# THE ICE AGE GEOLOGY OF DEVILS LAKE STATE PARK



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	5,300,000-			Miocene Epoch		
	24,000,000-		Paleogene Period		5and and mud eroded, uncovering Baraboo Hills and Devils Lake gorge; potholes formed?	
SENT	65,000,000-		Cretaceous Period			
PRE	110,000,000-		Jurassic Period			
BEFORE	210,000,000-		Triassic Period Permian Period Pennsylvanian Period			
33	250,000,000-					
YEARS	290,000,000-					
7	320,000,000-		ЭМ	lississippian Period		
	360,000,000-		Devonian Period Silurian Period Ordovician Period Cambrian Period			
	410,000,000					
	440,000,000-				Sand and mud bury Baraboo Hills and fill gorge	
	500,000,000-					
	570,000,000-		Pre	cambrian eras	Devils Lake gorge cut   Baraboo quartzite	
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■ The length of geologic time can be difficult to grasp. In our everyday frame of reference, 70 years — an average human lifespan — is a long time. But when dealing with geology, we need to expand our concept of time to comprehend spans of thousands, millions, and even billions of years. This time scale, which reduces about 4 billion years to a single page, shows the major divisions of geologic time in relation to some events in the geologic history of Devils Lake State Park.

## INTRODUCTION

**Devils** Lake State Park is a place of striking geologic contrasts — some of the oldest rock exposed in southern Wisconsin lies next to some of the youngest geologic materials in the state. For example, the purple rock (called Baraboo quartzite) in the walls of Devils Lake gorge is more than 1.7 billion years old; the glacially deposited ridges that block both ends of the gorge are only about 16,000 years old.

Throughout geologic time, periods of cold climate that resulted in the formation of huge ice masses have been interspersed with periods of mild climate. During the coldest periods of the last 2.5 million years, glaciers — masses of flowing ice that form when more snow accumulates each year than melts — covered the Upper Midwest. They advanced when more ice flowed toward their edges than melted; they retreated when more ice melted than flowed to the edges.

These glaciers had a profound effect upon the landscape: they eroded the land, deposited debris near their edges, and altered existing drainage systems. As the glaciers melted, water collected and formed lakes (such as Devils Lake) along the edges of the glaciers, and drainage networks were enlarged or changed to accommodate the large volume of meltwater. The most recent series of glacial events in the Midwest began about 2.5 million years ago; we refer to this period as the Ice Age.



In this booklet we describe the characteristics and origin of some of the interesting and scenic landforms that were created during the Ice Age. We hope that the information presented here will help you recognize the effects of the last glaciation while you are hiking

the trails or driving along the roads in the park. Perhaps you will see why the Devils Lake State Park area has been a favorite spot of study for geologists and students for many years, and why it has been designated a unit of the Ice Age National Scientific Reserve.

We suggest that you make frequent use of the geologic map in the pocket at the back of this guide as you explore the area. The map shows the variety of Ice Age features of the park and their locations as well as the locations of roads and hiking trails.

On the map and throughout the text we have used many geologic time terms. The annotated geologic time scale inside the front cover will help you visualize the major divisions of geologic time and the relationship of the Ice Age to earlier events in the geologic history of the park.

We hope this booklet adds to your understanding and enjoyment of the Ice Age geology of Devils Lake State Park.

■ For more than 100 years, Devils Lake has been a popular place for geologists to study glacial features. In 1910 these instructors and students traveled by train from Northwestern University and spent several days examining the geology of the area, "roughing it" at one of the hotels near the park.

#### THE ICE AGE

For the past 2.5 million years the climate of the Northern Hemisphere has fluctuated



between conditions of warm and cold. These cycles are the result of changes in the shape of the Earth's orbit and the tilt of the Earth's axis. The colder periods allowed the growth of glaciers that covered large parts of the Northern Hemisphere.

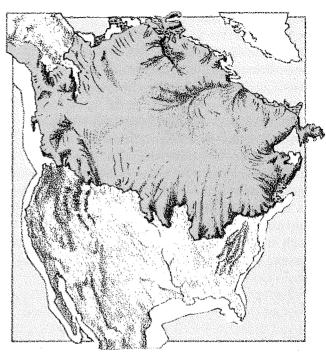
Changes in climate have followed a regular pattern for the past 700,000 years. Each cycle lasted about 100,000 years and consisted of a long period of generally cooling climate during which glaciers grew, followed by shorter periods of conditions similar to or warmer than those of today.

The last cycle of climate cooling and glacier expansion in North America is known as the Wisconsin Glaciation. About 100,000 years ago, the climate cooled and a glacier, the Laurentide Ice Sheet, began to cover northern North America.

During the last part of the Wisconsin Glaciation, the Laurentide Ice Sheet expanded southward into the Midwest as far as Indiana, Illinois, and Iowa. The Laurentide Ice Sheet advanced into Wisconsin about 26,000 years ago and reached its maximum extent in Wisconsin about 16,000 years ago before it began to melt back. The glacier retreated from northern Wisconsin about 9,500 years ago.

The ice advanced farther south in lowlands (such as the basins of the Great Lakes) than it did in





Ice covered a large part of North America at various times throughout the Ice Age. Near the end of the Wisconsin Glaciation, the Laurentide Ice Sheet (the eastern three-fourths of the area shown in blue) spread across the continent.

nearby highland areas. As a result, the Laurentide Ice Sheet was unable to expand across southwestern Wisconsin and some adjacent areas. This area, the Driftless Area, has never been glaciated. It retains the hilly topography characteristic of unglaciated regions. Although the Driftless Area is surrounded by areas covered with material transported by glaciers, it probably was never surrounded by glaciers at any one time. The western part of Devils Lake State Park lies in the Driftless Area.

The rough topography of the Driftless Area provides a sharp contrast to the ice-molded landscape of the rest of the state.

# THE LAST GLACIATION

About 26,000 years ago the Laurentide Ice Sheet reached the Midwest; after approximately 10,000 years growth and expansion, it bec

approximately 10,000 years of growth and expansion, it became large enough to cover the area shown in blue on the figure (below right). Highlands diverted this glacier into lobes (tongues or fingers of ice) that advanced into the lowland areas. The Lake Michigan Lobe of the glacier flowed down the Lake Michigan lowland to central Indiana and Illinois. The Langlade, Wisconsin Valley, Chippewa, and Superior Lobes covered northern Wisconsin. The Green Bay Lobe flowed south in the Green Bay lowland, advancing over the east end of the Baraboo Hills and into both ends of Devils Lake gorge.

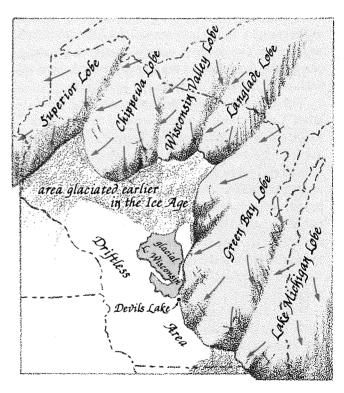
The edge of the Green Bay Lobe was probably a steep ice slope, perhaps several hundred feet high, littered with rock debris. Behind the steep slope, the ice surface probably rose very gently toward the center of the ice sheet, where the ice was thousands of feet thick.

Beyond the edge of the Green Bay Lobe lay a nearly treeless tundra, whose surface thawed for only a short time during the summer; beneath this soggy surface, the ground was deeply frozen. These tundra conditions persisted from about 26,000 to about 13,000 years ago. The polygonal patterns produced by the cracking of the deeply frozen ground can be seen on aerial photographs of parts of Wisconsin; these tundra polygons look much like those forming in the Arctic today.

The Laurentide Ice Sheet and the large volume of meltwater flowing from it greatly altered the land-scape of Wisconsin. As a result, the landscape of the area glaciated during the last part of the Wisconsin Glaciation is notably different than that of areas glaciated earlier in the Ice Age (where erosion has destroyed most earlier glacial landforms) and areas that were never glaciated. For example, the outer-

most limit of the last glacier is marked by a conspicuous ridge of glacially deposited debris. The many lakes and wetlands and the irregular landscape that characterize so many areas of eastern and northern Wisconsin are also a direct result of the last glacier.

The tundra that accompanied the last glacier in Wisconsin was the home of the woolly mammoth (pictured above left), which fed primarily on grass. As climate warmed near the end of the last glaciation, tundra gave way to spruce forest; this was the home of the American mastodon, which fed on twigs, cones, and grass.



All but the southwestern corner of Wisconsin was glaciated at one time or another. The last glaciation was not as extensive as some that had preceded it. Arrows point out the direction of ice flow.

## MORAINES: the edge of the glacier

When a glacier advances or retreats, the flow of the ice brings rock debris to the edge. If the edge stands in one place long enough, a ridge of debris, called a moraine, is deposited.

The geologic map shows that the moraines in the park wrap around high points in the landscape. Ice filled the lowlands in the eastern part of the park and flowed into both ends of the gorge but did not advance onto the higher parts of the landscape. (Dioramas in the park's Nature Center show how the Devils Lake area looked when ice plugged both ends of the gorge.) In the area around the Johnson Ponds and west of Devils Nose, several moraines formed, one behind the other, as the edge of the ice stood in each place before it continued to melt back.

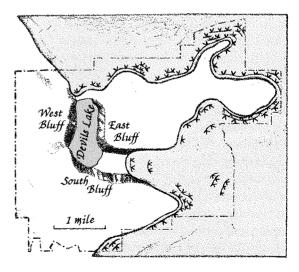
For a distant view of moraines, hike the West Bluff Trail to about 0.5 mile north of South Shore Road; there you will find a clear view through the gorge to the east. You can see the large moraine that crosses the gorge about 0.5 mile east of the lake and drapes across the south wall of the gorge, across the mouth of South Bluff Basin. Note how the mass of boulders, called talus, ends abruptly where buried by the moraine. You can also see these features from the overlook near the junction of the Devils Doorway and Potholes Trails, especially when the leaves are off the trees.

For a closer look at the characteristics of a moraine, hike the Johnson Moraine Loop (named after the Johnson family, who farmed the area for several generations) at the north end of Steinke Basin. About 1,000 feet north of Highway DL, this trail runs along the crest of the Johnstown moraine. North of the trail the hillside has the hummocky (uneven) appearance typical of a recently glaciated

landscape. Some of these hummocks are small moraines.

If you like getting off the trail and know how to use a map and compass, another good place to follow the Johnstown moraine is around the east end of South Bluff. In this area the moraine is a distinct ridge 10 to 20 feet high. On the moraine you can find many types of rock, some that the glacier had carried from far to the north and east. West of the moraine, you will find only fragments of hard, purple quartzite and other local rock types. Several smaller moraines occur just east of the Johnstown moraine in this area.

If you want to look at a moraine but don't want to hike, go to the Nature Center, which is on the crest of the Johnstown moraine where it crosses the north end of the gorge. South Shore Road crosses the crest of the Johnstown moraine about 0.5 mile east of Devils Lake.



Moraines (shown by the arrowhead symbol) mark the extent of the advance of the Green Bay Lobe into Devils Lake State Park (shown by dotted/dashed line). The area shown in blue had been covered by ice.

## **KETTLES:**

## the Johnson Ponds area

The Johnson Ponds in the north-central part of the park are kettles — basins that formed when buried glacial ice melted and the overlying debris collapsed, leaving a depression.



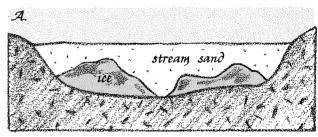
In the Johnson Ponds area, a river that flowed in a tunnel beneath the glacier cut a channel and washed away part of the Johnstown moraine. When the channel was cut, the edge of the glacier was probably frozen to the underlying rock and soil, which were also deeply frozen. Farther back from the edge of the glacier, the bed of the glacier thawed and meltwater accumulated. The channel probably was cut by the erosive effects of sudden outbursts of huge volumes of meltwater from beneath the glacier; it then was filled slowly with sand and gravel as flow in the river diminished. A string of marshy depressions and ponds, the Johnson Ponds, lies in the channel.

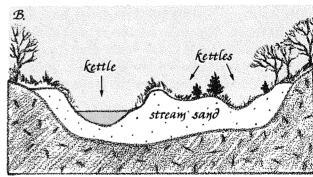
How did the kettles form? The gap in the Johnstown moraine is underlain by sand and gravel deposited in the bed of the river that flowed in the tunnel beneath the glacier. Ice blocks fell from the roof of the tunnel and were buried by stream sediment. When the edge of the glacier retreated to the north down the hill, water from the glacier no longer flowed through the gap in the moraine into Steinke Basin; instead, it followed the edge of the ice to the east or west. The buried ice blocks melted after the river no longer flowed through the gap in the moraine. As they melted, the overlying sand and gravel collapsed and formed the kettles. The Johnson Ponds are the deeper kettles that are partly filled with water. Marshes have formed in the shallow kettles.

The ancient river channel in which the Johnson Ponds developed is one of many similar channels

that formed near the edge of the glacier when it stood at its maximum extent.

To get to the Johnson Ponds area, follow Highway DL for 0.7 mile west of its junction with Highway 113 and park in the lot on the south side of the road. Take the gravel path straight north of Highway DL for 1,000 feet to the crest of the Johnstown moraine. The moraine ridge continues west from here for several thousand feet; immediately to the east, there is the gap of about 500 feet in the moraine. South of the gap is a fan-shaped deposit of sand and gravel that the river left in Steinke Basin.





Sequence of events in the formation of a kettle.

- A. A block of ice is buried by sand deposited in the bed of a stream carrying meltwater from the glacier.
- B. After the stream stops flowing through the area, the buried ice melts and the overlying sand collapses, forming a kettle.

#### GLACIAL LAKE WISCONSIN



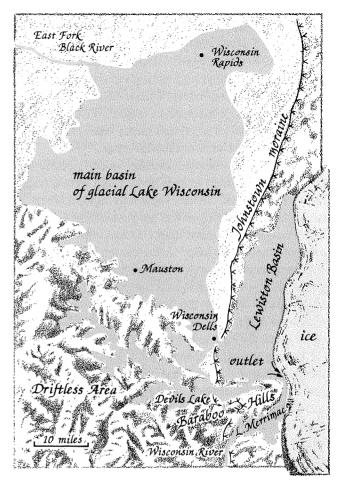
When the western edge of the Green Bay Lobe advanced onto the Baraboo Hills, it

dammed the south-flowing Wisconsin River, creating a large lake that filled until it could drain to the northwest down the Black River. Part of the shore of this lake, called glacial Lake Wisconsin, was near the northern boundary of the park.

At its greatest extent, glacial Lake Wisconsin occupied much of central Wisconsin. It was roughly the size of Great Salt Lake in Utah. It occupied a large main basin, the medium-sized Lewiston basin, and several smaller basins in the southwest. The main basin and the Lewiston basin were separated from each other by the Johnstown moraine.

An earlier version of glacial Lake Wisconsin had spilled out through the Devils Lake gorge; however, during the last phase, from roughly 19,000 to 14,000 years ago, the gorge was clogged by the Johnstown moraine and the outlet was to the northwest down the East Fork Black River, to the Black River and the Mississippi. During this final phase, the surface of glacial Lake Wisconsin was never quite as high as that of modern Devils Lake. Water from Devils Lake drained into glacial Lake Wisconsin, which then stood about 35 feet below the present level of Devils Lake.

Glacial Lake Wisconsin drained for the last time about 14,000 years ago, when the ice dam at the east end of the Baraboo Hills broke and water rushed through an outlet to glacial Lake Merrimac, which in turn drained to the Wisconsin River at Sauk Prairie. The water level was lowered rapidly in the Lewiston basin, the Johnstown moraine at the Wisconsin Dells was eroded, and water from the main basin rushed through the breach to the Lewiston basin, cutting the sandstone gorges — called dells — at Wisconsin Dells. Judging by the rate at which similar glacial lakes have drained in historic times, most of the



As the Green Bay Lobe melted back from the Johnstown moraine, glacial Lake Wisconsin expanded into the Lewiston basin. The lake drained (in direction indicated by arrows) when the ice retreated past the east end of the Baraboo Hills.

water in glacial Lake Wisconsin probably drained within a short time, possibly within a few days or weeks.

You can see the east Baraboo basin of glacial Lake Wisconsin by looking north from the crest of the Johnstown moraine just west of the Johnson Ponds.

# THE FORMATION OF DEVILS LAKE

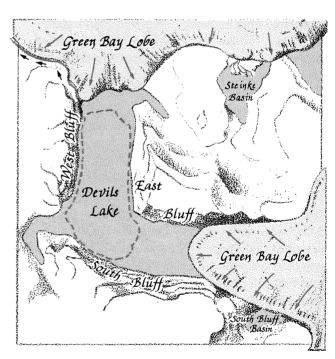
Lakes commonly are created along the edge of a glacier in places where ice dams the mouth of a drainage basin. Water collects in the basin until its level is high enough to reach the level of the lowest outlet. Most of these lakes are small, but glacial Lake Wisconsin in central Wisconsin was more than 70 miles long, and larger lakes formed in other parts of the midcontinental area.

Some of these lakes, including an early phase of Devils Lake, formed in the Devils Lake area during the last glaciation. Devils Lake was created when ice blocked both ends of the gorge, holding the water in the gorge more than 100 feet above the present level of the lake. After the ice melted, the Johnstown moraine still dammed the ends of the gorge, but the level of the lake dropped to its present level. Devils Lake is the only one of these lakes that remained in the park after the glacier melted; the other lakes drained as the edge of the ice retreated.

During the maximum extent of the last glacier in the park, lakes were ponded in Steinke, Feltz, Ott, and South Bluff Basins. In each of these areas the ice dammed the drainage basins, and water ponded until it rose to the level of the lowest outlet. For example, in South Bluff Basin the water level rose until it drained westward along the edge of the ice; in Steinke Basin the water level rose until it drained westward through a low divide. Arrows on the geologic map point out the direction of meltwater flow from the lakes. As the edge of the ice melted back, lower outlets became available and some lakes drained. At the same time, new lakes formed in East Bluff Basin, Roznos Meadow, and in Hanson Marsh basin, where water was ponded in front of the retreating edge of the ice.

The sites of former lakes can be recognized by the topography of the area. Lake-bottom silt usually forms a nearly flat plain after the lake drains; such lake plains are prone to gullying. Gullies in the margin of a plain hint at the presence of lake sediment, such as in the central part of Feltz Basin, where Griegol Gulch has been cut into lake-bottom silt.

The middle of Feltz Basin is a good example of the nearly level surface of the floor of a former lake. Similar but smaller lake plains exist in the other basins. A hike into South Bluff Basin will be a scramble through thick brambles (no trail exists), but there you can see well preserved remnants of a lake plain and deep gullies that expose the layered silt that accumulated in a lake during the height of the last glaciation.



When the Green Bay Lobe blocked both ends of the gorge, Devils Lake was much larger than it is now (dashes outline modern Devils Lake). The long arrows show the direction of ice flow of the Green Bay Lobe; the short arrows show the outlet of the larger Devils Lake, along the edge of the Green Bay Lobe.

# POTHOLES: Evidence of glaciation?

**Geologists** use the term pothole to describe a cylindrical hole that has

been drilled into rock by stones in the bottom of a permanent in a stream. Eddy stones become nearly perfect

spheres; an eddy stone from a pothole on East Bluff is on display in the Nature Center at the park. Streams that carried huge amounts of meltwater from the last glacier formed potholes in many areas of Wisconsin, the most notable being in the area of Interstate Park on the St. Croix River.

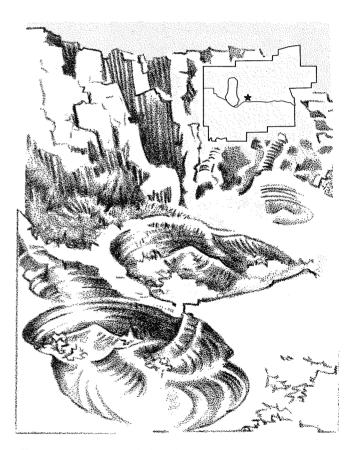
eddy

Some geologists have suggested that the potholes on East Bluff in Devils Lake State Park were cut by meltwater from a glacier. Although potholes are sometimes formed by rivers flowing from glaciers, they can be formed by other types of rivers. The potholes on East Bluff most likely were cut long before the Ice Age. There is no evidence that a glacier ever reached the top of the East Bluff; meltwater from the last glacier flowed around, not over, the East Bluff highland.

The potholes along Devils Doorway Trail have been cut into the flat quartzite surface of the uplands. They are typically several inches to slightly more than 1 foot in diameter and several inches deep. Some are almost perfectly circular. The rock surface in and around the potholes was polished by sand and gravel as the potholes formed; some of this sand and gravel is still present on the upland here. Geologists have correlated this sand and gravel with a body of gravel that occurs on ridgetops as far west as Minnesota and Iowa. In the Baraboo Hills, as elsewhere, the gravel consists mostly of rounded quartz pebbles. The age of the gravel (and of the potholes) is unknown, but it was probably deposited during the late Mesozoic or early Cenozoic, well before the Ice Age.

In Devils Lake State Park, you can see several potholes along Devils Doorway and Potholes Trails

near and at the top of the East Bluff. The potholes along Potholes Trail occur in the cliff face near the top of the gorge. Only the cliff-side part of some of these potholes remains; the opposite side has been destroyed by erosion. These potholes probably formed in the bed of a river as it began to erode sandstone from Devils Lake gorge. When these potholes formed, the quartzite cliff was the north bank of the river; the south bank, which was composed of sand, has been removed by erosion.



You can see some potholes along Potholes Trail, a short distance below the top of the East Bluff. These potholes are about 2 feet wide.



## TALUS IN THE GORGE

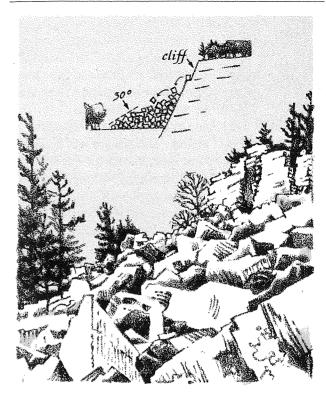
Talus is a mass of large, angular stones derived from a cliff individual frag-

ments of rock are loosened from the cliff and then accumulate at the base. Eventually, the fragments form a uniformly steep slope. In Devils Lake State Park, talus is composed almost entirely of quartzite blocks.

Is the talus still accumulating in the park? Except in a few places where quarrying or railroad construction has disturbed the base of the talus, there has been little movement of the talus blocks in recent times. If you look north and southeast of the lake when the leaves are off the trees, you can see that the talus ends abruptly where the Johnstown moraine abuts the gorge wall. This indicates that most of the talus accumulated before the edge of the ice melted back from the Johnstown moraine. During glaciation, freezing and thawing in the cliffs shattered the quartzite, loosening blocks that then accumulated as talus; this talus was buried under the moraine where the glacier advanced into the northern and southeastern ends of the gorge.

In a few places at the base of the talus you can see depressions that are a few feet deep and 10 or more feet wide. In the park, they are referred to as grottos. Their origin is not well understood by geologists. In the summer they trap pockets of cold air that has drained out of the cavities between the talus boulders.

The geologic map shows the locations of the talus in the park. The most spectacular talus occurs on the sides of Devils Lake gorge, where the talus is several hundred feet high and is composed of angular blocks of quartzite, some more than 10 feet across. The talus surface is consistently about 30° to 35° from



You can find this view of the base of the talus near the southeastern corner of Devils Lake.

horizontal, although it seems much steeper when you are looking up at it.

A handy place to view the talus is along the Tumbled Rocks Trail on the west side of the lake; you can also see the talus from East Bluff and West Bluff. You can look at the base of the talus and several grottos from the Grottos Trail southeast of Devils Lake. A hike around the loop formed by the Grottos, Balanced Rock, or Potholes Trails and the CCC and Devils Doorway Trails provides a good look at the quartzite cliff and the talus below it. The Devils Doorway is an arch of quartzite blocks left behind when surrounding frost-loosened blocks tumbled down to become part of the talus below.

#### OTHER STONY HILLSIDES

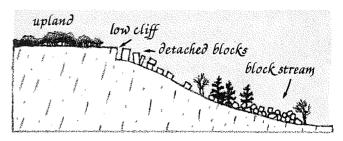


Stony hillsides make up a large part of the park. Such hillsides consist of several feet of rubble that forms a veneer over a hillside of Baraboo quartzite or sandstone. They are not as steep as the talus.

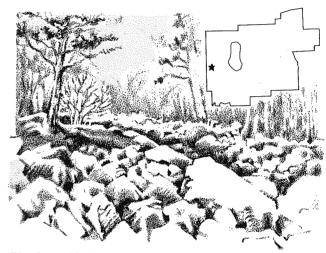
Most of this rubble moved down the hillsides when the area was tundra. The ground was deeply and permanently frozen then, except for a few feet of surface soil that thawed during the summers. As in tundra areas today, such as northern Canada and Alaska, the water-saturated material on top of the permafrost readily moved down the slopes.

Rubble at the edges of the uplands was loosened by frost, flowed down the hillsides, and accumulated on the lower slopes. When the cold climate ended and the permafrost thawed, the material in transit on the hillsides came to a halt, and it remains in that position today. This material commonly contains boulders of quartzite, but sand, silt, clay, and pebbles are also present in places. Near the edges of the flat uplands, there are large blocks of quartzite, many that are more than 20 feet wide. The large blocks were gradually broken up as they moved downhill; most of the blocks near the base of the hillsides are less than 10 feet wide.

In a few places the hillside material is in the form of block streams – masses of rock that slowly moved downhill. The most conspicuous block streams in the park consist of quartzite boulders that have little or no material in the open cavities between the boulders. In the park these block streams are generally several hundred feet long and tens of feet wide. The downhill ends of the block streams usually are bordered by a low ridge of boulders. They are conspicuous features because, like the talus, they have little vegetation growing on them. Block streams occur throughout the Baraboo Hills at the base of hillsides surrounding the flat uplands. Locations of several block streams are shown on the geologic map.



Detached blocks of quartzite slide down hill and break into smaller pieces that form the block streams.



This large block stream is west of Burma Road.

One of the best places to observe a block stream in the park is west of Burma Road, southwest of the Devils Lake. Park your car on the shoulder of the road near the bottom of the small valley 0.4 mile south of the junction of Burma Road and South Shore Road, and then walk several hundred feet up the valley (to the west). Block streams in the Baraboo Hills can sometimes be identified from a high point in the landscape by the presence of large pine trees growing on their edges. White pine is the only tree that grows well along the edge of the block streams; most large white pine trees in the park are associated with boulder accumulations.

## FLAT UPLANDS AND LOW CLIFFS



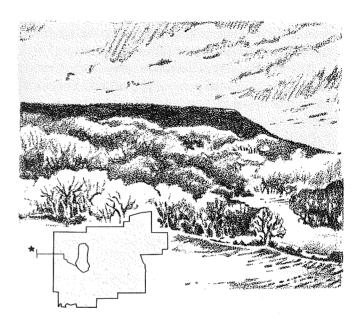
Throughout the Baraboo
Hills, the highest areas (between elevations of about
1,400 and 1,500 feet) are
flat uplands cut into
Baraboo quartzite. These
areas are shown on the geologic map. The origin of these

flat uplands is uncertain, but they were probably formed by wave erosion when sea level stabilized in Ordovician time. Afterward, sea level rose, and the quartzite was buried under sand and mud. Still later, perhaps during the late Mesozoic or early Cenozoic, erosion of this sediment exhumed the Baraboo Hills and the Devils Lake gorge. In the subsequent tens of millions of years, the shape of these quartzite hills has been altered little by weathering or erosion. The last period of accelerated weathering and erosion occurred during the last part of the Wisconsin Glaciation.

In many places the edges of the uplands are marked by low cliffs. These cliffs are no more than about 20 feet high and are generally forested. They formed when huge blocks of frost-loosened quartzite slid down hill from the edge of the uplands. These blocks were fractured into smaller blocks as they moved farther from the upland edge; eventually, they accumulated near the base of the valley side in block streams.

The cliffs and detached blocks have been inactive since the end of the Wisconsin Glaciation, after the permafrost melted. Today, blocks of quartzite can be seen below the edge of the uplands, just where they were left when the climate warmed. Some blocks are the same size and shape as the adjacent opening from which they came, like a piece of a huge jigsaw puzzle. Where the flat uplands border the Devils Lake gorge, the upland-edge cliffs merge with the gorge walls.

In some places on the uplands, outside the glaciated area, the surfaces of the quartzite have been polished and etched by sand blasting. During the Ice Age, blowing sand was common; the area beyond the glacier was tundra, and there was little vegetation to hold the sand in place.



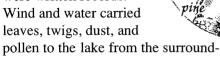
This low cliff at the edge of a conspicuous flat upland area is just outside of Devils Lake State Park. You can see this upland if you look west of Ski Hi Road about 0.5 mile east of Highway 12. Similar flat uplands can be seen in several areas in the park.

In the area that was glaciated (the eastern part of the park and the Baraboo Hills farther east), the flat uplands can still be recognized, but in most places they are covered by thick glacial material.

You can see uplands at the top of East Bluff, West Bluff, and South Bluff; along West Bluff, East Bluff, Devils Doorway, and CCC Trails; and along the Ice Age Loop.

# VEGETATION: 13,000 years of change

Devils Lake kept its own history of vegetation and fires long before there were written records.
Wind and water carried leaves twigs dust and



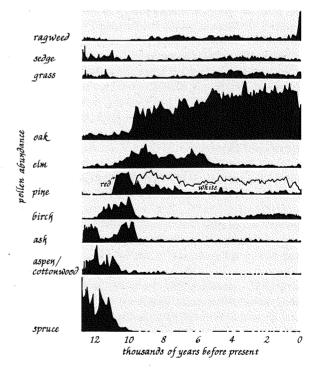
ing land. Leaves and twigs quickly rotted and disappeared, but dust and pollen collected on the lake bottom along with mud washed from the shore.

The oldest layers of sediment (those buried several feet below the present lake bottom) contain pollen that began accumulating in annual layers about the time tundra disappeared from the area. The youngest sediment layers (those nearest the surface of the present lake bottom) contain pollen that records the effects of land clearing by settlers. This sediment contains a record of vegetational change over nearly 13,000 years!

The sediment also contains charcoal from grass and forest fires, which can be dated using radiocarbon techniques to establish the age of sediment layers and the rate at which the sediment accumulated. The billions of pollen grains in the lakebottom mud provide a record of the vegetation on the surrounding landscape. The tiny pollen grains (three or four would fit in the diameter of a human hair) can last indefinitely in the absence of oxygen. Under a microscope the pollen from an oak is distinctly different from that of other trees, shrubs, and grasses; oak pollen in the sediment beneath Devils Lake indicates the presence of oak as surely as would acorns or oak leaves.

From about 12,000 to 10,000 years ago spruce, aspen, birch, and ash were common in the area. Red pine did not reach the Devils Lake area until around 11,000 years ago. A thousand more years would pass before white pine would appear on the rocky cliffs around Devils Lake.

Elm trees were most abundant in the area from 10,000 to about 6,000 years ago. Maple, basswood, and ironwood, although not shown on the pollen diagram, were also more abundant then than now. Between about 6,000 and 3,000 years ago, the climate became warmer and dryer, and oak savanna became common in the area. Less than 3,000 years ago, the climate became cooler and moister, and oak forest dominated the surrounding hills. The relatively recent increase of ragweed pollen marks the beginning of extensive land disturbance by settlers in the mid-1800s.



The abundance of various types of pollen accumulating at the bottom of Devils Lake has changed over the past 13,000 years. Spruce pollen was most abundant soon after the glacier melted; today oak and ragweed pollen are most abundant.

## SOURCES OF INFORMATION

Geologists and historians have been studying and writing about the Devils Lake area for more than 100 years. The information presented in this booklet is derived from our own studies of the area as well as

from information from many other sources. We suggest the following publications for more information about the geology and history of Devils Lake State Park and adjacent areas.

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