Lecture 22

Glaciers, Karst Topography, Earthquakes, and the formation of the Appalachian Mountains

ICE SCULPTS THE FINAL SCENE

{GLACIERS AND STREAMS}

~~April 27: Development of the Ohio River, especially as it passes Cincinnati;~~

.

May 4: The Wisconsin Glacier, and its effect on the Mill Creek Valley and downtown Cincinnati;

May 11: Erosion in The Desert south west, including Antilope Canyon;

May 18: Karst Topography, including Mammoth Cave and Viet Nam

May 25: Earth Quakes, including the movement of energy through the earth;

June 1 : Damage from Earth Quakes, including Tsunamis;

June 8: The Formation of Mountains, including" Death Valley";

June 15: Development of the Appalachian Mountains.

Last week we concentrated on ***stream erosion***, aided by the flow of water from the melting glaciers and large lakes, and their contribution to the development of our Ohio River..

Today we will concentrate more on **glaciers,** including both the Illinoian and the Wisconsin and their effects on our area.

Let's see what ***Dr. Renton*** says about

GLACIERS

(Ice sculpts the final scene)

DISK # 4

Lecture 22

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{Show 2:16→ 14:56, 19;16→ 28:00)

Who here was graduated from Mt. St. Joseph University?

Who flew out of the Greater Cincinnati Airport (CVG) in 1948?

Can anyone tell us what you would see if you

looked south towards Kentucky out an upper floor window of the Dorthey Ziv Academic Building on the campus of Mt. St. Joseph University during Dr. Henry James's sophomore English class?

Or what you saw as you flew into Greater Cincinnati Airport from the north across the Ohio River after your flight from seeing the damage from the earth quake in Anchorage , Alaska?

You would see a deep valley

No,
not this
deep)

That valley would have steep hillsides,

dropping off from Mt. Saint Joseph University on the Ohio side of the Ohio river,

&

And dropping off from CVG, on the Kentucky side,

to the *top* of the river

almost 400 feet below.

"When I moved to Cincinnati several years ago I was told that Cincinnati is a *city of seven hills.*

Really it is a city of three valleys.

Those three are THE MILL CREEK, LITTLE MIAMI RIVER AND GREAT MIAMI RIVER VALLEYS.

PLUS OF COURSE THE BIG VALLEY OF THE Ohio RIVER"

And, as we saw last week , the LICKING RIVER VALLEY

How many of you here think that when you are here at VPC that you are on the top of a hill?

Actually at this time we here at VPC, (Walnut Hills) are not on top of the hill.

Mt. Healthy, Mt. Adams, Price's Hill, Mt. Lookout, College Hill, Mt. Washington, University/Clifton Heights, Mt. Airy

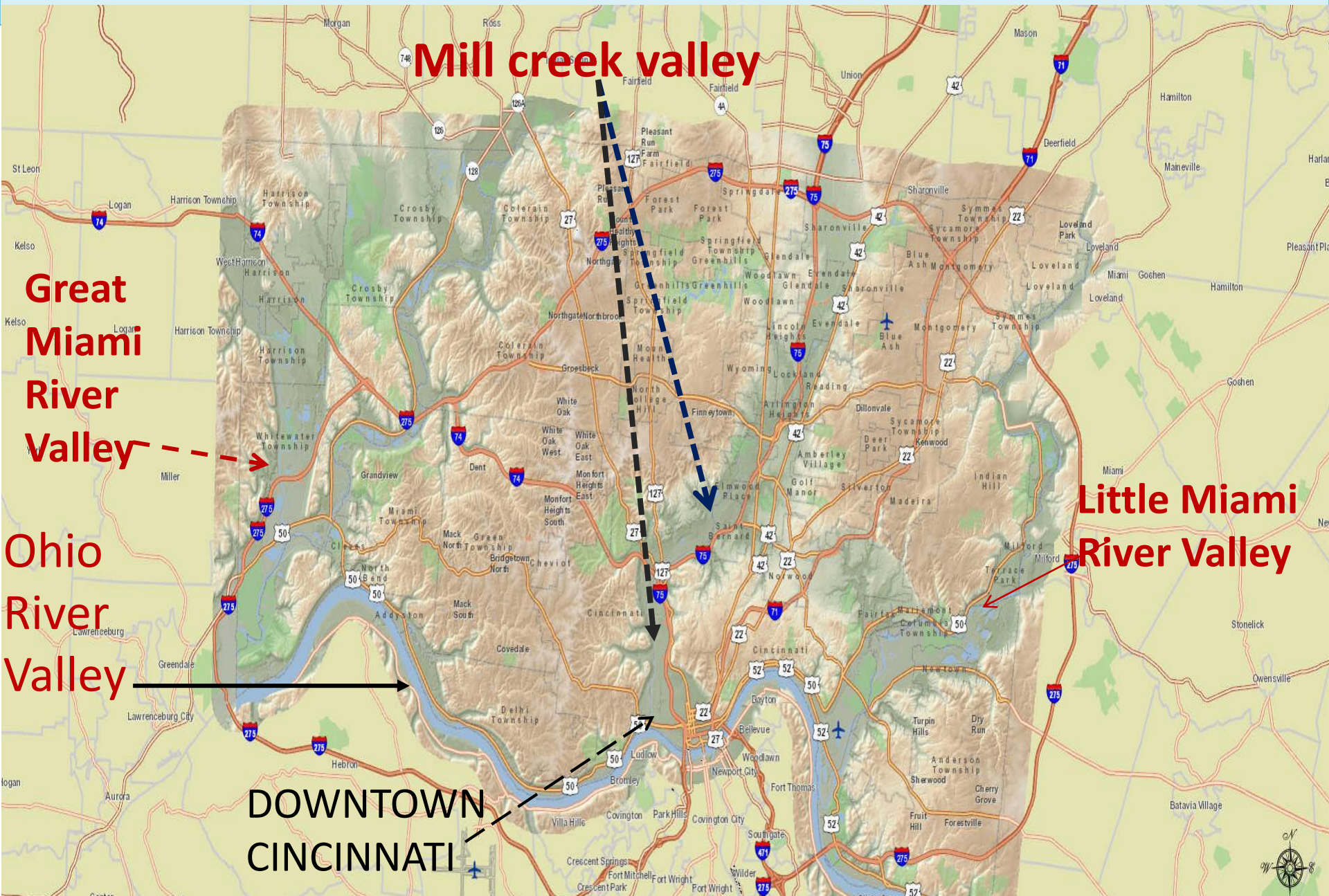
- - -

are not really hills.

These places are what remains of the flat <u>bottom</u> of the ancient <u>Ordovician Ocean</u> that used to exist here.

What we call hills are just higher than the River valleys.

Let's look at this area a little more.



Next August when you are coming home from your visit to Walt Disney World with your grandchildren and are driving North on I-75/I-71, shortly after you start down the hill in Northern Kentucky at the Cut -in –the-hill, ***look to your right***.

you will see the top of the Plateau in the distance.

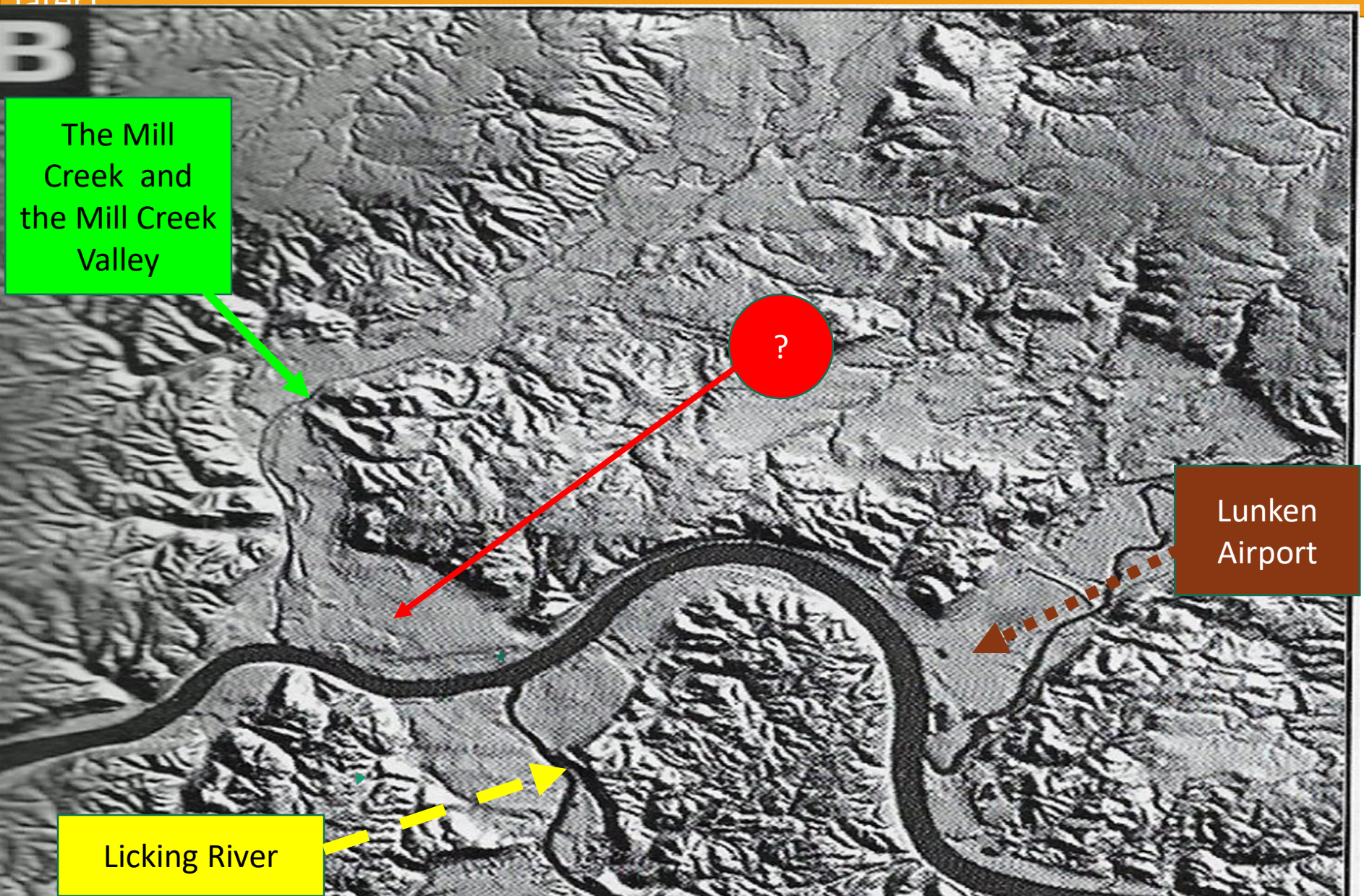
You will also see a deep valley.

This 300 feet deep valley was formed by **the Licking River**.

We looked at this last week.

let's see again to see what the Licking River gouged out.

The now-much-smaller Licking River is at the bottom of this deep valley. This steep sided river HELPED **the DEEP OHIO river** gouge out the entire downtown/ Northern Kentucky areas as it swept north through the Mill Creek. (We'll discuss this more later)



Let's look at a topographic map so we can get a better image of the depths of the Ohio River Valley

Note the topographic lines:

There is a 10 feet difference in height between each *brown* line

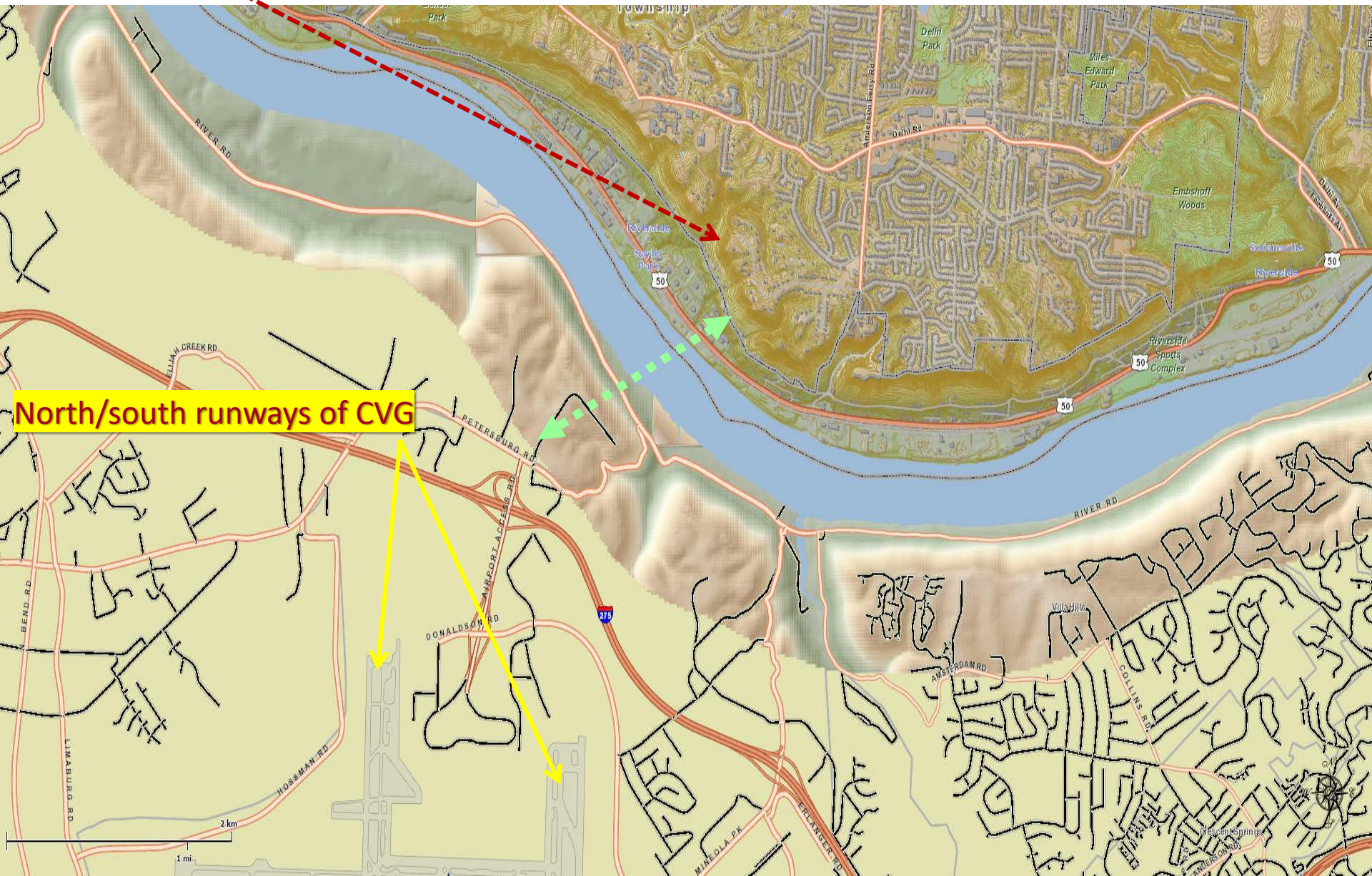
And a 2 feet in height between each

light colored line

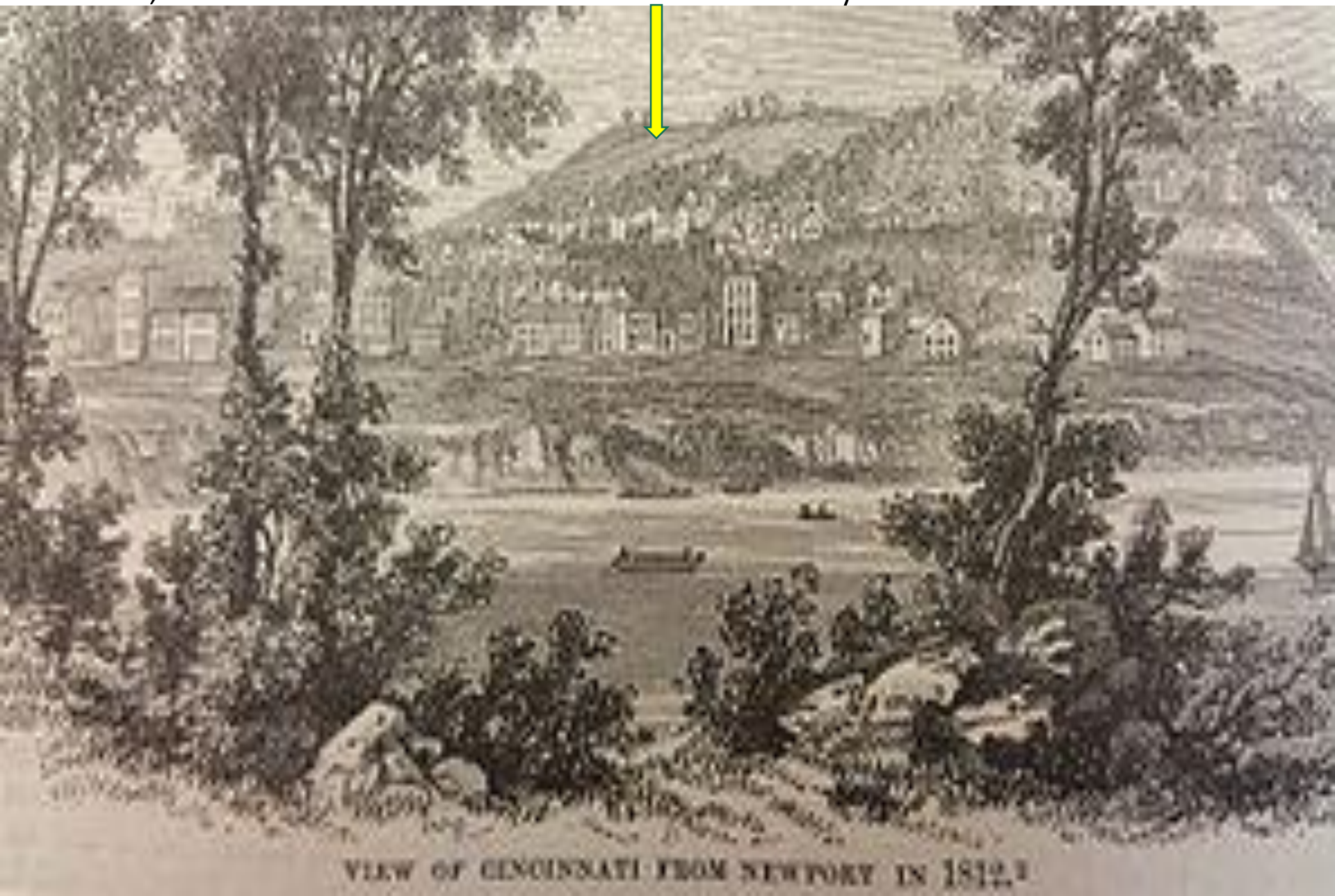
These topographic lines show the hill where Mt. St. Joe University is located, at 848 feet above sea level. The Ohio River elevation at the foot of the hill is 470 feet above sea level. This means that the height of the hills at Mt. Saint Joe (& Bellevue Hill Park and CVG) are almost 400 feet above the **top** of the river ..

These topographic lines are very close together, indicating that this is a very steep hill.

Here is an image across the valley from the top of the hill in Ohio at Mt. St. Joe University to the top of the hill in Kentucky by CVG. This distance is about is about 1 mile.



A view of Clifton Hill, on which the University of Cincinnati will eventually be built, as viewed from the Northern Kentucky side of the Ohio River.



And here is a photo showing the Bellevue House..

It used to be located at the top of this steep hill (Clifton Hill), which we just saw on the previous slide.

The Bellevue Incline 1876-1926
with a great view of The Bellevue House

The point is, most of this Ohio River Valley has very steep hillsides.

How high is high?

Let's add up these numbers to see again how deep this steep sided Ohio River Valley is:

Elevation at the top of the hills(At Mt. Saint Joseph University/ Greater Cincinnati Airport): ----------→ 848 'absl.

elevation at top of river water: ·····→ 470 ' absl

(So height from top of the hill we live on down to the top of the Ohio River is = 378 feet

+ Depth of river ~28 feet

+ Depth of stones, sand, rocks, other alluvia

at bottom of the water *to bedrock* ~100 feet

TOTAL DEPTH OF THE OHIO RIVER VALLEY HERE:

~500 FEET

Ok, Ok, I get it. At least a large section on the Ohio River Valley is a 500 foot deep, steep sided crevasse. But, tell me again, how did it get there?-And don't tell me aliens did it!

Last week we alluded to how much **water** would be in a glacier that is ~ 1000’ thick (at Columbus, Ohio) and 400-500 miles wide, extending across western Pennsylvania through middle Ohio, Indiana, and Illinois.

And how this *enormous* amount of melt water roared down the valleys , like the Ohio River Valley, pushing /shoving the rocks along the bottom as it surged along.

.

We also talked about he impounded water from lakes, like Lake Tight and Lake Monongahela,

added to the glacial melt.

And finally how the rocks on the bottom of this rushing water

scoured /ground down into the bottom of the valley

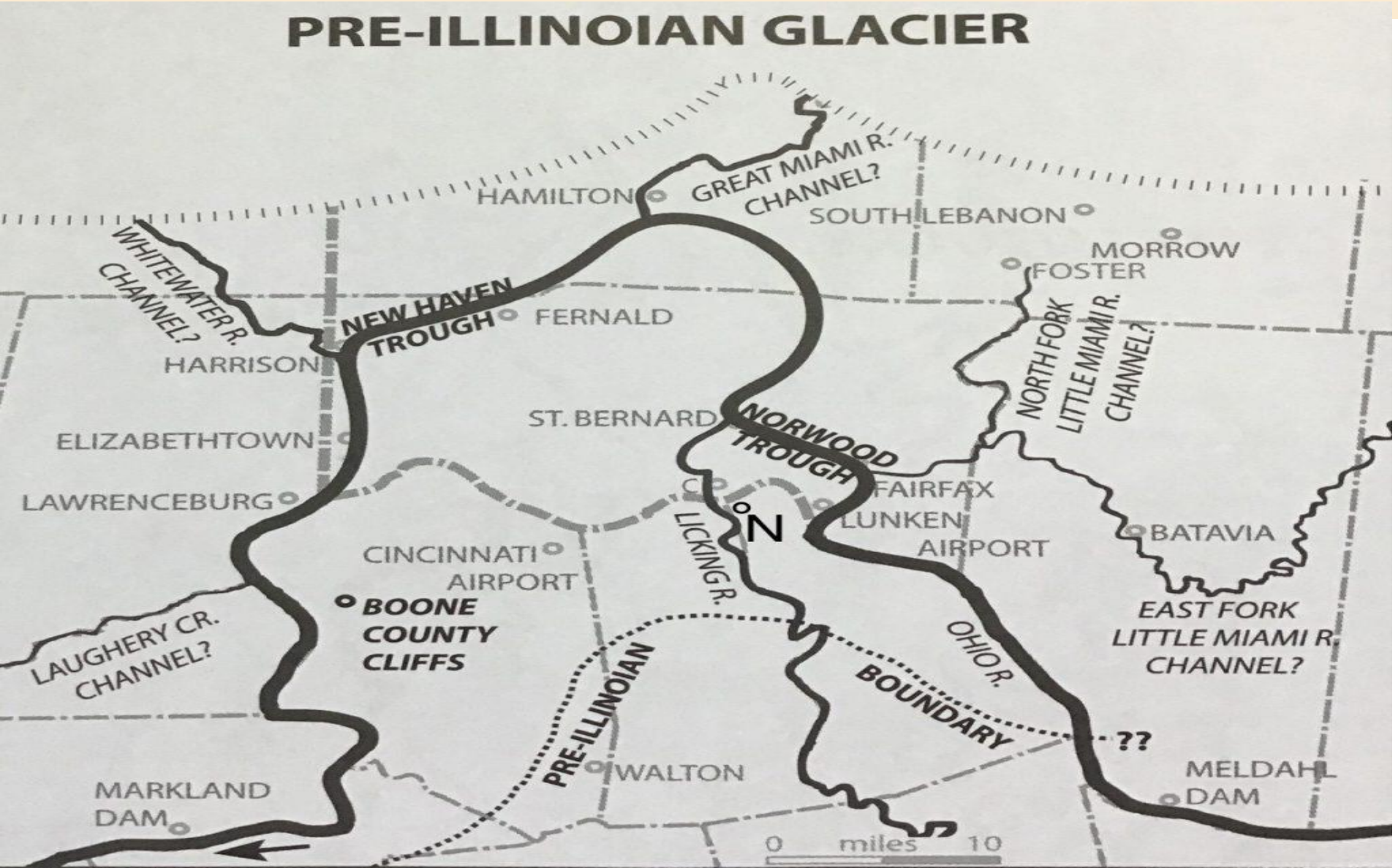
of the DEEP OHIO making it deeper and deeper.

Kelly's Island State Park

Here on Kelly's Island we see the effects of the grinding of the stones on the bedrock. This grinding action **by glaciers** caused these groves in the bedrock. The bedrock beneath the mud/rocks on the bottom of the Ohio River looks a little like this

Let’s look again at the path of the DEEP OHIO.

We saw this image a couple of times last week.
It shows the path of the Deep Ohio River as it flowed around Cincinnati.



After the **DEEP OHIO** was formed , and it flowed up and around Cincinnati, there were two barriers of land that blocked it, preventing it from becoming its present course.

One of these barriers of land **extended south from Walnut Hills to the hill beyond the present city of Dayton, Kentucky .**

We can see it now when we look out from the Eden Park overlook toward the horizon in Kentucky,

And also from the windows on the 8th floor of this building.

The other One of these barriers of land extended

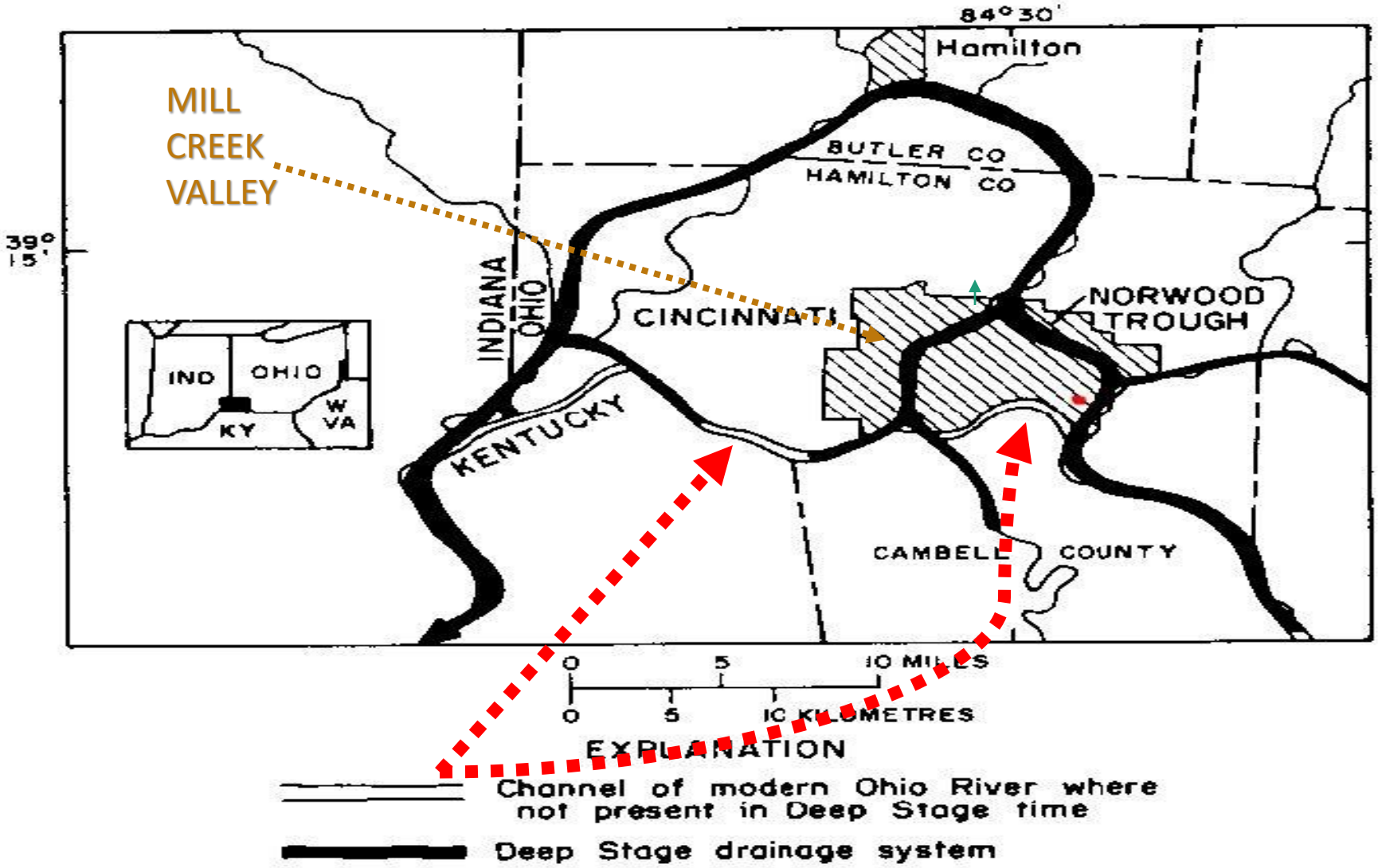
from Mt. St. Joe University on the north hill top

across

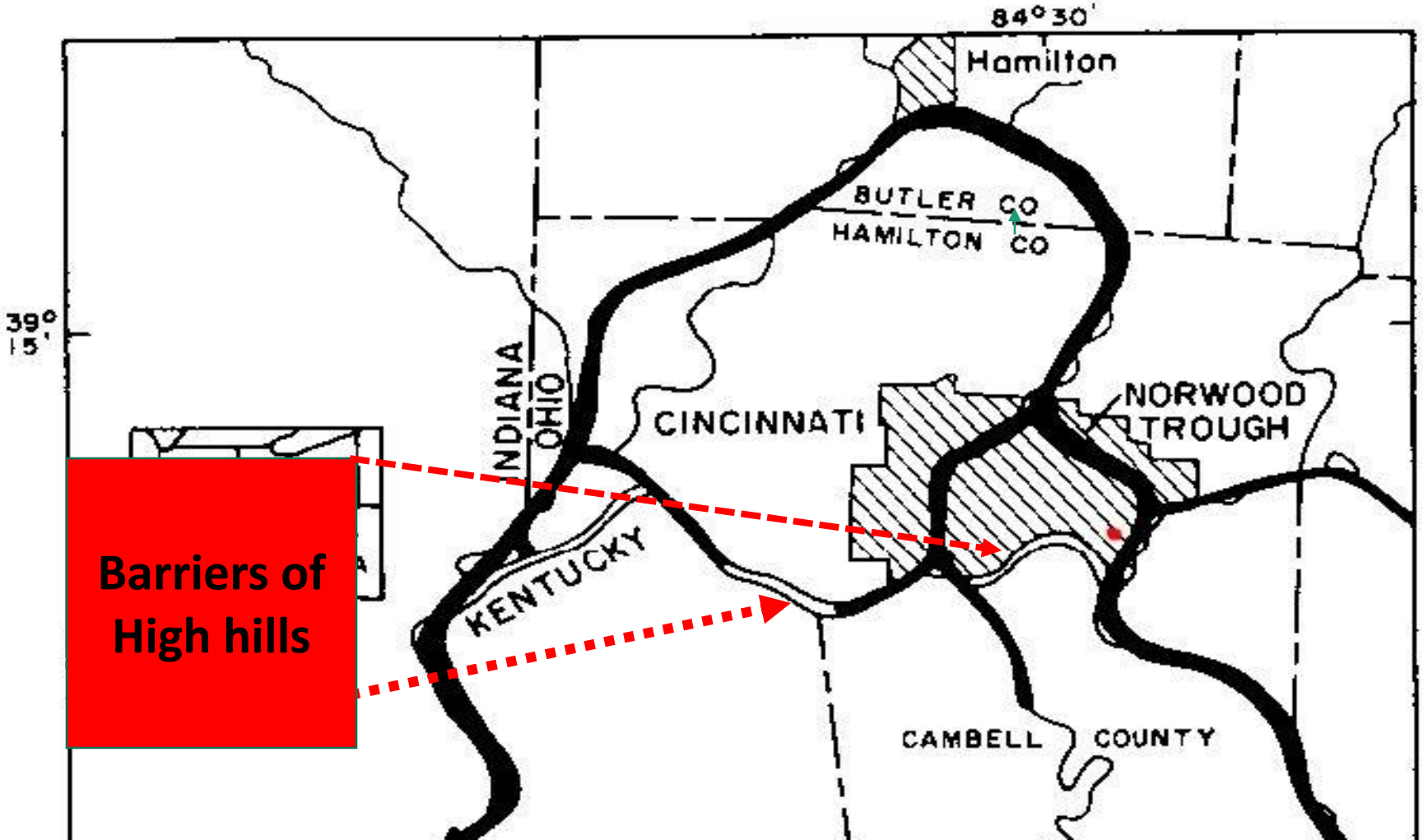
what is now the Ohio River

to the top of the hill on which is the Greater Cincinnati Airport now is on the south (Kentucky) side of the river..

Here again (we saw this slide last week) we **SEE the location of these two barriers/ blockages/high hills**, as well as the path of the Deep Ohio as it flowed north of Cincinnati.



TWO THINGS HAPPENED TO THESE TWO BARRIERS :



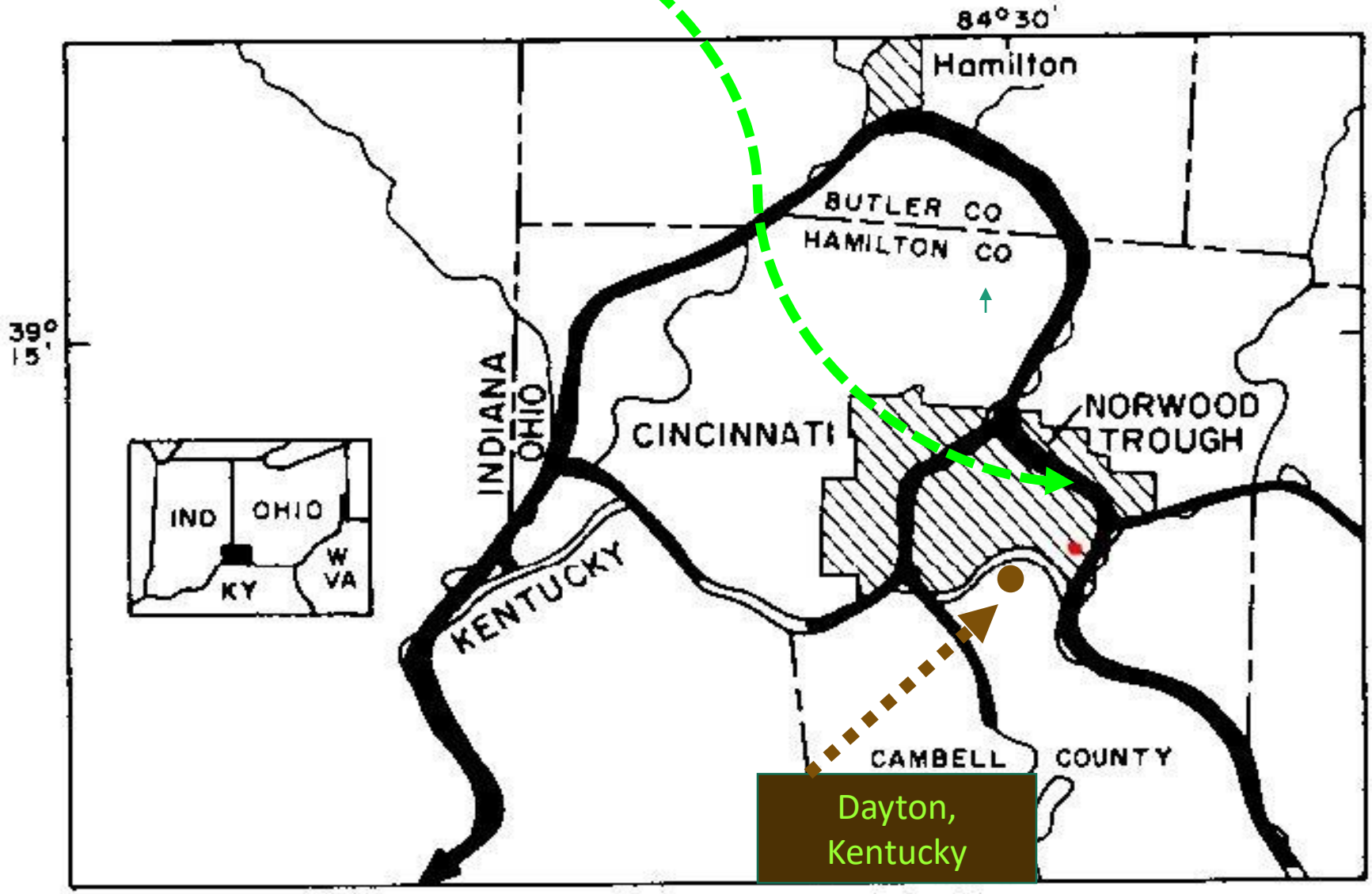
The first event that happened was that about 400,000 years ago a limb of the Illionian Glacier advanced until it blocked the flow of the Deep Ohio *at Lunken Airport*.

The result was that the water flowing down from the east was impounded.

The water could not move up across Lunken Airport, because of the glacial ice dam.

And it could not move directly west, next to Columbia Parkway, because of the earthen barrier/high hill that stretched across from Walnut Hills to the hill behind Dayton, Kentucky

. Here we **see** *where* that tongue of Illionian glacier advanced and **blocked the flow of the Deep Ohio as it went north.**



What happened then?

The impounded water backed up, forming a lake behind the Walnut Hills → Dayton, Ky barrier.

Eventually the impounded water got high enough overflowed that dam.

The impounded water surged through the now broken barrier;

This water could not go west (because of the barrier at Anderson Ferry);

It turned the "corner" of where the Mill Creek (and Licking River) were and *went north, up the Mill Creek Valley;*

AS THIS SURGING WATER WENT NORTH IT VASTLY DEEPENED/WIDENED THE MILL CREEK VALLEY,

But, But Esmeralda- - -, I thought the Ohio River went south /south west of Cincinnati, not North up the Millcreek Valley→) Hamilton→ down the Great Miami River Valley→ Ohio River at Lawrenceburg !!

Ooooh Yeessss, from here at the top of the Carew Tower Observation Deck where I am I DO see that **now** the Ohio River runs SOUTH WEST of Cincinnati, through the valley where the Anderson Ferry is.

But you just said that the Deep Ohio went NORTH, up through the Mill Creek Valley to Hamilton.

How did the Ohio River get

THERE,

where the Anderson Ferry is !?

I KNOW!

Remember, there was another barrier/steep hill impoundment.

Oh woe is me! Not another barrier/hill!

WHERE WAS IT LOCATED!?

The *Illinoian glacier* came south out of Ontario and **AGAIN**

blocked the Deep Stage Ohio. But THIS TIME it blocked it AS IT FLOWED NORTH, through the Mill Creek Valley

As we noted above, there already was a huge barrier/large hill present

in the area between Mt. St. Joseph University and CVG,

about three miles west of downtown Cincinnati.

.

The glacier blocked the water going north up the Mill Creek valley.

This barrier/dam at the edge of the hill on which sits Mt. Saint Joseph University

prevented it from passing south west through there.

The result was that the water in the Deep Ohio was again completely blocked.

Oh No ! Here we go again!

This impounded water formed (another) large lake.

It filled the entire Cincinnati area including the Licking River to the South and up the valley of the Deep Ohio to Portsmouth, ~ 112 miles.

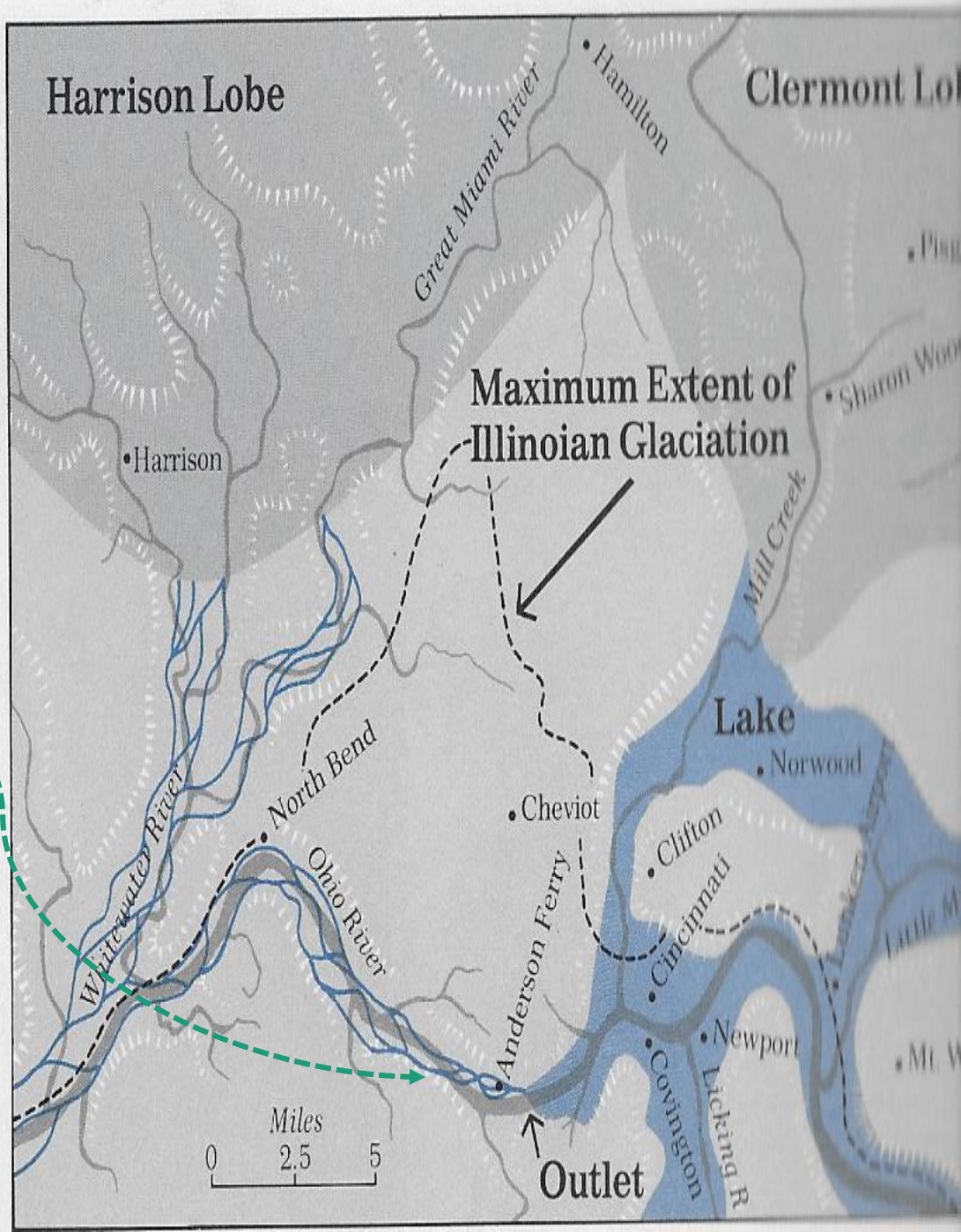
Let’s look at an image of that area.

Two Illinoian Instants

When the Illinoian Glacier advanced into our area it dammed the northward-flowing portions of the drainage which had been established in Deep Stage times. Again a glacial lake was formed, and clays were deposited on the lake-bed (upper

e

, at a point near the site of today's Anderson Ferry; this overflow established the present-day course of the Ohio River.



Eventually the lake rose high enough to spill over the western edge. This waterfall, just like the one which impounded Lake Monongahela, steadily wore back the dam until finally the impounded water broke completely through.

This allowed the water to rush through the valley

at Anderson ferry

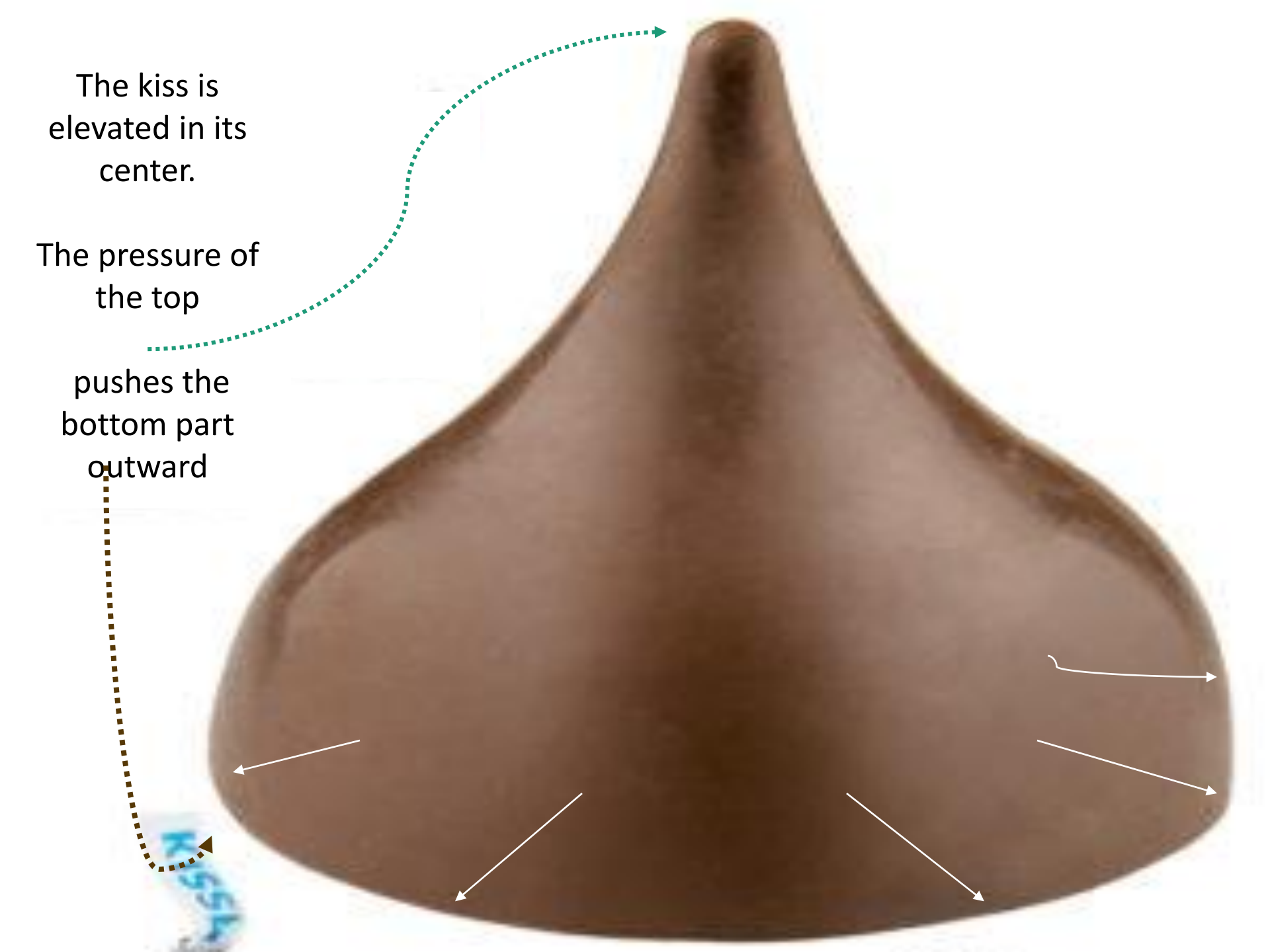
How many of you have ridden the Anderson ferry across the Ohio River? Could the photo below have been taken shortly after the dam was completely obliterated?

Can we digress a little?

North America is pretty flat.

What makes a glacier on “flat” land, like the Wisconsin Glacier, move?

Here is an image of A Hershey Kiss


The kiss is elevated in its center.
The pressure of the top
pushes the bottom part outward

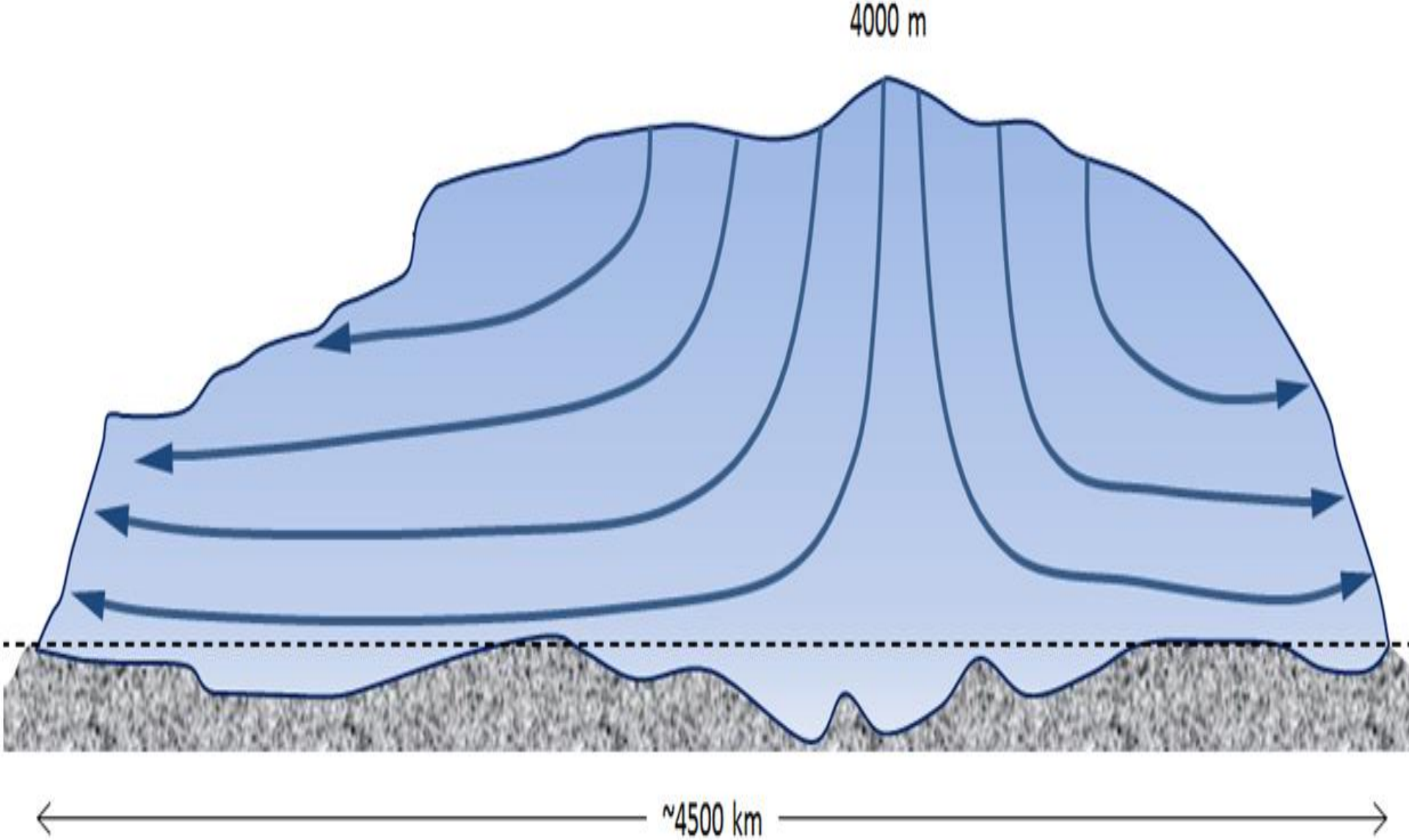
BUT I DON’T LIKE HERSEY KISSES. !

I LIKE PANCAKES !

Here we see the pressure of the top/center of the mass of the pancake batter pushing down.

The pressure of the batter pushes the edges of the batter outward.

This image of an ~ 12,000 foot high glacier again shows how the pressure of the snow at the peak of the glacier pushes the “sides” (the advancing part of the glacier) outward (forward)



The bottom parts of a glacier (anything beneath the top 150 feet) are under tremendous pressure.

Where as regular ice cracks and shatters under force, the lowers parts *of a glacier* flow more like a liquid, *an extremely viscous, slow-moving liquid.*

That ice on the bottom of a continental glacier is said to be "plastic", which essentially means that it bends, stretches, and **flows** without breaking.

(Remember that the top of the glacier does not do these things. The top will crack, creating crevasses).

Which leads us into the final glacier we will discuss, the Wisconsin Glacier.

It came down through western Ohio

past the city of Pisgah

and continued south into Sharon Woods.

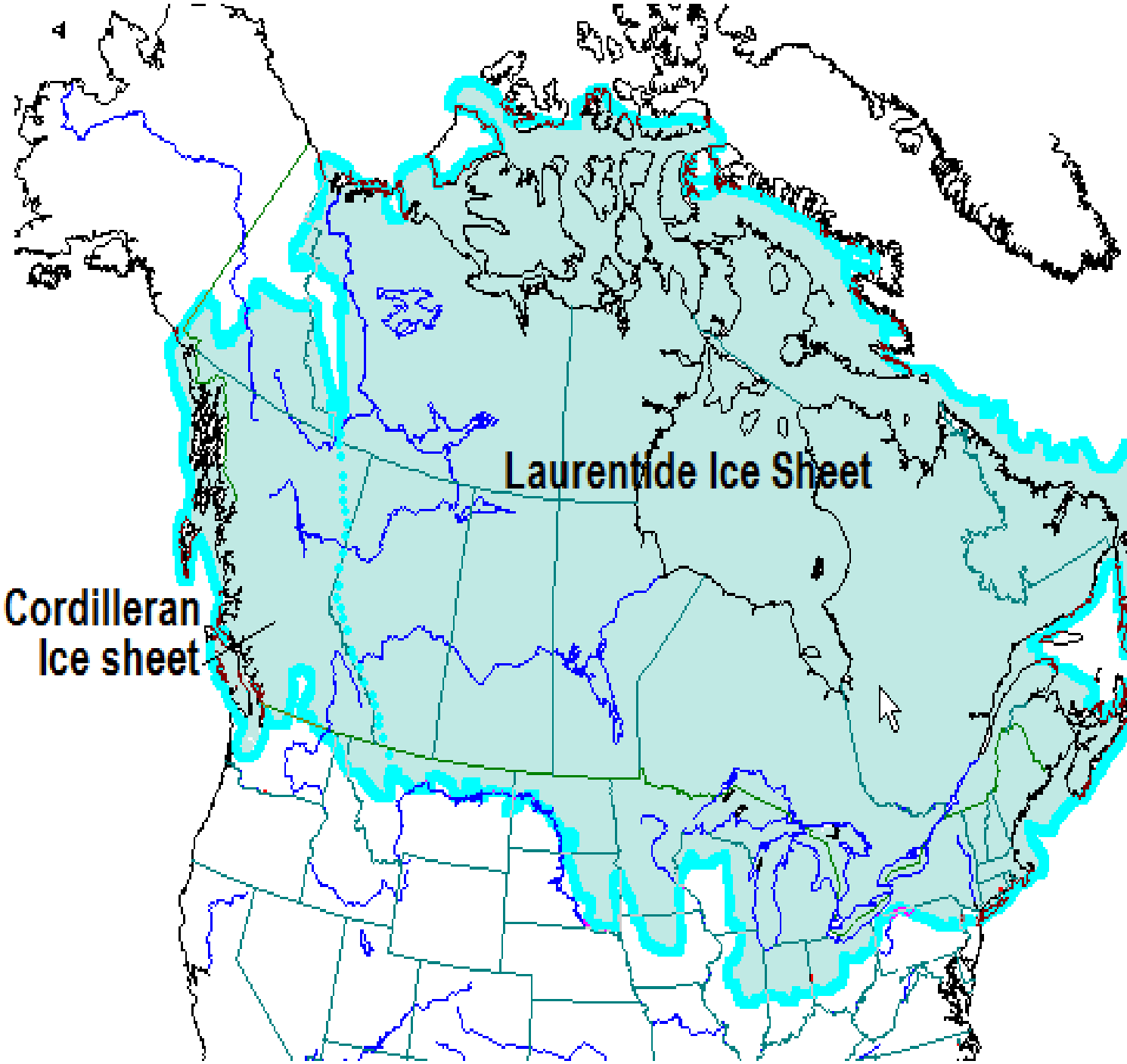
Let’s look again at that image of this Wisconsin glacier when it was located just north of Cincinnati.

The Wisconsin Glacier started in the Hudson Bay area ~ 75,000 years ago.

The glacier at Northern Canada was, like previous glaciers, probably over 2 miles thick. There It acted as the top of that pancake batter.

The pressure of the ice at this point pushed the sides/edges away from itself.

→The outer part of the glacier was shoved forward into Ohio.

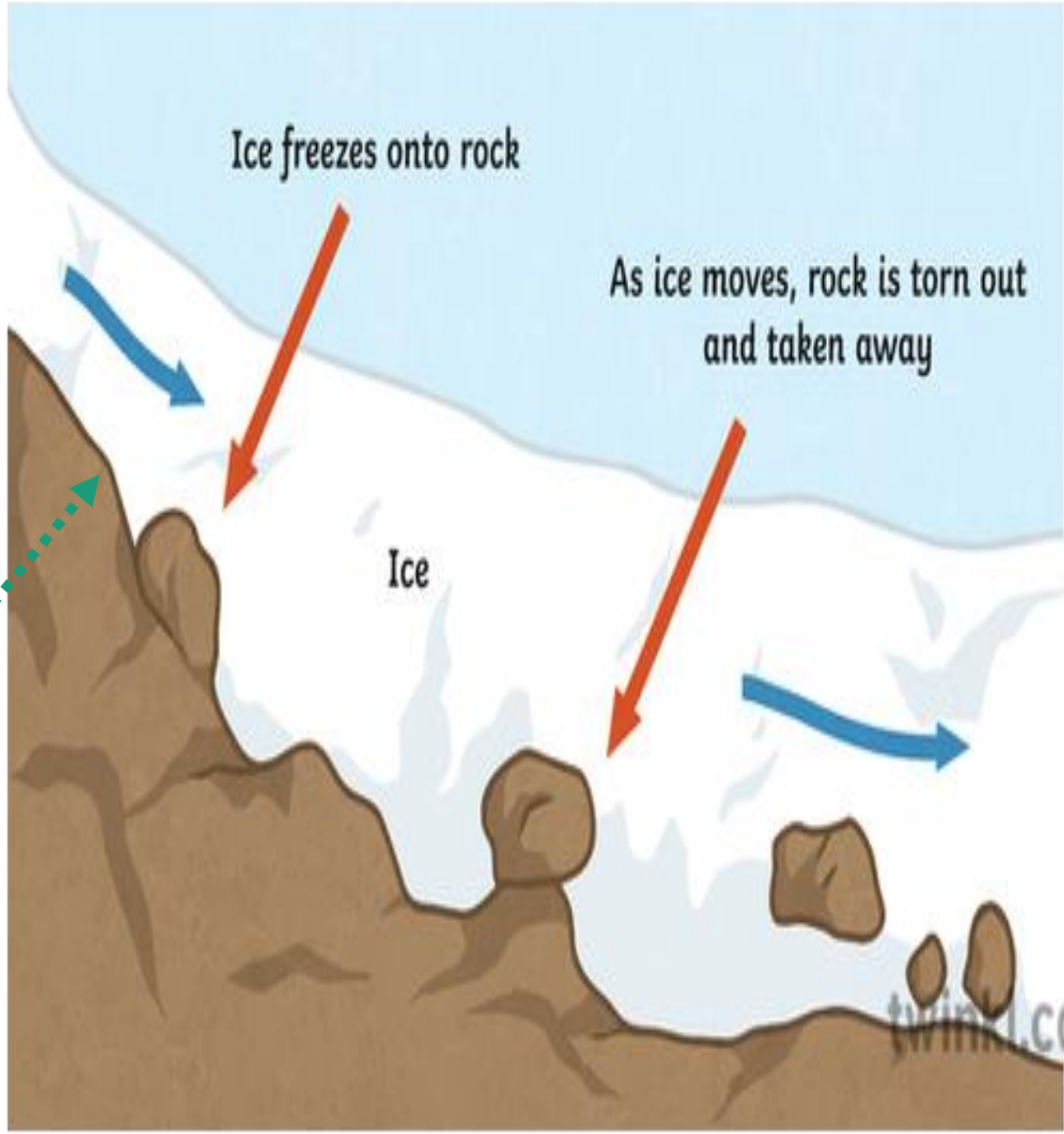


This is another image or what might have been the location of the Wisconsin Glacier.

Hay, Let’s look again at some of the things that Dr. Renton told us about that glaciers did on the way here to Cincinnati.

We already know what a glacier **DOES** to the rocks beneath it.

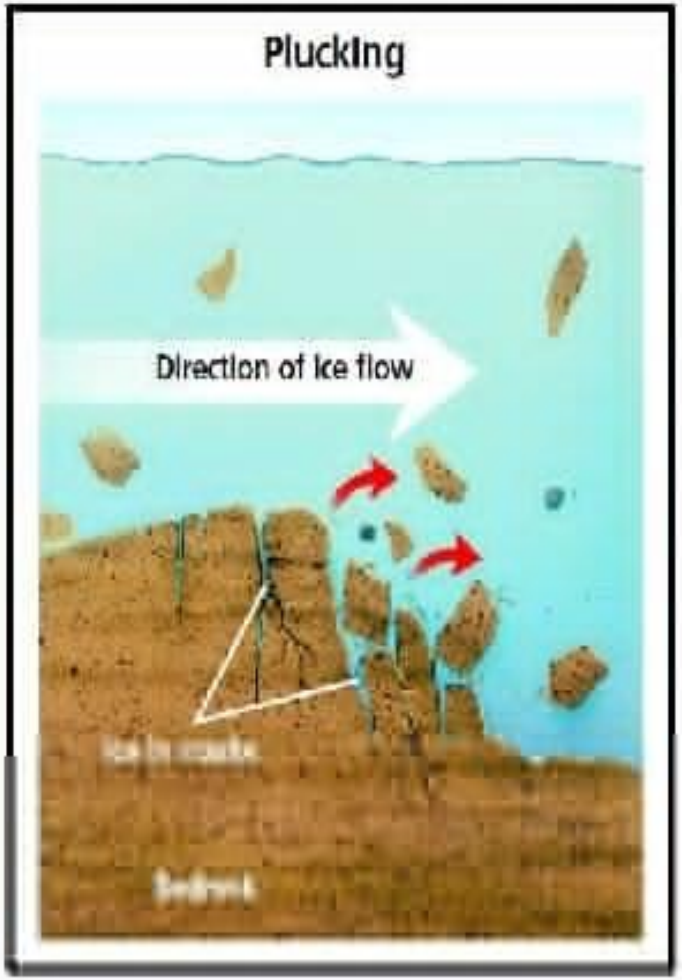
Bottom of continental glacier freezes to ground/rocks



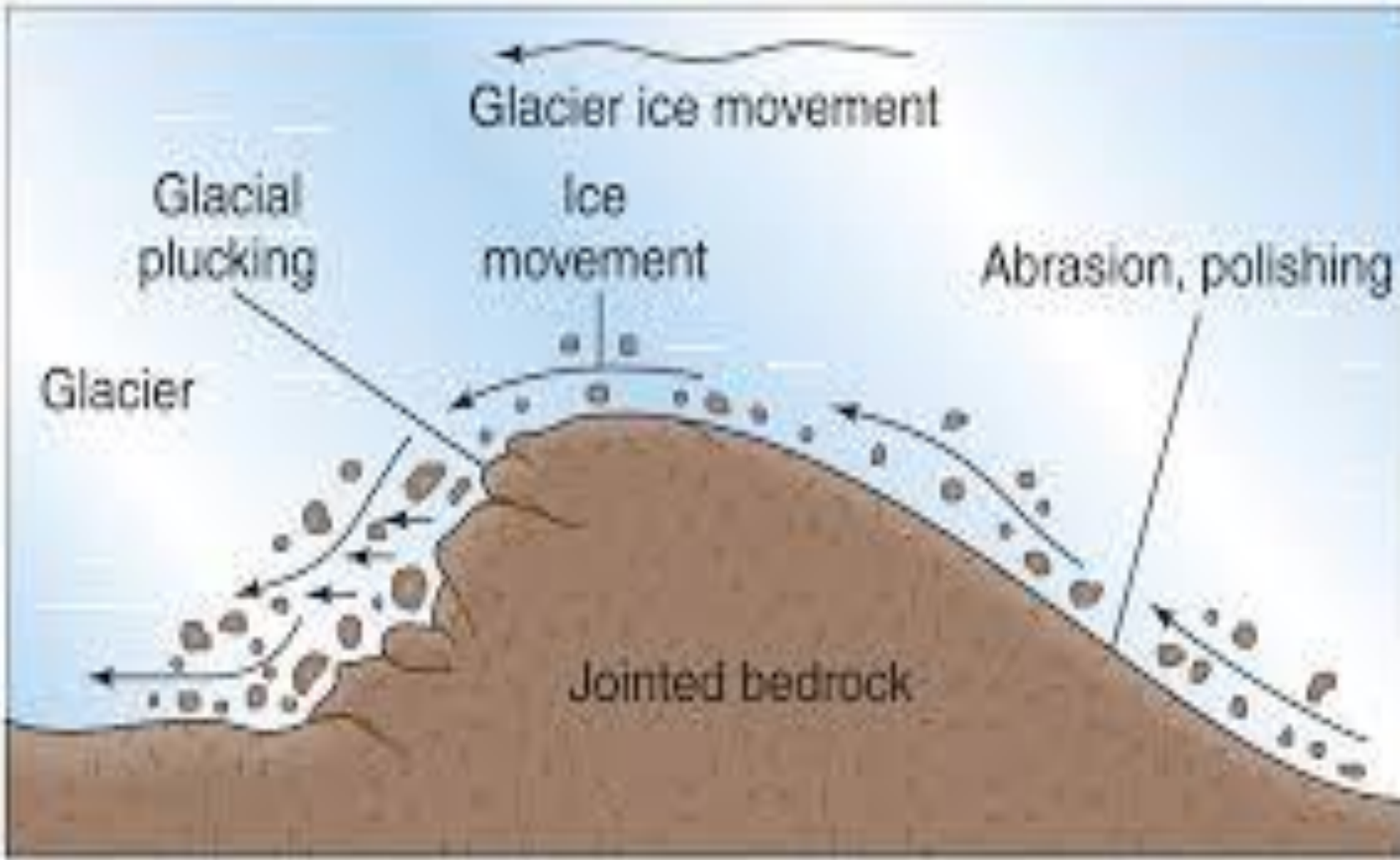
A similar image of how rocks end up in the body of a glacier.

Plucking

- As a glacier flows over the land, it picks up rocks in a process called plucking.
- Beneath a glacier, the weight of the ice can break rocks apart.
- These rock fragments freeze to the bottom of the glacier.
- When the glacier moves, it carries the rocks with it.

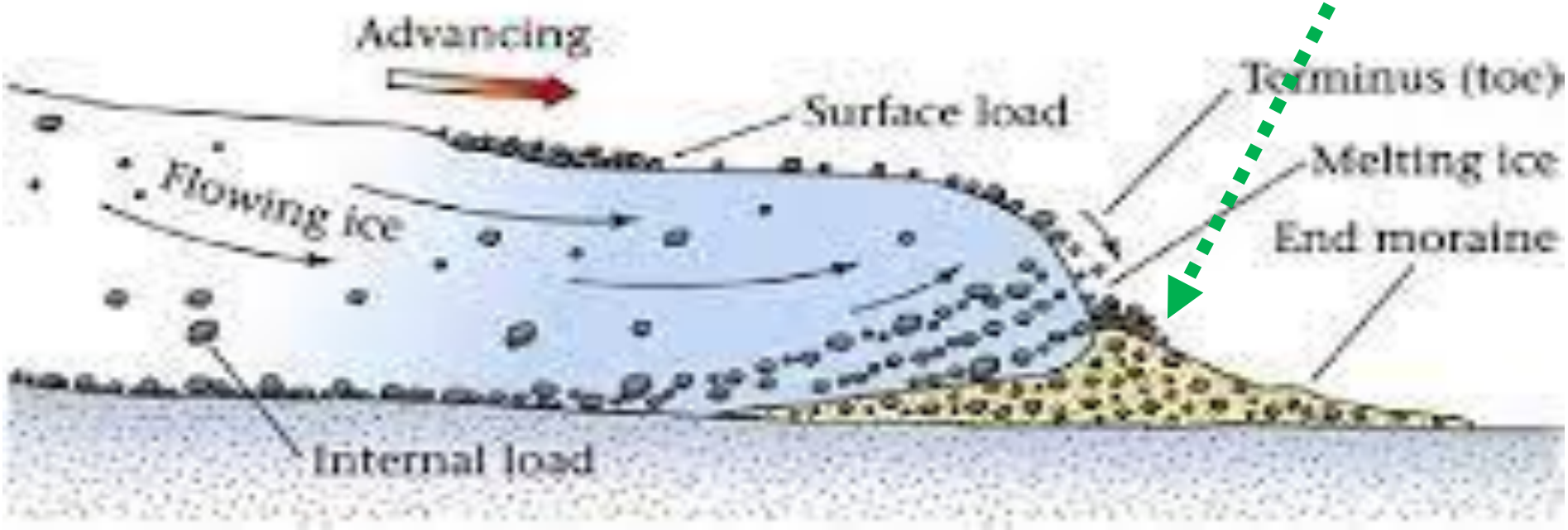


The plucked out rocks stay in the ice and are carried by the movement of the glacier

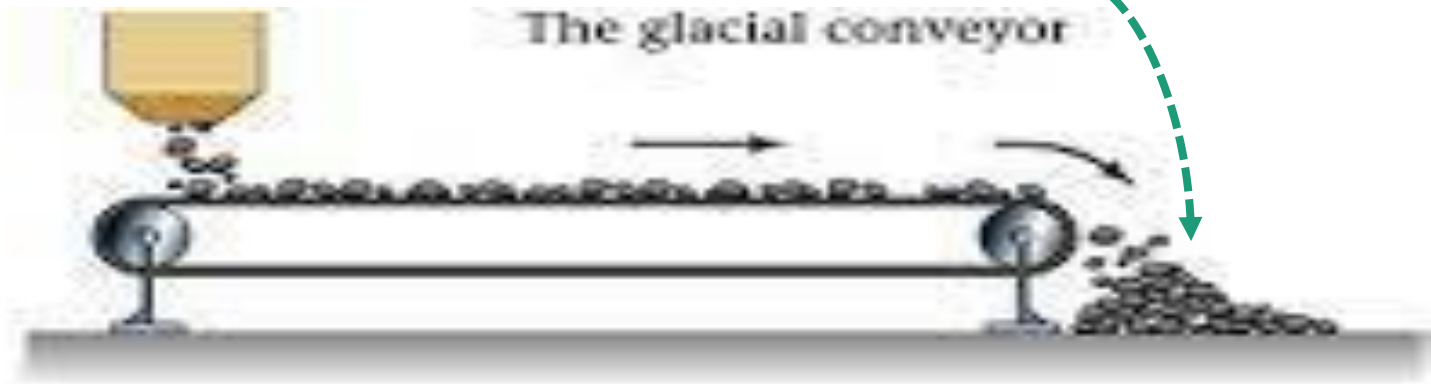


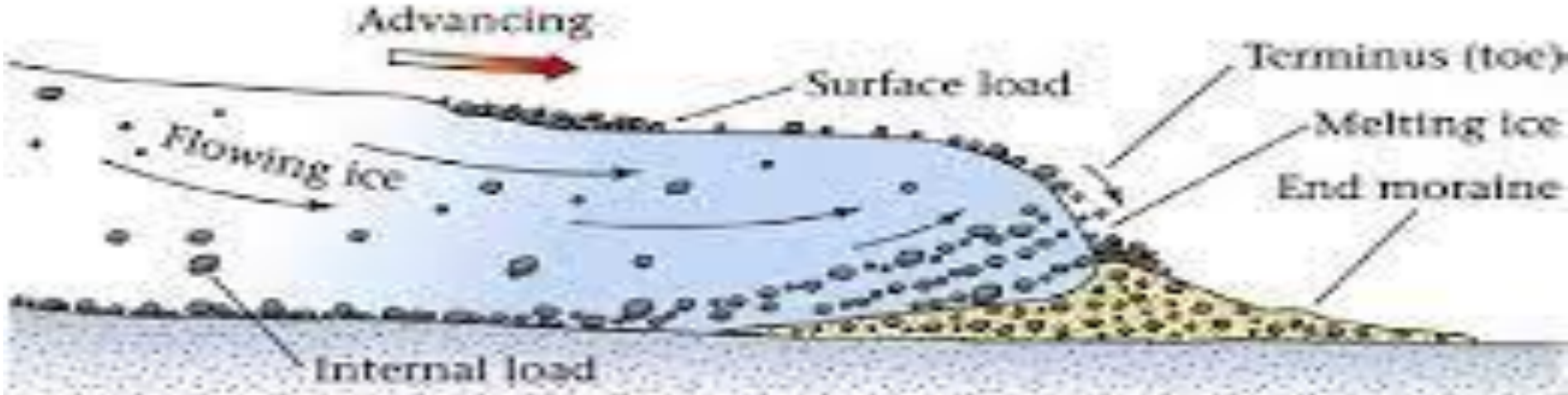
. At the end of a glacier, the ice at the end of a glacier *will probably* be melting,

But since it still being shoved forward, the stones it is carrying will be dropped off the end of the melting glacier, making a pile of stones/soil, called a terminal moraine.



similar to this conveyer belt image, (which we saw last week).





Last week too we learned that the Wisconsin Glacier entered Ohio ~24,000 (+/-) years ago.

It left Sharon Woods ~ 14,700 years ago.

It was gone from Toledo ~ 11,000 years ago.

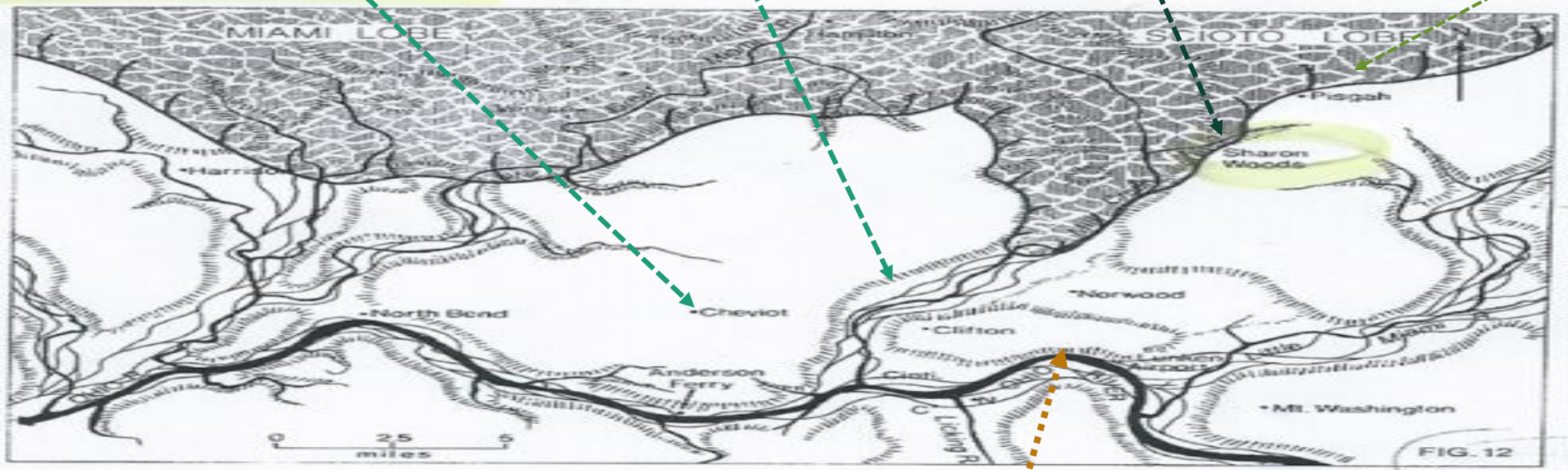
• **THE WISCONSINAN GLACIATION (70,000 BP).** The last continental gla-

Cheviot

Mill Creek Valley

Sharon Woods

WISCONSINAN AND BEYOND

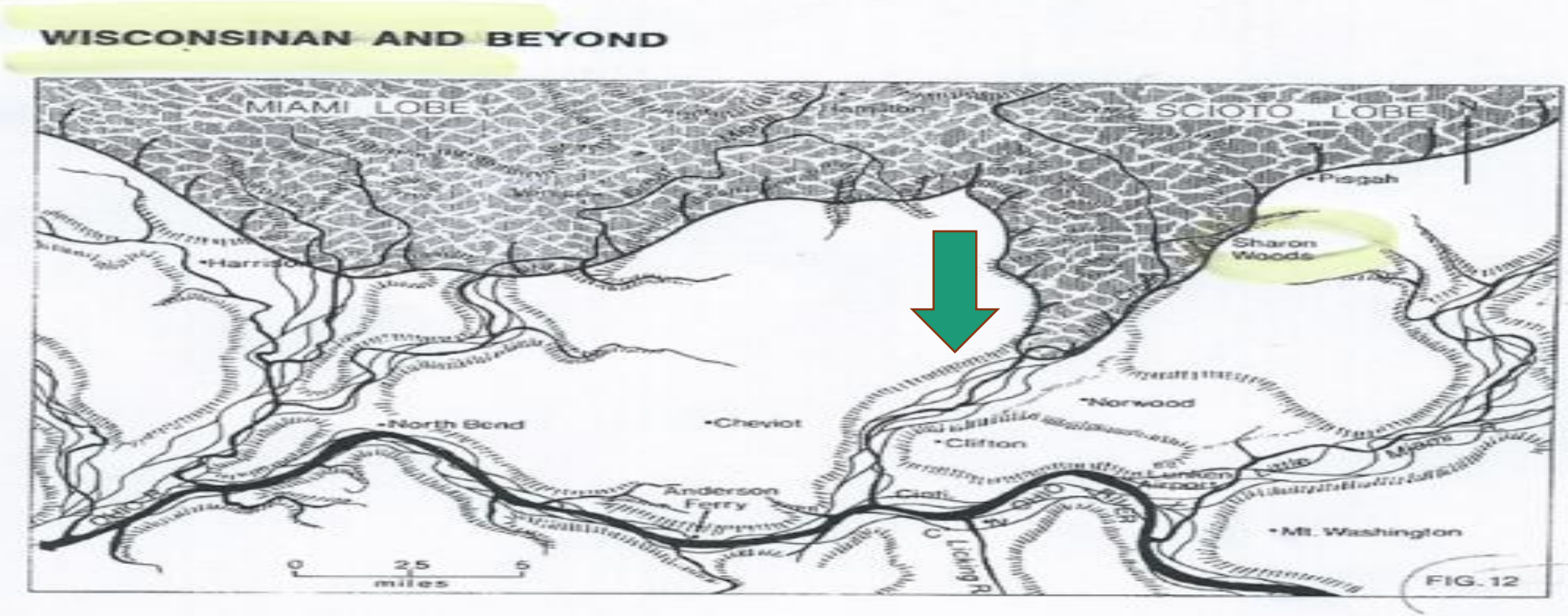


Here we are at VPC

Here is another image showing the location of some of the big hills (terminal Moraines)at the **tips** of the **Wisconsin Glacier**

What became of all those stones, gravel, rocks, which we call *GLACIAL TILL* which had been carried by the glacier as it was pushed southward especially the piles of stones in the MORAINES that it left behind?

n at the farthest places the Wisconsin Glacier reached. The outwash of one lobe emptied into the River valley, ***the other emptied into/through the Mill Creek Valley***.



The area south of the lower parts of the Wisconsin Glacier, the Great Miami River valley

***and the Mill Creek Valley*,**

served as a major sluiceways

for glacial melt water and ***glacial debris (glacial till/outwash)***

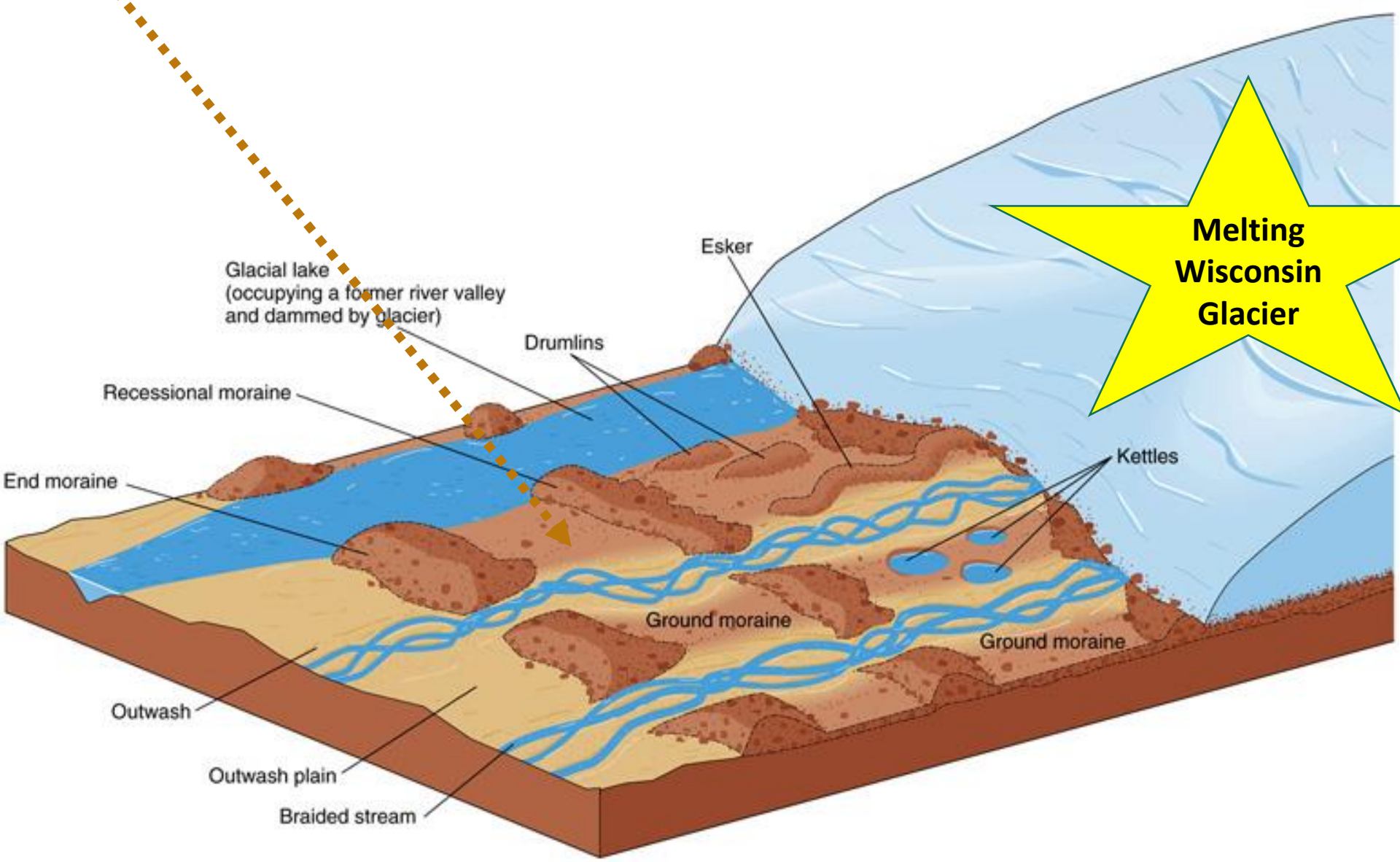
which the Glacier had carried.

As the glacier melted, its melt water pushed the rocks /stones it carried, including some of those in the moraines,

farther away (downstream) from the melting glacier.

. The massive wall of ice (The Wisconsin Glacier) behind this pile of rocks, continued to melt.

It dropped the rocks, etc. it was carrying, **filling the valleys and making AQUIFERS**, in addition to washing those rocks, stones, gravel, sand downstream.



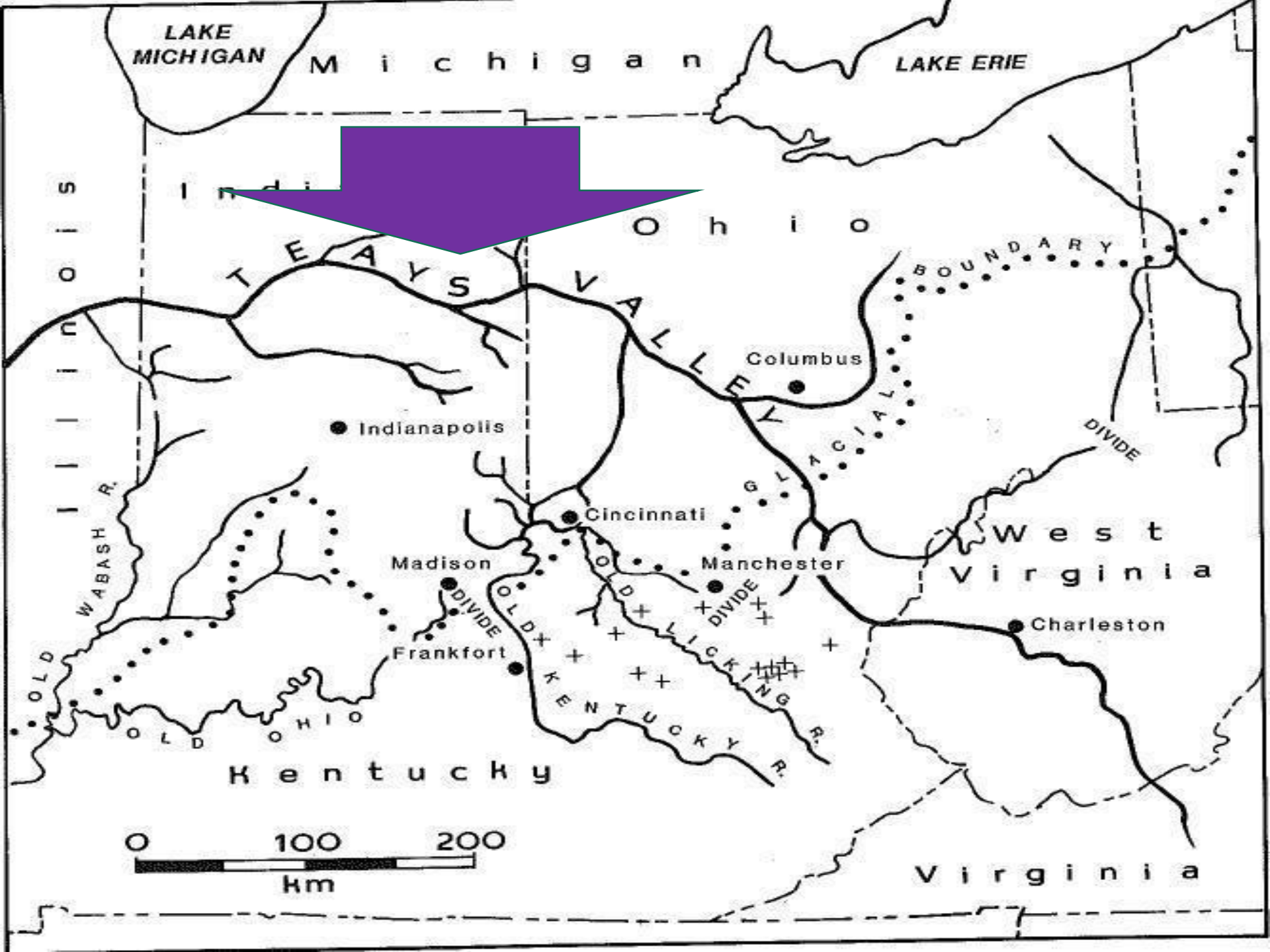
For example there is an extensive sand and gravel aquifer known as the *Great Miami Buried Valley Aquifer (GMBVA).*

The stones, rocks, - - -from the retreating Wisconsin glacier were dumped here, forming this aquifer.

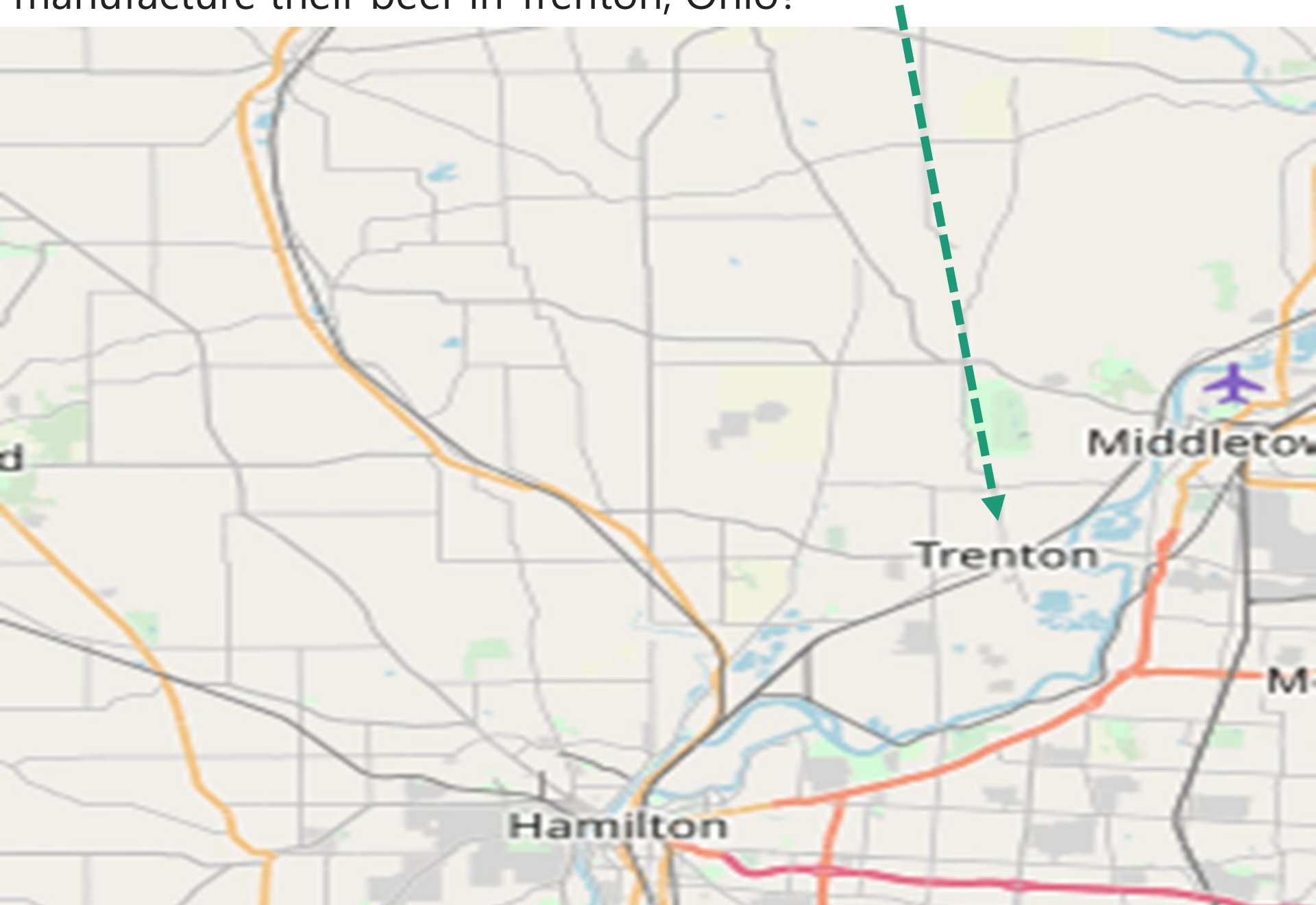
The GMBVA extends in a southwesterly direction from Indian Lake, north of Dayton, Ohio to the Ohio River. The aquifer generally follows the course of the present day Great Miami River.

Water is stored in the spaces found between adjoining sand and gravel particles in these deposits.


HARDIN
AUGLAIZE
Indian Lake
MERCER
Loramie Creek
SHELBY
LOGAN
Great Miami River
Lake Loramie
SIDNEY
Mad River
Stillwater River
Tawawa Creek
Kiser Lake
MIAMI
Great Miami River
CHAMPAIGN
Greenville Creek
Lost Creek
TROY
DARKE
Painter Creek
Stillwater River
Buck Creek
C.J. Brown Reservoir
SPRINGFIELD
Honey Creek
Mad River
Indiana
Ohio
CLARK
Twin Creek
Wolf Creek
EATON
MONTGOMERY
DAYTON
PREBLE
Great Miami River
Holes Creek
XENIA
GREENE
Acton Lake
Clear Creek
Elk Creek
Seven mile Creek
BUTLER
Four Mile Creek
Indian Creek
HAMILTON
LEBANON
WARREN
Great Miami River
HAMILTON
CINCINNATI
Ohio River

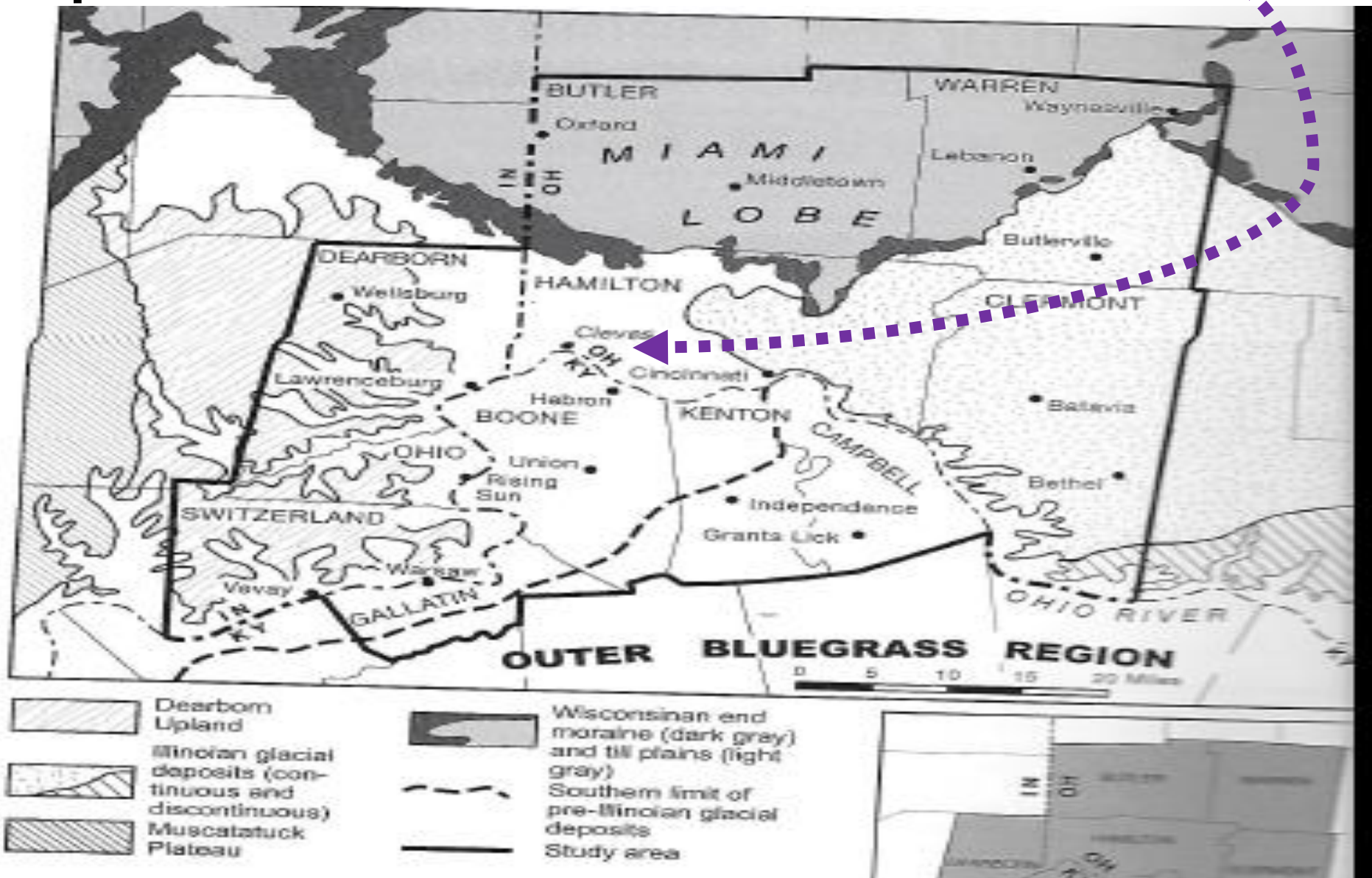

LAKE MICHIGAN
Michigan
LAKE ERIE
Illinois
Indiana
Ohio
TEAYS VALLEY
GLACIAL BOUNDARY
Columbus
Indianapolis
DIVIDE
Cincinnati
WABASH R.
Madison
Manchester
West Virginia
DIVIDE
DIVIDE
Charleston
OLD LICKING R.
Frankfort
OLD KENTUCKY R.
OLD OHIO
Kentucky
0 100 200
km
Virginia

Who knows why MillerCoors Brewing built a big place to manufacture their beer in Trenton, Ohio?



In 1826 the third most valuable item produced and sold in ***the Cincinnati area*** was WHISKEY. This building could have been one of the several distilleries located here. They were located next to the canal and ***took the water to produce its whiskey from the aquafer beneath them.***

As the Wisconsin Glacier continued to melt, it's melt water continued to push the stones/ material in the moraines, depositing its glacial till **into the previously gouged-out areas , we now call downtown Cincinnati→ Covington, Newport.**



So this vast amount of glacial till/outwash/alluvial material was dumped/deposited in the deep valleys.

*This glacial till **filled in** those areas.*

These area included not only the Mill Creek Valley, it filled in all of "downtown" Cincinnati, Covington, Newport, the Ohio River Valley itself, et.al.

to a height of > 125 feet above the solid bedrock of the Mill Creek Valley and the Ohio River valley.

So the “DOWN TOWN AREA” Of Cincinnati, et al, which **WAS a big hole,** some of which had been gouged out by Licking River as it flowed north up through the Mill Creek Valley,

(***but mainly from the flow of the Deep Ohio River after it began to flow north up the Mill Creek Valley,)***

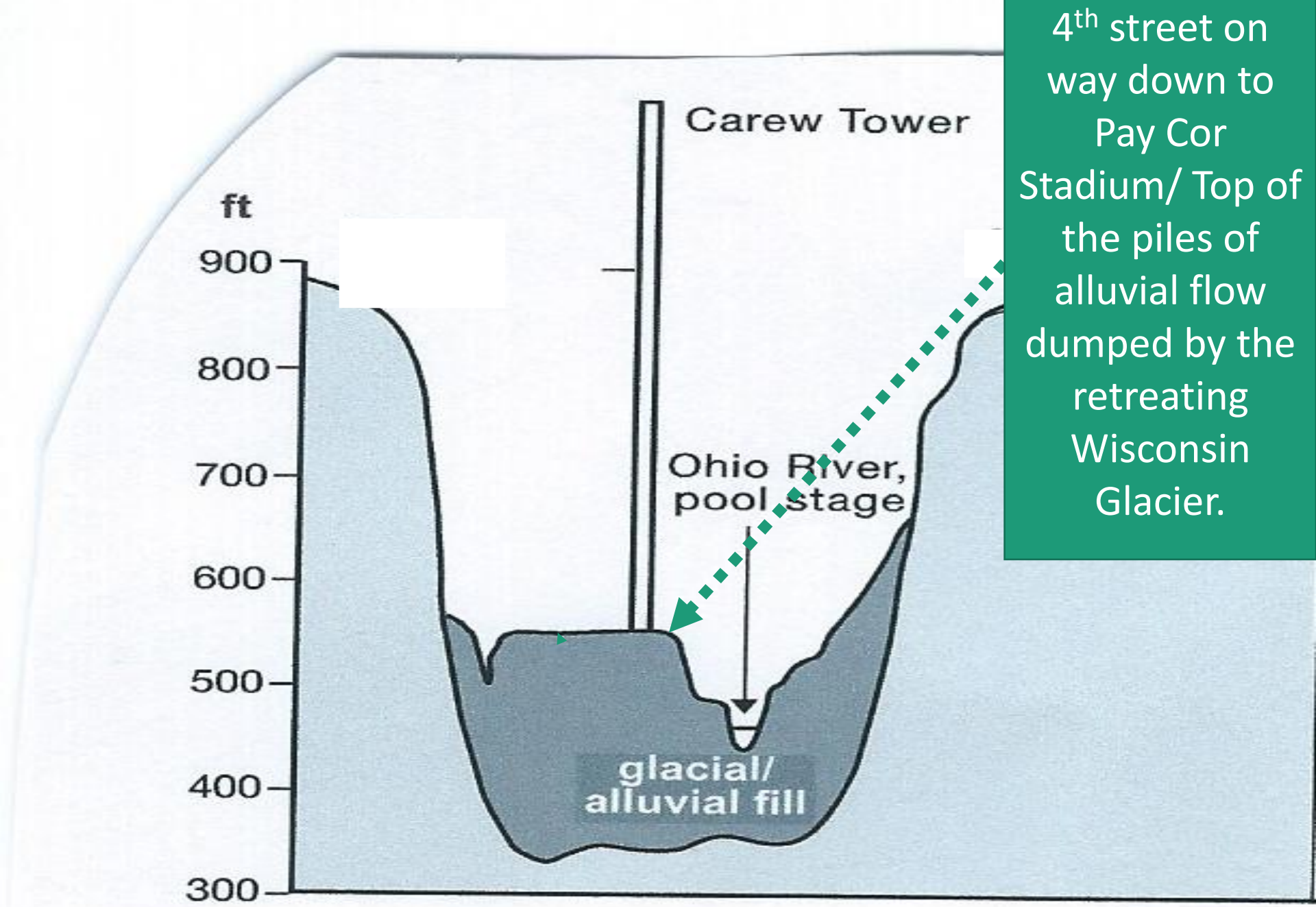
became filled with this alluvial till from the outwash of the stones etc. from the Wisconsin Glacier..

But in the 12,000 or so years since the Wisconsin Glacier has been gone form Cincinnati, ***the water from*** Pittsburgh, Portsmouth, Charleston, Ashland, - - - has continued to flow through the Ohio River Valley.

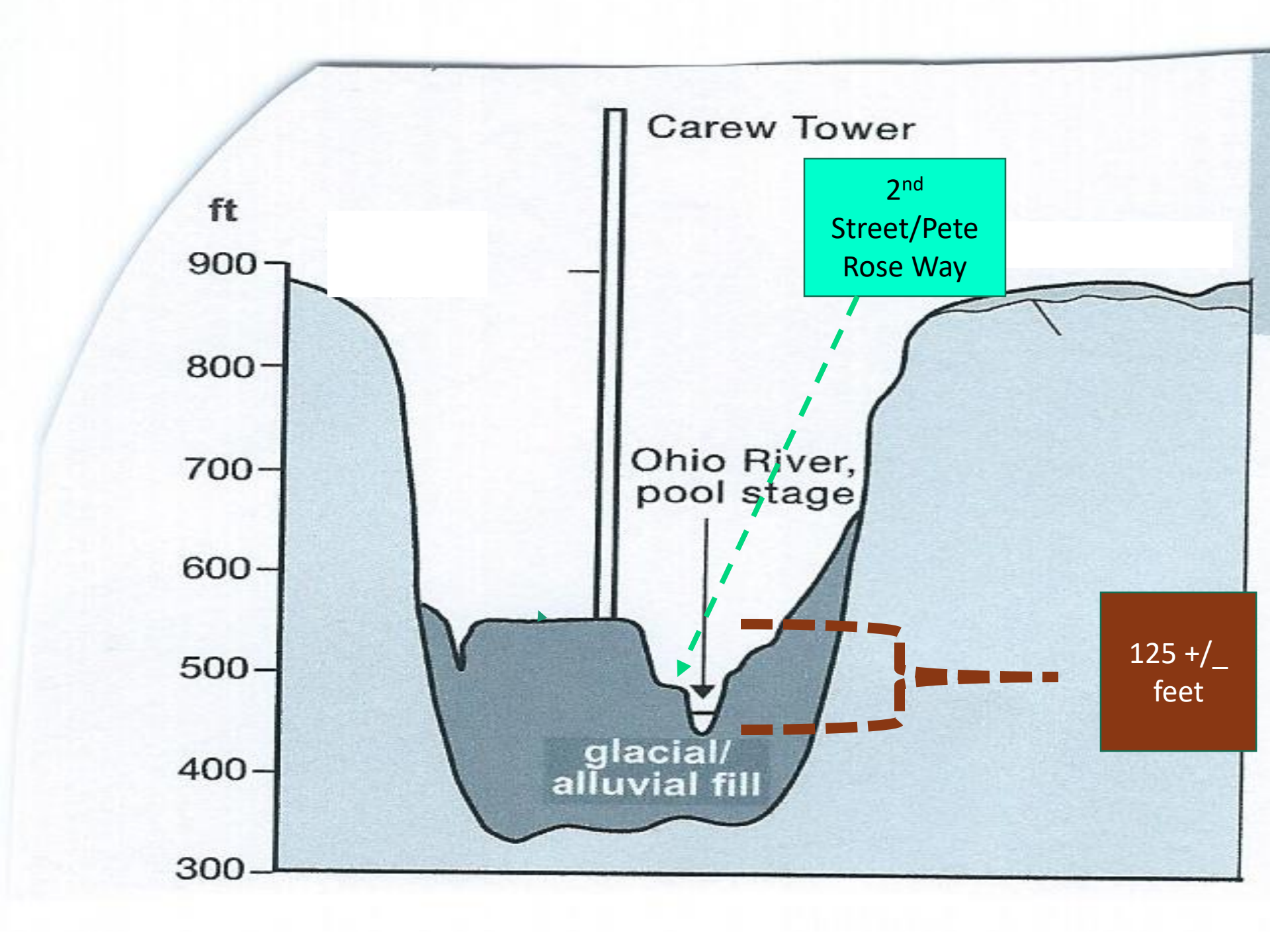
The flow of this Ohio River water gradually eroded the alluvial till dumped from the melting glaciers ,carrying it away.

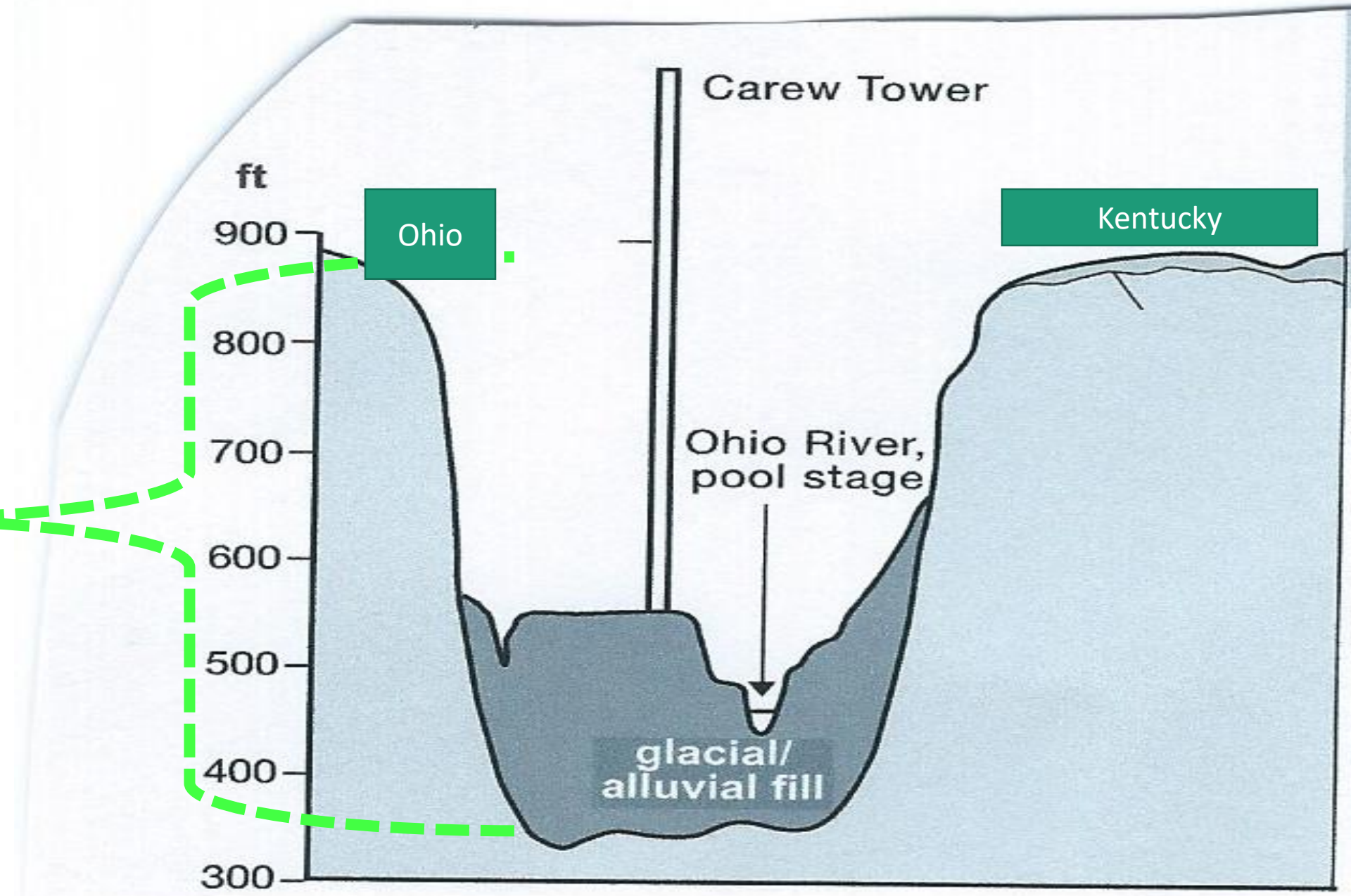
This lowered the water level of the Ohio River while leaving sloping gravel banks on each side.

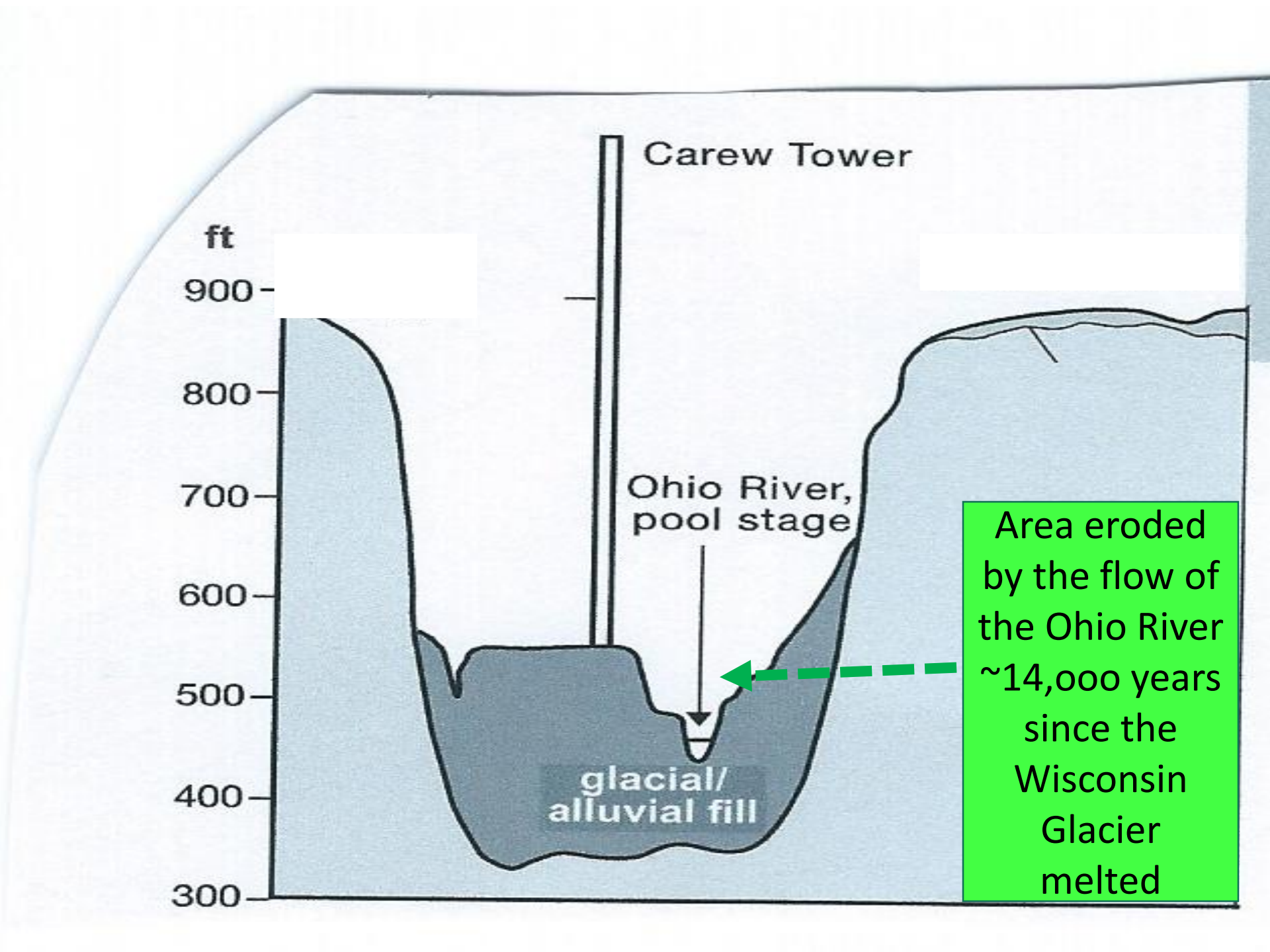
As an example, 4th street is much higher than where the river level now is because the Ohio River cut through and carried away some of this alluvial fill.

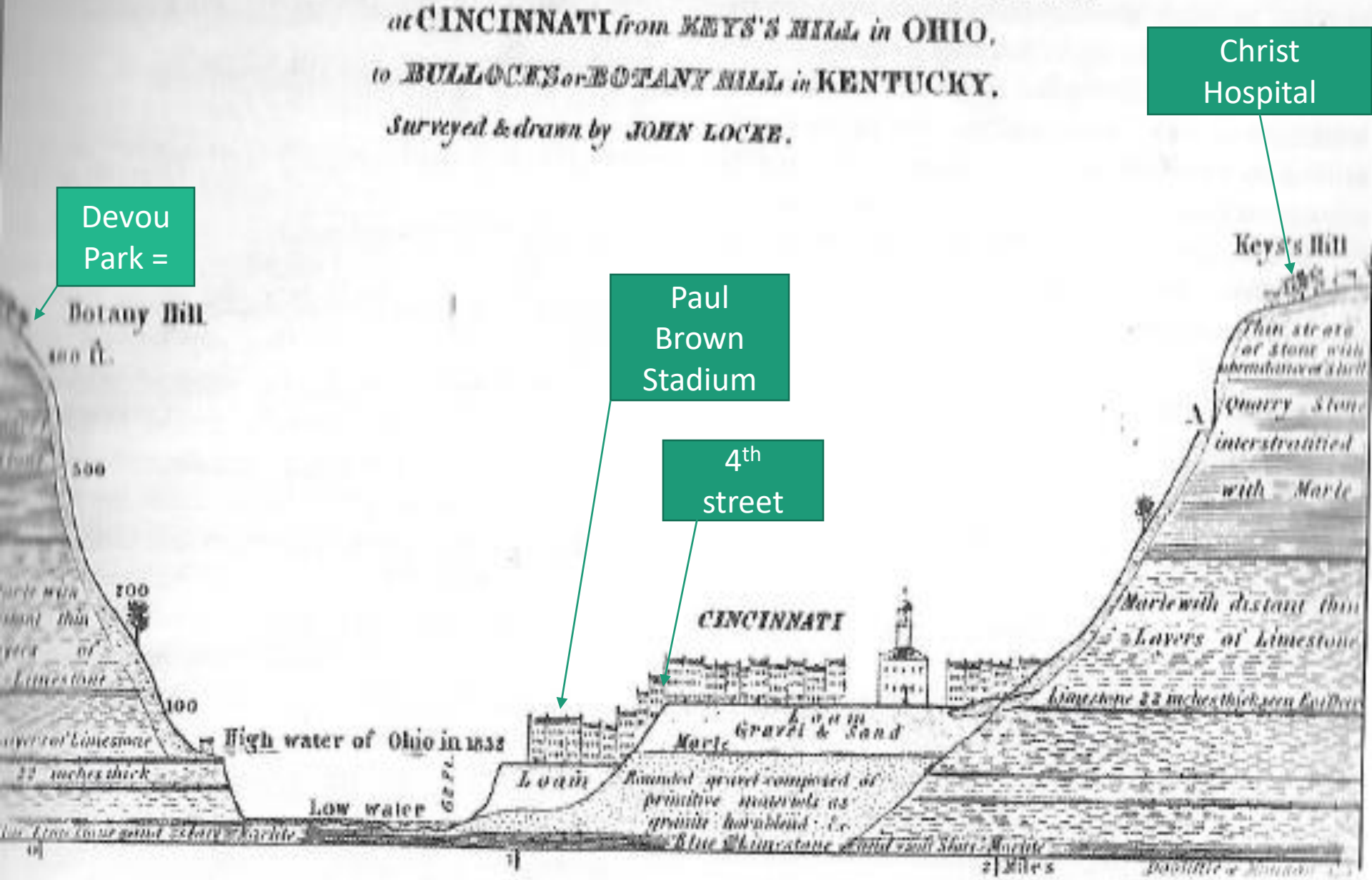


4th street on way down to Pay Cor Stadium/ Top of the piles of alluvial flow dumped by the retreating Wisconsin Glacier.


Carew Tower
2nd Street/Pete Rose Way
ft
900
800
700
600
500
400
300
Ohio River, pool stage
glacial/ alluvial fill
125 +/_ feet


Carew Tower
ft
900
800
700
600
500
400
300
Ohio
Kentucky
Ohio River,
pool stage
glacial/
alluvial fill


Carew Tower
ft
900
800
700
600
500
400
300
Ohio River,
pool stage
glacial/
alluvial fill
Area eroded by the flow of the Ohio River ~14,ooo years since the Wisconsin Glacier melted



gure 4. The first detailed geologic cross section published for the Cincinnati region shows both bedrock geology and its overly- g unconsolidated glacial outwash much as we know it today (Locke, 1838, Plate 2). Keys Hill in Cincinnati is now called Mount lburn and Botany Hill is Devou Park in Covington. Today, different names are used for these rock units, but Locke

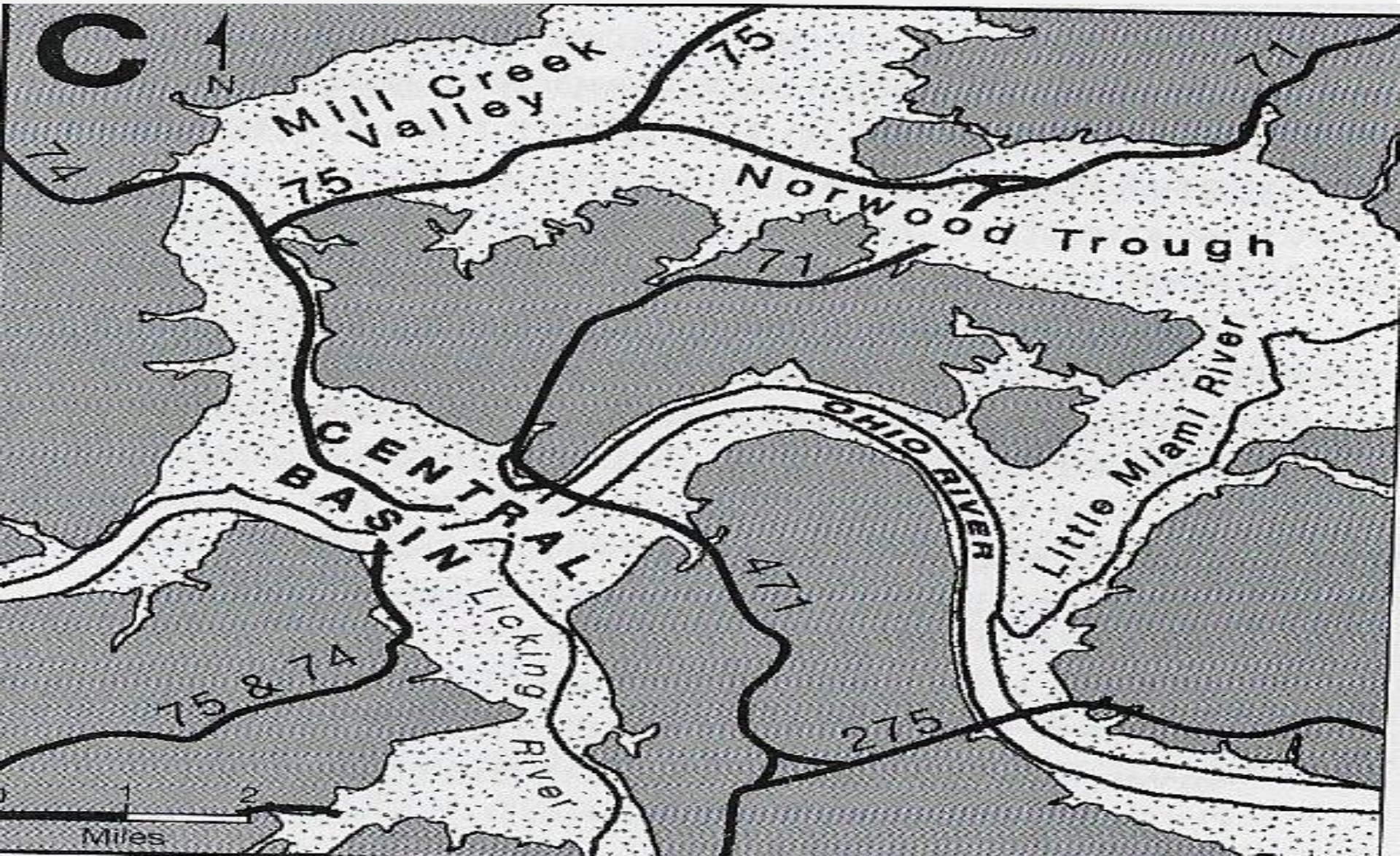
Let’s look again at those-now-filled-in--with- glacial- till areas:

The melt from this Wisconsin glacier not only helped widen the Mill Creek Valley, its alluvium eventually filled in the whole “Cincinnati area” with its glacial till (sand, gravel, stones, larger rocks).

including places like Lunken Airport, Marymount, Red Bank Road,

Does that flat expanse of glacial till still exist?

This image again shows the present location of the areas where the glaciers, but especially the Wisconsin glacier, dropped a lot of their glacial till/material, {as well as the location of some of the larger highways)



Almost all those areas, like those below, still exist

downtown Cincinnati,

Other the Rhine,

the Museum Center area/The West End,

Camp Washington,

Fairmont,

Northside,

Carthage,

Covington,

Newport

as well as beneath the rivers in our area,

INCLUDING THE AQUIFER FROM BELLEFONTAINE.

In summary, when they began to melt,

streams of water from the melting glaciers and lakes initially gouged out the land while forming valleys, *then,*

especially in the case of the Wisconsin Glacier,

left deposits of sand and gravel in these valleys

such as in the Mill Creek Valley and the Miami Rivers Valleys and of course the Ohio River Valley.

This was especially true of the deposits of rocks which became the downtown areas of Cincinnati, Covington, Newport and Dayton, Ky.

Finally ,*erosion,* caused by the ~14,000 years of Ohio River water streaming through the Ohio Valley, cut into these deposits of sand and gravel, dredging out a little of the glacial till that is present as sediment at the bottom of the Ohio River.

In addition, the flowing Ohio river left terraces along the sides of the present path of the Ohio River, as well as providing a flat space where our Reds can play baseball, Joe Burrow can sling the football, Garth Brooks can sing and play his guitar at the Heritage Bank Center and I can down 1 or 2 at the Cristian Morelian saloon.

YEA! NOW WE KNOW HOW THE OHIO RIVER GOT HERE!

NEXT Thursday,

.

we are going to go to a warm (during the summer) place,

The West.

And we will discuss:

STREAM EROSION IN ARID REGIONS

Hold on there, Pilgrim!

Erosion by streams in arid regions? What streams? There are no streams in Utah, New Mexico, Nevada, Southern California.

How can you have stream erosion in arid regions when there are no streams?

I'll see you next Thursday at 11:00 and we'll talk.