

## Build Illinois

### THE LAST 500 MILLION YEARS

Geologists are storytellers! They read the rocks like the pages in a book and recreate for our imagination the vanished landscapes of ancient Illinois. Illinois was not always a land of prairie and farm. It was built by the strange landscapes of long ago—this is the geologist's story! Let's go back to those ancient landscapes. I brought my imaginary time machine; let's hop in and head back in time!

### ANCIENT OCEANS OF ILLINOIS

We jump back in time to more than 500 million years ago. What type of equipment should we bring? Camera? Sure. Food? Yes. What else? How about a boat? That's right! The Illinois of long ago, back in the early PALEOZOIC ERA (Fig. 1), was often under the water of a shallow, warm ocean—like the Bahamas, but with no palm trees or resort hotels!

We step out of our time machine on a small island. The sky is blue, the breezes are tropically warm, and the sun is shining hot! Imagine warm waters, teeming with life, washing against a barren shore. On the land, we see few signs of life. However, in the water (Fig. 2), we find sea-shells, corals, and perhaps the first primitive fish. Great CEPHALOPODS, looking like octopuses in "ice cream cone" shells, float menacingly along. Strange creatures, TRILOBITES, crawl along the ocean bottom; their flexible shells make them look something like a horseshoe crab.

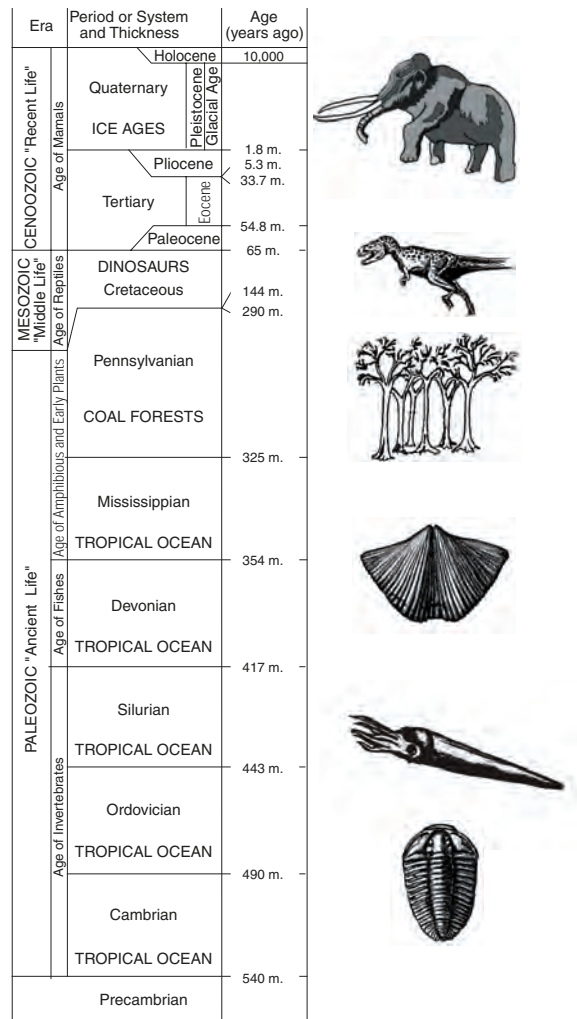


Figure 1 Approximate time scale for rocks present in Illinois.

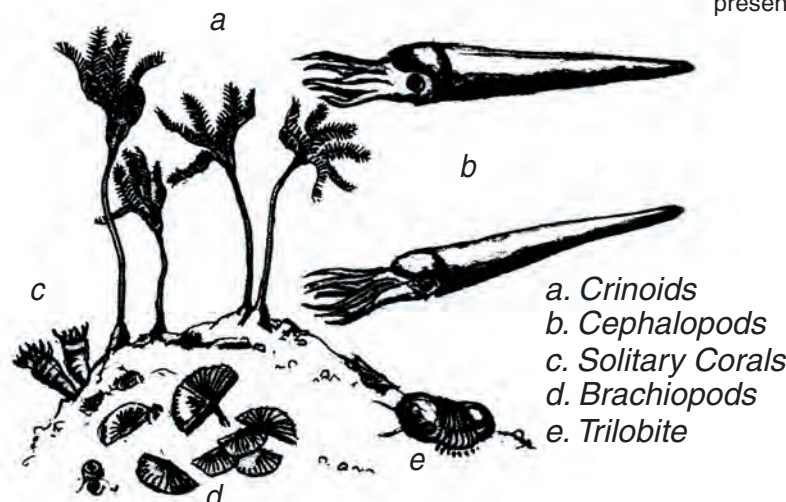
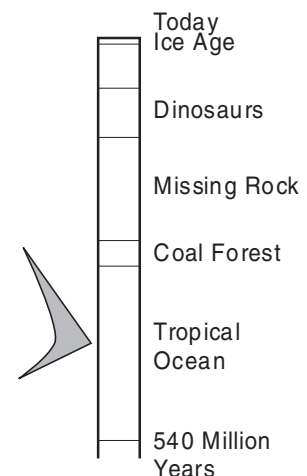
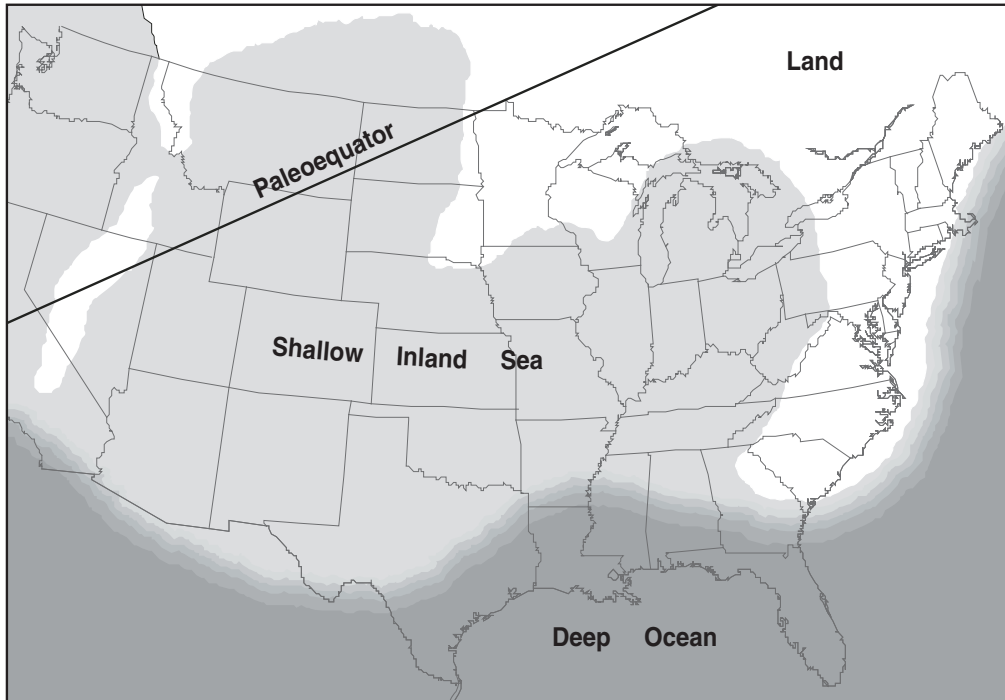


Figure 2 The ancient ocean of Illinois.

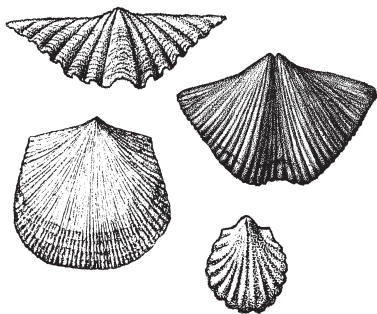




**Figure 3** The landscape of 350 million years ago—Illinois under water!

**Did you know?**

*Brachiopods are a form of sea life that lived near ancient tropical shores by the billions. Many species died out at the end of the Paleozoic; the survivors are much rarer and few types remain. The seashells commonly found today are pelecypods, not brachiopods, and are not even closely related to them!*



The Illinois of 325 to 540 million years ago was a shallow tropical ocean (Fig. 3). Illinois was located almost at the equator at that time. What did these ancient oceans do to Illinois? They left great thicknesses of SEDIMENT on the ocean bottom. What types of sediment? What do oceans leave behind? Well, SAND—great deposits of sand along the shore and offshore. These sands became SANDSTONE. Thick layers of sandstone were created in Illinois, particularly in the early part of this time period.

Oceans also leave behind billions of SEASHELLS. These whole shells and fragments, all made of CALCIUM CARBONATE, combine to form the rock we know as LIMESTONE (or DOLOMITE). A glance at a rock from that time may show beautifully preserved seashells and other animals from the ancient oceans of Illinois.

During this time, the Paleozoic Era, the rocks that make up Illinois were periodically bent and folded. In southern Illinois, the Earth's crust periodically sank, creating a broad, bowl-shaped feature—the ILLINOIS BASIN. Over time, this basin continued to sink as the ancient oceans of Illinois filled it with thick deposits of limestone and sandstone.

**Did you know?**

*Crinoids are sometimes called “sea lilies,” but they’re not plants! They are Echinoderms, cousins of the starfish. When they died, their hard skeletons (calcium carbonate) broke apart, and the “stems” that held them up became many little round pieces sometimes called “Indian beads”!*



**Did you know?**

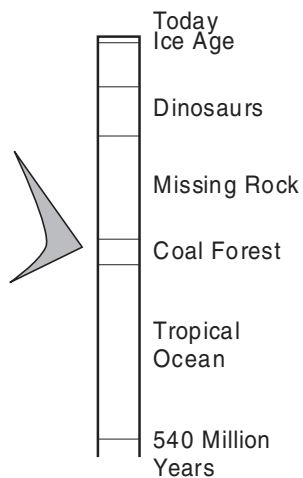


*Trilobites were cousins of crabs and even distant cousins of the insects. They used to be very common and came in many different and bizarre shapes. They are now extinct—totally gone! They died out before the dinosaurs ever lived!*

# DELTA SWAMP

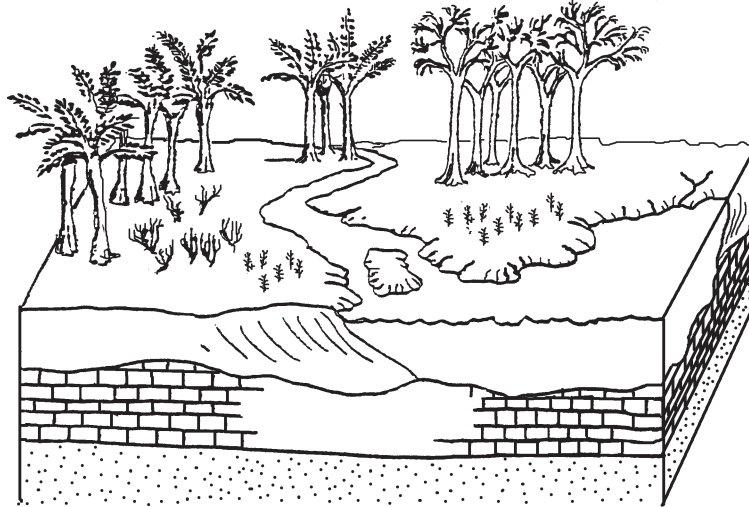
*We hop back into the time machine and time moves on. The landscape changes. We get out. We're still about 325 million years in the past, but things have changed. We're standing ankle-deep in mud! Nearby we see a muddy river winding its way through a dark woodland. We're in the middle of a great river delta. This ancient wet, muddy delta swamp (Fig. 4) is a fascinating place! On it grows the first great forests Earth has seen. The trees tower 100 feet or more above us—strange shapes that spread across the low swampy land. The swamps are inhabited by many types of amphibians—cousins of the frogs—but some are 10 feet long, with big teeth! Small reptiles scamper about, rushing to hide in hollow trees. As we walk, huge cockroaches crawl along fallen tree trunks and scramble across the muddy forest floor. Dragonflies as big as hawks fly overhead, darting through the wet, dark forest hunting for food.*

What has happened? The bowl-shaped feature that is the Illinois Basin was still sinking and still filling up. Far to the east, mountains have risen, and rain has washed sand, silt, and clay down the slopes to rivers that carried the sediment westward into the shallow midcontinent ocean. Where a river enters an ocean or lake, the silt and clay the water carries are deposited in a DELTA. Deltas are muddy places that constantly change as the river moves back and forth across them. In Illinois, these rivers deposited mud in a vast delta. For millions of years this process continued. It filled up the warm shallow ocean and turned Illinois into a dark, muddy swamp. The trees and other plants that made up the great delta forests were buried and compacted through time and became a major state resource—COAL!



**Figure 4** The coal swamps.

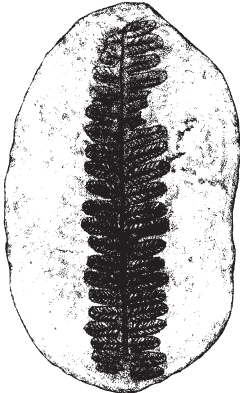




**Figure 5** The delta buries the ancient ocean rock.

The delta sediments accumulated to great thicknesses on top of the ancient ocean sediments. Like thick fudge frosting on top of a cake, the mud and underlying layers of seashells and sand changed over time into SHALE on top of limestone and sandstone (Fig. 5).

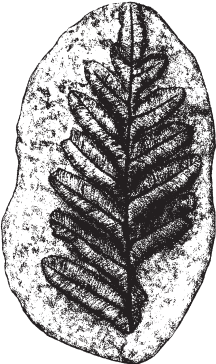
After the Pennsylvanian Period, vast forces in the earth twisted Illinois, folding and faulting rock and bringing some of the ancient ocean rock to the surface in north-central Illinois. The huge Sandwich Fault formed, slashing across Illinois from southwest of Chicago to southwest of Rockford! Tectonic forces also produced faults and other geologic activity in extreme southeastern Illinois, causing FLUORITE, the state mineral, to be deposited. Geologic activity in the northwest deposited GALENA...an ore of LEAD. Near what is now Des Plaines, a meteor crashed to Earth, smashing and faulting the bedrock (Fig. 7).



*Pecopteris hemiteloides*  
J. R. Jennings, ISGS

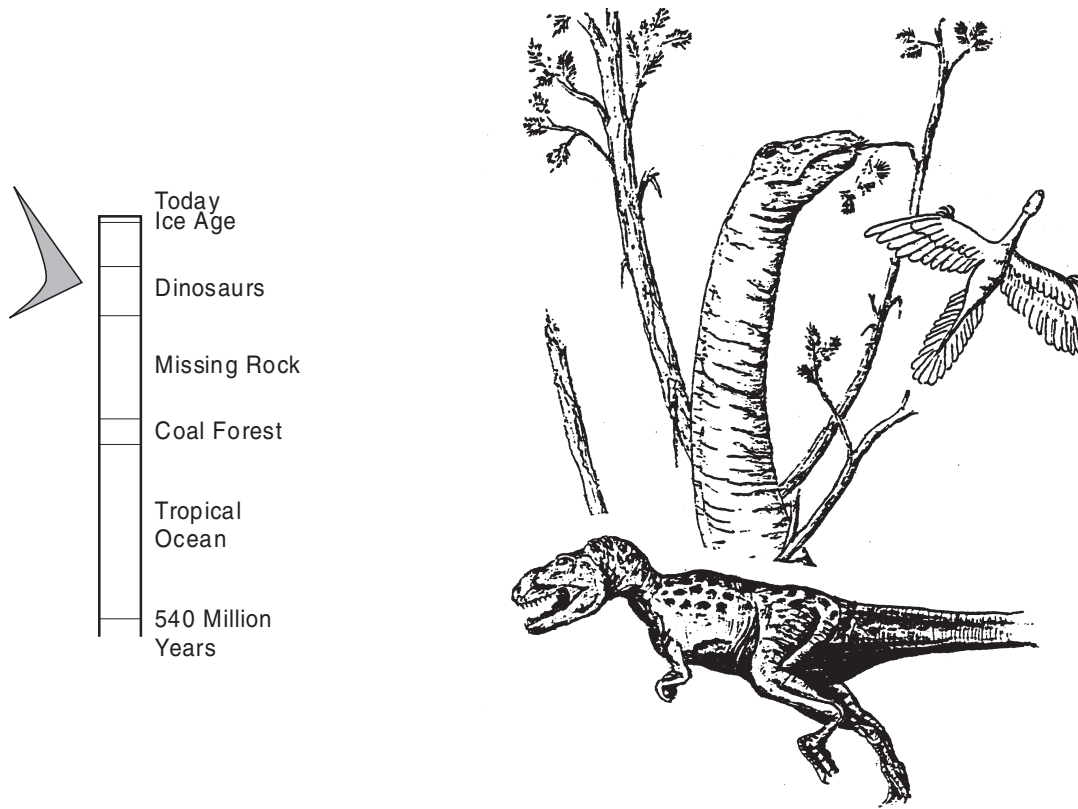
**Did you know?**

*Fossil leaves are commonly found in some parts of Illinois. These leaves represent several types of large trees found in the coal swamps. In some places these leaves are found in oval rocks called CONCRETIONS. The Coal Age fossils from Illinois' Mazon Creek locality are world-famous!*



*Alethopteris serlii*

# WHEN DINOSAURS RULED!

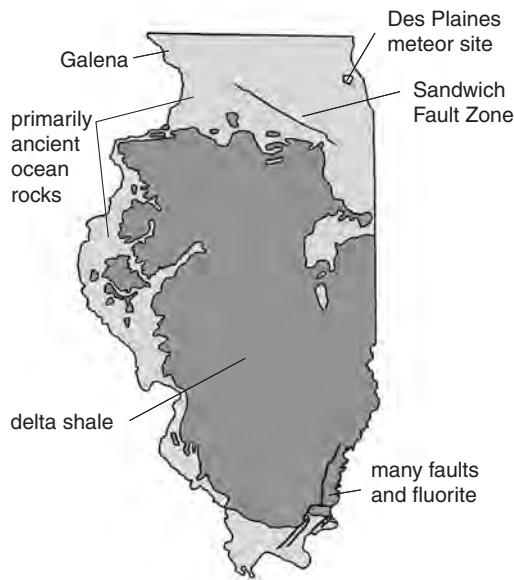


**Figure 6** The Dinosaurs of Illinois?

*We climb back in the time machine and travel forward. The time machine stops, and we step out into Illinois of the MESOZOIC ERA. Illinois is no longer under the ocean, nor is it a dark swamp. Instead, it is a warm, dry place, a landscape of hills and valleys. Around us are strange plants, much different from the coal forests. For the first time on our trip, we see birds! They look strange, almost lizard-like. As they call and fly about, we realize that their mouths are full of sharp teeth! Also overhead are strange creatures with leathery wings—flying reptiles flapping their way above the prehistoric landscape. Flowers bloom on a nearby tree—the first flowers we’ve seen on our trip! And now, also for the first time, we see DINOSAURS (Fig. 6)! They wander across a nearby meadow; they feed in the forests! A huge treetop-eating sauropod stops munching to stare down at a small predator. The little meat-eater retreats from the towering herbivore—it’s much too big to tackle!*

There seem to have been dinosaurs everywhere, but no trace of dinosaurs has ever been found in Illinois! Why not?

WATER and WIND! Illinois, no longer an ocean or a swamp, was a land exposed to WEATHERING and EROSION. Water and wind broke up the youngest rocks (the ones on top!) and carried the pieces far away. In the northern quarter and along the western edge of the state where the rock layers were thinner, the delta rocks, including the coal within them, and some of the younger ocean rocks were removed by erosion. This exposed the old ocean rocks at the surface (Fig. 7). In the central and southern parts of the state, much of the delta rock and most of the ocean rock remained. The dinosaurs and other animals and plants of the Mesozoic Era lived in an Illinois that was washing away, and their bones and the leaves were not safely buried and fossilized, but were destroyed or removed. So, actually, we have no proof that dinosaurs were ever here—but they probably were!



**Figure 7** Bedrock geology of Illinois

**Did you know?**

*There is one area of the state that might have dinosaur bones. In the southernmost part of the state, near Cairo and Metropolis, are deposits of sand, silt, and clay. These sediments were left by water—the Gulf of Mexico! Strangely enough, the Gulf of Mexico reached up to southern Illinois in late Mesozoic times, just before the end of the dinosaurs. We may someday find their bones in those sediments!*



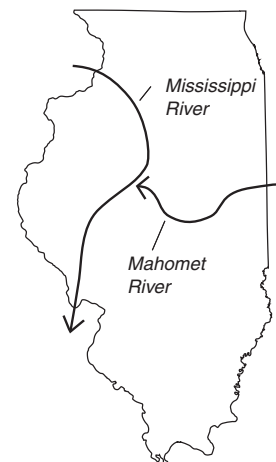
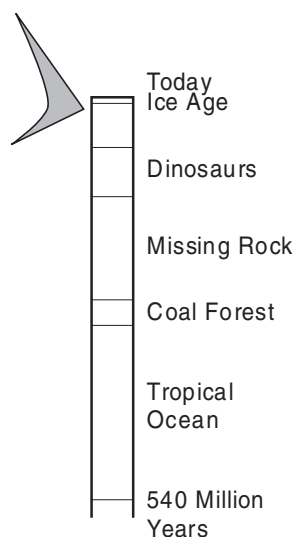
**Did you know?**

*Flowers appeared in the Mesozoic Era. One of the earliest flowers was the magnolia!*

## LOST RIVERS OF ILLINOIS

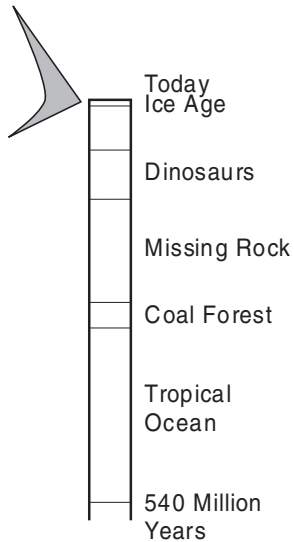
*We return to the time machine, and after traveling many more millions of years, we stop near where the city of Peoria will be in 2 million years! We stand on cliffs overlooking a large valley. A great river flows in front of us—the Mississippi River (Fig. 8)! What is it doing here? We travel across Illinois to the future site of Champaign-Urbana, where the University of Illinois will someday stand. There is a huge river valley here, too—the Mahomet—with great waters flowing west to meet the Mississippi River south of Peoria! This is not the Illinois we know today! What happened to this landscape?*

The Illinois landscape of a few million years ago was still quite different from what we see today. The Mississippi River flowed through present-day Bureau and Henry Counties, passing east of the present site of Peoria! The Mahomet River met the Mississippi near the town of Havana, Illinois, and flowed southwest from there. In order to find out what happened to this landscape, we need to travel through time again.



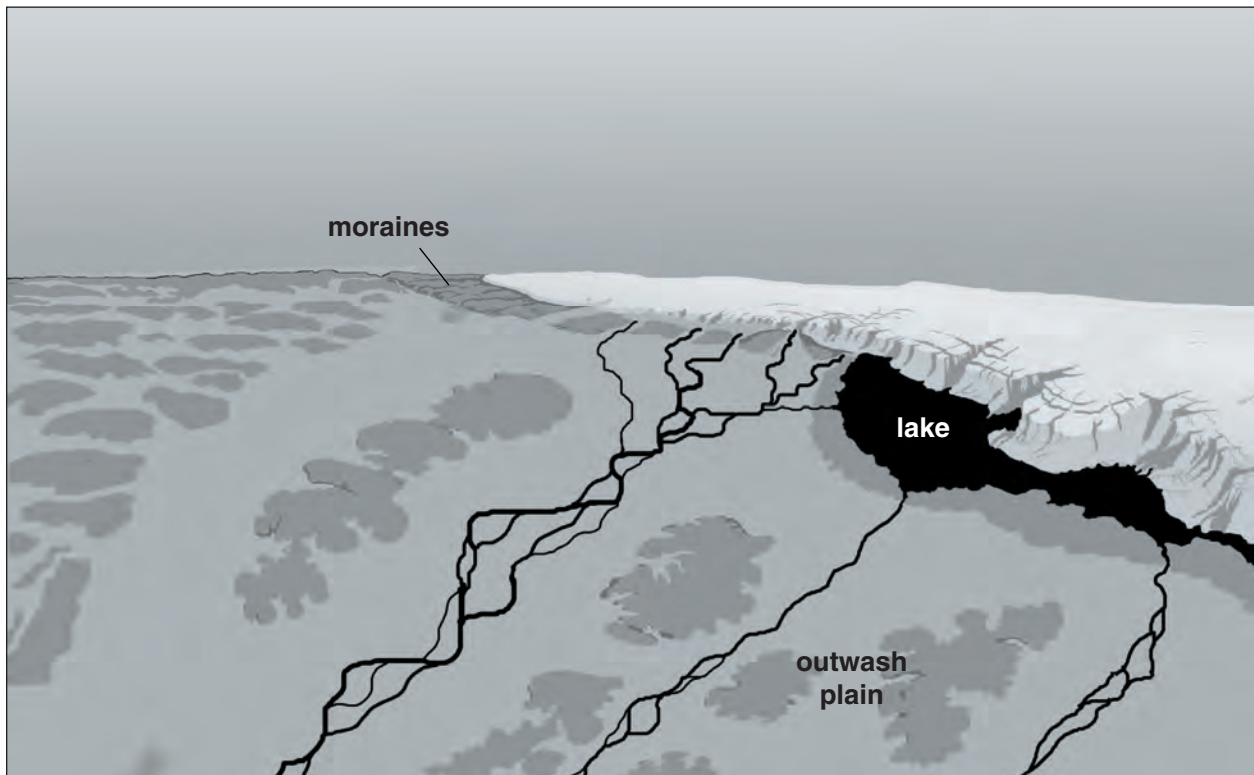
**Figure 8** Ancient Rivers of Illinois.

# ICE AGES



We step out of the time machine. We're in the late part of the Pleistocene Epoch-the Ice Ages! **GLACIERS** cover much of Illinois. We stand next to a glacial moraine, a great muddy mound of clay and rocks piled up by the glacier. A lake stretches in front of us, ending at a great, crumbly wall of dirty ice: the glacier. A cold wind blows off the glacier, chilling us to the bone! The glacier groans and creaks and with a great roar, pieces of ice break off and tumble into the cold, silty water below. Can this be Illinois?

What is a **GLACIER**? It's a large mass of moving ice, formed when snow piles up until its own tremendous weight recrystallizes it into **ICE**. Ice will bend and flow if enough weight is piled on it! Glaciers are messy machines. Like giant icy sandpaper, they grind rock into gravel, gravel into sand, and sand into silt and clay. The glaciers carry this material along like a conveyor belt. The ground-up mix, left behind when the ice melts, is called **TILL**. Till is spread out across the ground or piled up in long, curved hills called **MORAINES** (Fig. 9). Glaciers are also "billion ton ice cubes"! They melt! The tons of water melting from a glacier sort out the mixed glacial sediments, depositing vast quantities of sand and gravel, called **OUTWASH**, downstream from the glacier in river valleys and transporting silt and clay still farther away (Fig. 9).



**Figure 9** The stark and eerie landscape of Illinois during the Ice Age!

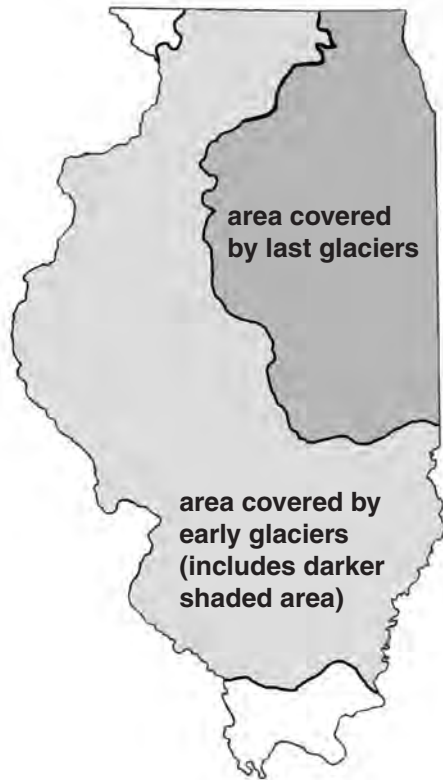


Figure 10 Glaciers in Illinois.

Snow accumulated in what we now call Canada, became ice, and flowed under its own weight south over what is now the northern United States. Many times during the last 1.8 million years, glaciers ground slowly across Illinois, reshaping the landscape.

Glaciers covered most of the state (Fig. 10), bypassing only the northwestern corner (the Galena area), the extreme south (the Shawnee Hills) and a small area in western Illinois. The cliffs and rocky ridges of these areas were never touched or covered up by the glaciers. Glaciers filled in river valleys (Fig. 11) with outwash and buried them under till. The Mahomet River and others ceased to exist.

The last glaciers entered Illinois about 25,000 years ago (the Wisconsin Glacial Episode) and covered just the northeastern quarter of the state. As these glaciers moved across northeastern Illinois, they again modified the landscape, leveling hills, filling valleys, and building new moraines.

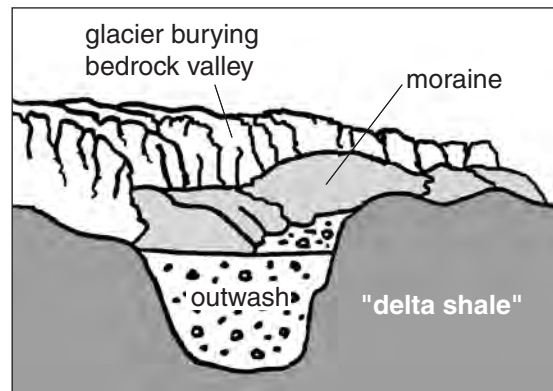
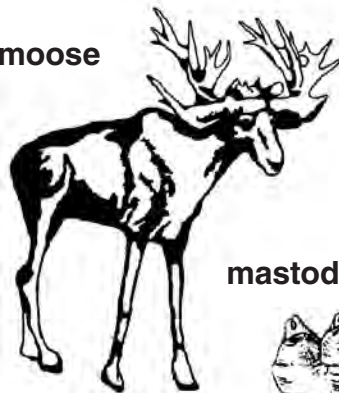


Figure 11 A glacier buries a bedrock valley filled with outwash.

**Did you know?**

The glaciers advanced and melted several times as the climate changed from cold to warm and back again. The animal life in Illinois also changed as the climate changed. Warm periods brought jaguar, peccary, and armadillo, cold periods brought the Ice age mammals: mammoth, mastodon, stag moose and giant beaver. We know these animals lived here because we find their fossils. Their teeth and bones have been found all over Illinois. All of them are now extinct. Other animals, such as the snowshoe hare, also lived here. They still exist today—where the climate still suits them—in the northern U.S. and Canada!

stag moose



mastodon tooth

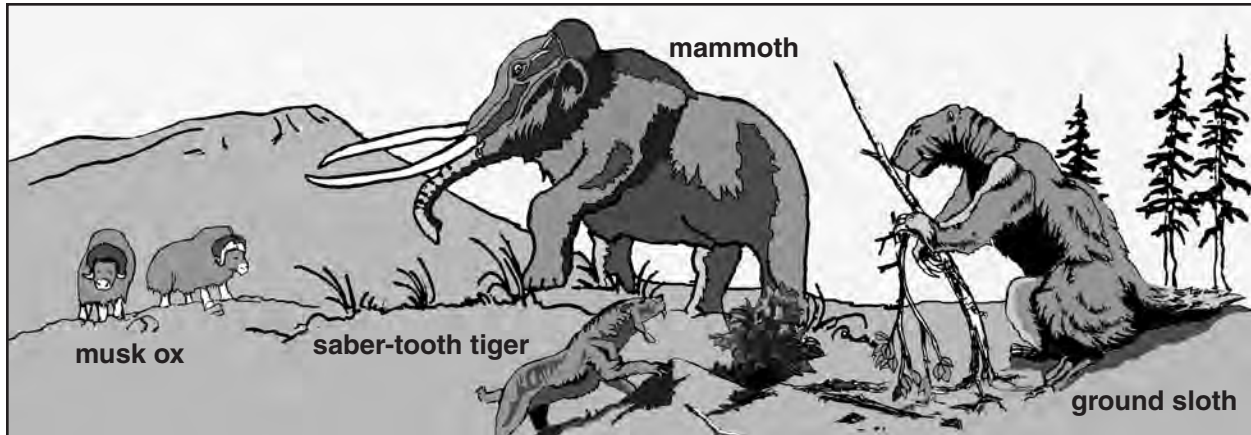


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We turn away from the glacier and walk. Soon we reach an area with strange plants, called **TUNDRA**, just like in northern Alaska and Canada today! Herds of musk oxen graze. We walk farther and pass through areas of meadows and spruce tree forests. The glacier left these areas years ago. Now we see more exciting things! A huge mammal—the ground sloth—slowly walks nearby (Fig. 12). It stops, rising up to reach high into a tree to feed on leaves. Skulking in the brush, a saber-toothed tiger forms a menacing silhouette as it follows the sloth. A massive bear, larger than any we've ever seen, crosses our path and fortunately moves on! Off in the distance, truly "mammoth" animals are moving—a herd of woolly mammoths, elephants covered with long hair. They bend their heads, grazing in the grass with their long trunks. The breaking of branches announces the arrival of other large creatures. From nearby woods emerge a pair of mastodons! What a strange world the glaciers created!



**Figure 12** Mammals of Illinois.

The glaciers melted for the last time and left a changed landscape (Fig. 13). The millions of tons of water melted from the glaciers carried vast quantities of sand and gravel outwash into the Mississippi River, filling the valley in the north. The Mississippi River, blocked from its old channel by the outwash, carved a new channel near Rock Island and moved to where it is today.

In some places, the moraines blocked the melt waters and formed large lakes that, for a short time, covered hundreds of square miles. These old lake beds are now the parts of Illinois that are really flat!

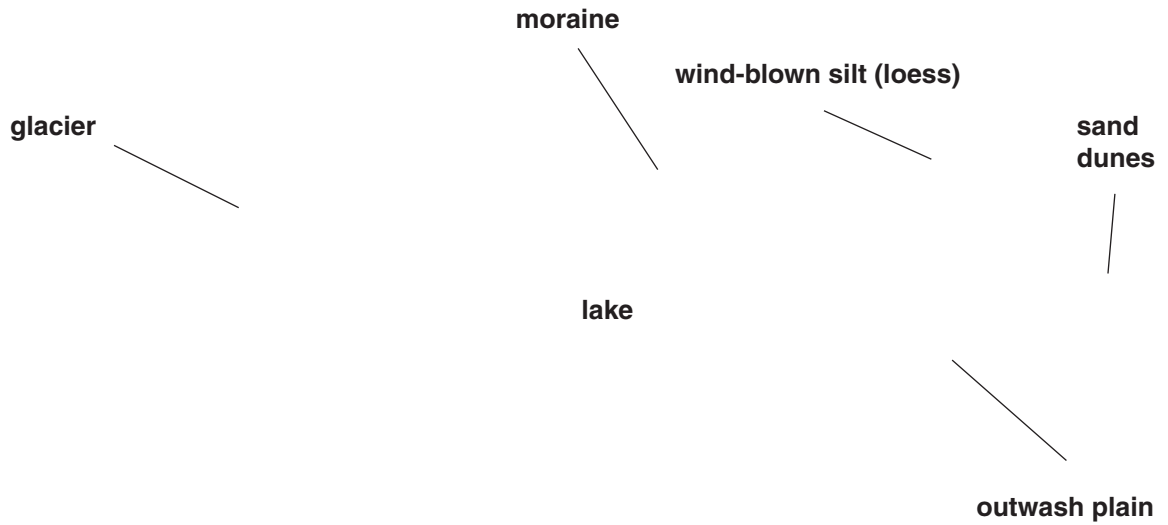
Some lakes drained catastrophically when moraine dams collapsed, producing massive floods. The floods eroded the upper Illinois River Valley and ripped out a path through the ancient ocean sandstone where it lay near the surface, carving out the towering cliffs that now form Starved Rock State Park! The Illinois River took over the lower part of the old Mississippi River Valley and assumed its current course.

Strong winds blew across the outwash plains and piled sand into hills that moved across the land. Yes! **SAND DUNES** in Illinois! They are now covered with vegetation (including prickly pear cactus), but Illinois must have looked like the Sahara Desert for a while!

The glacial meltwaters also left thick deposits of silt in the Illinois, Mississippi, and other river valleys. Blown around in great dust storms, the silt was deposited all over the state as **LOESS**. Near the Illinois and Mississippi Rivers, the loess may be 20 to 30 feet thick! It's only 2 or 3 feet thick over most of the rest of the state.

As the climate warmed, the tundra and spruce forests of the arctic like glacial climate gave way to oak woodlands and then to great landscapes of prairie. Slowly, the prairie created a rich, black soil in the loess.

The change in climate that accompanied the melting of the glaciers was the "last straw" for the vast menagerie of animals that inhabited Illinois. Most of the large animals, and some of the smaller ones, died out as the Ice Age ended. Hunting by humans may have played a part in some extinctions.



**Figure 13** What the glaciers did to Illinois.

*We are at the end of our story. With a few thousand more years of wind and rain making minor changes, Illinois gradually came to look like it does today! We hop out of our time machine after traveling from tropical ocean, to dark and muddy swamp, to river valleys buried under a frozen landscape, to today.*

## HOW DOES THIS HISTORY AFFECT US TODAY?

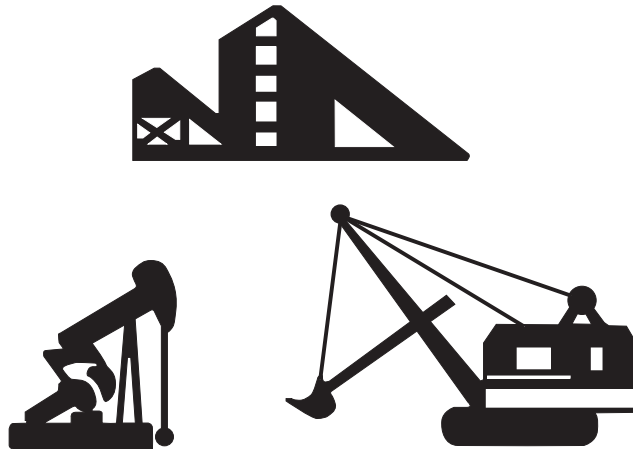
**COAL** isn't found in northern Illinois! The delta rocks (where the coal is) were eroded away in the northern quarter of the state. Only the central and southern parts of the state contain coal.

**OIL**, too, is essentially limited to rocks that are present in the central and southern parts of the state, but are eroded away to the north.

**SAND and GRAVEL** are easily obtained wherever the glaciers deposited outwash and along modern rivers. There is also gravel in the materials deposited in southernmost Illinois when the Gulf of Mexico waters covered that area.

**LIMESTONE** aggregate for building can be found wherever the ancient ocean limestone is near the surface—mostly in northern Illinois and along the western and southern edge of the state.

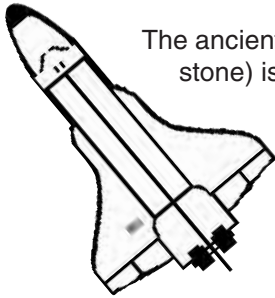
Some types of **CLAY** were deposited in those shallow waters of the Gulf of Mexico—clay that is very absorbent and is now dug up and sold as kitty litter! Other types of clay, useful for making bricks, molded porcelain products and even fine china come from the shales of the ancient delta deposits.



**GROUNDWATER**—Much of our water supply comes out of the ground! When we drill a well, we're not really looking for water! Water is the desired product, but first we need to find the right geologic materials to obtain it from: materials that act as sponges—materials that hold water and give it up to a well. Sandstone and limestone are good materials to get water from, as are sand and gravel. Shale, however, yields only a small amount of water. Unfortunately, in three quarters of the state, the bedrock surface is the delta shale! This means that much of the state has very limited groundwater supplies! Could we drill deeper? We could, but water quality worsens as depths increase, and in most (but not all) areas, water from the deep rocks is undrinkable—it's saltier than seawater!



Then where do we find most of our groundwater? We get it from the ancient ocean rocks exposed in the northern quarter of the state and along the Mississippi River Valley and a few other areas. Also, remember the ancient valleys buried by the glaciers? These valleys are partially filled with glacial sand and gravel. Even though they're not visible at the surface, we can drill into them in many places and obtain a good water supply. Areas with thick deposits of sand and gravel, or where limestone or sandstone are near the surface, generally have good groundwater resources.



The ancient ocean SANDSTONE mined near Starved Rock (a very pure sandstone) is made into high-quality glass used for many purposes. The sand is also used to make the heat-resistant tiles that are attached to the outer skin of the space shuttle. The next time you see a shuttle blast off into orbit, remember that part of Illinois is going with it!

The history of Illinois is an exciting story! Illinois has seen a fascinating variety of different landscapes. The processes that formed these ancient landscapes produced the Illinois we know today, and it's important to understand that long story! Why? In part, because the presence of the resources that we all use is determined by the processes of long ago that combined to build Illinois!

***Contributed by Robert C. Vaiden  
Geologist and Storyteller***

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