RAGBRAI Geo-pedia

What is loess?

Loess (rhymes with bus) is wind-blown silt that is very consistent in material and size. Loess is highly erodible when wet, but is surprisingly stable in vertical sections. Loess is thickest near its source (the Missouri River) and thins in the predominant wind direction, in this case west to east. You'll see some examples on the landscape in the first few miles of RAGBRAI (photo below).

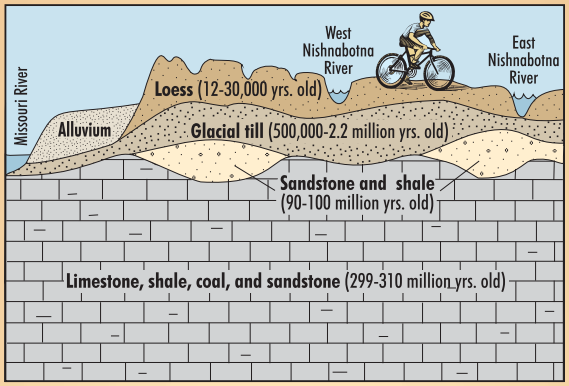
The origin of loess is usually attributed to glacial activity. Meltwater from glaciers carried abundant material that was deposited in river valleys. Three loess units are recognized in the Loess Hills of Iowa (oldest to youngest): the Loveland, Pisgah, and Peoria. The Loveland is associated with the older Illinoian glacial advance (300,000 to 130,000 years ago) and the Pisgah and Peoria were deposited during Wisconsinan time (30,000 to 10,500 years ago). The Peoria Formation loess is the most regionally extensive loess in Iowa and makes up the greatest thickness of the Loess Hills.

What is a 'glacial erratic'?

Although glaciers are often romanticized as pure snow and ice, they are actually very dirty and carry tons of soil, stones, and boulders. When a glacier retreats, the stones and boulders are usually left behind, scattered across the landscape. Geologists call these rocks 'glacial erratics' due to their random placement on the land.

COVER PHOTO: A *view looking east across the Missouri River Valley in Monona County. Photo by Mark Engler.*

Day 1 Milestones



Start: Council Bluffs
Loess Hills/loess outcrops: 10 miles
Loess terraces: 15.7 miles after Council Bluffs
Sioux Quartzite erratic: 3.4 miles after Mineola
West Nishnabotna River: 1.8 mi. after Henderson
East Nishnabotna River: 8.2 miles after Emerson
Finish: Red Oak – 51 miles

Iowa Geo-books

Iowa's Geological Past
by Wayne Anderson, University of Iowa Press, 1998

"The only authoritative overview of Iowa's geologic record… [Wayne Anderson's] coverage is so current, comprehensive, and authoritative that professionals as well as rock and fossil enthusiasts will each need a copy."

Brian F. Glenister, A.K. Miller Professor of Geology Emeritus, University of Iowa

Landforms of Iowa
by Jean C. Prior, University of Iowa Press, 1991

"Jean Prior writes about the glacial geology of Iowa as if it's an old friend. She knows and cares about her subject and explains Iowa's geologic attractions with a sure hand."

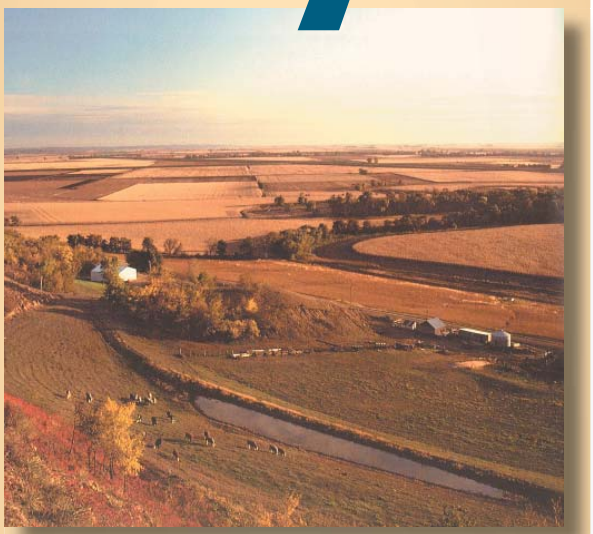
Rex Buchanan, Kansas Geological Survey

RAGBRAI 2009

Learn about the Land

Sunday, July 19

Day 1



Iowa DNR – Geological and Water Survey
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Iowa City, IA 52242-1319
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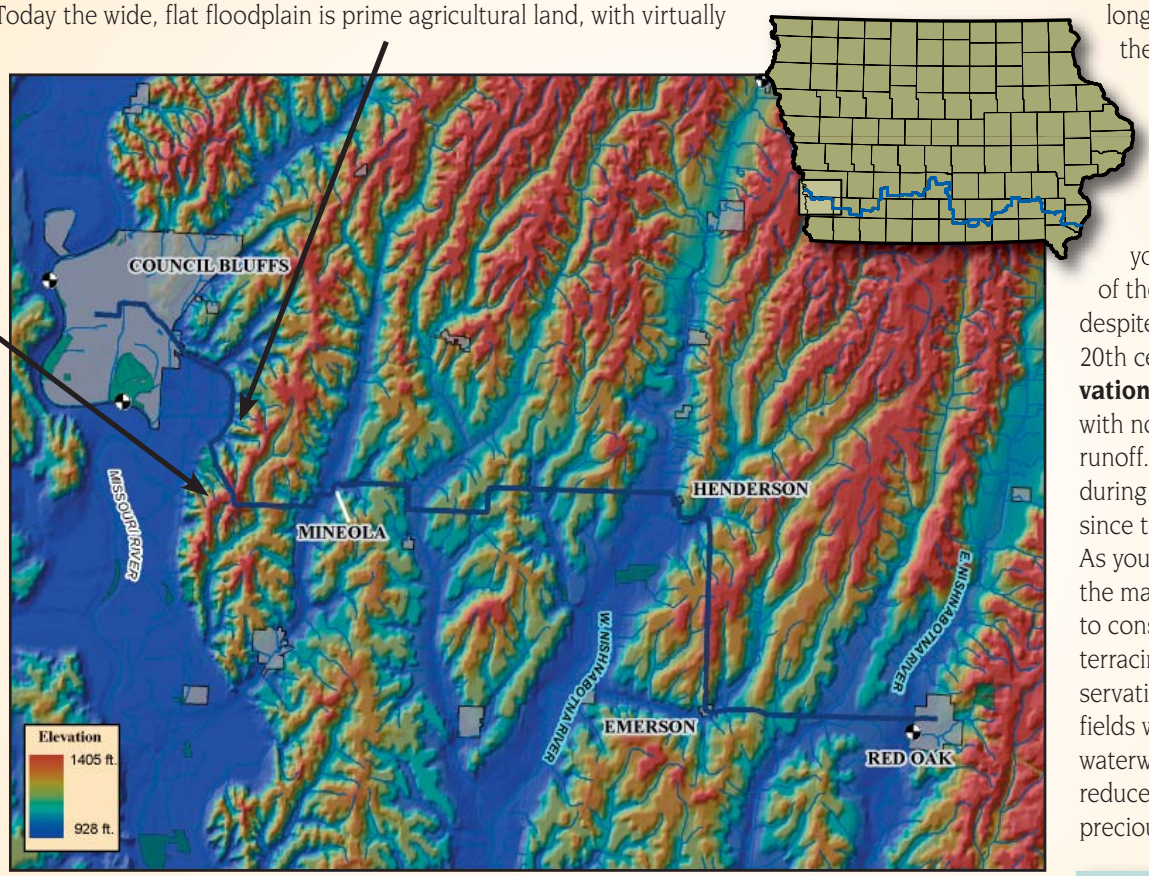
www.igsb.uiowa.edu

US Geological Survey
Iowa Water Science Center
400 S. Clinton St.
Iowa City, IA 52240
(319) 337-4191
http://ia.water.usgs.gov

Like most years, you'll begin RAGBRAI 2009 in the **Missouri River Valley**. Draining 1/6 of the United States, the Missouri River flows for 2,300 miles before joining the Mississippi River at St. Louis. This makes it the longest river in North America. Like most rivers in Iowa, the Missouri is relatively young by geologic standards, about 2 million years old. It was created by melt waters from the great continental glaciers, ice sheets that repeatedly advanced into Iowa over the last 2.5 million years. The width of the valley, up to 17 miles in Monona County, attests to the huge volumes of water that the ancient Missouri River carried. Today the wide, flat floodplain is prime agricultural land, with virtually unlimited supplies of irrigation water just a few feet below the land surface.

Although RAGBRAI usually crosses some portion of the **Loess Hills** landform region every year, 2009 is unique in that the route crosses near the thickest loess deposits, illustrating their impressive relief. Near Council Bluffs, loess thickness has been known to exceed 175 feet! Riders will have numerous opportunities to see loess exposures on the first day while leaving Council Bluffs, including a road cut only a few feet from the route.



USGS streamflow station

Parks and Preserves

About three miles after Mineola, if you look to the left, you'll find a wonderful large glacial erratic of **Sioux Quartzite** (photo left). Sioux Quartzite was deposited as sand on the shore of an ocean that stretched from north-central Wisconsin to Arizona about 1.6 billion years ago. It is exposed in far northwest Iowa and adjoining regions of Minnesota and South Dakota. If you look closely, you'll see that it gives many roads in western Iowa a distinctive pink hue. It is common as rocks and boulders in the glacial tills of western Iowa and can be identified by its uniform pink color and, when closely examined, the presence of rounded quartz grains.

The **Nishnabotna River** is a tributary of the Missouri River. It mostly flows through SW Iowa as two parallel streams, called the East and West branches. Both branches are about 100 miles long and 20 miles apart. From their confluence, the Nish flows another 12 miles before joining the Missouri River. Sections of both branches have been straightened and channelized (photo above).

Riding up and down the hills of SW Iowa, you might be surprised to observe how much of the land is devoted to corn and soybeans, despite the steep hillslopes. In the first half of the 20th century, little attention was given to **conservation**, and intensive plowing turned over the soil with no consideration given to topography and runoff. Soil erosion occurred at a massive scale during this time. Agriculture has come a long way since then to reduce soil loss from cropped fields. As you are pedaling across the landscape, note the many types of conservation practices used to conserve the soil. Common practices include terracing contour planting (photo below), and conservation tillage practices, along with surrounding fields with buffer strips, field borders, and grass waterways. Together, these practices serve to reduce erosion and protect one of Iowa's most precious natural resources, its soil.

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RAGBRAI Geo-pedia

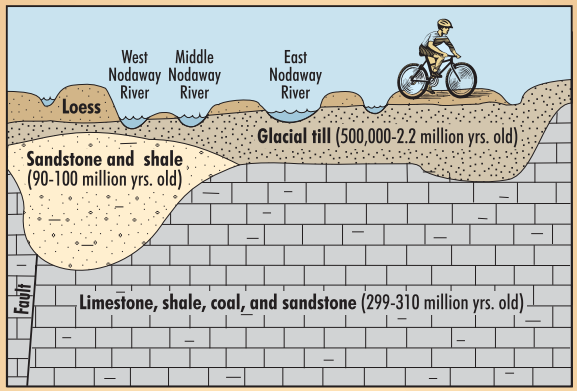
Iowa Stream banks / health of a stream

The shape and condition of stream banks can provide insight into the quality of the stream and the aquatic life it supports. Are the banks high crumbling walls or gently sloping banks with grass, shrubs, and trees growing on them? You can tell much about the stream's long-term stability by looking at the shape and condition of its banks.

A stable bank is a sign of a stable stream (photo right). All streams and rivers move within their floodplains, but a mature, stable stream will not move very rapidly. In Iowa, most streams naturally wind or "meander" back and forth across their floodplains. Bank sloughing, cut banks (shown below in photo of Nodaway River), and high-wall banks without trees or other plants are signs of bank instability. A sloping bank covered with vegetation is more stable and indicates a healthier watershed. Not only do gently sloping banks offer better habitats for wildlife near the water's edge, they help to slow and filter watershed runoff.

COVER PHOTO: *The Swedish Heritage Cultural Center in Stanton, Iowa*

Day 2 Milestones



Start: Red Oak
West Nodaway River: 8.2 miles after Stanton
Middle Nodaway River: 0.7 miles after Villisca
East Nodaway River: 3.6 miles after Villisca
Lake Binder: 1.5 miles after Corning
Nodaway Lake Park: 1.8 miles after Fontanelle
Greenfield Lake Park: 4 miles after Fontanelle
Finish: Greenfield – 70 miles

For more information...

about Viking Lake, Nodaway River, and other surface water bodies, along with how to improve watersheds or start an improvement project, visit: **www.iowadnr.gov/water/watershed)**

The Iowa DNR has many online interactive maps available for Iowa's natural and manmade resources. An index for these maps is at:
www.iowadnr.gov/mapping/index.html

Iowa's oil exploration information can be found at:
www.igsb.uiowa.edu/Browse/oilex/oilex.htm

RAGBRAI 2009

Learn about the Land

Monday, July 20

Day 2

Iowa DNR – Geological and Water Survey
109 Trowbridge Hall
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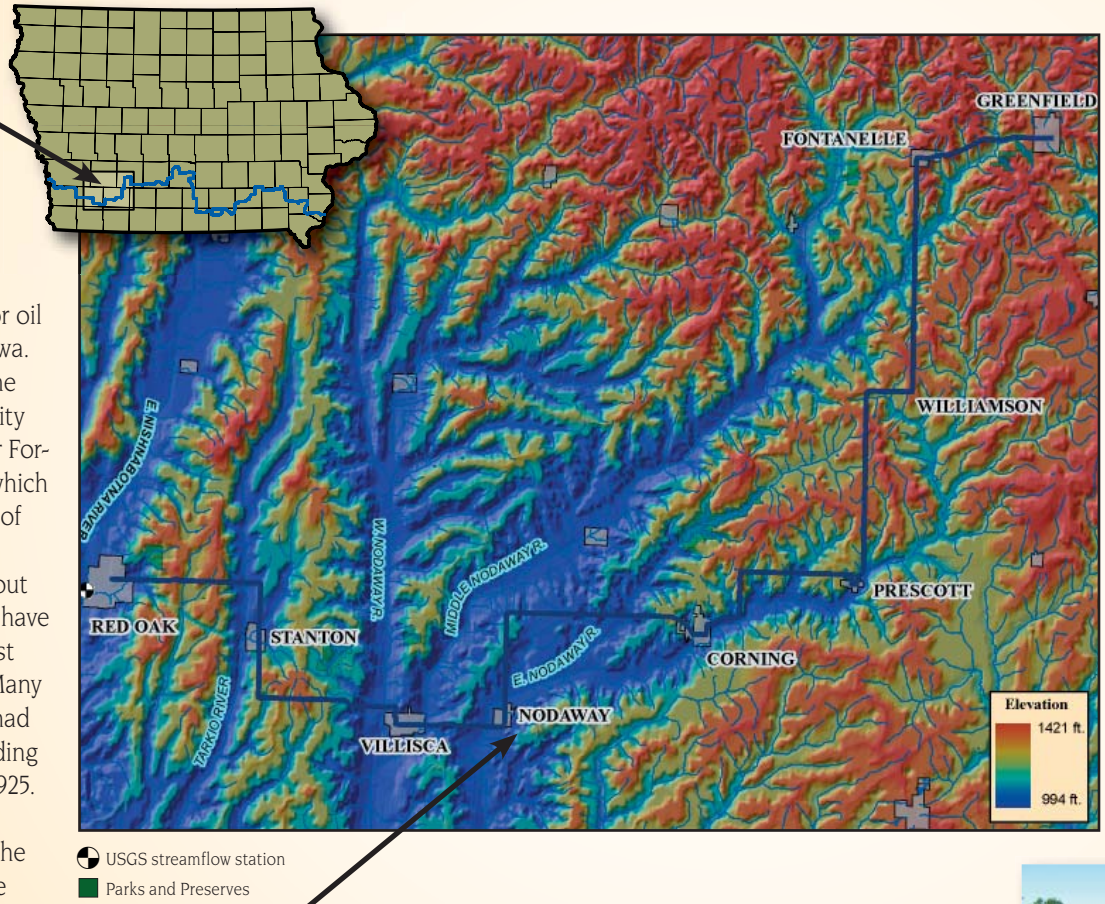
www.igsb.uiowa.edu

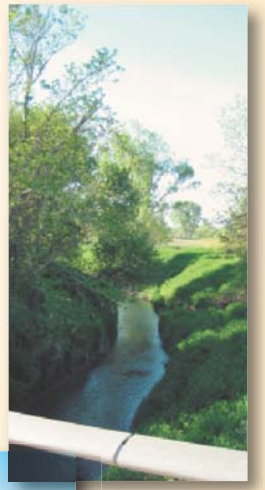
US Geological Survey
Iowa Water Science Center
400 S. Clinton St.
Iowa City, IA 52240
(319) 337-4191
http://ia.water.usgs.gov

Today, you will see the landscape change from dominantly corn and soybeans to more extensive **grasslands** (photo right). Roughly two-thirds of Iowa was covered by grasslands prior to European settlement – that's roughly 23 million acres! Much of it was tallgrass prairie, with short-grass prairie in some of the drier areas. Most of the grasslands you now see are farm fields enrolled in USDA's Conservation Reserve Program (CRP). Farmers can choose to enroll their land into 10–15 year CRP contracts, and receive payments throughout the life of their contract. These grasslands hold and store carbon, reduce erosion, and slow storm water run-off, while at the same time providing vital habitat for wildlife. Wildlife species that you may see on these grasslands include whitetail deer, pheasants, quail, turkeys, bobolinks, meadowlarks and more!

In all of Iowa's history only 133 **oil exploration wells** have been drilled in the state. Of these, only three have encountered oil. Many geologists believe the best potential for oil in Iowa lies in SW Iowa. This area includes the edge of the Forest City Basin (centered near Forest City, Missouri), which has yielded millions of barrels of oil for surrounding states. About 45 exploration wells have penetrated the Forest City Basin in Iowa. Many of these wells have had "shows" of oil, including Iowa's first show in 1925. The area of greatest speculation is near the town of Grant, where 8 oil exploration wells have been drilled. Most experts expect that a successful oil well will be drilled in this area of SW Iowa in the near future.



As you bike across the streams and rivers, you will find that many are artificially straightened, or channelized. **Channelization**, or stream bank straightening, removes the natural meanders in the stream path so that the stream flows in a straight line. Streams are often channelized (photo below, right) to reduce flooding in low-lying areas. Channelization in streams quickly removes water from the area, so the streams often have extremely high flow at certain times during the year, producing cut banks and erosion. Many streams in southern Iowa have been channelized, including segments of the Missouri, Nishnabotna, and Nodaway rivers.



The **Nodaway River** (photo right) is a 120-mile long river in SW Iowa and NW Missouri. The river's name first appears as N*odawa* in the journal of Lewis & Clark, who camped at the river's mouth on July 8, 1804. The Nodaway River basin area is 1,820 square miles and is prone to extensive flooding, contributing as much as 20% of the flood crest of the Missouri River near its mouth. In 2008 the USGS streamflow gage recorded a record peak-discharge, one of 47 new records set in Iowa during the '08 flooding.

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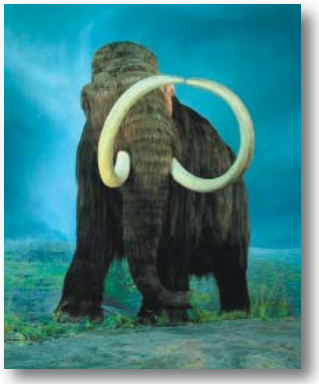
RAGBRAI Geo-pedia

Mammoths in Iowa



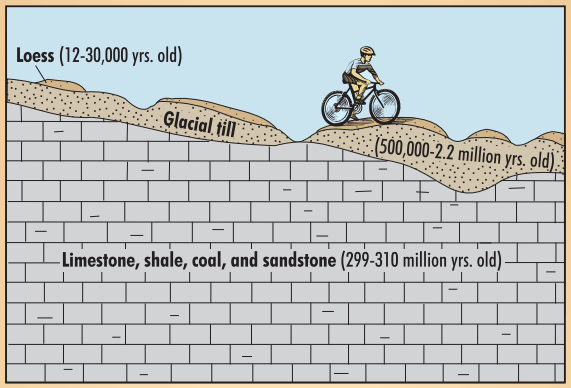
Woolly Mammoth.
Photo courtesy of the Royal British Columbia Museum, Victoria, BC, Canada.

The close of the great Ice Age brought many changes to the upper Midwest. This change is well documented by the sediments exposed along Clanton Creek near St. Charles. The creek sediments provide geological evidence of ancient fluvial and biotic environments, along with well-preserved mammoth (Mammuthus) bones that have been radiocarbon dated to 34,000 years ago! Evidence shows that this area was once a weedy flood plain filled with a wide variety of vegetative species. The younger alluvial fill contains well-preserved pollen, plant macrofossils, and insects. The Iowa landscape changed drastically as the climate warmed in this 'Great Plains' area. With these changes came human habitation. Great beasts, such as the mammoths that lived during the Pleistocene, watched as their world and their dominance disappeared.

Mammoths are close relatives of modern elephants; they had long curved tusks and long brown hair that covered their entire body. Mammoths, unlike Mastodons, had molar teeth that were flat and used for grinding grasses and other long thin plant material, while Mastodons had teeth used for crushing and eating hard plant materials such as tree and thick bushes. Mammoths are believed to have lived in the Pliocene epoch about 4.8 million to 4,500 years ago. Prehistoric human hunting was likely a strong contributing factor in the extinction of the mammoth, along with many other large mammal species.

COVER PHOTO: *Imes covered bridge in Madison County, Iowa*

Day 3 Milestones



Start: Greenfield
Glacial Erratic: Orient
Thompson River: 5 miles after Zion
Clanton Creek: 0.7 miles after East Peru
Pennsyvanian Outcrop: 1 mile after East Peru
Imes Bridge: 0.5 miles after St. Charles
Middle River: 4.2 miles after St. Marys
Finish: Indianola – 75 miles

For more information...

about the health of Iowa's rivers, including the South, North, and Middle Rivers, visit:
http://programs.iowadnr.gov/adbnet/search.aspx

Iowa has created a water quality index (or IWQI) to better compare and contrast streams and rivers in the state. This monthly-updated index is available at:
http://wqm.igsb.uiowa.edu/wqi/IA/WQI_IA.asp

Information on mammoths, mastodons, cephalopods, along with many other Iowa fossils can be found at:
www.igsb.uiowa.edu/Browse/fossils/fossils.htm

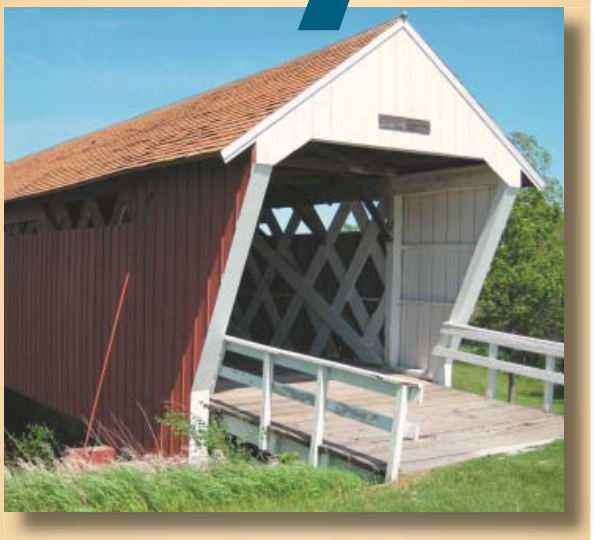
For information about the Pennsylvanian bedrock of Southern Iowa, visit: **www.igsb.uiowa.edu/gsbpubs/gsbpubs4.asp?findit=PENNSYLVANIAN**

RAGBRAI 2009

Learn about the Land

Day 3

Tuesday, July 21



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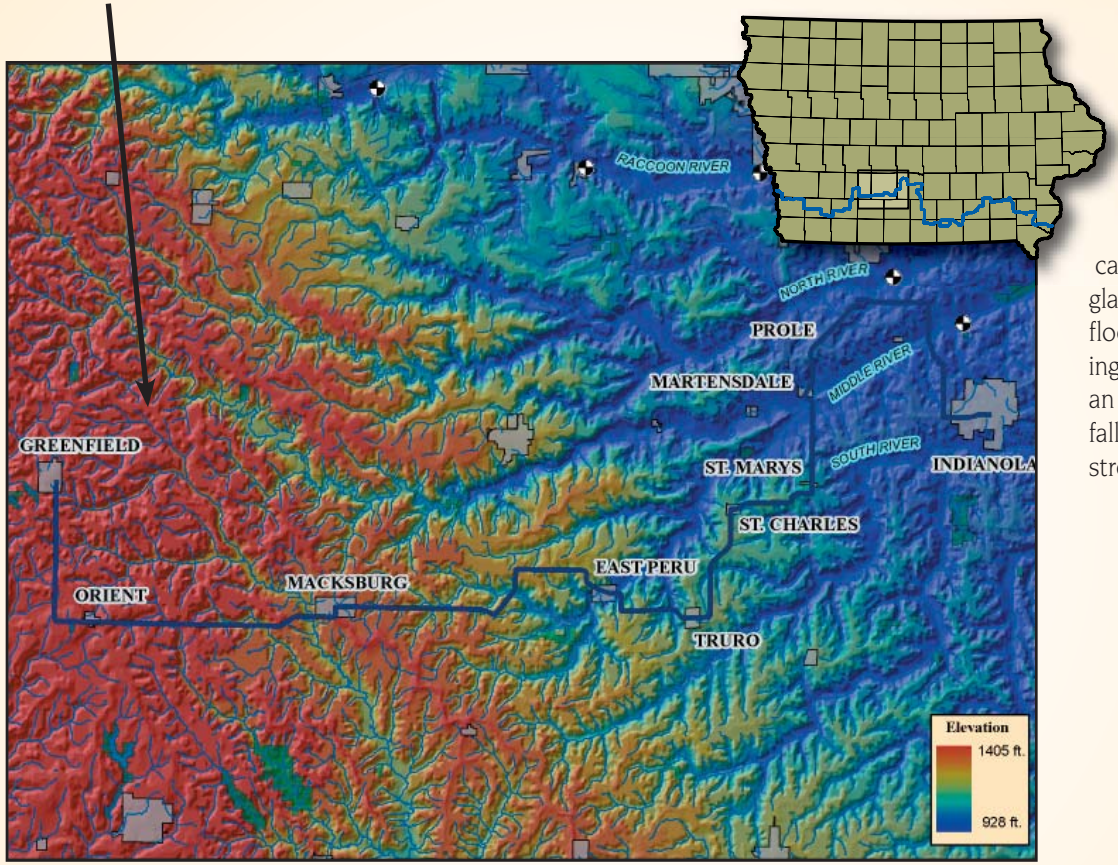
Throughout southern Iowa numerous **windmills** are still visible on farmsteads. Although most are no longer functional, their presence tells us something about the local geology. Generally speaking, the surface geology of the area consists of a loess mantled till plain. In many areas in Southern Iowa, a shallow "perched" water table is present at the boundary between a relatively thin (10-15 feet) section of loess and the older, deeper till. The perched water develops because the clay-rich paleosols (ancient soil) in the till slow the water infiltration, keeping water in the loess near the land surface. Many farmers constructed simple wells and windmills to pump this shallow, accessible water for their livestock and homesteads.

On the third day, as RAGBRAI travels from the town of Orient to Macksburg, you will cross the **drainage divide** between the Missouri River to the west and the Mississippi River to the east. Several rivers have their headwaters along this drainage divide, including the South, Middle, and North rivers. You will travel through all three of these river's watersheds today.

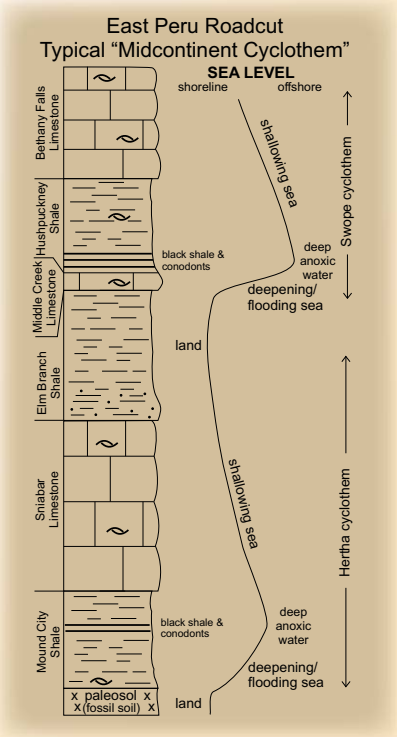


USGS streamflow station

Parks and Preserves

As you have probably noticed, this year's RAGBRAI route is far more hilly than usual. This is because RAGBRAI 2009 is almost exclusively on the mature landscape of the **Southern Iowa Drift Plain**, the largest landform region in Iowa. The Southern Iowa Drift Plain comprises most of the southern half of the state. Iowa was glaciated numerous times from 2.2-0.5 million years ago. These glacial advances left behind a thick package of glacial till that has subsequently eroded. The long period of erosion and landscape development created the well-defined river valleys and topography that we see today. More recently, this area was thinly mantled by several loess deposits. The loess deposits are thickest near river sources that carried material from the Des Moines Lobe.

Pennsylvanian-age, 306 million year-old rocks at East Peru (photo above) preserve the cyclic record (cyclothems) shown below of rising and falling sea levels caused by the waxing and waning of ancient glaciers. As glaciers melted, rising sea levels flooded coastal & interior lowlands depositing limestones and black shales that contain an abundance of fossils. As glaciers grew, falling sea levels led to river delta migration, stream erosion, and soil formation.



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RAGBRAI Geo-pedia

Iowa's Coal History

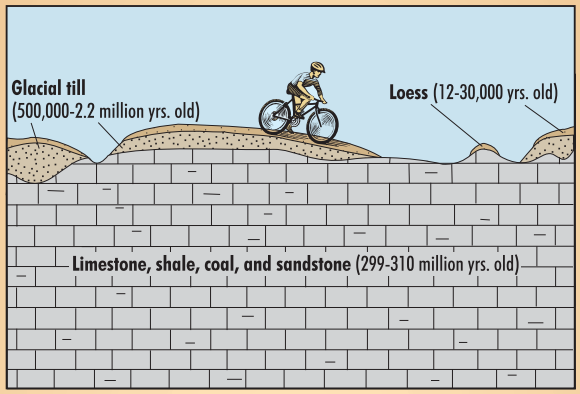
Iowa's coal resources played an important role in the state's social and economic history. Small quantities of coal were first mined in the 1840s near Fort Des Moines to fuel the post's blacksmith forge. In 1854 the Rock Island Railroad reached the Mississippi River, and by 1860, 500 miles of railroad track existed in Iowa. By 1876, Iowa was the leading coal producer west of the Mississippi and fifth in the U.S. By 1918 annual coal production in Iowa peaked at 9.3 million tons. Production declined thereafter and the industry shifted from underground to surface mining operations. The last coal mine in Iowa closed in 1994.

Calvin Collection, University of Iowa

Many large coal companies, such as Consolidation Coal Co. (photo above – Consolidation Mine #8 in Mahaska County), constructed camps in southern Iowa to house miners and their families. A few camps have persisted as small communities, but most have disappeared. Buxton was one of the best known of these, and was a thriving community with schools, stores, a YMCA, a municipal band, and a baseball team. Children went on to become doctors, lawyers, and teachers. Eventually, the coal was mined out, and in 1927 the last of the Buxton coal mines closed Many of the residents resettled in Des Moines where their descendants still live today.

COVER PHOTO: *The hilly terrain of the Southern Iowa Drift Plain a few miles south of Lacona, Iowa.*

Day 4 Milestones



Start: Indianola
South River: approx. 7 mi. after Indianola
Glacial erratic in field: 5.3 mi. after Milo
Pennsyvanian limestone (creek): 6.8 mi. after Milo
Whitebreast Creek: 5.6 mi. after Lacona
Hotel Charitone: Chariton (endangered site)
Finish: Chariton – 42 miles

For more information...

about the John L. Lewis Memorial Museum of Mining and Labor, visit: **www.coalmininglabormuseum.com**

The IOWATER program is a statewide volunteer effort to help sample and keep tabs of Iowa's streams and rivers. If you would like to find out more on how to become a volunteer, visit: **www.iowater.net**

Pennsylvanian-age coal beds in south central Iowa have been studied extensively, both for economic reasons and to develop greater understanding of Iowa's rich geological history. For in-depth information about Pennsylvanian geology, including the cyclic nature of deposition, and important stratigraphic formations and groups, go to: **www.igsb.uiowa.edu/inforsch/coalkyst.htm**

RAGBRAI 2009

Learn about the Land

Wednesday, July 22

Day 4

Iowa DNR – Geological and Water Survey
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Iowa City, IA 52242-1319
(319)-335-1575
www.igsb.uiowa.edu

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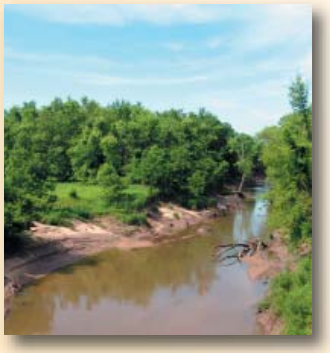
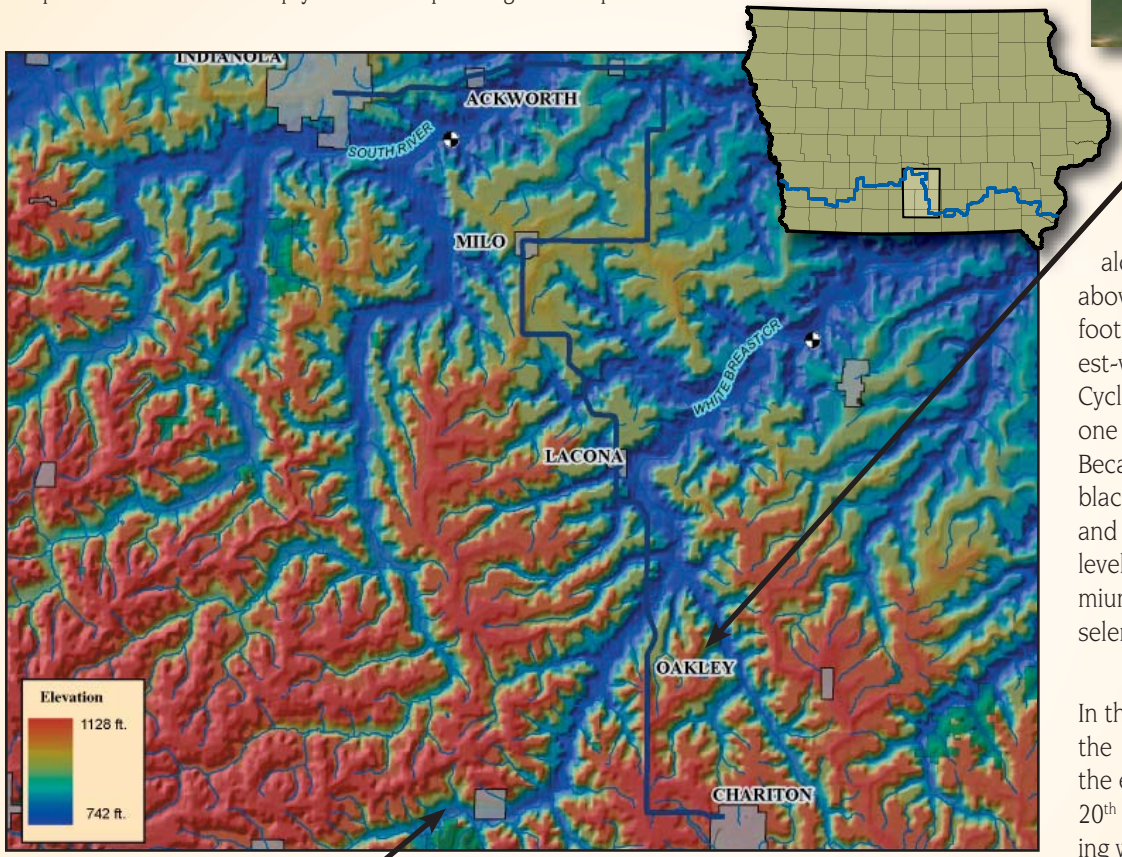
Looking across the landscape in southern Iowa, it would be easy to assume that geologic processes have been working uniformly forever. However, a closer look at the distant profile of the landscape reveals that the hillsides are not smoothly flowing slopes, but rather have broad "steps" carved into them (photo below, left). These **stepped erosion surfaces** are the result of alternating periods of active erosion and relative stability that have acted on the landscape over thousands of years. During periods of rapid erosion, valleys deepened and widened, and steeper slopes were notched into the landscape. But, during long periods of relative stability, soil profiles weathered deeply into the exposed glacial deposits and created a relatively stable and level surface. Take a look at the distant landscape while riding in southern Iowa and see if you can spot the telltale stepped erosion surface that indicates past irregularities in the long erosional history of the region.





The **Whitebreast Creek Watershed** has been the subject of many water quality improvement and sampling efforts since 2002, including several IOWATER volunteer snapshots. Water quality monitoring has been coupled with improvement in land uses to try to clean up water in the creek (photo above).

Geologic units are commonly named after nearby places. One such unit is the **Oakley Shale**, named for the small town of Oakley, Iowa. Its "type section" (the exposure that typifies the unit) lies along Whitebreast Creek near Oakley (photo above). The Oakley Shale is a wide-spread 1½-foot thick, black, fissile "core shale" (the deepest-water deposit) of the Verdigris-Ardmore Cyclothem. It lies above the Whitebreast Coal, one of Iowa's most valuable coal resources. Because of their environment of deposition, black shales and coals like the Oakley Shale and Whitebreast Coal frequently contain high levels of toxic metals such as copper, cadmium, mercury, lead, chromium, uranium, and selenium and have a high sulfur content.

Library of Congress, Prints and Photographs Div.

In the second half of the 19th century, and the early part of the 20th century, coal mining was a major industry in southern Iowa. Lucas, Iowa, is the site of the **John L. Lewis Memorial Museum of Mining and Labor**. Lewis (photo right), who served as president of the United Mine Workers of America (UMWA) from 1920-1960, was born in a mining camp about one mile east of Lucas in 1880 to Welsh immigrant parents. He began working in the mines near Lucas as a teenager then left Iowa at 21 and worked in mines around the country for the next five years while educating himself. A persuasive speaker and labor organizer, he rapidly rose to power in the UMWA, advancing from branch secretary to president in only 10 years. As president of the UMWA, John L. Lewis was instrumental in the founding of the Congress of Industrial Organizations in the early 1930s.

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RAGBRAI Geo-pedia

The Ottumwa Coal Palace

While in Ottumwa, take a moment to remember Iowa's dominance in the coal mining industry in the later part of the 19th century. In 1890, twelve counties and various businesses banded together to build the Coal Palace in Ottumwa, Iowa. Together, they hosted an exposition there to promote Iowa coal and other Iowa products.

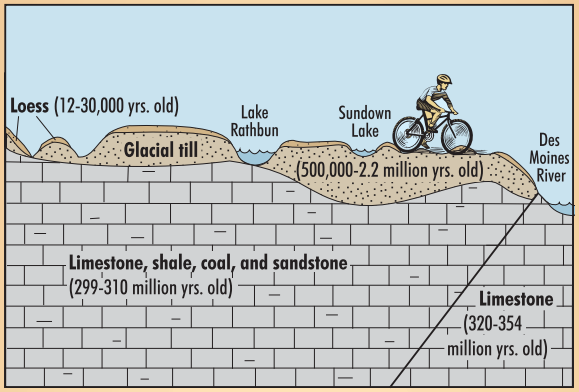
The Coal Palace was a unique and imaginative example of geologic materials used as building stone in Iowa. Completely veneered with blocks of coal, it was built to honor area miners and to publicize the coal resources of southern Iowa. These coal deposits are the carbonized remains of plants that flourished in tropical coastal lowlands that were present here about 300 million years ago (Pennsylvanian age).

The lavish palace-like building displayed a lofty 200-foot tower, with a dance floor near the top. In contrast to its dark exterior, the interior was bright, with vast rooms decorated with colorful displays made of wheat, oats, corn, sorghum and cattails, including a wall-sized portrait of Chief Wapello. There was a large auditorium for concerts, plays and speeches, and even a 30-foot tall waterfall. A reconstructed coal mine, complete with a functional shaft and hoist, was featured beneath the structure so that visitors could experience being lowered into a coal mine.

The Ottumwa Coal Palace was dismantled following the 1891 exposition season.

COVER PHOTO: *Coal Palace, Ottumwa, Iowa* 1890.
Photo courtesy of State Historical Society of Iowa – Iowa City.

Day 5 Milestones



Start: Chariton
Chariton River: 1.7 miles
Pin Oak Wetland: 0.1 mile after Chariton River
Confidence: 21.9 miles after Chariton River
Lake Rathbun: 5 miles after Confidence
Des Moines River: Downtown Ottumwa
Finish: Ottumwa – 74 miles

For more information...

about Honey Creek Resort or to make online reservations, visit: **http://honeycreekresort.com**

The USGS operates and maintains the streamflow gage at Rathbun in cooperation with the U.S. Core of Engineers. Real-time discharge and water-quality data can be found at: **http://ia.water.usgs.gov/**

A replica of the Iowa Coal Palace is housed at the Wapello County Historical Museum in Ottumwa. The website, which shows photos of the replica, can be visited at: **http://wapellocountymuseum.com**

RAGBRAI 2009

Learn about the Land

Thursday, July 23

Day 5

Iowa DNR – Geological and Water Survey
109 Trowbridge Hall
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(319)-335-1575
www.igsb.uiowa.edu

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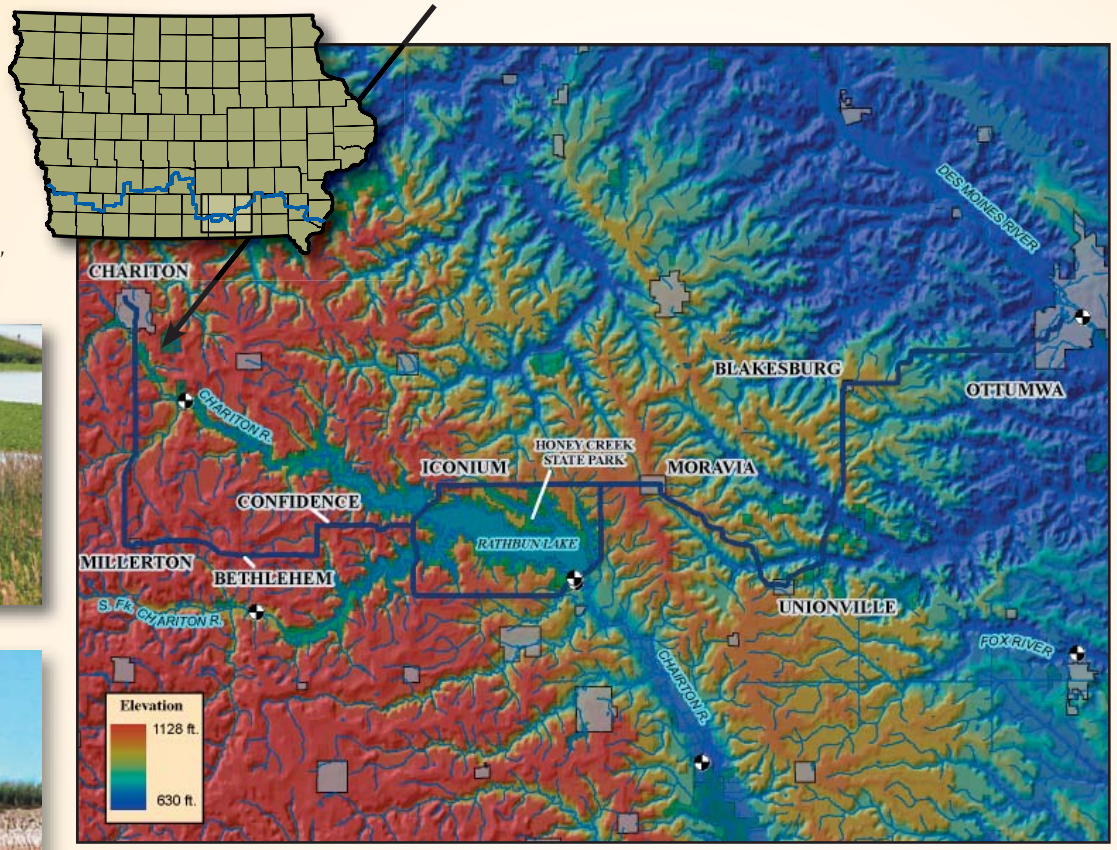
(319) 337-4191
http://ia.water.usgs.gov

Today, as you begin biking south from Chariton, you'll see **Pin Oak Marsh** (photo below, left). Pin Oak Marsh is a haven for wildlife, and is part of nearly 2,000 acres of land in the Chariton River watershed protected by the Lucas County Conservation Board. Species you may see in this area include ducks, Canada geese, great blue herons, and several species of songbirds. This time of year marshes are alive with activity, from the chorus of frogs, to bird-life busy with raising their broods. Additionally, Pin Oak Marsh and other marshes you see along the way provide beautiful outdoor venues for hiking, birding, and hunting. These marshes also help improve the quality of our water by allowing it to pool. Pooling gives contaminants time to break down, surface water time to filter as it percolates into the ground water, and flood waters somewhere to go, instead of our homes.



USGS streamflow station

Parks and Preserves

See if you can spot a feature geologists call the **Late Sangamon Paleosol** on RAGBRAI today. This paleosol (ancient soil) is frequently found as a red exposure along the side slopes of a hill. When the soil was originally exposed 130,000 to 30,000 years ago, it was continually eroded and weathered, giving it a distinct red color. As time progressed, a thin mantle of loess was deposited and stripped away. Today the paleosol is recognizable as red zones on the hillsides and is often identified by the presence of red cedar groves.

According to comprehensive state-level damage data, Iowa has had the largest flood losses of any state in the nation from 1983-2008. To reduce flood damage to communities located along the Des Moines River, the construction of the Red Rock and Saylorville dams and flood storage reservoirs was initiated in the 1960s upstream from Ottumwa. The construction of **Rathbun Dam & Reservoir** upstream of Centerville (Rathbun Reservoir shown above) was authorized by the Flood Control Act of 1954. Construction of the dam and embankment began in September 1964 and was completed in 1969. The U.S. Army Corps of Engineers manages all three dams and lakes to benefit the nation by providing flood damage reduction, recreation, water supply storage, fish and wildlife management, and downstream water quality improvement.

Lake Rathbun is one of the largest lakes in Iowa, covering 11,000 acres with an additional 23,000 acres of land surrounding it. **Honey Creek Resort** on Lake Rathbun (photo right) is Iowa's first state park "destination resort." Recently opened in 2008, the resort overlooks the 11,000-acre lake and has a variety of fun activities for the whole family, including bike trails, an 18-hole golf course, boat rentals, and a pirate themed water park!

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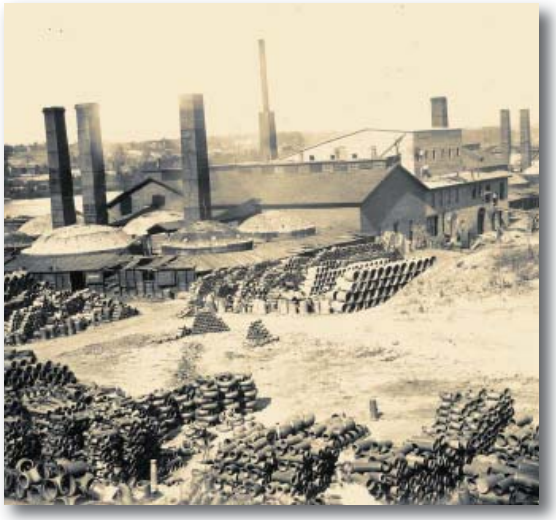
RAGBRAI Geo-pedia

Ceramics

Ceramics, principally the production of brick and clay drainage tile, has been a very important industry in Iowa's history (photo below). Pennsylvanian clays and shales were extensively mined for this industry in southeast Iowa, including the Ottumwa area. Among the finest ceramic clays to be found in Iowa are Pennsylvanian-age underclays, the ancient soils that nurtured vegetation that formed the great coal swamps 325 million years ago. These clays now underlie the coal beds in Iowa and are still mined and utilized by southeast Iowa potters.

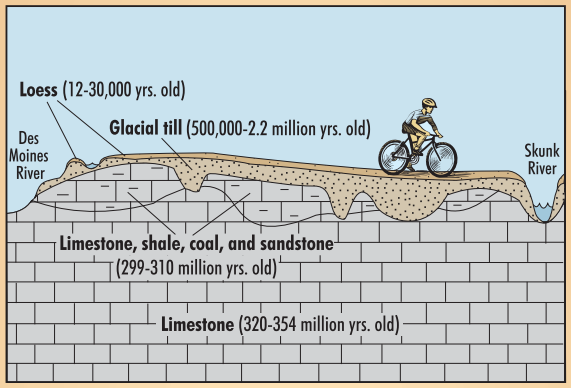


Calvin Collection, University of Iowa

Kilns, sheds, and neat stacks of finished clay products at the Iowa Pipe and Tile Company plant in Des Moines, about 1896.

COVER PHOTO: *Lake Darling, named for the legendary Iowa conservationist Jay "Ding" Darling, is home to a watershed success story. Landowners and other stakeholders installed numerous conservation practices to reduce sediment, nutrients, and bacteria entering the lake. Photo from Iowa DNR Fisheries Bureau.*

Day 6 Milestones



Start: Ottumwa
Des Moines River: Downtown Ottumwa
Cedar Creek: 10.2 miles after Ottumwa
Skunk River: 1.3 miles after Rome
Big Creek: 3.5 miles after Skunk Rver
Finish: Mt. Pleasant – 74 miles

For more information...

about the efforts being undertaken to improve the water quality at Lake Darling visit their website: **www.iowadnr.gov/water/watershed/lakedarling/index.html**

Water well information will be available within the upcoming months for Web accessible viewing at: **http://ia.water.usgs.gov/**

Lake Darling has had many monitoring projects, including attempts to track bacteria sources like *E. coli*. To view a short report of this project, visit: **www.igsb.uiowa.edu/gsbpubs/pdf/WFS-2005-04.pdf**

RAGBRAI 2009

Learn about the Land

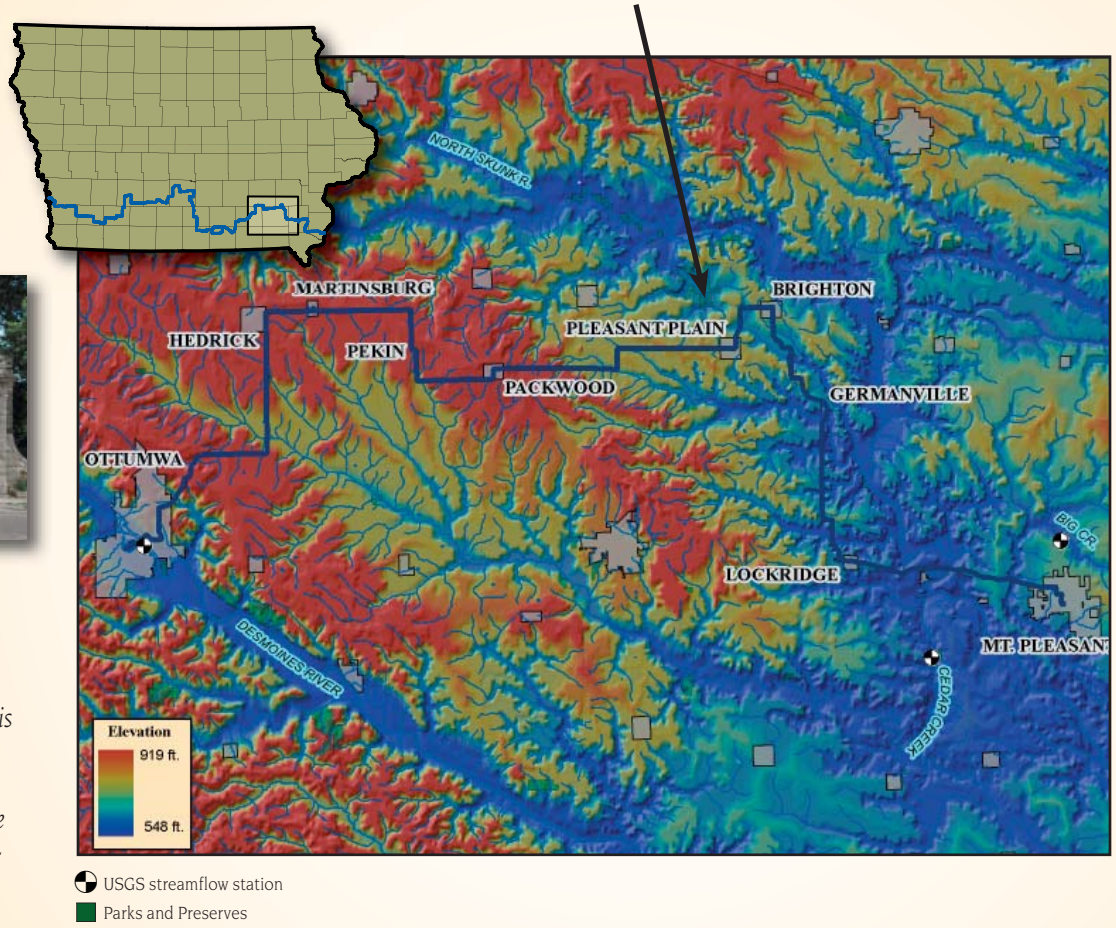
Day 6

Friday, July 24

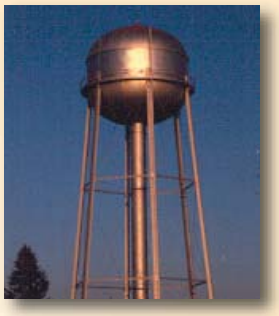
Iowa DNR – Geological and Water Survey
109 Trowbridge Hall
Iowa City, IA 52242-1319
(319)-335-1575
www.igsb.uiowa.edu

US Geological Survey
Iowa Water Science Center
400 S. Clinton St.
Iowa City, IA 52240
(319) 337-4191
http://ia.water.usgs.gov

Today, just before entering the town of Pleasant Plain, you'll be entering the **watershed of Lake Darling**. The Lake Darling watershed consists of 19.8 square miles in Washington, Keokuk and Jefferson counties. Built in 1950, the once 305-acre lake had shrunk to 267 acres. Sediment washing in from the watershed has gradually filled in the lake and caused other problems. Excess nutrients, pesticides and bacteria washed into the lake with the sediment. Over time, the water became cloudy, fish habitat declined, and high bacteria levels led to swimming advisories at the beach. However, over the last five years, the lake has undergone drastic improvements in water quality, due largely to the involvement of a variety of stakeholders, from government groups to individual citizens interested in seeing water quality improvements. A number of cooperative efforts in the lake watershed have had demonstrable effects in the initial phases of the improvement process.



The rock used in the Edgarly Gateway (photo above), St. Mary's Church, and many other Ottumwa buildings is called Bedford Limestone, and is quarried between Bloomington and Bedford, Indiana. Many famous buildings, including the Pentagon, Empire State Building, and Yankee Stadium also use Bedford Limestone.



Biking through southern Iowa you may notice many water towers in the open country, away from towns and cities (photo above). These water towers are part of vast **Rural Water Systems** that cover most of the southern part of the state. In response to the scarcity of good clean water in the region, in the past 20 years rural water systems have spread to provide clean drinking water to rural residents in the countryside, as well as towns and subdivisions. These Rural Water Systems often span several counties and serve hundreds of thousands of people, in addition to ethanol plants and other businesses.

Riding through southeast Iowa, as in many parts of the state, you are guaranteed to see (and smell!) numerous **livestock operations**. Within the first few miles after Ottumwa, there will be several animal confinement buildings that look like large sheds (photo left). In case you were wondering, one standard confinement building can hold up to 1,200 hogs!

The U. S. Geological Survey Water Resources Program, in cooperation with Federal, State, and local agencies maintains a national network of **monitoring wells** to measure the effects of droughts and other climate variability on groundwater levels. In Iowa, the network consists of nine wells, one in each of the State's nine climatological districts including one near the towns of Chariton and Fairfield. These wells are equipped with telemetry that transmits by satellite a reading of water level to a data relay office. These measurements constitute real-time hydrologic data and are updated every four hours.

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RAGBRAI Geo-quiz

1. This year's RAGBRAI route travels over the land form region known as _____.
   a. Iowan Surface b. Des Moines Lobe
   c. Southern Iowa Drift Plain

2. Roughly how much of Iowa was once grasslands.
   a. 1/4 b. 1/2 c. 2/3

3. One hundred thirty-three _____ wells have been drilled in Iowa.
   a. deep water b. oil exploration c. ag drainage

4. Glacial erratics are _____ deposited by glaciers.
   a. stones b. fossils c. vegetation

5. Rock units are often named after _____.
   a. rock stars b. famous geologists c. nearby places

6. Iowa's first "destination" state park is _____.
   a. Backbone St. Park b. Honey Creek Resort
   c. Geode St. Park

7. A paleosol is a(n) _____.
   a. ancient soil b. ancient sun c. dinosaur femur

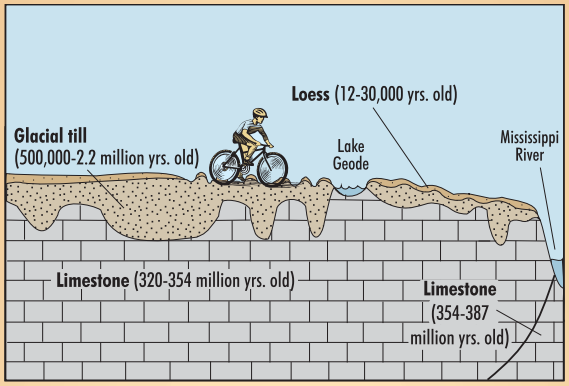
8. Iowa's State Rock is the _____.
   a. Oakley Shale b. Whitebreast Coal c. Geode

9. Iowa was once a leader in producing this natural resource.
   a. oil b. gold c. coal

10. The Illinoian till plain covers _____ Iowa.
    a. central b. southeast c. northeast

Answers: 1.c, 2.c, 3.b, 4.a, 5.c, 6.b, 7.a, 8.c, 9.c, 10.b

Day 7 Milestones



Start: Mt. Pleasant
Big Creek: 4.7 miles
Skunk River: 0.1 mile after Lowell
Geode State Park: 3.3 miles after Lowell
Quarry: 1 mile after Geode State Park
Entering Mississippi Valley: Burlington
Finish: Burlington – 42 miles

For more information...

about the water quality improvement plan for Lake Geode: **www.iowadnr.gov/water/watershed/tmdl/files/final/geode09tmdl.pdf**

For more detailed information on the formation and location of geodes in Iowa, visit: **www.igsb.uiowa.edu/browse/geodes/geodes.htm**

Lake Geode has been the subject of an intensive beach monitoring study. This report can be viewed online: **www.igsb.uiowa.edu/gsbpubs/pdf/WFS-2005-06.pdf**

COVER PHOTO: A *geode from southeast Iowa.*

RAGBRAI 2009

Learn about the Land

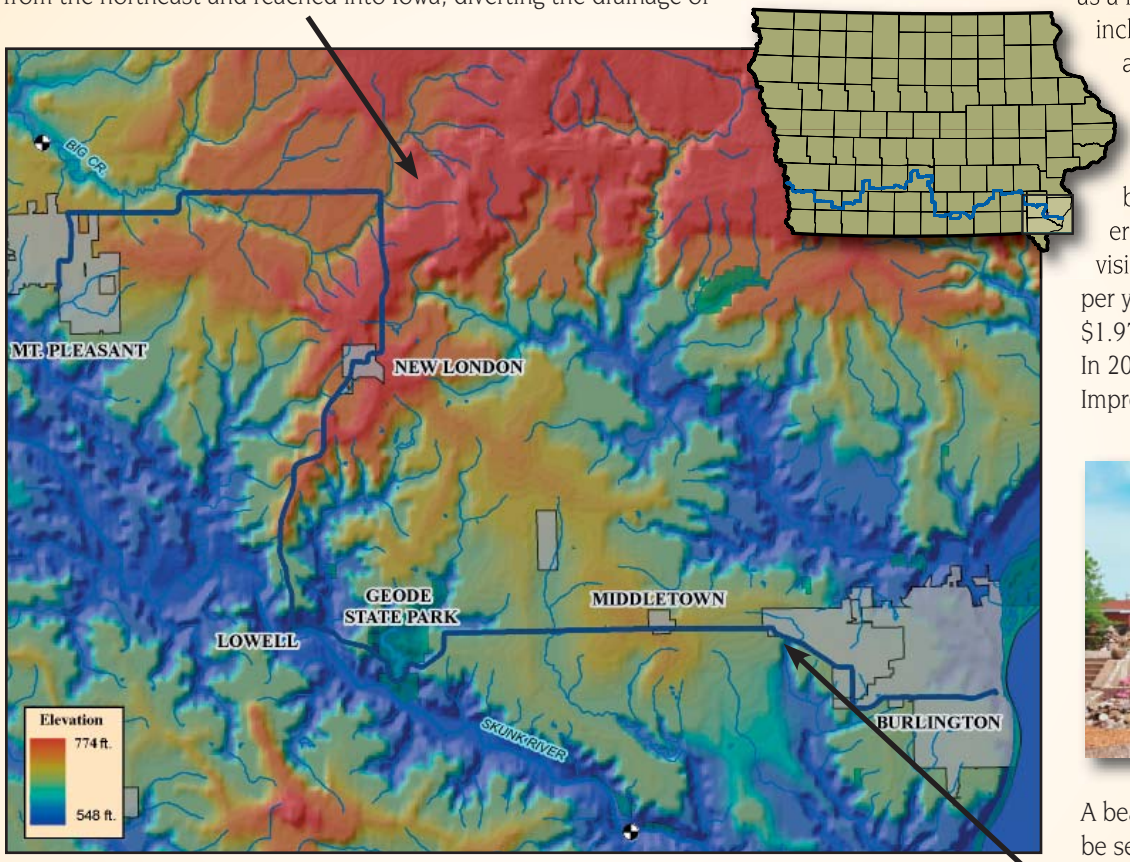
Saturday, July 25

Day 7

Iowa DNR – Geological and Water Survey
109 Trowbridge Hall
Iowa City, IA 52242-1319
(319)-335-1575
www.igsb.uiowa.edu

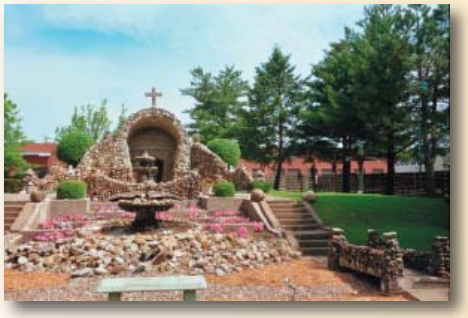
US Geological Survey
Iowa Water Science Center
400 S. Clinton St.
Iowa City, IA 52240
(319) 337-4191
http://ia.water.usgs.gov

After exiting Mount Pleasant, RAGBRAI will cross the **Illinoian till plain**. These glacial deposits are much younger than the Pre-Illinoian tills you have been biking over previously. The western margin is difficult to see while riding because of the loess cover, but the north-south RAGBRAI route along X23 follows very close to the boundary. The Illinoian Glacial Episode occurred around 300,000 to 130,000 years ago when the Lake Michigan Lobe glacier advanced from the northeast and reached into Iowa, diverting the drainage of the Mississippi River to the west. The Illinoian till is the only northeastern sourced till in Iowa, making its composition unique within the state. The Illinoian till extends from south of Fort Madison to the mouth of the Wapsipinicon River. The Illinoian exposure extends up to 20 miles into eastern Iowa.



Lake Geode is located in Henry and Des Moines counties in southeast Iowa. The lake is nestled within scenic Geode State Park, and is a man-made reservoir constructed in the 1950s. Lake Geode is well known for fishing, and offers significant economic value to the region. The Iowa DNR identified Lake Geode as a major recreational area based on factors including visitation rates, campground use, and population within a 50-mile radius of the lake. The Center for Agricultural and Rural Development (CARD) at Iowa State University estimates that between 2002 and 2005, Lake Geode averaged over 99,700 annual visitors. Those visitors spent an average of $7.35 million per year, which supported 146 jobs and $1.97 million of labor income in the region. In 2009 the DNR completed a Water Quality Improvement Plan for Lake Geode.

Later today, and until the end of RAGBRAI, you'll be biking over the region of Iowa that provides us with our state rock, the **geode** (photo above). In Iowa, geodes are often exposed in small streams and ravines after heavy rains. The outer shell is often limestone, and must be broken open to expose its inner beauty. Typically quartz crystals and chalcedony form the inside of a geode.



A beautiful display of Iowa's state rock can be seen at the **Our Lady of Grace Grotto** (photos above and to the left), just east of St. Mary's Church in West Burlington. The grotto, begun in 1929 by two Benedictine priests, was completed by depression era volunteers. The grotto includes rocks from many nations and the holy land, but is dominated by an impressive domed interior lined with hundreds of split geodes with quartz crystal interiors framed by unsplit geodes. The grotto fell into disrepair in the 1950s and 60s, but was renovated in the early 1970s with additions of a fountain, the seven stages of the cross, and other features. Today the grotto ranks as one of the best displays of geodes in Iowa. The Our Lady of Grace Grotto can be seen at 420 West Mt. Pleasant Street in West Burlington.