composition, distribution, and population levels. The goal of wildlife management activities at Wildcat Den is the continuance of self-sustaining and diverse woodland wildlife populations. The management goal of an oak-dominated upland forest will provide significant habitat and mast (acorns and nuts) production for a variety of woodland wildlife species. Several additional practices will act to enhance woodland wildlife viewing opportunities and habit, such as the clover field by the pine plantation, maintaining the pine stand, planting shrubs in the pubic use areas, and leaving dead trees for cavity nesters as long as they do not pose a threat to visitors.

White-tailed deer could have negative impacts on area vegetation if their population becomes too high. The major predators of deer have been extirpated from the state and hunting remains the principal population control tool. Although hunting is prohibited in Wildcat Den State Park, it appears that hunting on adjacent lands is currently keeping the local deer herd at a manageable level. Should this change, appropriate management activities, including hunting, should be considered. The planting of food crops at Wildcat Den State Park is not necessary to provide food for resident wildlife species and is probably not desirable in the absence of population controls for selected species such as deer.

Finally, woodland (and park) management activities should be accomplished with due regard for the various species of bats that may utilize the park. All nine species of bats that regularly occur in Iowa live in forest areas during the summer season. Although no formal surveys of bat populations have been conducted at Wildcat Den, the heavily wooded nature of the park, coupled with staff observation, point toward the presence of a diverse bat population. An effort should be made in the future to survey bat populations at Wildcat Den to document the presence and extent of specific species, to include the possible presence of the threatened Indiana bat. Whether or not a survey is done, because the park falls with in the Indiana bat summer range, any tree harvesting should follow IDNR *Guidelines for Protection of Indiana Bat Summer Habitat* (Iowa Department of Natural Resources, 1994).

Several species of bat use live and dead trees with loose bark for nursery roosts while others utilize cavities and the foliage of trees for roost sites. In general, woodland management should include protection or retention of the following:

1. Dead or dying trees with loose bark
2. Live or dead trees with cavities
3. Live trees with loose bark such as large silver maples and shagbark hickory

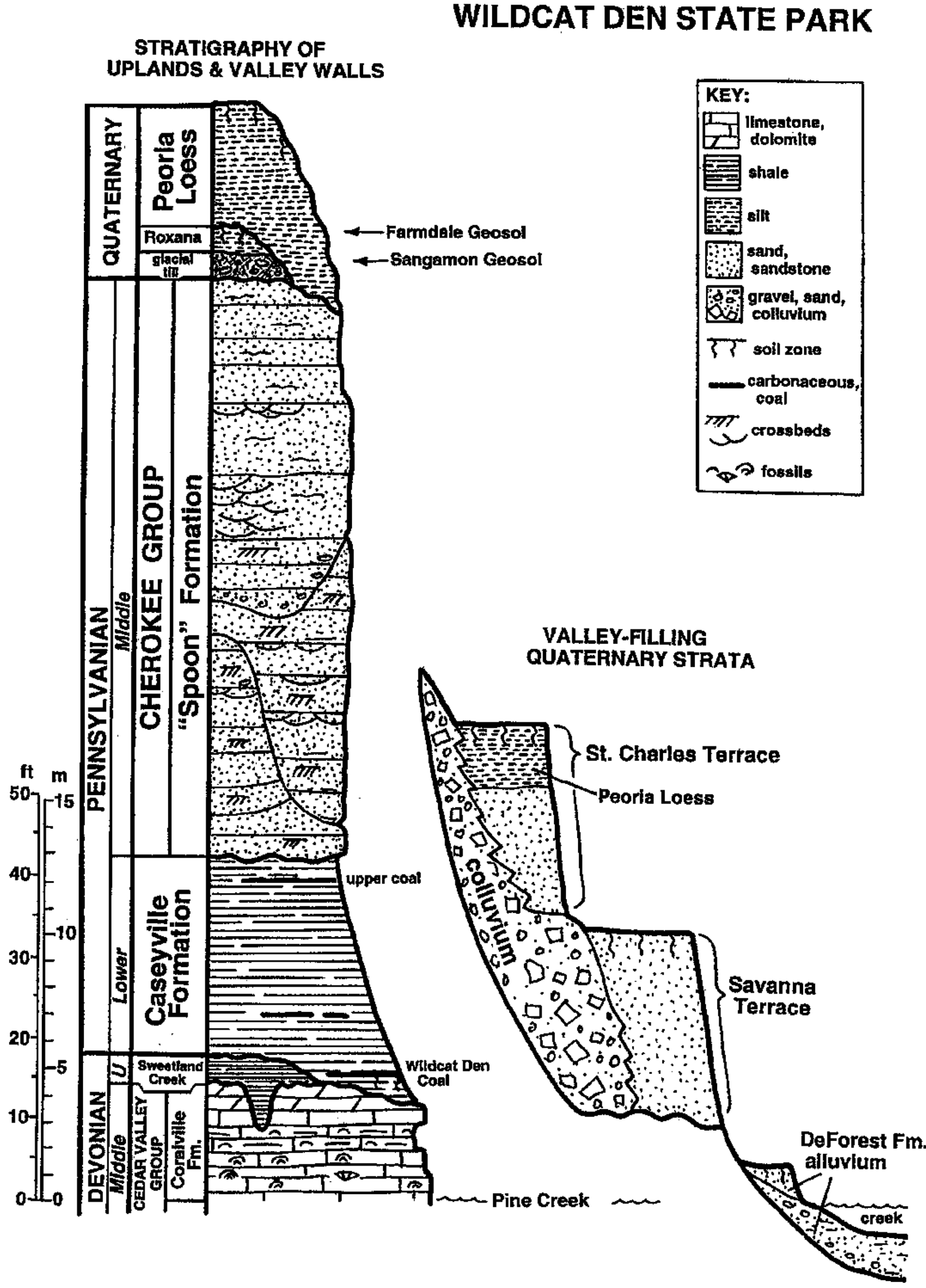
Information about bats is available in *A Guide to the Bats of Iowa* (Laubach and others, 1988). This IDNR publication is available from the Wildlife Diversity Program at the Boone Wildlife Research Station or the IDNR Central Office in the Wallace State Office Building in Des Moines.

References

Iowa Department of Natural Resources. 1994. Guidelines for protection of Indiana Bat summer habitat. Iowa Department of Natural Resources, Des Moines, IA. 4 pp.

Laubach, Christyna M., John B. Bowles, and Rene Laubach. 1988. A guide to the bats of Iowa. Nongame Technical Series #2 1994, Iowa Department of Natural Resources, Des Moines, IA. 32 pp.

FIELD TRIP STOPS



Stratigraphic column of Paleozoic and Quaternary strata at Wildcat Den State Park, Muscatine County, Iowa.

STOP 1. INTRODUCTION TO THE NATURAL HISTORY OF WILDCAT DEN STATE PARK

The first stop on this GSI field trip examination of the Natural History of Wildcat Den State Park is at the base of the sandstone bluff, below the Brant Memorial (Fig. 1-1) and just west of the park's north picnic area. At this stop the trip leaders will provide a brief overview of what will be seen as the field trip progresses. Richard Heathcote (GSI President) will welcome the trip participants and describe some of the day's activitries; Ken Hyman (DNR, Wildcat Den Park Ranger) will discuss the park history; Brian Witzke and Art Bettis (DNR, Geological Survey Bureau) will describe the Paleozoic and Quaternary geology; Susan Snow (Office of State Archaeologist) will describe the pre-history; and John Pearson (DNR, Parks, Recreation, and Preserves) will discuss the park's vegetation.

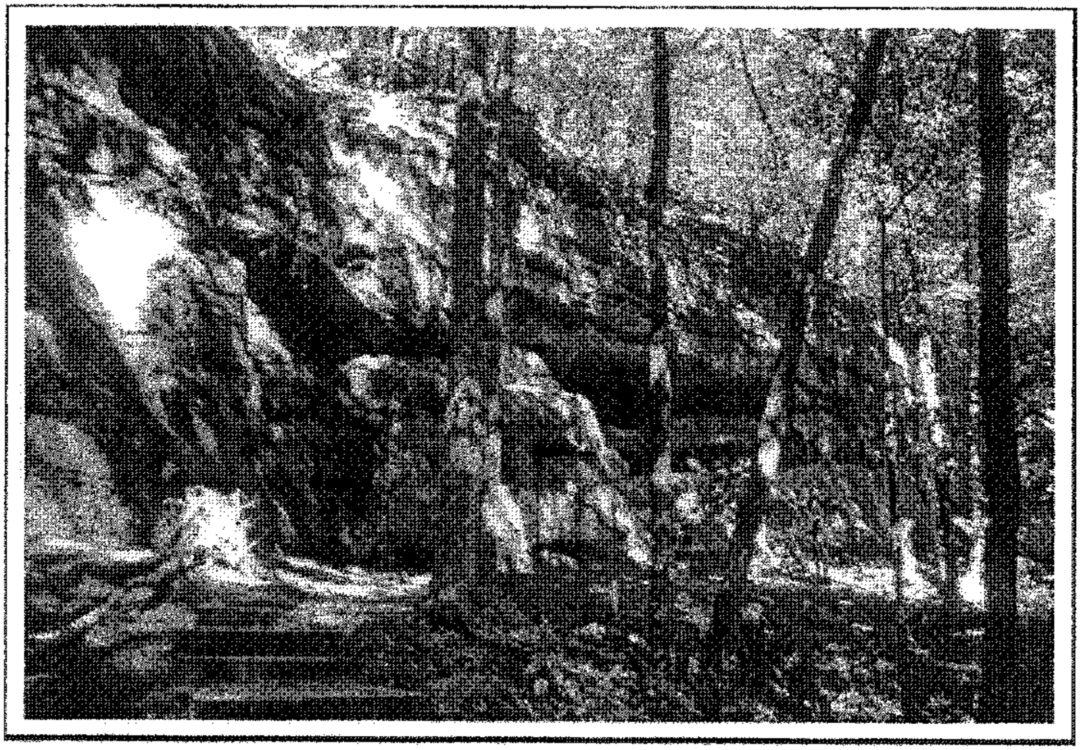


Figure 1-1. Sandstone bluff at the Brandt Memorial near the picnic area in the north end of Wildcat Den State Park.

STOP 2: GEOLOGY AND ARCHAEOLOGY OF THE ROCK SHELTER NORTH OF THE BRANDT MEMORIAL

Archaeology
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Office of the State Archaeologist
The University of Iowa
302 Eastlawn
Iowa City, IA 52252

Geology
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Iowa Department of Natural Resources
Geological Survey Bureau
109 Trowbridge Hall
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Pre-History of the Wildcat Den State Park Area

Two caves located in the vicinity of the Brandt Memorial, and Steamboat Rock may have been utilized by Native Americans, although no investigation for artifacts has been undertaken. It is known from the investigation of sites outside the park (for details see the overview of the archaeology of Wildcat Den State Park, page 33) that native people lived in Iowa from ca. 12,000 years ago to the recent past. Over 17,000 archaeological sites have been recorded in the state, ranging from the very earliest Paleo-Indian peoples' campsites to World War II training grounds. The known sites represent only a small portion of all of the archaeological sites within the state. Many archaeological sites are under extreme pressure from activities such as farming, erosion, and development. State parks and preserves provide protection for archaeological sites within their boundaries. This protection makes state parks unique areas to study these archaeological sites within their original environments with minimal disturbance.

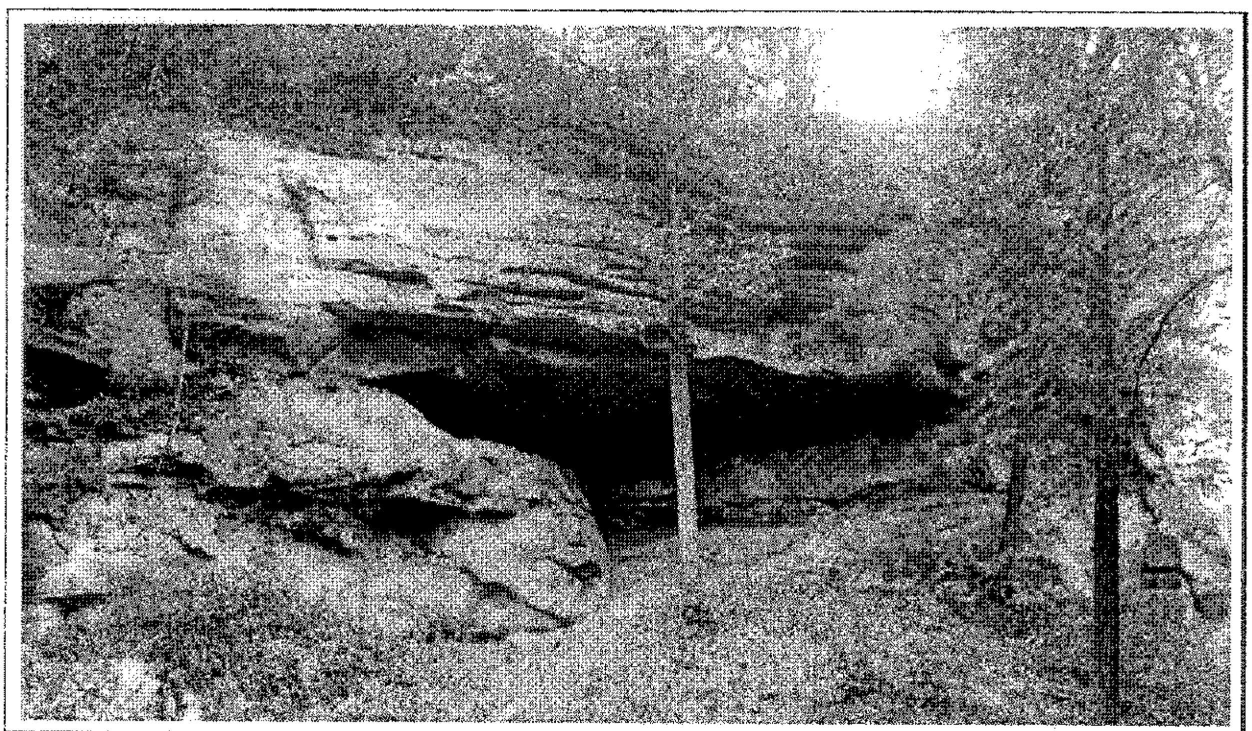

Figure 2-1. The rock shelter north of the present location of the Brant Memorial as it appeared about one hundred years ago. Photo by Samuel Calvin, 1898, from University of Iowa Calvin Collection.

Geology of the Rock Shelter

The Pennsylvanian Cherokee Group sandstone exposures at the Rock Shelter section (near the Brandt memorial plaque) and along the extensive cliff sections to the south provide an exceptional example of multi-storied channel deposition by an aggrading large river system. Major episodes of fluvial channel incision into underlying sedimentary deposits, with local relief of up to 25 m, is recorded by reactivation surfaces which truncate underlying strata (see Figure 3 in discussion of *Pennsylvanian Rock Strata of Wildcat Den State Park*, page 24). The development of the main overhanging rock shelter is related to one of these surfaces, where a swale along a reactivation surface is immediately overlain by a deposit of mud-clast conglomerate that weathered out preferentially in relation to the enclosing pure sandstone strata. To the north of the main rock shelter is a smaller sandstone cave in a higher stratigraphic position. This feature appears to have developed by preferential weathering along two inclined rock fracture surfaces. For more information on these rocks, see discussion of *Pennsylvanian Rock Strata of Wildcat Den State Park* (page 21).

STOP 3: GEOLOGY OF THE CHEROKEE GROUP SANDSTONE AT STEAMBOAT ROCK SANDSTONE BLUFF AND THE ARCHAEOLOGY OF GRAFFITI IN THE "FAT MAN'S SQUEEZE"

Geology
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Geological Survey Bureau
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Iowa City IA 52242-1319

Archaeology
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The University of Iowa
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Iowa City, IA 52252

Geology of Steamboat Rock

The sandstones that form the dramatic bluffs at Wildcat Den State Park (Fig. 3-1) have traditionally been referred to the DesMoinesian Spoon Formation of Illinois, an inference based of their framework grain compositions and stratigraphic architecture, although no data are currently available to confirm the correlation of these units. These sandstones are notably micaceous, and petrographic analyses have shown that they are feldspathic litharenites, with rock fragments of sedimentary, metamorphic, and igneous derivation. Compositional characters like these are certainly consistent with data from the Desmoinesian Spoon Formation, and its Iowa correlate the Floris Formation (see Figure 1 in the discussion of the *Pennsylvanian Rock Strata of Wildcat Den State Park*, page 21).

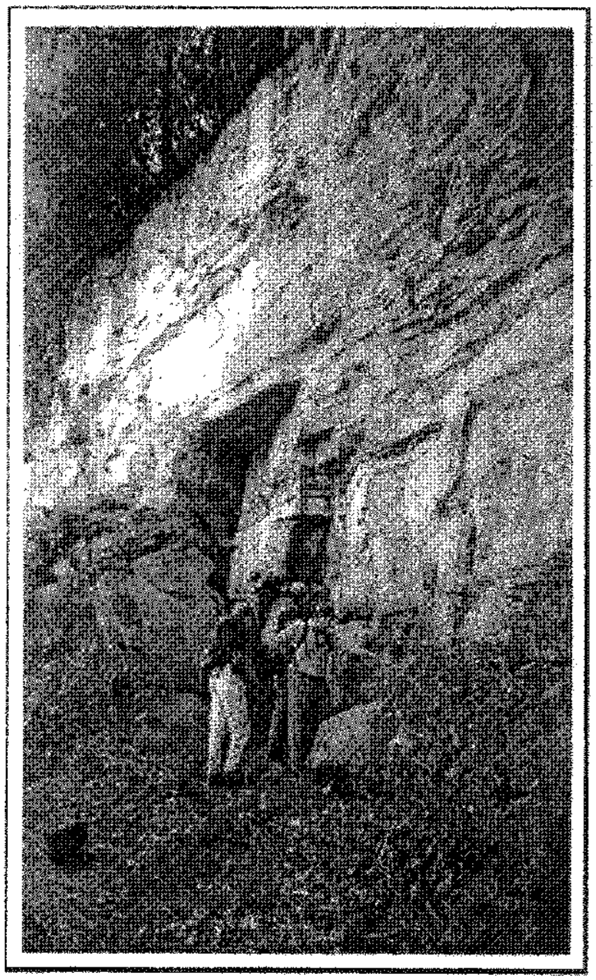

Figure 3-1. Pennsylvanian Cherokee Group Sandstone at Steamboat Rock.

Cross bedding and other sedimentary structures are very well displayed in the sandstone exposures of the park. These have served as the basis for paleocurrent studies, which consistently have shown southwestward sedimentary transport directions.

Stratigraphic changes in sedimentary style are evident, with decimeter to meter-scale planar cross bedding dominating the lower portions of the section. These include several stacked sets of meter-scale tabular crossbeds capped by shallow decimeter-scale trough cross-bedding. Exposures of this part of the section, viewed in and near the Devil's Punchbowl, display tabular cross beds with convolute and overturned laminae. Care must be taken in this area to distinguish between iron-cemented cross bedding and iron-cemented liesegang banding that cross-cuts bedding at high angles. Above the major channel-bounding reactivation surfaces at both the main cliff and the rock shelter sections, tabular cross bedding sets pass vertically into meter-scale trough festoons that are best observed in the upper reaches of the Devil's Lane. Higher yet, plane-bedded sandstones with very low-angle cross laminae are very common in the uppermost parts of the sandstone section. For more information on these rocks and references see *Pennsylvanian Rock Strata of Wildcat Den State Park* (page 21).

Graffiti Archaeology at Fat Man's Squeeze

The passageway to the north of Steamboat Rock has been called the "Devil's Lane". If one passes up the Devil's Lane, a second, narrower passageway joint from the right. This narrower passage has been named the "Fat Man's Squeeze". The sandstone formations of Steamboat Rock and Fat Man's Squeeze, in particular, as well as the other sandstone cliffs at the park have been subject to almost 150 years of "name carving" or graffiti. The carvings date as early as 1861 and some of the earliest inscriptions may have been buried by erosional deposits along the trail which leads to these formations.

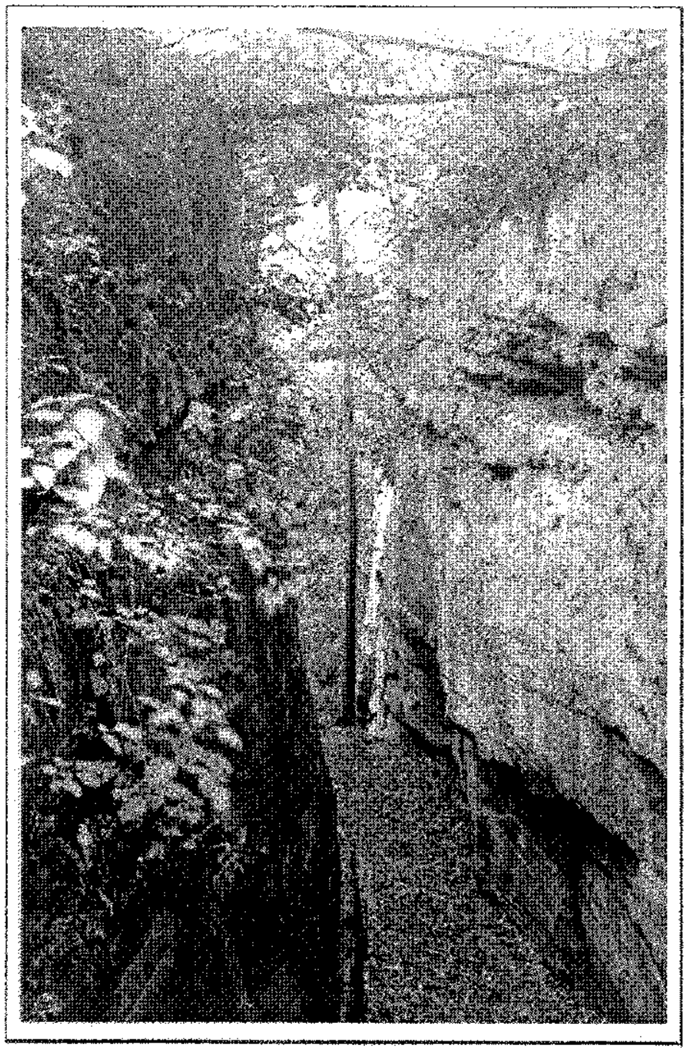

Figure 3-2. View down the "Devil's Gulch" at Steamboat Rock. See front cover of guidebook for view up the gulch. Photo by Samuel Calvin, 1898, from University of Iowa Calvin Collection.

STOP 4: EXPOSURE OF CASEYVILLE FORMATION SHALE

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Geological Survey Bureau
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Iowa City IA 52242-1319

Caseyville Formation

Field trip Stop 4 is an exposure of shales of the Pennsylvanian Caseyville Formation in a small, unnamed creek just beyond the second bridge on the trail. The Caseyville Formation is the oldest Pennsylvanian unit in the Upper Mississippi Valley region. Thicknesses of up to 30 meters of Caseyville strata are known from the Quad Cities region, and the 29 meters exposed at Wyoming Hill represents the most complete section known in the area. The type section of the Caseyville was designated in the southern portion of the Illinois Basin in western Kentucky, and the unit is overlapped northward by younger Pennsylvanian rocks in Illinois. The Caseyville exposures in Muscatine County and the Quad Cities area represent a northern outlier of the formation. Caseyville strata in Wildcat Den State Park consist exclusively of carbonaceous shales and coals, both with abundant fossil plant material. Most of the plant material is unidentifiable, but specimens of *Sigillaria, Lepidophlois,* and *Mariopteris* are known from the park. Elsewhere in the area, the Caseyville Formation has produced an abundant and diverse fossil flora.

Sedimentologic evidence for marginal marine deposition of the Caseyville has also recently been developed at the nearby Wyoming Hill section. The Wildcat Den Coal at Wyoming Hill is immediately overlain by a finely-laminated white siltstone unit containing carbonized plant fossils and marcasite nodules. This unit buries upright *Lepidodendron* trees that were rooted in the underlying Wildcat Den Coal. Analysis of rhythmic variations in the thickness of sub-millimeter-scale laminae from this unit have shown it to be tidally influenced. In view of the rapid sedimentation recorded by burial of upright logs rooted in the underlying coal, the unit is now interpreted as an estuarine fill that recorded transgressive flooding of a river valley. For more information on these rocks and references see *Pennsylvanian Rock Strata of Wildcat Den State Park,* beginning on page 21 of this guidebook.

A limited number of trip participants who are interested in seeing a more complete section of Caseyville shale, and can endure a rigorous hike, will be invited to trek to Stop 8 in the early afternoon.

STOP 5: CHEROKEE GROUP SANDSTONES, CROSS-BEDDING, AND LIESEGANG AT THE *DEVIL'S PUNCHBOWL*

Greg A. Ludvigson, Brian J. Witzke, and Robert M. McKay
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Field trip Stop 5 is the *Devil's Punchbowl* (Fig. 5-1), a bowl-shaped feature sculpted by the erosive forces of the water of an intermittent creek and its sediment load cascading over the escarpment from the bluff above. This feature is one of Wildcat Den State Park's premier attractions, and it showcases some of the interesting features of the Cherokee sandstones. This area of the park provides an excellent opportunity to observe cross-bedding and Liesegang bands in the sandstones.

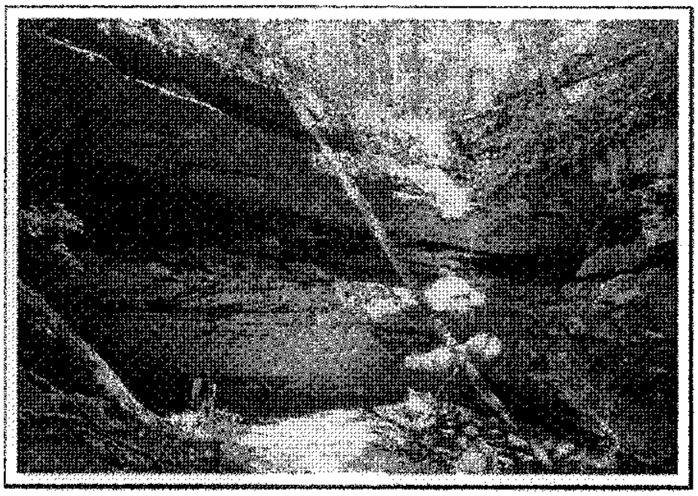

Figure 5-1. The *Devil's Punchbowl.*

Cherokee Group Sandstone

Cross bedding (Fig 5-2) and other sedimentary structures are very well displayed in the sandstone exposures of the park, especially in the area around the *Devil's Punchbowl*. These have served as the basis for paleocurrent studies, which have generally shown southwestward sedimentary transport directions.

Stratigraphic changes in sedimentary style are evident, with decimeter to meter-scale planar cross bedding dominating the lower portions of the section. These include several stacked sets of meter-scale tabular crossbeds capped by shallow decimeter-scale trough cross-bedding. Exposures of this part of the section, viewed in and near the Devil's Punchbowl, display tabular cross beds with convolute and overturned laminae. Care must be taken in this area to distinguish between iron-cemented cross bedding and iron-cemented liesegang banding that locally cross-cuts bedding at high angles. For more information on the Cherokee Group sandstones and references see *Pennsylvanian Rock Strata of Wildcat Den State Park* beginning on page 21 of this guidebook.

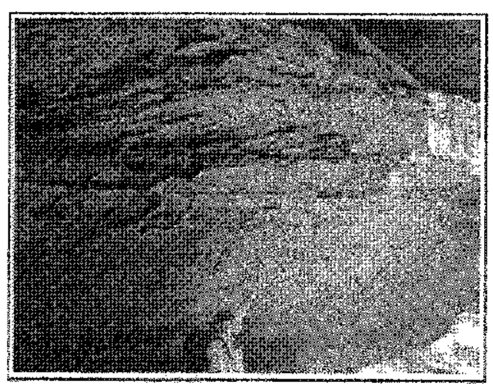

Figure 5-2. Greg Ludvigson points out cross-bedding in the *Devil's Punchbowl.*

The Origin of Cross Bedding

by Robert M. McKay

Early in the educational studies of any geologist or observant outdoor enthusiast one learns about the peculiar effects of water flowing across a loose bed of sand. At a threshold velocity, the frictional stress imposed on the loose sand by the fluid flow results in grain movement along the sand bed. The grains initially move by combinations of rolling and bouncing, so called traction movement, while at higher flow velocities the grains may also move as particles suspended in the fluid. Soon after sustained grain movement is initiated, the configuration of the bed rapidly changes from being featureless to being covered by distinctive bedforms.

For fine to medium-grained sands the initial bedform that appears is the familiar straight-crested small ripple. With increasing flow velocity the configuration of the bed changes systematically to ripples with sinuous crests and then to larger ripples that have been called dunes or sandwaves. At even higher flow velocities the large ripple or dune-shaped bedforms disappear and are replaced by a flat or plane-shaped bed configurations.

While ripple and dune-shaped bedforms can be readily observed on modern river sandbars during low water conditions, these same forms are rarely preserved in the rock record. What is very commonly preserved however is the distinctive internal structure of those ripples and dunes. The most commonly described internal structure of such bedforms has long been called cross-bedding (Fig. 5-3) or cross-stratification, so named because the laminae are inclined at various angles or crossways to the general horizontal orientation of the sedimentary bedding.

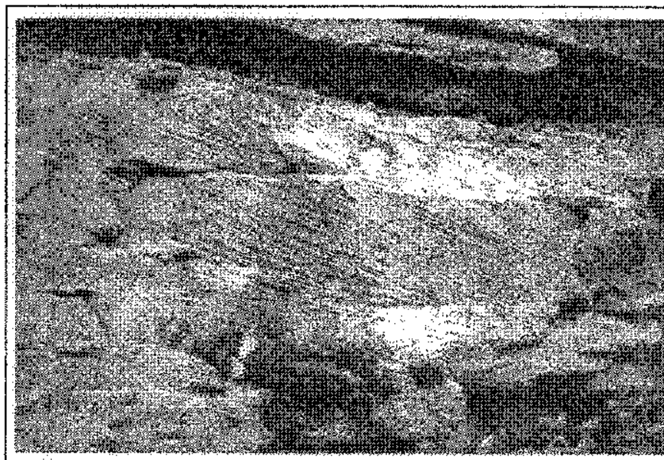

Figure 5-3. Cross-bedding in Cherokee Group sandstones at Wildcat Den State Park

A ripple migrates laterally as a three dimensional form by grains moving up the upstream or stoss slope of the ripple and accumulating on the down flow side or lee slope of the ripple. The inclined lamina within a cross-bedded stratum, usually called cross-lamina or foreset lamina, result from the accumulation of grains on the lee side of the ripple or dune either by avalanching downward from the ripple crest or by falling out of suspended flow. After the flow clears the crest of the ripple, portions of it separate into downward directed eddies that scour and erode the bed in front of the advancing ripple. This bed-scouring eddy action maintains the trough immediately in front of the ripple.

During times of limited sand supply, groups or so-called "trains" of isolated ripples will cover the bed, but there will be no upward building or aggradation of the depositional bed. However, if sand supply is adequate the depositional bed will aggrade by ripples climbing obliquely up and over the stoss slope of the ripple immediately down current. The angle at which the ripple climbs over the next ripple downstream is appropriately called the "angle of ripple climb". It is this angle of climb that determines how much of the foreset laminae in the down-stream ripple will be eroded by the scouring action taking place in the trough of the upstream climbing ripple.

The stoss side of the average ripple has a slope of about ten degrees, so in general, erosion of that slope will occur by an upcurrent ripple climbing the stoss slope at an angle of less than ten degrees while the stoss slope and its thin laminae will be preserved if the next ripple climbs at an angle greater than approximately ten degrees. The majority of ripples and dunes climb at angles less than ten degrees and erode a significant portion of the underlying bedform, so the portion of the ripple likely to be preserved in the rock record is the internal foreset lamina or cross-bedded part.

The ubiquitous cross bedding preserved in the sandstone layers of the Wildcat Den channel sandstone complex record the formation and the down current migration of dune size bedforms within a river channel supplied with large amounts of sand. Sand supply in this fluvial system certainly was abundant but not so abundant that dune bedforms could climb at angles great enough to preserve stoss side laminae. Numerous sets of foreset laminae or cross beds represent only the fraction of the original dune that was not eroded by the passing of the following dune, so dune height was probably significantly greater than preserved foreset thickness. Some of the dunes in this channel may have attained heights of two meters or more, and at that scale in size would be referred to as sandwaves.

The Origin of Liesegang Rings

by Raymond R. Anderson

Liesegang (pronounced Lee'-sa-gang) rings or band are roughly concentric, omnidirectional (3-dimentional) hematite or limonite bands that are frequently deposited in porous rocks, most commonly sandstones. These rings may also be formed as planar features in fractures or joints in less porous rocks. They derived their name from R.E. Liesegang, who first documented the features in 1896, and who recognized them as diffusion phenomena due to a periodic alteration between solution mobility (diffusion) and supersaturation (nucleation and precipitation). This process was described in part by Fairbridge (1983). He noted that under certain conditions of oxidation, generally epidiagenetic, rainfall (containing CO_2 and O_2) enters the groundwater system where it picks up additional carbon dioxide and calcium (Ca) from dissolving carbonate rocks such as limestone ($CaCO_3$) or from carbonate that cements sandstone. This carbonate and oxygen rich groundwater can liberate sulphuric acid (H_2SO_4) from pyrite or marcasite (FeS_2) found in coaly organic-rich layers in the Cherokee sandstones. Fairbridge noted that this reaction also produces iron sulfate ($FeSO_4$):

$$2\ FeS_2 + 2\ H_2O + 7\ O_2 \bullet\ 2\ FeSO_4 + 2\ H_2SO_4$$

The $FeSO_4$ then reacts with the calcium in the groundwater to produce iron oxides and in some cases gypsum ($CaSO_4$).

$$4\ FeSO_4 + 4Ca + 3\ O_2 \bullet\ 2\ Fe_2O_3 + 4\ CaSO_4$$

The gypsum may or may not form, if not the SO_4^{-2} may remain in the water.

This process is still in action in the park. Evidence can be seen as the iron-rich groudwater seeps observed throughout the park.

Although this is probably the process responsible for most Liesegang rings, the phenomonon can also be created in other ways. Similar banding has been reported in syndiagenetic marine and fresh water sediments and in syndiagenetic cherts.

Liesegang rings are easilly confused with other features in rocks, such as cross-bedding, slumping, load casts, and and concretions.

References

Fairbridge, R.W., 1983, Syndiagenesis-Anadiagenesis-Epidiagenesis: Phases in Lithogenesis. *in* Larsen, G., and Chilingar, G.V. (eds.), *Diagenesis in Sediments and Sedimentary Rocks, 2*, Developments in Sedimentology 25B, Elsevier Scientific Publishing Company, Amsterdam, p. 17-114.

STOP 6: THE VEGETATION OF WILDCAT DEN STATE PARK

John Pearson, Plant Ecologist
Parks, Recreation & Preserves Division
Iowa Department of Natural Resources
Des Moines, IA 50319

Stop 6 at the viewing platform above the *Devil's Punchbowl*, provides an opportunity to observe and discuss the forest vegetation of Wildcat Den State Park.

Most of the park contains natural forest covering a landscape with a surprising diversity of topography and substrate. Gently rolling uplands mantled with deep loess supporting dry forests are found in the western half of the park while level alluvial deposits along Pine Creek supporting bottomland forest prevail over much of the eastern half. Weaving between these landforms along the west bank of Pine Creek and its tributary ravines is a belt of steep slopes supporting a mesophytic forest community. The steeply sloping land in the park contains several additional features that create special habitats for many plants, including sandstone bluffs, slumps, and thin-soil hillcrests. Together, the diverse landforms in the park support a wide variety of plant communities and an exceptionally rich flora of over 300 species.

Dry forest communities dominated by mature white oak (*Quercus alba*) and red oak (*Q. borealis*) trees prevail on most of the rolling uplands in the park. Good examples of this community-type can be seen north of the upper picnic area and south of New Era Road in the extreme southern part of the park. Relatively young black oaks (*Q. velutina* and *Q. ellipsoidalis*) and ironwood (*Ostrya virginiana*) trees predominate on uplands in the northwestern part of the park which were subjected to heavy grazing and logging as late as the 1970's; interestingly, a rare orchid, oval ladies'-tresses (*Spiranthes ovalis*) occurs in Wildcat Den State Park only in a stand of disturbed upland woods in the "youngest" tract of land in the park. Black locust (*Robinia psuedoacacia*) is a dominant species on much of the ridge traversed by New Era Road and on the hillside west of the park office.

Mesophytic forest communities dominated by red oak, basswood (*Tilia americana*), and sugar maple (*Acer saccharum*) are found on the steep slopes in the park, especially where the aspect is north- or east-facing. The slopes and bluffs along Pine Creek and in the Devil's Punchbowl contain good examples of mature, mesic forest; in April and May, these areas are known for their showy display of spring wildflowers. Additionally, these steep slopes support other, highly distinctive plant communities. The sandstone bluffs provide ideal habitat for the growth of many species of ferns, including walking fern (*Asplenium rhizophyllus*), polypody fern (*Polypodium virginianum*), cliff fern (*Woodsia obtusa*), and Goldie's fern (*Dryopteris goldiana*). Shining clubmoss (*Lycopodium lucidulum*) is another species that is restricted to the sandstone bluffs, but has not been reported since 1976. A rare plant associated with the slope forests is the forked aster (*Aster furcatus*). For more information on the Cherokee Group sandstones and references see *The Vegetation of Wildcat Den State Park*, beginning on page 37 of this guidebook.

STOP 7: DEVONIAN STRATA EXPOSED BENEATH THE BRIDGE ON THE NORTH END OF THE NORTH PICNIC AREA

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Field trip Stop 7 is an examination of Middle and Upper Devonian limestone and shale exposures under the bridge at the north end of the north picnic area. The section at the stop is described below. For more information on these rocks and references see *Devonian Rocks of Wildcat Den State Park,* beginning on page 11 of this guidebook.

WILDCAT DEN STATE PARK
Bridge Section (below bridge over Pine Creek)
NW NE NW SW sec. 17, T77N, R1E
Unit Descriptions

UPPER DEVONIAN
Sweetland Creek Shale

Unit 5. Shale, green-gray to medium gray, with thin-bedded siltstone; fills in irregular depression that cuts across units 3 and 4 of the Coralville Formation. Shale and siltstone are poorly preserved in fill. Fill also contains blocks of sparsely fossiliferous dolomite of the upper Cedar Valley Group; may include Pennsylvanian shale fills (Caseyville Formation); variable thickness.

MIDDLE DEVONIAN
Cedar Valley Group
Coralville Formation

Unit 4. Limestone, fine- to coarse-grained packstone to grainstone, similar to below; common large crinoid debris and stem pieces; common large brachiopods, variably abraded to whole shell; brachiopods include *Pseudoatrypa*, *Strophodonta* (to 4 cm); upper surface displays large subhorizontal thalassinoid burrows; gastropod noted; observed thickness – 30 to 35 cm.

Unit 3. Limestone, fine- to coarse-grained packstone, ledge former, laterally splits into irregular beds 5 to 15 cm thick; very crinoidal with common to abundant large crinoid stem segments; scattered to common brachiopods, shells variably abraded and broken to whole-shell, whole-shells locally concentrated in lenses or stringers; brachiopods include *Pseudoatrypa*, *Independatrypa*, large *Strophodonta*, *Cranaena*, *Athyris*; thalassinoid burrow prods noted; gradational above, locally with stylolitic surface at top; thickness – 55 cm.

Unit 2. Limestone, fine- to coarse-grained packstone; brachiopods and coarse crinoid debris generally increase upward; brachiopod shells are broken and abraded in upper part; brachiopods include mostly *Pseudoatrypa*, scattered large *Orthospirifer*, *Strophodonta*; thalassincoid burrow prods noted; argillaceous parting at top of unit; thickness – 25 cm.

Unit 1. Limestone, fine-grained packstone, slightly dolomitic, thin to medium bedded (5-15 cm thick), light gray to light orange gray (oxidized); scattered to common fine- to medium-grained crinoid debris; scattered horizontal burrows; scattered to common brachiopods, some in lenses or stringers, *Pseudoatrypa*, *Strophodonta* (to 4 cm), *Orthospirifer*; small *Favosites* (3 cm) noted near top; upper surface with lumpy irregular horizontal burrows prods, nautiloids noted at top (orthoconic form,"*Acleistoceras*"); observed thickness – 65 cm.

STOP 8: EXPOSURE OF CASEYVILLE FORMATION SHALE ALONG PINE CREEK

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After lunch a limited number of trip participants will be selected to hike to Stop 8. At this stop participants will be able to examine the most complete section of Caseyville Formation available in Wildcat Den State Park. The section is accessed via an unimproved trail, and to make the trek participants will have to scramble over several large fallen trees. The hike is rigorous, and only an enthusiastic few will be asked to participate.

Participants on the trek to Stop 8 will hike south for about ¾ mile along Pine Creek to the Caseyville exposure. After viewing and discussing the section with trip leaders, they will then continue about an additional ½ mile to the eastern end of the park where they will join the other field trip participants for the remainder of the trip stops. Stop 8 participants will be ferried back to the northern end of the park to retrieve their cars when the field trip concludes.

For information on Caseyville Formation rocks please refer to *Pennsylvanian Rock Strata of Wildcat Den State Park,* beginning on page 21 of this guidebook.

STOP 9: PINE CREEK GRIST MILL, WILDCAT DEN STATE PARK

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Introduction

Stop 9 provides participants with an opportunity to tour and discuss the Pine Creek Grist Mill with Park Ranger Ken Hyman and Susan Snow of the Office of the State Archaeologist. The Pine Creek Mill, one of Wildcat Den State Park's major attractions, is one of the finest examples of mid-nineteenth century mills left in the country. The Iowa Department of Natural Resources is working to slowly restore the mill to its original condition. The Pine Creek Grist Mill has been placed on the National Register of Historic Places. A restored "turn of the century" schoolhouse, the Melpine Country School, is located near the mill and will also be open for tours by trip participants.

In Pine Creek Grist Mill

In the spring of 1834 Benjamin Nye, Muscatine County's first white settler, arrived and built a cabin on Pine Creek, just below what is now Wildcat Den State Park. Nye went to St. Louis to purchase a supply of goods to open a store at the mouth of Pine Creek, where he traded primarily with Indians. In the fall of 1834, having built a place to live and established a business, Nye returned to Ohio to bring his wife and two daughters to Pine Creek.

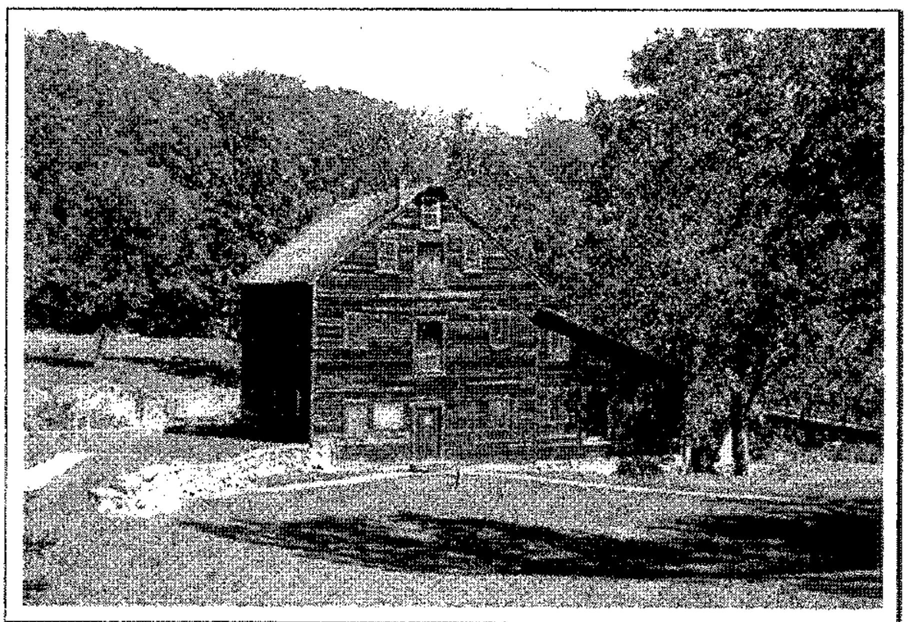

Figure 9-1. The Pine Creek Grist Mill located near the park office is one of Wildcat Den State Parks major attractions

Benjamin Nye was only the first of many settlers and the area quickly filled with pioneers. In the next few years, Nye was busy building mills. The first mill he built was a sawmill located about one half mile below the present day boundary of the park. The mill, however, was built too close to the Mississippi River and whenever there was high water on the river, the water would back up on his dam and prevent sufficient fall to turn the mill wheel. To cure this problem, Nye moved his sawmill to a location that is thought to be just upstream from the present mill and within the boundaries of the present day park.

Much of the original forest covering the park land was cut to supply logs to the sawmill. Most of the large oak trees that now grow in the park sprouted after this episode of logging. In 1837 Ben Nye built his first grist mill to grind the crops grown by the burgeoning tide of settlers. It is believed this grist mill was built across from the sawmill.

As the settlers cleared more land and began breaking the prairie, there was increased demand for milling. Nye's first grist mill was outgrown and in 1848 he built a larger mill with three runs of burr stones. This larger mill was built just downstream from his earlier grist mill and sawmill. This larger mill built in 1848 is the mill that is preserved today in Wildcat Den State Park, and has become known as the Pine Creek Grist Mill. The two earlier mills are gone; and without an archaeological search, it is impossible to pinpoint their exact location. From the time of its construction until early in this century, the Pine Creek Grist Mill was the center of the local farming community. It was the destination of the crops raised and also a social center of the community. Through the years from 1850 to 1900, the various owners of the mill installed more and newer milling equipment. The water wheel was replaced with a turbine and a steam engine was installed for use during periods of low water. By 1900 the enclosed an example of various milling equipment from the stone milling era to the modern steel roller milling era. But with increasing ease of transportation from the railroads towards the end of the nineteenth century, the water powered mill was slowly displaced by giant industrialized milling concentrated in larger cities. The Pine Creek Grist Mill slowly lost business until by 1923 the business was dissolved. The structure and surrounding land was purchased by the State of Iowa in 1927 as part of Wildcat Den State Park. This purchase effectively preserved the mill and its equipment.

Melpine Country School

The park also contains a second historical structure, the Melpine Country School. The Friends of Melpine School were organized to restore the Melpine Country School. The Friends of Pine Creek Grist Mill were organized to restore the old mill. The goal of this effort is to develop the two historic structures into living history sites, while preserving an important part of the heritage of Iowa.

STOP 10: DEVONIAN STRATA EXPOSED NEAR THE PINE CREEK GRIST MILL

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Introduction

Field trip Stop 10 provides another opportunity to examine additional strata of the Middle Devonian Coralville Formation on the east bank of Pine Creek just south of the Pine Creek Grist Mill dam (Fig. 1). The rock section present at this stop is described on the following pages. For more information on these rocks and references see *Devonian Rocks of Wildcat Den State Park*, beginning on page 11 of this guidebook. Rocks from this exposure were apparently used to construct the mill pond dam and the foundation of the Pine Creek Grist Mill

To reach the Devonian exposure from the mill side of Pine Creek, participants must cross an old iron bridge. This bridge is a Pratt truss iron bridge, erected about 1883.

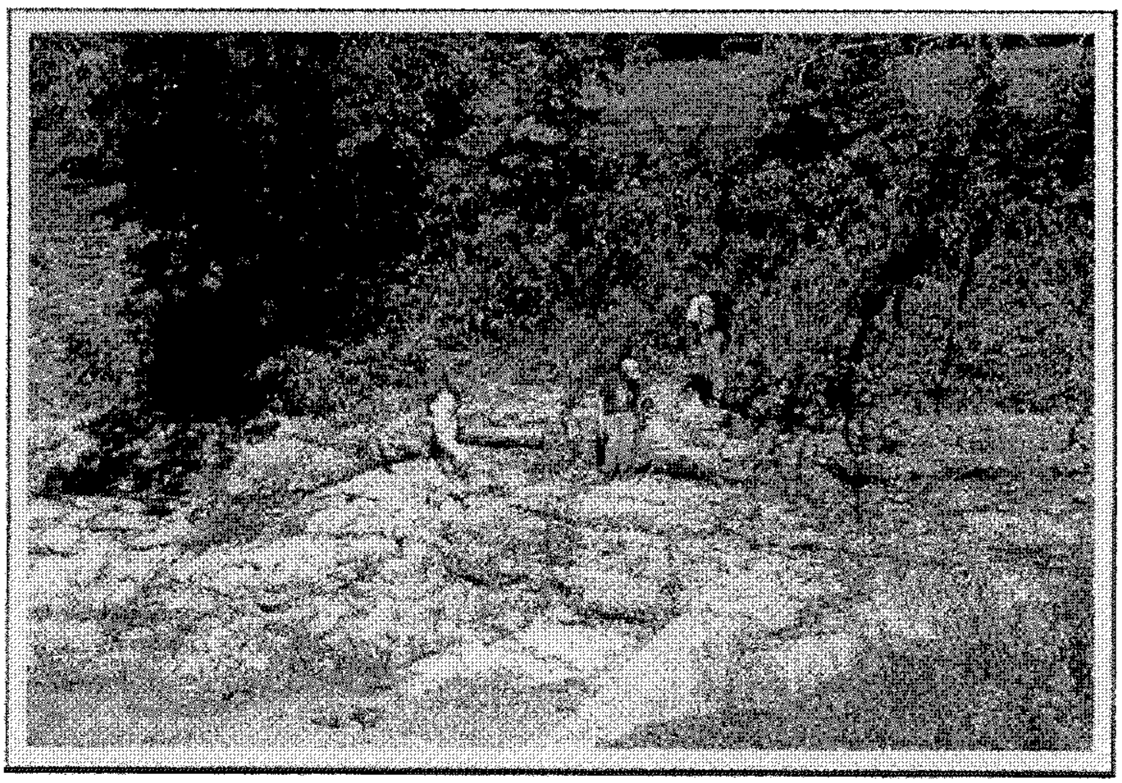

Figure 10-1. Devonian Coralville Formation limestone exposed below Pine Creek Grist Mill.

WILDCAT DEN STATE PARK
Old Mill Sections
SW SE SE sec. 17, T77N, R1E
Unit Descriptions

MIDDLE DEVONIAN

Cedar Valley Group

Coralville Formation

"Upper Dolomitic Interval"

Unit 8. Dolomite, calcitic, dark yellow brown, irregular to wavy bedded (3 to 20 cm thick); sparsely fossiliferous skeletal wackestone(basal part) to mudstone above; sparse fossils include brachiopods in lower beds (*Pseudoatrypa*, *Strophodonta*, ?*Schuchertella*); scattered crinoid debris includes calcitic columnals and skeletal molds in dolomite; fish bone (placoderm tritor) noted 60 cm above base; part weathered with leisegang iron staining; maximum thickness 1.0 m (gravelly alluvium above).

"Athyris Beds"

Unit 7. Limestone, skeletal (crinoidal) wackestone, scattered brachiopods (*Pseudoatrypa*, *Strophodonta*); scattered crinoid debris and stem segments; abrupt lithologic change above to dolomite; upper surface displays up to 30 cm of relief; locally contains Pennsylvanian sandstone fill; variable thickness – 0 to 30 cm.

Unit 6. Limestone, skeletal (crinoidal) wackestone, notably less fossiliferous and less argillaceous than below; forms overhanging ledge; fine to coarse crinoid debris, indeterminate small crinoid cups also noted, large stem segments scattered in upper part; scattered brachiopods include Athyris, Pseudoatrypa, Tylothyris, Eosyringothyris, Stophodonta; planispiral gastropod (2 cm) and large nautiloid ("Acleistoceras") noted at top; scattered large subhorizontal burrow prods; thickness – 65 cm.

Unit 5. Limestone, brachiopodal skeletal wackestone to packstone, argillaceous, generally becomes more argillaceous upward; upper half with argillaceous to shaley partings; unit recessive, weathers into thin irregular beds; brachiopod-rich, mostly whole shells in lenses and stringers; scattered to common crinoid debris in lenses in stringers, small to large debris, some stem segments; scattered horizontal burrows; brachiopods dominantly Athyris and Pseudoatrypa; Strophodonta, Orthospirifer, Tylothyris, Eosyringothyris also present; thickness – 88 cm.

"Lower Coral-Stromatoporoid Interval"

Unit 4. Limestone, fine- to coarse-grained packstone; scattered coarse crinoid debris, scattered to common brachiopods; biostromal in part with scattered massive stromatoporoids (up to 35 x 10 cm) and horn corals (to 8 cm); brachiopods include *Pseudoatrypa*, *Cyrtina*, *Tylothyris*, *Orthospirifer*, *Eosyringothyris*, *Strophodonta*; scattered horizontal burrows; shaley reentrant at top; thickness – 40 cm.

Unit 3. Limestone, fine- to coarse-grained packstone, ledge former, irregularly bedded; lumpy to nodular burrow-like forms (10-15 cm long x 2-5 cm wide) near top; richly crinoidal in part, lenses of coarse crinoid debris (columnals to 1-2 cm diameter), stem segments; unit is biostromal, scattered to common hemispherical to tabular stromatoporoids (most < 15 cm, some 35-50 cm diameter, largest specimen 1 m x 15 cm near top); scattered corals include Hexagonaria (to 8 cm), downstream section with additional corals including Favosites (3-7 cm), alveolitid, horn coral (to 7 cm), and broken pachyporid branches (to 8 cm); scattered bryozoans include fenestellids and branching cystodictyonids; brachiopods include Athyris (common), Pseudoatrypa, Independatrypa, Cyrtina, Tylothyris, Orthospirifer (to 5 cm at top), Strophodonta, Cranaena (to 3.5 cm); thickness – 40-42 cm.

Unit 2. Limestone, fine- to coarse-grained packstone, irregularly bedded; brachiopods common in packed lenses or stringers, includes both whole-shell and broken-abraded grain accumulations; crinoid debris common, includes coarse-grained columnals up to 1 to 2 cm in diameter; stems to 20 cm long; scattered bryozoans include branching cystodictyonids and trepostomes (to 3 cm at top); horizontal burrows noted; scattered Hexagonaria (to 5 cm) in upper part; brachiopods include Pseudoatrypa, Independatrypa, Athyris, Orthospirifer (to 4.5 cm); thickness – 30 cm.

Unit 1. Limestone, fine-grained packstone, biostromal in part; common crinoid and brachiopod debris, becomes more crinoidal upward, scattered fenestellid bryozoans; lower half with massive to hemispherical stromatoporoids (up to 15-20 cm), scattered *Hexagonaria* (to 8 cm); upper half with smaller hemispherical stromatoporoids (up to 20 cm, most < 6 cm); brachiopods include *Pseudoatrypa*, *Independatrypa*, *Strophodonta*, *Cranaena*; sharp contact at top, may be hardground surface; thickness – 45 cm exposed at Mill, 65 cm downstream section.

STOP 11. SELECTED ELEMENTS OF THE PARK'S QUATERNARY HISTORY

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At this stop we will examine two of the three suites of deposits that represent most of what is preserved of the park's Quaternary history (exclusive of the Holocene). In order to accomplish this we will examine two cores at this stop and an outcrop at Stop 12.

Upland Stratigraphic Sequence

A core taken from a narrow upland ridge at the pull off for the observation deck along New Era Road (Fig. 11-1) contains a typical upland Quaternary stratigraphic sequence for the park (see stratigraphic column, page 44). The stratigraphy is dominated by loess and stratigraphic units are separated by buried soils.

This core contains about 20 feet (6.1m) of Peoria Loess with the modern surface soil developed in it. The loess is silt-dominated, buff to brown color, and contains primary matrix carbonates below the modern soil. A close examination will reveal a few tests of land snails. The lower few feet of the Peoria is very friable and breaks into plate-like lenses. This zone is commonly observed in Iowa and adjacent states and I interpret this as the portion of the loess that accumulated when periglacial conditions occurred in the area between 21,000 and 16,500 B.P. The lenzoid structure formed by repeated freezing and thawing in and just below the active zone of permafrost as has been documented in modern periglacial environments and silty deposits affected by past periglacial conditions (van Vliet and Langohr, 1981).

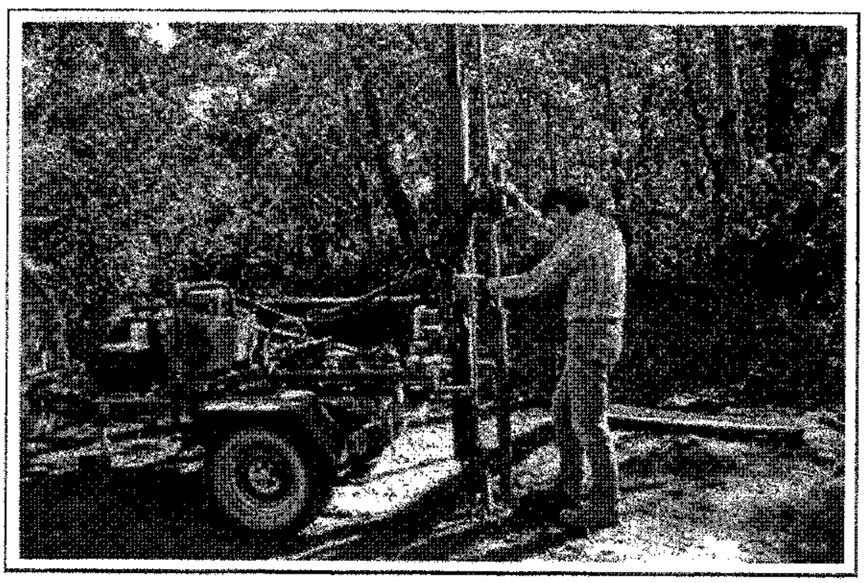

Figure 11-1. Art Bettis drilling a core of the Quaternary materials near the parking area for the observation deck off New Era Road, near the east end of Wildcat Den State Park.

The Peoria Loess gives way downward to approximately 2.5 feet (0.75m) of leached, slightly redder silt loam that exhibits weak development of soil structure and contains a few flecks of charcoal. This is the Roxana Silt, deposited between about 55,000 and 28,000 years ago. The Farmdale Geosol has developed in the Roxana, having leached the primary matrix carbonates, reddened the unit, and imparted a weak subangular blocky structure to the originally structureless loess. The A horizon of the Farmdale Geosol, expressed as a dark brown or grayish, organic-enriched zone is not present in this core, probably signifying the erosional removal of the upper part of the paleosol during periglacial conditions of the last full glacial.

Near the base of the core sand and clay content pick up markedly, pebbles begin to occur, and the deposit becomes much redder. The coarse fraction contains erratic lithologies (such as granite) indicating that this is a Quaternary unit. The origin of this unit is unknown but may be glacial sediments, or possibly interglacial erosional lag material, or alluvium. Regardless or the deposit's origin, the redness, high clay content, and soil structure exhibited here are indicative of soil development. The stratigraphic position beneath the Roxana Silt indicates that this is an eroded remnant of the Sangamon Geosol formed, at least in part, during the last interglacial.

Savanna Terrace Core

A core collected from the Savanna Terrace in the picnic area (Fig. 11-2) at the eastern park entrance exhibits a typical stratigraphic sequence found underlying the Savanna Terrace in tributary valleys along this portion of the Mississippi Valley. Important features include multiple beds of reddish brown silty clay, some with associated white, coarse silt laminae; the reddish brown silty clay beds decrease in abundance with depth; planar-bedded brown and gray silt loam is the dominant lithology; the deposits coarsen downward irregularly with pebbly clayey sand at the base of the core; soft sediment deformation structures are common. These deposits accumulated between about 20,000 and 13,000 B.P. as Pine Creek valley aggraded with the adjacent Mississippi floodplain. The reddish brown silty clays were deposited when glacier-related floods originating in the Lake Superior Basin passed down the Mississippi Valley and backflooded tributaries. The other silt-dominated deposits in the core were deposited by glacial floods originating outside of the Lake Superior Basin as well as from local tributary basin inputs. The coarse deposits at the base of the core are Pine Creek channel deposits. The uppermost deposits in this core are brown silt loam that may be a thin veneer of loess that has been modified by development of the modern surface soil.

Figure 11-2. Art Bettis removing core from the core barrel during drilling of Quaternary materials on a Savanna Terrace near the parking area for the Pine Creek Grist Mill at Wildcat Den State Park.

STOP 12. CONTINUED DISCUSSION OF SELECTED ELEMENTS OF THE PARK'S QUATERNARY HISTORY

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Stop 12 is a sand pit (Fig. 12-1) located about ¼ mile north of the Pine Creek Grist Mill, just north of a road that branches to the north-east just north of the river. This stop exposes sediments underlying St. Charles Terrace Family remnant, and completes the Stop 11 discussion of Wildcat Den's three suites of Quaternary materials.

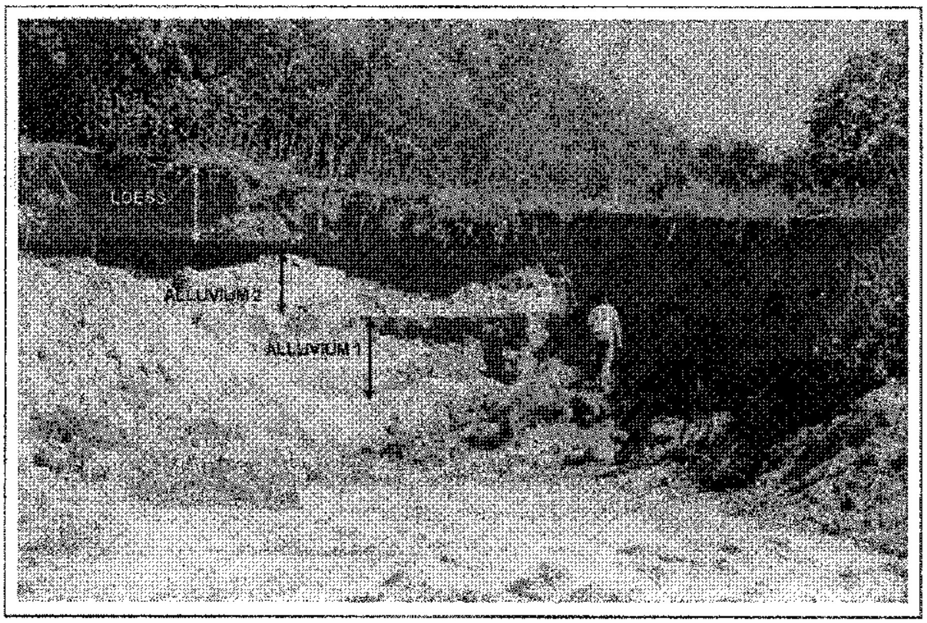

Figure 12-1. Sand pit on the northeast edge of Wildcat Den State Park that displays the structure of a St. Charles Terrace Family remnant. This pit shows two upward-fining alluvial sequences that is capped by loess.

Outcrop, St. Charles Terrace Family

A small sand pit in the SW1/4 of Section 17, T17N R1E along the north wall of Pine Creek Valley provides a view of sediments underlying a St. Charles Terrace Family remnant. This terrace family was recognized by Hajic (Hajic et al., 1991) in the Mississippi/Illinois/Missouri river junction area and includes at least two distinct levels of loess-mantled terraces. In this outcrop Peoria Loess overlies several meters of stratified pebbly sand, loam, and silt loam. The loess grades downward into sandy alluvium, suggesting that the two are temporally related. These relationships suggest that the exposed alluvium was probably deposited during the aggradation event that immediately preceded the diversion of the Ancestral Mississippi into the Andalusia Gorge and the subsequent downcutting that formed the Savanna Terrace. This would put accumulation of the exposed alluvium between about 24,000 and 20,000 B.P.

Features to look for in this exposure include trough cross-bedded pebbly sand deposited in a bed load stream; two prominent upward-fining sequences grading upward from trough cross-bedded pebbly sand to silt loam; liesengang banding in the transition between the alluvium and overlying loess; nodules of secondary (pedogenic) carbonate in the lower part of the Peoria Loess formed where infiltrating soil water gets hung up on the underlying larger pores in the sandy alluvium; and Peoria Loess and modern surface soil at the top of the section.

STOP 13. THE NYE CEMETERY

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Stop 13, the last stop of the field trip, is at the Nye Cemetery (Fig. 13-1), on the southeast edge of Wildcat Den State Park. The Nye Cemetery is one of the earliest historic cemeteries in Muscatine County, and contains burials dating back to as early as 1838. Some graves in the cemetery are marked with natural rocks having no inscriptions.

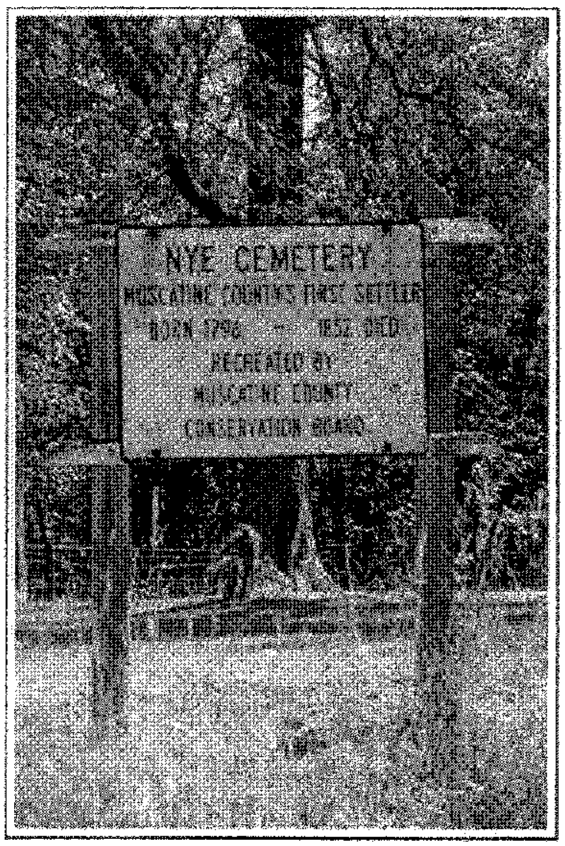

Figure 13-1. The Nye Cemetery on the southeast edge of Wildcat Den State Park is one of Iowa's oldest.

The monument for the Nye family, including Benjamin Nye, builder of the Pine Creek Grist Mill, is located in a cluster of markers in the southeast corner of the cemetary. The marker notes that Benjamin Nye died on March 3, 1853 at the age of 56. (For the story of the death of Benjamin Nye see page 9 of this guidebook). His wife Axubah (who was 23 years old when Benjamin died) survived until 1879. Other marble markers in this area include the oldest marked graves in the cemetery, Nancy M. Shelley, who died at age 1½ on October 1, 1838 and Mary Shelley "wife of William" (Mary's mother?) who died on October 13 of 1838.

In the southwest end of the Nye Cemetery are a cluster of marble markers identifying graves of Civil War vintage. These include John O. Page, Company 8 8th Iowa Infantry, who died on December 12, 1862, at the age of 22 years, 8 months, and 18 days. Also in this area is the grave of Comelia C., "wife of Jinken Davis, who died on February 18, 1862. She was 29 years old at the time of her death.

Along the western edge of the cemetery, just north of the Civil War era graves, a cluster of natural stone markers surround a weathered marble monument with two names inscribed on it. The names are William Whitter, who died on April 12, 1846, and George Whitter, who died on October 11, 1940. Nothing is known about whose graves are marked by the natural stones.

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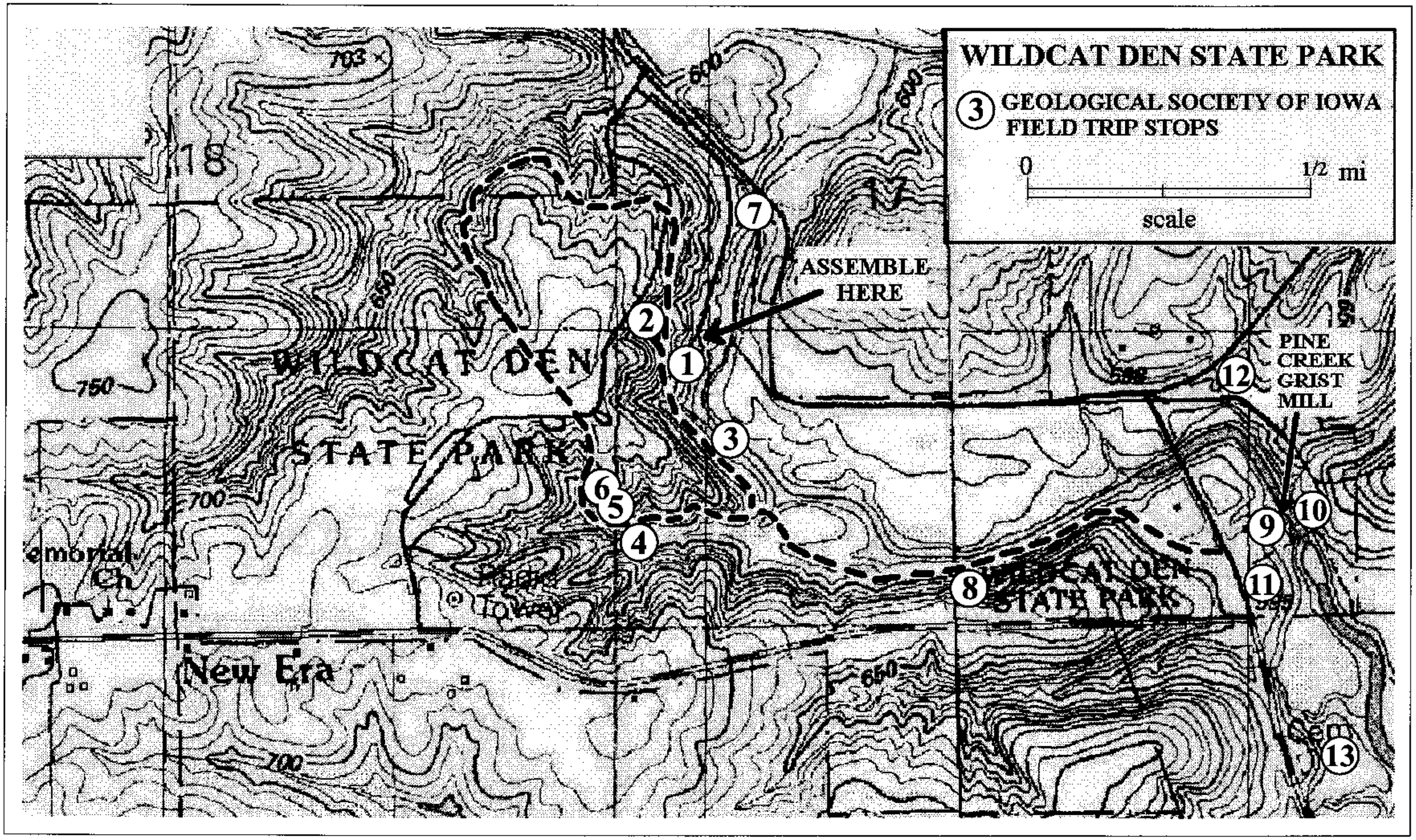
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