Glacial geology of Wisconsin.

Bancroft, Genevieve; Madison Public Schools (Wis.); Instructional Materials Center

Madison, Wisconsin: Instructional Materials Center, Madison Public Schools, [s.d.]

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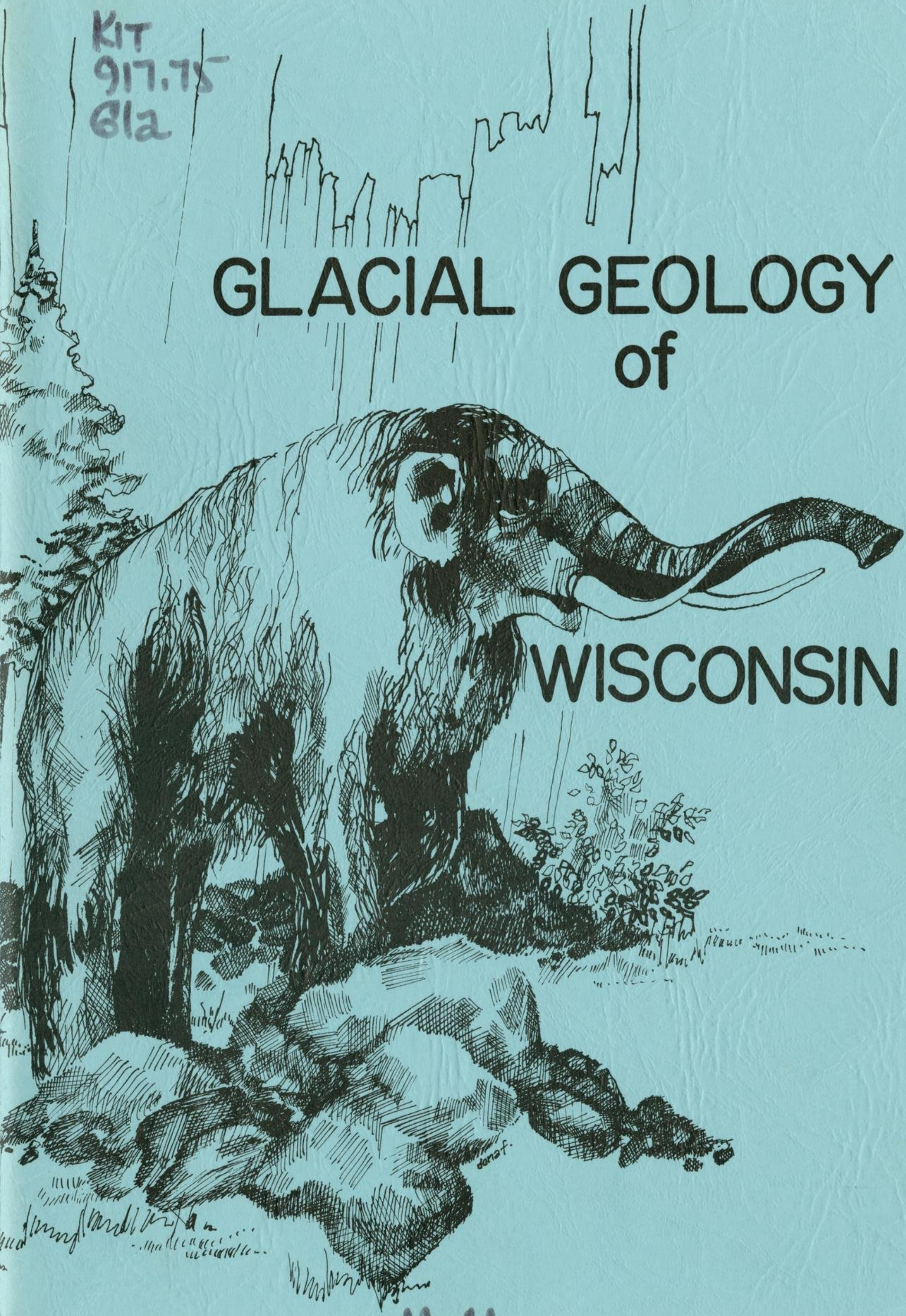
GLACIAL GEOLOGY of WISCONSIN



Instructional Materials About Our Community

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The Instructional Materials Center

Madison Public Schools

Madison, Wisconsin

GLACIAL GEOLOGY OF WISCONSIN

SECTION I: Teacher Information

The filmstrips and guidebook were produced by the Instructional Materials Center, Madison Public Schools, Administration Building, 545 West Dayton Street, Madison, Wisconsin 53703.

The work presented or reported herein was performed pursuant to a grant from the U.S. Office of Education, Department of Health, Education, and Welfare.

GLACIERS

Objectives

1. Develop an awareness of
   - the glacial history of Wisconsin
   - the time that it took to develop glacial land forms
   - the topographical effects of the glaciers in Wisconsin
   - the economic use of glacial materials today
   - the recreational use of glacial materials today
   - the relationship of life to the climate during the Pleistocene

2. Stimulate inquiry about Wisconsin Glaciers

3. Acquire knowledge to help learn to interpret the landscape of Wisconsin

4. Develop an appreciation for and wise use of the land forms created by the glaciers that once covered Wisconsin

GLACIAL GEOLOGY OF WISCONSIN OUTLINE

Part I — Introduction

A. Evidence of the Glacier
   1. Driftless Area near Richland Center
   2. Madison Four Lakes
   3. Drumlins — hills
   4. Glacial Lake bed
   5. Springfield Corners Area — field boulders
   6. Boulder with striations
   7. Excavation in Madison — soil
   8. Lake Michigan — great lakes

B. The Continental Glacier — Wisconsin Stage
   1. Wisconsin Geologic Time Chart — Pleistocene
   2. Mastodons in a snowstorm — climate change
   3. Ice — snow accumulated
   4. Continental Glacier
   5. Alpine Glacier
   6. Map of North America — Extent of Ice Sheet
   7. Wisconsin Map — Advance of Ice over Wisconsin
   8. Wisconsin Map — Showing Four Lobes and Driftless Area
   9. Dane County Glacial Map — includes Driftless Area
   10. Cross section of Southern Wisconsin from Mississippi River
   11. The End

Part II — How The Glacier Reshaped The Landscape

A — Deposits left by The Ice

1 — Ground Moraine
- a — Picture of a Glacier
- b — Ground Moraine near Springfield Corners
- c — Illustration of bedrock covered by till

2 — Erratics
- a — Chamberlain rock — erratic boulder
- b — Striated boulder
- c — Boulder fences
- d — Foundation of barn using glacial boulders

3 — Moraines
- a — Map of Moraines
- b — Aerial of Terminal Moraine
- c — Terminal Moraine at Verona

4 — Drumlins
- a — Drumlin
- b — Glacial Map showing drumlins in green
- c — Drumlin country
- d — Drumlin — parallel to ice movement
- e — Token Creek Drumlin — Cut in

B — Deposits left by melt water

1 — Eskers
- a — Map shows eskers
- b — Parnell Esker in North Kettle Moraine Park
- c — Esker in North Kettle Moraine Park

2 — Kames
- a — Picture of Ice Cave
- b — Aerial of Kettle Moraine Country
- c — Close-up of Kame

3 — Outwash
- a — Map
- b — Aerial of outwash
- c — Stratified outwash
- d — Outwash and loess

C — How the Inland Lakes are formed

1 — Kettle Holes
- a — Kettle Hole Lakes Fish and Crystal Lakes
- b — Diagram of The Formation of a Kettle Lake
- c — Picture of a Kettle without water — south of Madison

2 — Dammed up pre-glacial streams
- a — Illustration of pre-glacial Yahara River Valley
- b — Pre-glacial streams with present lakes and terminal moraines in Dane County
- c — Four lakes of Madison area

3 — Irregular deposition
- a — Marsh
- b — Map of Dane County wetlands

D — Glacial Lakes

1 — Glacial Lake Wisconsin
- a — Map of old Glacial Lakes
- b — Flat country
- c — Glacial Lake Wisconsin
- d — Buttes or mesas in Glacial Lake Beds

2 — Glacial Lake Oshkosh
- a — Oshkosh area
- b — Glacial Lake deposits

3 — Glacial Lake Middleton
- a — Map of Glacial Lake Middleton
- b — Glacial Lake Middleton Bed

E — The Great Lakes

1 — Lobes of Glacier eroding Lake Michigan
2 — Wave-cut cliff and sea-cave at Peninsula State Park
3 — Ridges along Wisconsin shore of Lake Michigan
4 — Beach at Two Creeks
5 — Wood of Two Creeks Forest near Two Creeks Wisconsin

F — Effect of The Glacier on the Wisconsin River and Driftless area

1 — Wisconsin River Valley
2 — Sand Bars of Wisconsin River
3 — Abandoned river valley in Driftless area
4 — Dendritic pattern of Driftless area

G — Ice Age Reserve — Holy Hill

H — The End

Part III — Fossils of The Ice Age

A — Map of Pleistocene glaciers and animals

B — Picture of Mastodon

C — Skeleton of Mastodon

D — Mastodon and Tooth

E — Tooth of Mastodon

F — Mammoth and Tooth

G — Mastodon and Mammoth Tooth

H — Panorama — Skull

I — Buffalo Skull

J — Beaver Skulls

K — Natural Bridge

Part IV — Economics and Value to Man

A — Gravel for Concrete
- 1 — Gravel pit at Verona
- 2 — Gravel
- 3 — Concrete roads

B — Gravel for Blacktop roads
- 1 — Blacktop plant

C — Farms

D — Recreation — Lakes

E — Wildlife Habitat

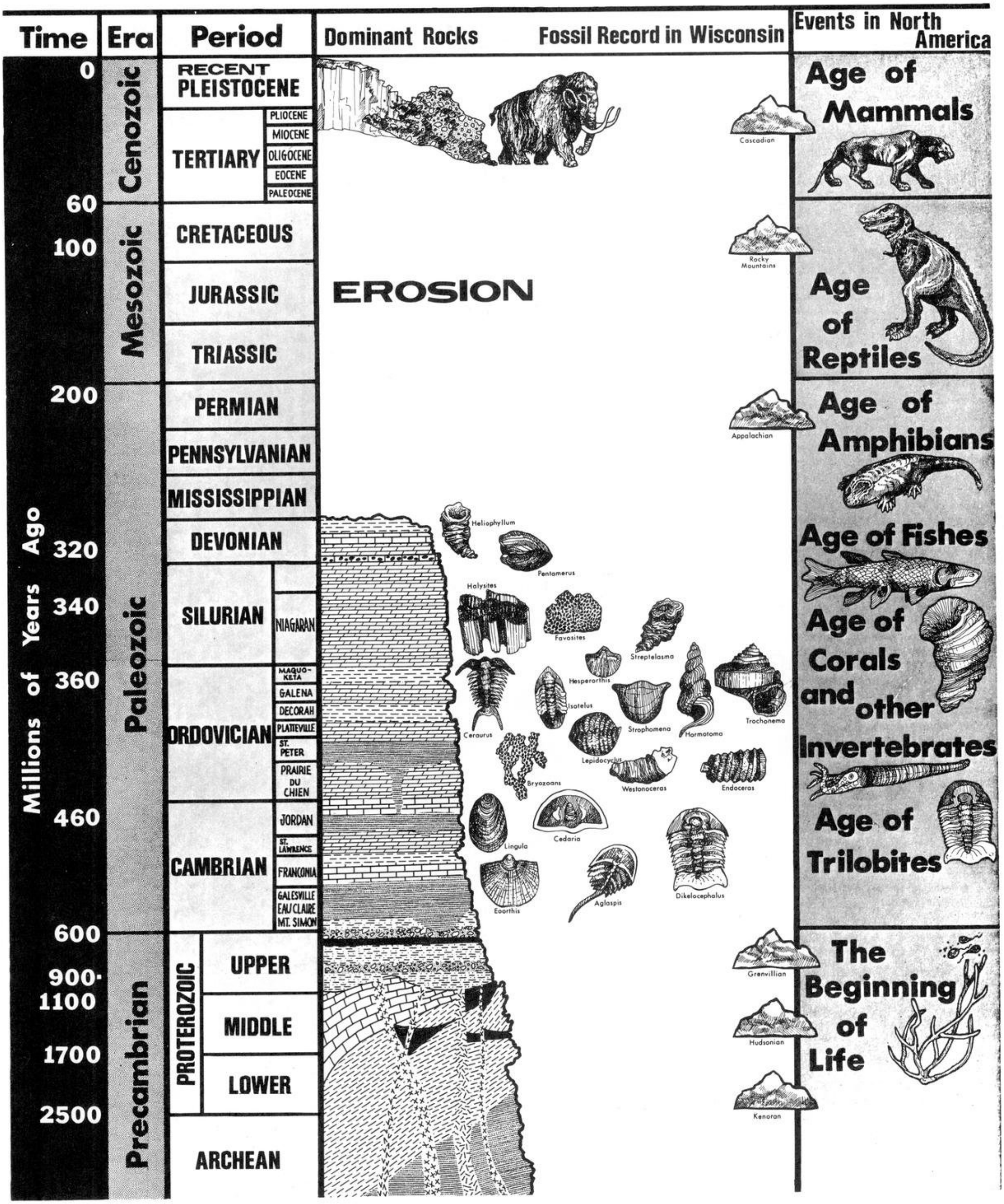
F — Great Lakes Transportation and Industry

G — Glacial landscape — Ice Age Reserve Park

H — The End

WISCONSIN GEOLOGIC TIME CHART

ESEA TITLE III
LOCAL MATERIALS PROJECT OF IMC
MADISON PUBLIC SCHOOLS



PLEISTOCENE OR GLACIAL EPOCH

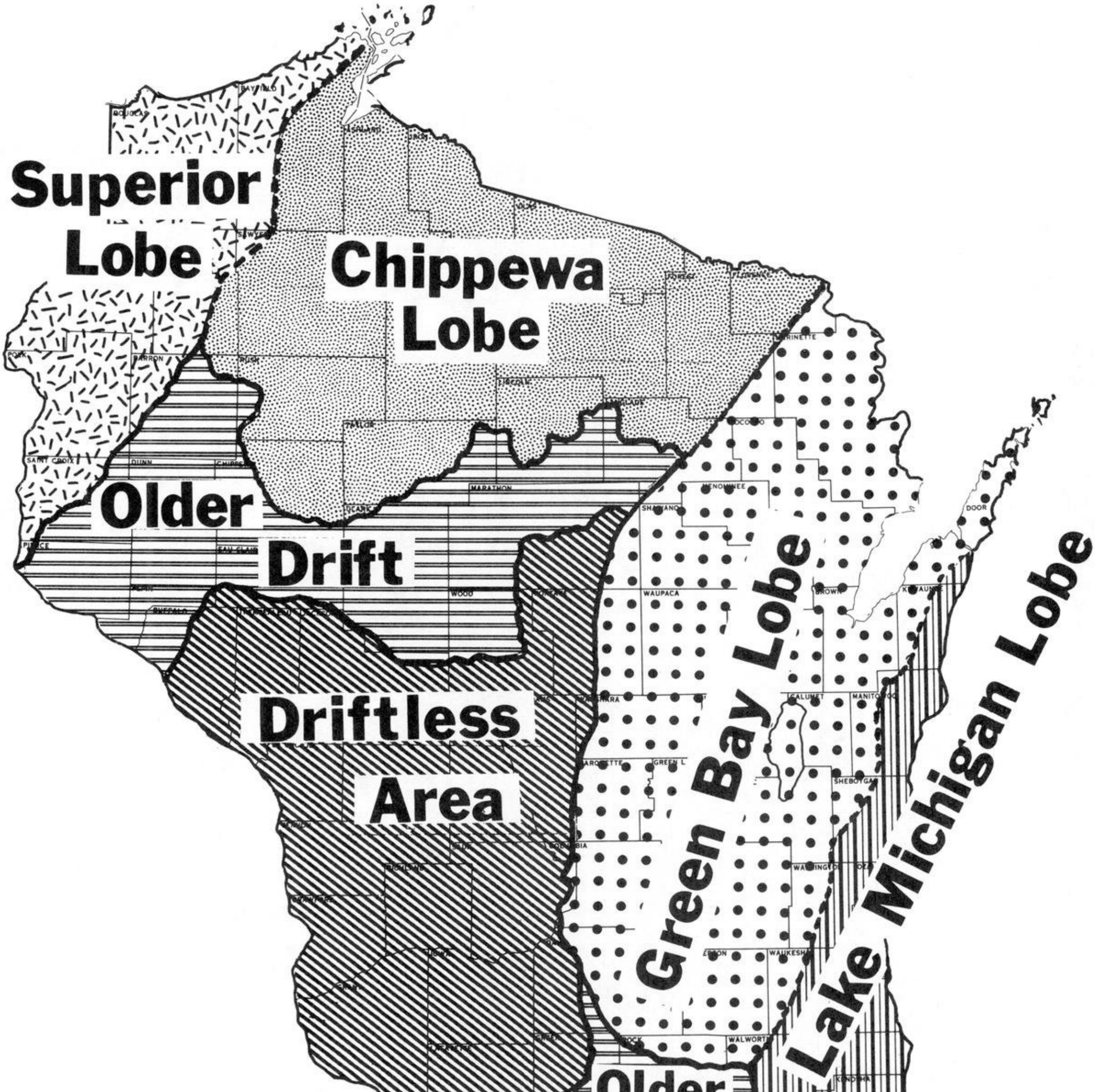
GLACIAL STAGES (Substages)	INTERGLACIAL STAGES	APPROXIMATE AGE IN YEARS
WISCONSINAN STAGE		8,000 — 70,000
Valderan		
	Two Creekan	
Woodfordian		
	Farmdalian	
Altonian		
	SANGAMONIAN INTERVAL	70,000 — 120,000
ILLINOIAN STAGE		120,000 — ?
	YARMOUTHIAN INTERVAL	
KANSAN STAGE		?
	AFTONIAN INTERVAL	
NEBRASKAN STAGE		?

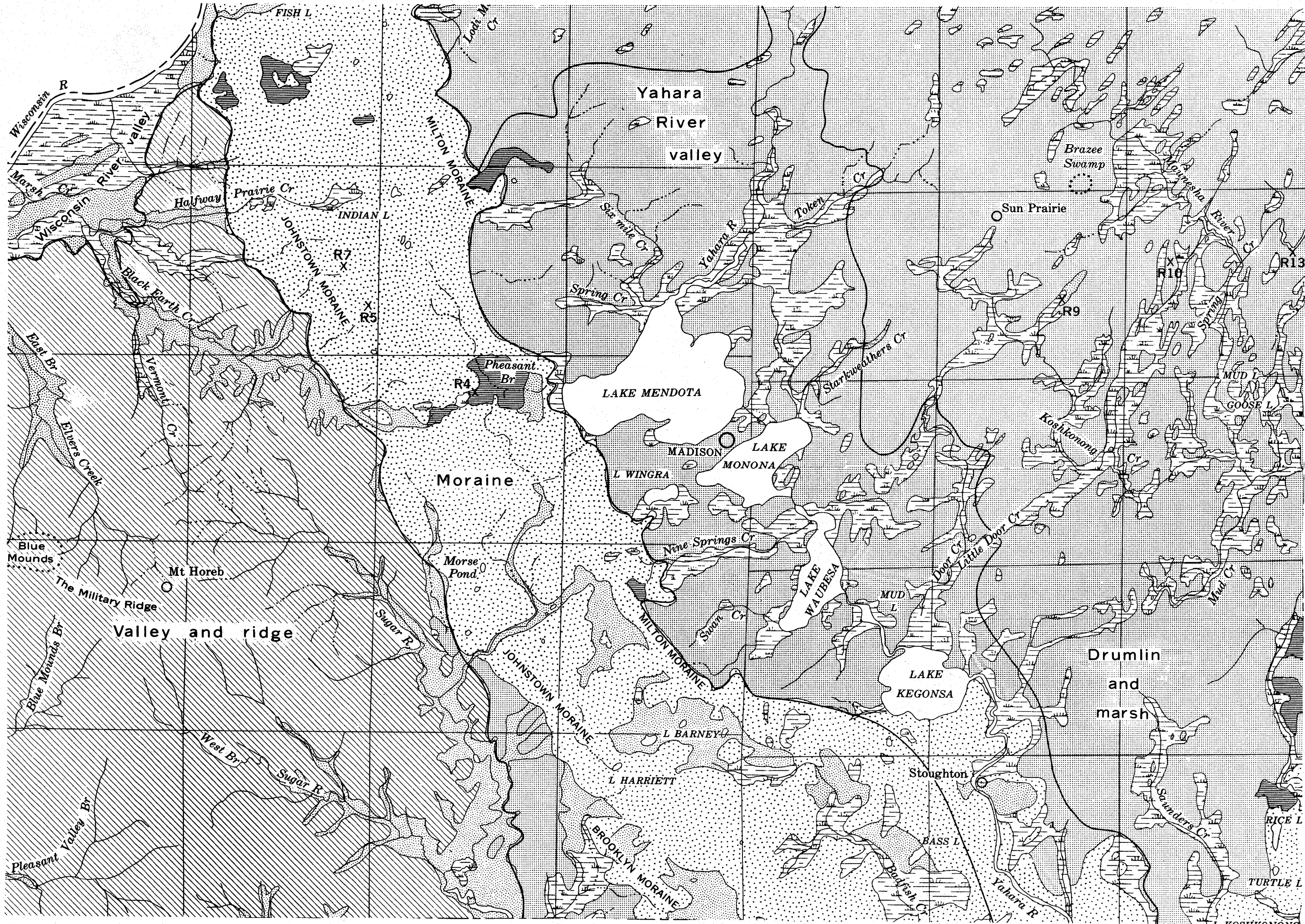
Enclosed with this booklet are duplicates of several pages which can be used for bulletin board displays or as masters for ditto copies for students.

North America during Glacial Period

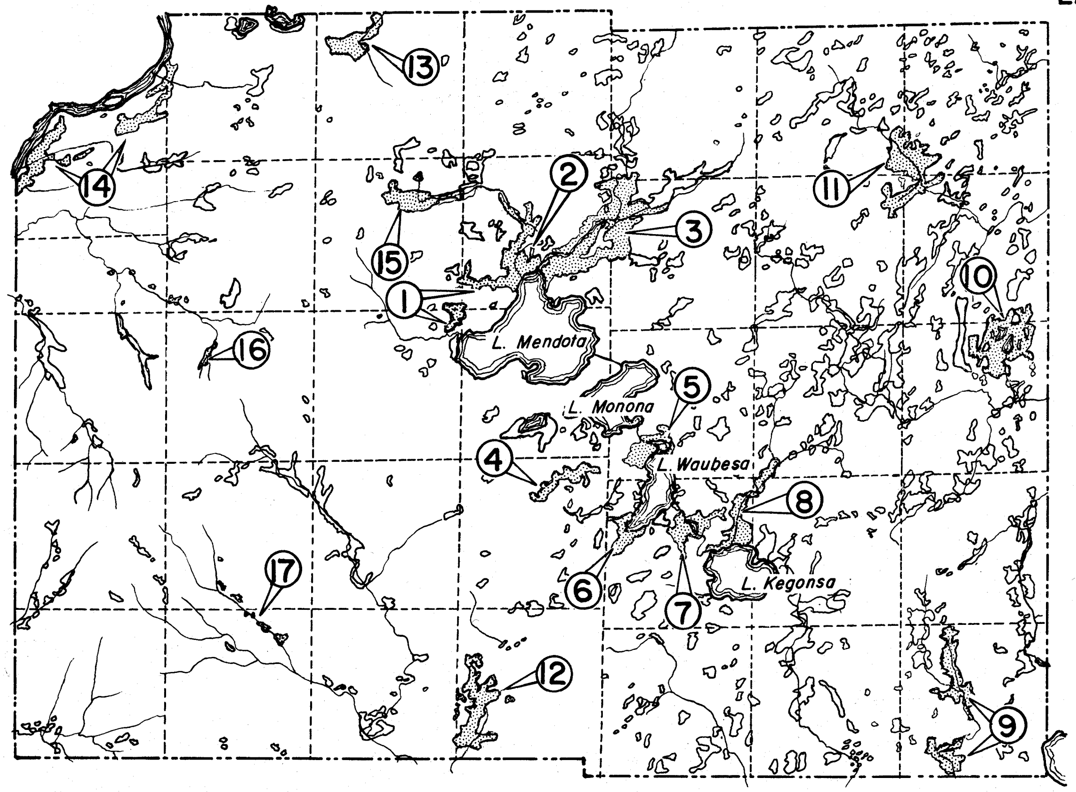
Wisconsin-
showing
extent of
glaciation

Glacial Wisconsin Showing Four Lobes and Driftless Area





Glacial Geology of Dane County



LEGEND

Wetlands of Public Importance

1. Dorn Creek - F
2. Six Mile Creek - *F*
3. Cherokee Marsh - *F*
4. Nine Springs Creek - *F*
5. Upper Waubesa - *F*
6. Lower Waubesa - *F, W*
7. Lower Mud Lake - *F, W*
8. Door Creek - *F, W*
9. Albion Marsh - *W*
10. Goose Lake - *W*
11. Deansville Marsh - *F, W*
12. Brooklyn Marsh - *F, W*
13. Lodi Marsh - *F, W*
14. Mazomanie Marsh - *W*
15. Waunakee Marsh - *F, W*
16. Black Earth Creek - *F*
17. Mt. Vernon Creek - *F*

F = Fishery
W = Waterfowl

Other wetlands

WETLANDS, LAKES AND STREAMS

Wetlands.........44,599 acres

Lakes..........20,975 acres

Streams.........399 miles

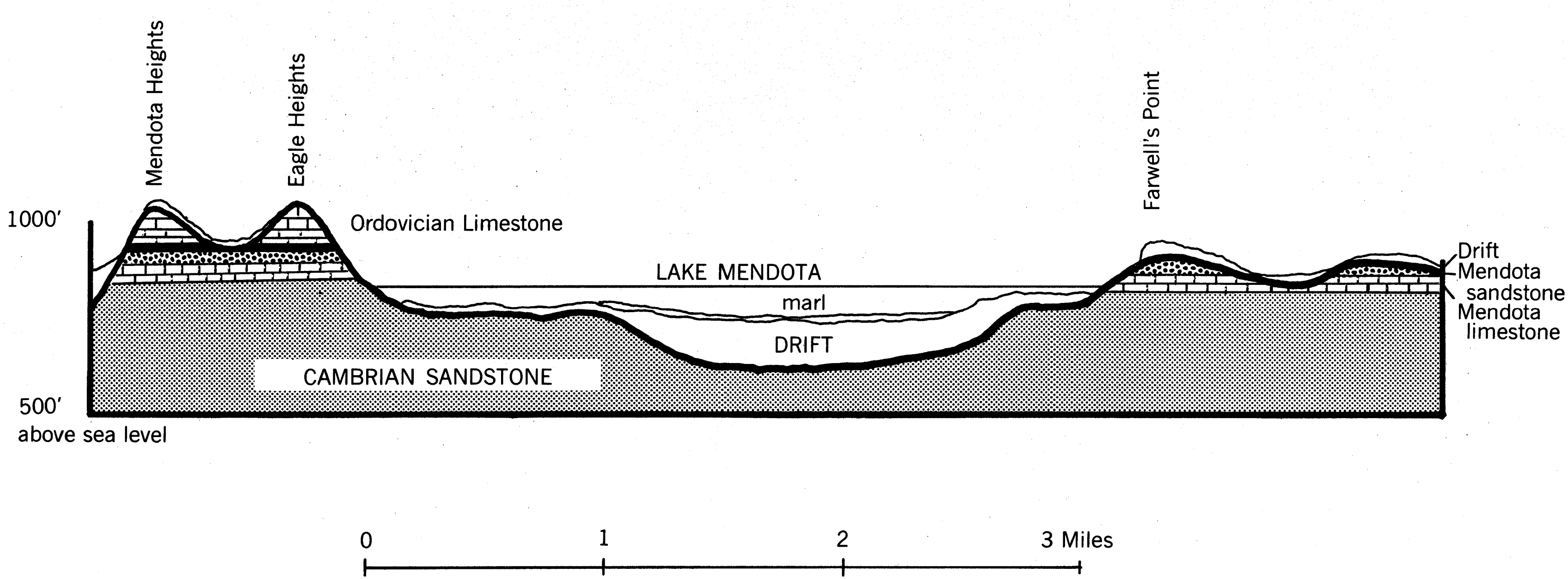
Scale 0 1 2 Miles

Blueprint for Growth

Figure 7

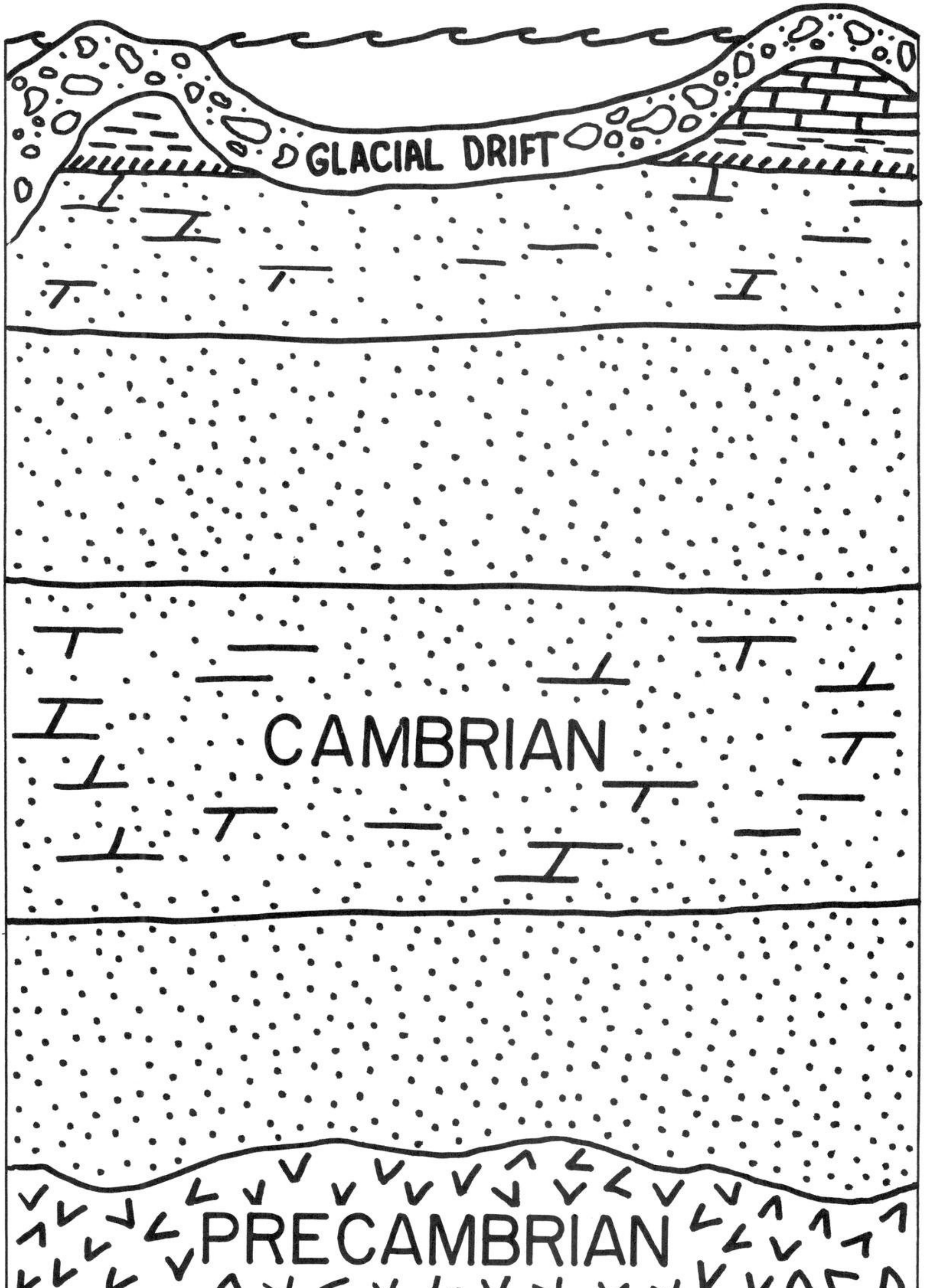
Dane County Citizens' Planning Committee

Cross Section of the Yahara Valley at Madison Where the Cambrian Sandstone Forms a Wide Valley

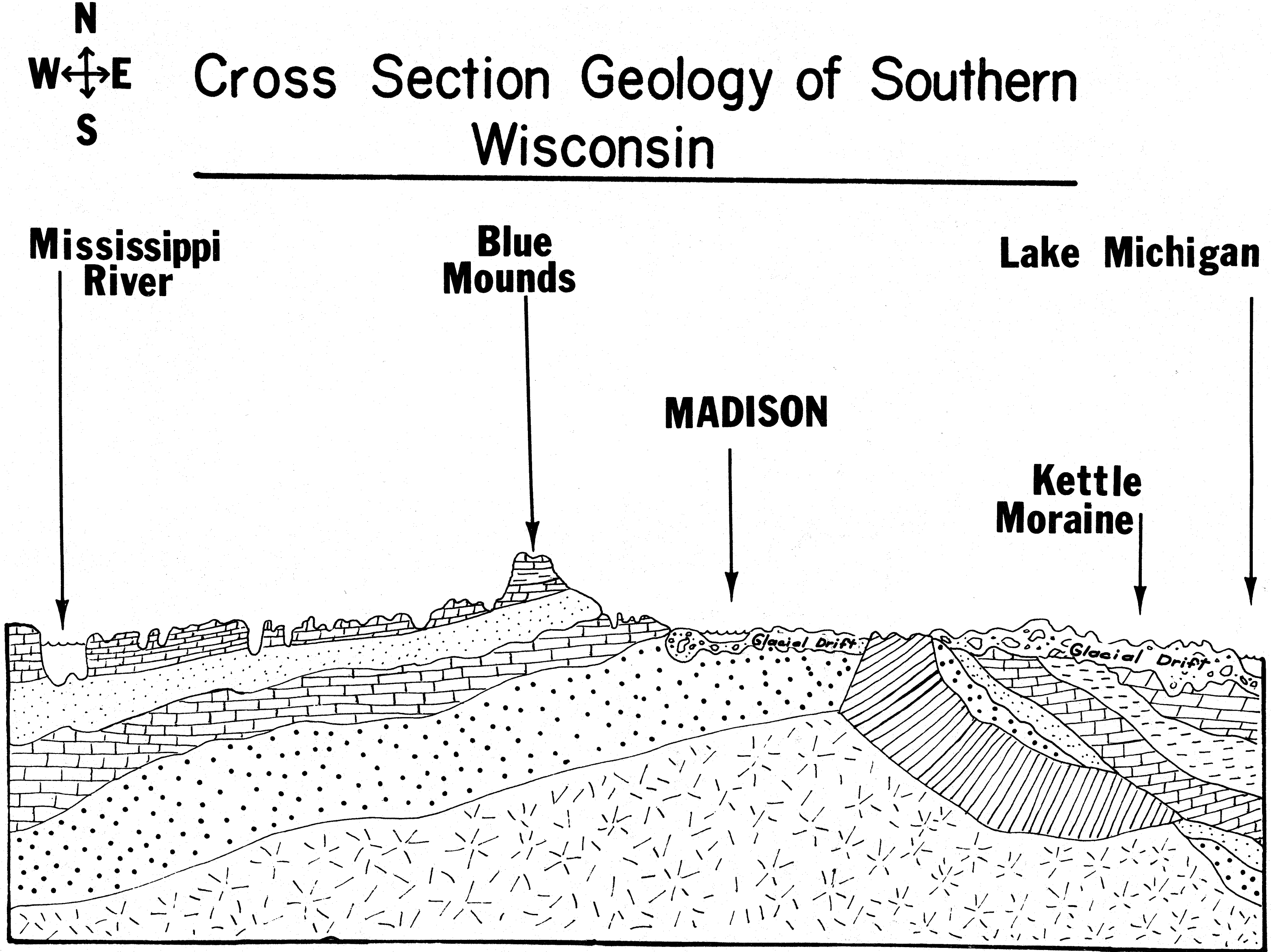


SOURCE: Lake Mendota Origin and History The Technical Club of Madison 1936

Cross Section Precambrian to Glacial Drift



Cross Section Geology of Southern Wisconsin



GLACIAL DEPOSITS IN SOUTHEASTERN WISCONSIN - SIMPLIFIED

SCALE 5 0 10 20 MILES

TERMINAL & RECESSIONAL MORAINES
GREEN BAY LOBE
LAKE MICHIGAN LOBE
GROUND MORAINES
DRUMLINS
LAKES
TRIP ROUTE

SELECTED VOCABULARY — GLACIAL GEOLOGY

RECESSIONAL END MORAINE — A large deposit of glacial drift formed at the edge of the ice when the receding glacier oscillated for a time behind the position of its maximum advance.

MORAINAL LAKE — Lake formed by the blockade of drainage by a moraine.

TERMINAL MORAINE — A moraine formed at the end of a glacier at its farthest advance.

GROUND MORAINE — The material carried forward in and beneath the ice and finally deposited from its under surface, constitutes the ground moraine. The flat to undulating surface forms a till plain.

OUTWASH PLAIN — A plain of sand and gravel sometimes containing silt and clay deposited by melt water streams which flowed from the ice when it stood at the terminal moraine.

DRUMLINS — Elongated hills or ridges of boulder clay (till), usually oval and shaped like half an egg. Their long axis is parallel with the direction of advance of the glacier.

ESKER — Narrow ridge of sand and gravel which was deposited in the bed of a stream flowing beneath or in the ice of a glacier.

KAME — A mound of gravel and sand which was formed by the deposition of the sediment from a stream against the front of the ice or in a hole in the ice.

KETTLE LAKE — A kettle (or kettlehole) is a hollow depression formed by the melting of an ice block which had been covered by ice laid material or by gravel borne by streams emerging from the glacier, if the bottom of the kettle is below the water table, a lake occurs in it.

SWAMP — A tract of low-lying land which is just at the water table and is thus saturated with moisture; moisture loving plants grow in it.

KETTLE — A hollow formed by collapse of material when a buried ice block melted. See KETTLE LAKE, number 111.

STREAM TERRACE — A shelf-like remnant of material once continuous across the valley at this level. As the river swings from side to side in the flood plain, it erodes the material.

FLOOD PLAIN — A plain, bordering a river, which has been formed from deposits of sediment carried by the river. When a river rises and overflows its banks, the water spreads over the flood plain, depositing a layer of sediment at each flood.

GLACIAL TILL — The mass of boulders, cobbies, pebbles, sand and finely ground rock flour dragged along largely in the lower part of the ice of a glacier and left behind when the ice melts. A layer of glacial till covers the northern third of the model and is shown in yellow.

SHORT HISTORY OF THE ICE AGE IN WISCONSIN

The Pleistocene Epoch or "Ice Age" began about 1,000,000 years ago which, in terms of geologic time, is a very short time ago. There were four separate glacial advances in the Pleistocene each followed by an inter-glacial period when the ice receded. The fourth glacial stage is called the Wisconsin Stage because it was in this State that it was first studied in detail.

The glaciers were formed by the continuous accumulation of snow. The snow turned into ice which reached a maximum thickness of almost two miles. The ice sheet spread over Canada and part of it flowed in a general southerly direction toward Wisconsin and neighboring states.

The front of the advancing ice sheet had many tongues or "lobes" whose direction and rate of movement were controlled by the topography of the land surface over which they flowed and by the rates of ice accumulation in the different areas from which they were fed.

The ice sheet transported a great amount of rock debris called "drift". Some of this was deposited under the ice to form "ground moraine" and some was piled up at the margins of the ice lobes to form "end moraines." "Drumlins" are elongated mounds of drift which were molded by the ice passing over them and hence indicate the direction of ice movement.

The pattern of end moraines, in red, shows the position that was occupied by four major ice lobes. One lobe advanced down the basin of Lake Michigan, another down Green Bay, a third down Lake Superior and over the northern peninsula of Michigan and yet a fourth entered the state from the northwest corner. The well-known "Kettle Moraine" was formed between the Lake Michigan and Green Bay lobes. As the ice melted the drift was reworked by the running water. Large amounts of sand and gravel were deposited to form "outwash plains"; pits were formed in the outwash where buried blocks of ice melted and many of these are now occupied by lakes.

The action of the ice profoundly modified the landscape, smoothing off the crests of hills and filling the valleys with drift. In some places it changed the course of rivers forcing them to cut new channels such as that of the Wisconsin River at the Dells; elsewhere it dammed the valleys to create lakes such as those of the Madison area.

During recent years there have been intensive studies made of the polar ice caps, and methods have been developed for dating glacial events from the radioactivity of the carbon in wood, bones, etc. which are found in many of the deposits. The results of these studies are causing many previously accepted concepts to be changed or challenged.

We once thought that there were rather extensive glacial deposits older than Wisconsin age in the State, but age determinations do not support this. It was also thought that the ice left Wisconsin some 20,000 years ago but a forest at Two Creeks in Manitowoc County was buried under an advancing ice tongue only 11,000 years ago. Evidence is accumulating to indicate that ice may have occupied the so-called "Driftless Area" of the southwestern part of the State which hitherto has been held to be unglaciated.

Most scientists now believe that the cause of the Pleistocene "Ice Age" was due to variations in the solar energy reaching the earth, but how these may have occurred is still a matter of conjecture. We are still in the Ice Age and it is anybody's guess whether future millenia will see the melting of the ice caps and the slow drowning of our coastal cities, or the regrowth and once more the inexorable advance of the glaciers.

Prepared by the University of Wisconsin Geological & Natural History Survey, August 1964

Source: U. of Wis. Geological Museum
Information Circular Number 1 1940

ANIMALS OF THE ICE AGE IN WISCONSIN

The geological museum of the University of Wisconsin has a number of specimens which are of value in helping to piece together a picture of this state as it was during the Great Ice Age from 25 thousand to a million years ago, when vast sheets of glacial ice moved down from Canada and completely covered the Northern part of the United States with an ice cap such as is found over Greenland today.

Plant and animal life was largely absent while the ice sheets lay over this region. That the ice visited us at least four successive times, between which advances, Wisconsin was covered with forests through which strange and gigantic creatures roamed, is known to be true because the bones of these animals are sometimes found between accumulations of dirt and stones dropped by the different ice sheets when they melted away.

Many of these specimens have found their way into the museum at Milwaukee and at the University of Wisconsin. The best known and most striking of these specimens of ice age animals is the skeleton of the mastodon, which forms so conspicuous a part of the university museum. These mastodons are a primitive type of elephant and have been found in many parts of the United States.

But the museum's example is a "local boy", which was found in a bed of black mud in a creek near Richland Center. As is usual in these cases, some of the bones had rotted away and are replaced in the mounted skeleton by plaster imitations copied from the bones of other mastodons.

Remains of mastodons and other ancient elephants have been picked up in widely separated places in Wisconsin, notably Milwaukee, Dover (Racine County), Waukesha, North Lake, Madison, Boscobel, near LaFarge, and Menomonie. The latest find, a tusk from the gravel pits at Janesville, was donated to the geological museum by G. F. Ehrlinger of that city. These elephants were both the largest and the most commonly discovered of the ice age animals, but many other forms have been found.

About the time of the Civil War, lead miners near Blue Mounds came upon a crevice full of bones which proved to be of great age. Among them were found remains of the mastodon and an extinct peccary (a pig-like animal with living relatives in Central and South America), along with the remains of the modern wolf, coyote, and bison.

The skeleton of a large fish, which turned out to be the only known fossil specimen of the common lake trout, was found by Sammuel Weidman in a clay bank near the city of Menomonie in northwestern Wisconsin, where brick clays have been quarried for many years. About 20 years ago Mr. Weidman, then of the State Geological Survey, studied these clays and determined that they were formed in a large lake whose waters had been dammed up by the glacier. The specimen of the fossil is now among the treasures of the university collection.

Other bones have been found in these clays from time to time, including those of the mammoth, mastodon, reindeer, common deer, and an unknown bird. All these bones except those of the trout are badly worn and are believed to have been washed into the lake from the shore or dropped from icebergs which broke off the glacier to float in the lake as they do today in Glacier National Park.

Dense spruce forest flourished in Wisconsin at one time, during the warm interval between the visits of two ice sheets. In some parts of the state the stumps of these trees may be seen in place just where they grew when the ice sheet overwhelmed them. Well known places where these forest beds may be seen are near Two Rivers, Neenah and Woodville in St. Croix County.

The forest near Two Rivers has been carefully investigated by Leonard R. Wilson now of Coe College, who unearthed many interesting details about the smaller animal and plant life of this evergreen forest and about the climate in which they throve.

It is possible that many specimens of these extinct creatures are now in private hands and unknown to scientific authorities. The university museum will welcome any information concerning the location of finds of this kind so that this information may be preserved for scientific record.

From U. Press Bulletin Account
by G. O. Raasch and M. Trayser.

F. T. Thwaites made some corrections.

Source: Wisconsin Tales and Trails
Spring, 1969

Geological Odyssey

Practically every Wisconsinite makes the trip between our two largest cities, Madison and Milwaukee, sometime in his life. Many of us travel the route so frequently we think we know it almost by heart. But few people realize that this drive passes through some of the most spectacular, glacially sculptured land in the country. So try something different the next time you travel by car between Madison and Milwaukee — a geology and soils field trip. As Professor Francis Hole of the Geological and Natural History Survey and the University of Wisconsin Extension notes, the hills, lakes, rivers, and marshes tell the story of the giant ice sheet that covered Wisconsin some 12,000 to 15,000 years ago. The pattern of farm fields and woodlots makes visible the work of the glacial ice and its meltwaters.

If you begin your trip from the State Capitol, you'll be starting from the top of a peculiar kind of glacial hill known as a drumlin. And the lakes Monona and Mendota are giant puddles of water across which the glacier built dams. Before you have driven five miles eastward on Interstate 94, you will cross fish-shaped drumlins. These hills have a steep slope on one end and a gradual one at the other. The gentle slopes point southward, the direction the ice was moving.

The road cuts through large and small drumlins, in many places covered with oak woodlots, and crosses broad muck flats on old glacial lake bottoms, now drained and used for raising vegetables, sod, and mint. Some of the biggest drumlins can be seen after you cross Highway 73 and enter Jefferson County. One of these, near Highway 89, has unusually reddish-brown soil.

Farther east, at Highway 26, you will see a different shaped hill called a recessional moraine. This is a ridge formed at the tip of the glacier as the melting ice, like a giant conveyor belt, dropped sand and rock at its leading edge.

Aztalan Road leads to an ancient Indian village built along the Rock River, and farther east, the Interstate crosses the river itself. The Rock forms a boundary between the hardwood forest of the east and the prairie and oak savanna of the west. It is believed that the river was a natural barrier, stopping the frequent prairie fires that were fanned by westerly winds until they reached the river.

At Johnson Creek, a sharp-eyed observer may see an artesian fountain shooting out of a pipe in the ground to the south of the road. Flowing wells and springs are numerous in Jefferson County. Over some of the artesian springs, mounds of peat have built up as high as twenty feet. In this area, some of the wetlands between the glacial drumlins are marked by tamarack groves, remnants of a time when the climate was cooler and wetter.

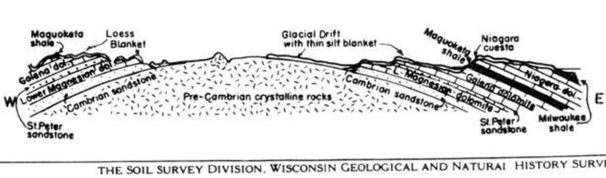
After crossing Highway 67, the scenery changes. The countryside here is pocked with pits called "kettles," formed when large blocks of buried ice melted and the soil caved in from above. Kettles come in all sizes, but the biggest ones you will see are filled with water and form Upper and Lower Nemahbin lakes between which the Interstate passes.

You are now in the Kettle Moraine, a high ridge of land running north and south, which was formed between the edges of two great fingers of ice, one pushing down the Lake Michigan basin and one down the Green Bay-Lake Winnebago lowland. At this point, the moraine forms some of the highest land in southeast Wisconsin.

At Highway 83, the Interstate crosses a flat plain — the abandoned river valley of a glacial stream. This valley connects with Lake Nagawicha to the north. And as the highway approaches the urban area of Milwaukee, you'll notice that the drumlins now point west (indicating that the glacier was traveling west) rather than south like the ones nearer Madison. The soils also change, becoming more clayey as you near Lake Michigan and Milwaukee.

So keep your eyes open the next time you travel this route. You'll have a first-class lesson in glacial geology spread right out in front of you.

IMAGINARY CROSS-SECTION FROM THE MISSISSIPPI RIVER TO LAKE MICHIGAN



THE SOIL SURVEY DIVISION, WISCONSIN GEOLOGICAL AND NATURAL HISTORY SURVEY

THE TWO CREEKS FOREST BED

F. T. Thwaites

It is less than a century since geologists were all convinced that much of the northern United States was once buried under immense masses of moving ice, glaciers. At first it was generally believed that only one ice invasion had occurred, bringing conditions like those of Greenland and Antarctica. But the discovery of buried soils and vegetation at length demonstrated that the Ice Age was not a simple, isolated event but was instead divided into a number of glacial maxima separated by intervals during which the climate of that particular locality moderated to something like the present. Among such discoveries the vicinity of Two Creeks, Wisconsin is famous. Although first described by J. W. Goldthwaite in 1907, it was not until the studies of L. R. Wilson from 1930 to 1936 that the significance of the occurrence was well understood.

The lowest, and hence oldest, deposit which is exposed by storm waves in the bank of Lake Michigan is one made directly by the melting of glacial ice, a till. At this time the ice moved almost due south across this locality as shown by scratches on the limestone at Valders. That till is gray and contains limestone pebbles from the local rock along with boulders brought from far to the north. Overlying the gray till is a very tough clay from 7 to 20 feet in thickness, replaced locally by silt and sand. The clays are banded red and gray, the former the finer material which must have settled from a glacial lake when it was frozen during the winter. Geologists term these "annual rings of the earth" verves, but despite many earnest attempts it proved impossible to connect the years they register with those of our modern calendar, for such bands are not being formed in the lakes of today. The lake in which the clays were deposited is called Early Glacial Lake Chicago and its level was maintained by the melting ice to the north. When the ice margin had melted back far enough to free the Straits of Mackinac, the water level fell below its present stage. Then trees and other vegetation grew on the silts and clays, although not yet found where the soil was the older till as it was on ridges in the landscape of that day. Stumps and roots of these spruce trees are often exposed in the lake bank of today. Peat shows that the land was wet and marshy. Some of the trees were 142 years old before the return of the glacier and the making of later Lake Chicago killed them. A number of different kinds of mosses, water mollusks, mites, fungi, and wood-boring beetles have been found. The outer growth rings of the trees are narrow suggesting a deterioration of climate as the ice front again advanced. Silt was then deposited around the trees but the logs were reasonably sound when the trees were pushed over by ice advancing toward the southwest.

In many places the silt and clay in which the forest once grew were greatly disturbed by the ice and little trace is left of the Forest Bed. South of the old wharf, however, the deposits were little disturbed. The ice margin at last reached Milwaukee and on melting left a till which contains much red iron oxide.

Some local layers of silt, clay and gravel occur in this red till. As the ice margin again wasted away under the onslaughts of the sun, later Lake Chicago occupied the area for a relatively short time before the Straits were again freed.

But the question remains how old is the Forest Bed in years. Until very recently this could not be answered. But now Prof. W. F. Libby of the Institute for Nuclear Studies at Chicago has developed a method. He finds that cosmic rays are always changing some of the nitrogen of the air into a radio-active form of carbon. This is taken up by growing organisms but when they die or are buried in the ground this kind of carbon gradually changes into normal carbon. The degree of change shows the age in years within a relatively small margin. Prof. Libby has determined the age of form specimens of wood and silt from Two Creeks at 11,400 years.

TWO CREEKS INTERVAL

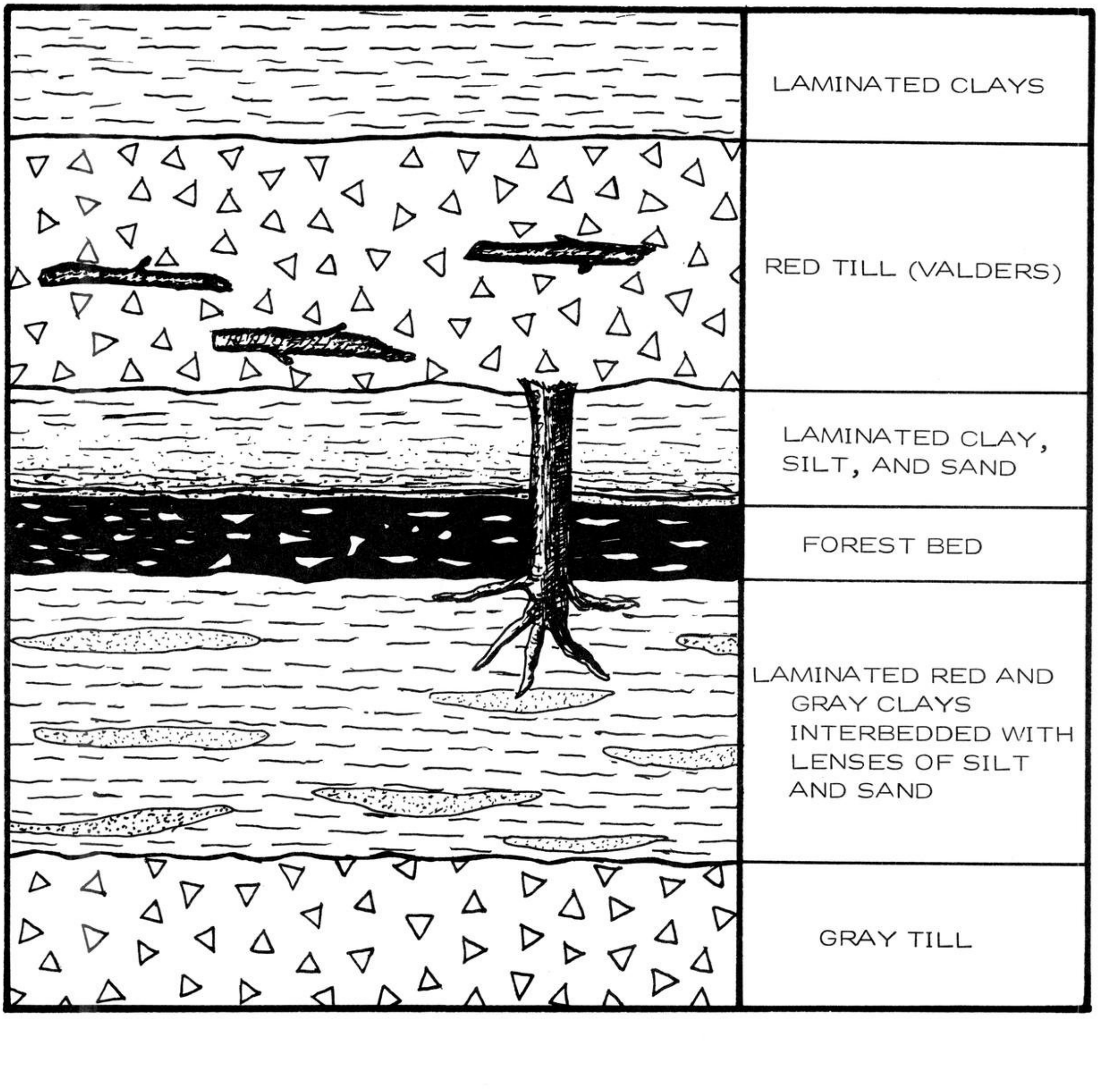
One of the major points of reference in the Wisconsin stage in the Great Lakes region is the Two Creeks forest bed near Manitowoc, Wisconsin. The bed marks an interval between gray till, presumably of Port Huron age, and the overlying red till of Valders age. Wood from the forest bed has been dated by the radiocarbon method and has been found to have an age of 11,400 years before the present. Spruce, pine, and birch trees have been identified in the bed, and mosses and several kinds of mollusks are present also. This assemblage suggests a climate like the present one in Ontario north of the Great Lakes. The Two Creeks forest bed is represented by correlative material in an area of 500 square miles in the Fox River valley in Wisconsin.

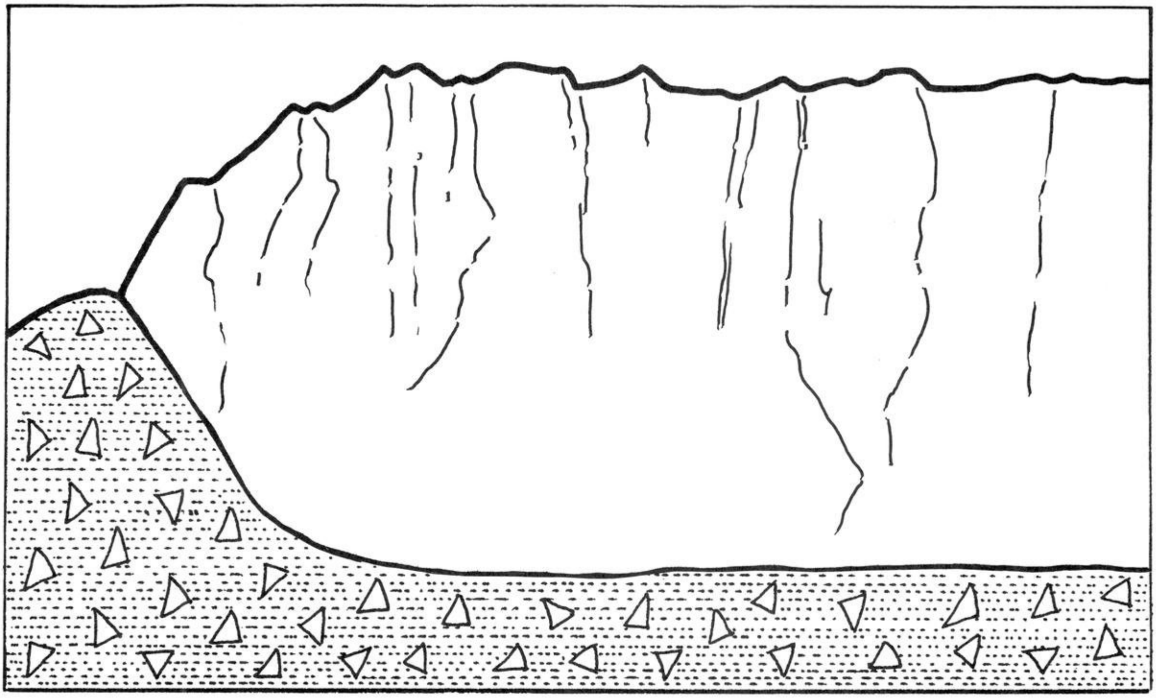
The sequence of deposits illustrated in the diagram record the following events: (1) Deposition of gray till by glacial ice. (2) Retreat of the ice from this locality allowing the waters of Lake Chicago to flood the area, and deposition of laminated clays and lenses of silt and sand in the lake. The lake was 60 or 40 feet deep at first, because either the Glenwood or the Calumet stage (more probably the former) existed at this time and discharged southward through the Chicago outlet. (3) Drainage of the lake, caused by further retreat of the ice front to the north at least far enough to open a lower outlet; this outlet could have been through the lowland extending eastward from Little Traverse Bay to Lake Huron, or it may have been the Straits of Mackinac. (4) Growth of the forest. The forest bed extends down to an elevation at least as low as the present surface of Lake Michigan. This indicates that the lake must have drained through an outlet considerably lower than the one at Chicago, and the only available dischargeway must have been at the northeastern edge of the Michigan lake basin. (5) Readvance of the ice over the low outlet to the northeast, causing flooding of the forest and deposition of sand, silt, and clay over the forest floor. (6) Advance of the ice over the forest, breaking off the trees and laying them over in a southwesterly direction and depositing red till. (7) Retreat of the ice from the locality, allowing lake water to flood it, and deposition of laminated clays. (8) Further retreat of the ice front to uncover a lower outlet to the northeast and allow drainage of the area.

The most significant aspect of this sequence of events is not the probable length of time required for establishment and growth of a forest while the locality was above water (this period could have been measured in only hundreds of years), but the extent of retreat of the ice which was required to open a new, lower outlet to the northeast.

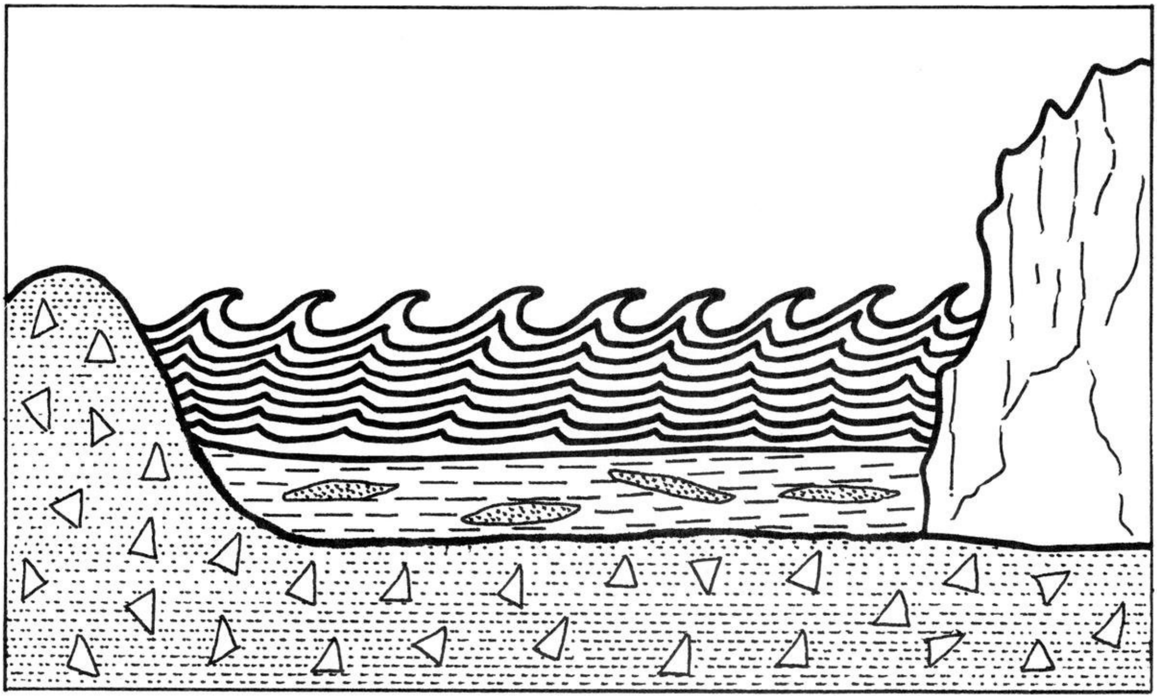
The Two Creeks interval separates the Valders from the Port Huron. If the Port Huron is Mankato in age, the Two Creeks interval is not pre-Mankato, but is post-Mankato and pre-Valders. Several writers have correlated the Two Creeks low-water stage with the Bowmanville low-water stage, which is indicated by deposits found in the Chicago region. The name "Two Creeks" will be used to designate the Port Huron-Valders interval.

Two Creeks Forest Bed

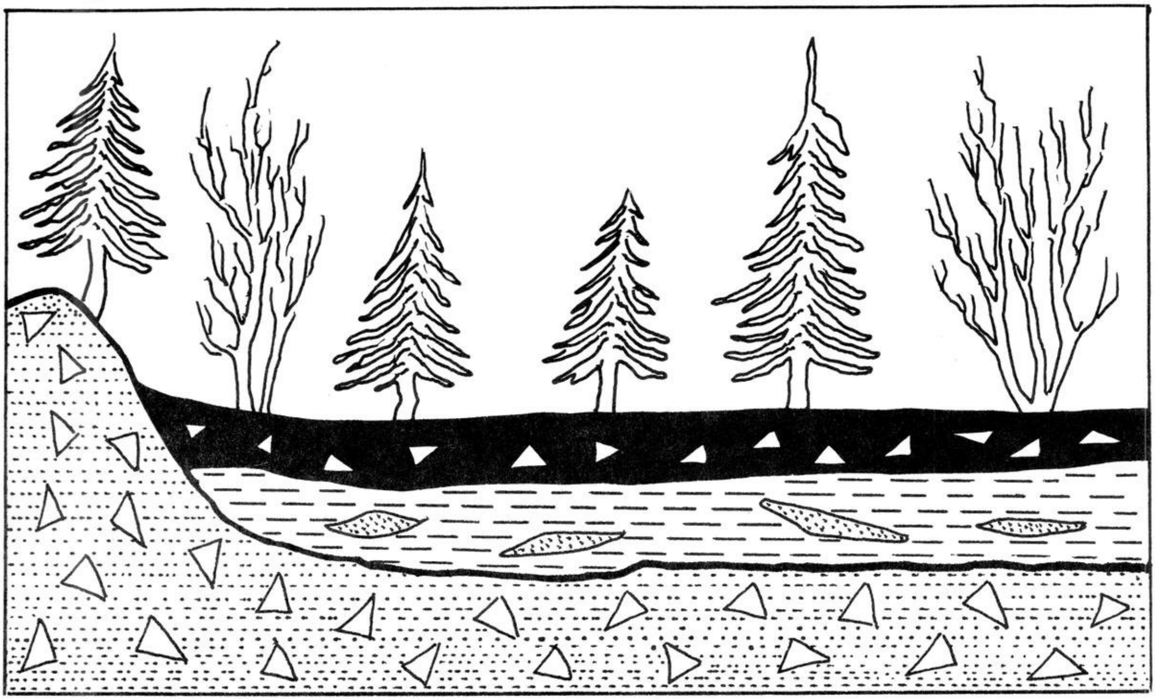




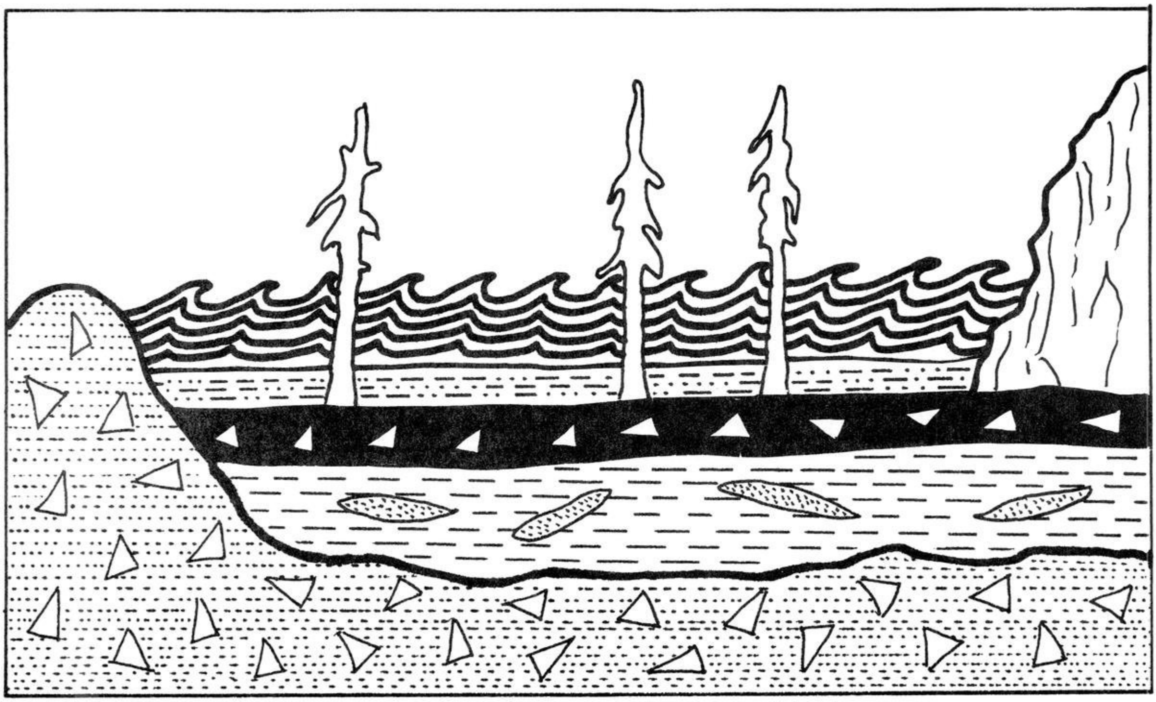
1. Deposition of gray till by glacial ice.



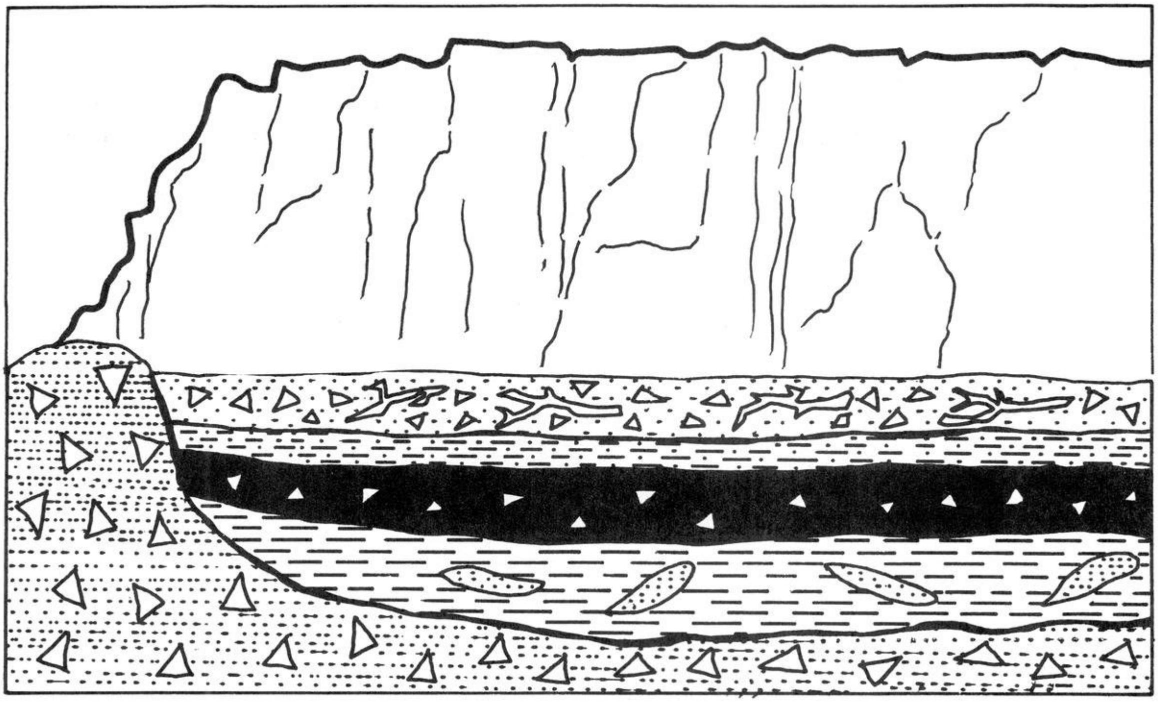
2. Retreat of the ice allowing waters of Lake Chicago to flood the area, and deposition of laminated clays and lenses of silt and sand in the lake.



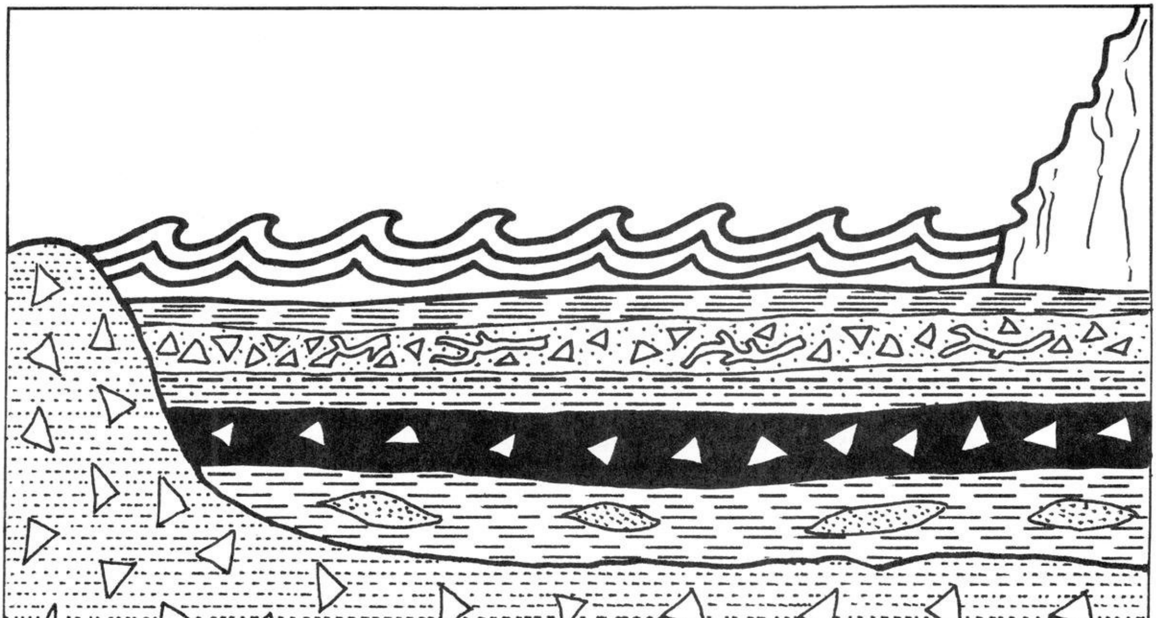
3. Drainage of the lake, caused by further retreat of the ice front to the north at least far enough to open a lower outlet. Growth of the forest. The forest bed extends down to an elevation at least as low as the present surface at Lake Michigan.



4. Re-advance of the ice, causing flooding of the forest and deposition of sand, silt, and clay over the forest floor.



5. Advance of the ice on the forest, breaking off trees and laying them over in S.W. direction and depositing red till.



6. Retreat of the ice from the locality, allowing lake water to flood it, and deposition of laminated clays.

Covered by Glacier in 10,000 B.C.

Film Replaces Field Trips In Study of Buried Forest

University of Wisconsin scientists and cameramen have completed a first season of work at the state's famed Two Creeks buried forest on a major "bring-the-mountain-to-Mohamet" project calculated to improve instruction for thousands of undergraduate geology students.

"We have covered the gross features of the buried forest," Geology Prof. Robert F Black, specialist in glaciation and project chairman, said Friday.

"We've made 8,000 feet of colored movies at the excavations and several hundred color slides. We have also taken hundreds of samples."

Black pointed to piles of small transparent boxes neatly stacked in a Science Hall laboratory. Each held forest soil and the brown, brittle, but still recognizable remnants of trees which perished on Wisconsin land under glacial ice nearly 12,000 years ago.

* * *

Geology is one of the most popular subjects taught on Wisconsin's Madison campus, Black pointed out. Approximately 1,200 students enroll each semester in introductory courses in earth science. But these large enrollments at Wisconsin and elsewhere greatly increase the problems of transportation and instruction on field trips.

While cameras turn at Two Creeks, Wis., Robert F. Black, University of Wisconsin geologist, uncovers another one of the remnant trees in a 12-000-year-old buried forest which has made the area near Manitowoc internationally famous. The on-the-spot record of repeated glaciation, made by Wisconsin scientists and technicians, is the pilot effort in a cooperative universities project aimed at substituting audio-visual materials for field trips.

Banded together, Wisconsin and 10 other midwestern university members of the Committee on Institutional Cooperation are out to lick such problems by bringing the field's geological phenomena to the student, largely through film.

Chosen to carry out the pilot effort in this direction, the Wisconsin crew of geologists and cameramen, plus a scientist from the University of Indiana moved into the Two Creeks site in August. The area, bordering Lake Michigan in Manitowoc County, has been internationally recognized for the exceptionally vivid evidence it holds of repeated glaciation, ever since a University of Chicago geologist discovered the buried forest beds in 1905. The Wisconsin chapter of the Nature Conservancy, national organization to preserve America's natural treasures, now owns the land.

"We don't really know how many advances of the ice there were, but probably many more than four," Black explained. But what the geologists do read from their careful excavations is that with each advance, the glaciers carried into the area rock and soil and upon melting, left behind great loads of these unstratified materials. They know also from the stratified sands and muds there that the bordering great lake has made its own contributions between glacial periods.

"The final two ice sheets removed all evidence of the others," Black indicated. But the Valders, last glacier to push southward into Wisconsin lands, did not completely destroy the evidence of the northern-type forest it mowed down. Though buried with glacial till, tamarack and spruce and the forest soil in which they grew have remained. In nearly 12,000 years of death and subsequent curing, these trees have not lost their woody identity. After almost 12 milleniums their needles and cones retain the original form.

Many of the stumps and logs from this geological past, some as much as 10 feet long, are now revealed. But the geologists have been careful to leave them in their original fallen positions and still partially imbedded. Wisconsin hopes that the Nature Conservancy will make all this a permanent exhibit, and has proposed that the area be incorporated within Wisconsin's Ice Age Reserve, Black said.

* * *

A temporary building to cover the excavations, and a viewing platform have been constructed and educational groups are permitted to visit the beds.

But for the thousands of beginning geology students for whom field journeys en masse are not feasible, Two Creeks will teach the lessons of multiglaciation and Great Lakes geology through color film and video tapes.

"Next summer we'll turn the cameras on details of the forest and of the lake deposits," Black said. The $50,335 which the National Science Foundation has provided for the project, is a two-year support.

After that, Black concluded, if this first attempt is successful, the other CIC member universities will attempt other geological subjects with the camera substituting for on-the-spot viewing.

—THE CAPITAL TIMES, Saturday, Sept. 30, 1967

Mastadon Find One in a Million

WISCONSIN STATE JOURNAL, TUESDAY, AUGUST 26, 1969

DEERFIELD -- There was a happening the other day on the John Neath farm in eastern Dane County — a million-to-one shot happening.

Scores of interested people came to watch a University of Wisconsin team unearth the finest skeleton of an extinct, tusked mastadon ever found in the state.

AND THE spectators were impressed as one of the first bones pulled from an 8-foot hole was the huge beast's 175-pound skull. Other bones from the 9-foot-tall, elephant-like creature followed.

Zoology specialist John E. Dallman — who was working with graduate students Frank Iwen and Steve VanHorn said the skull belonged to a fairly young adult.

"The fifth molar of this mastadon was just coming in when it died; by comparison with modern elephants, this would mean that our specimen was about 25 to 30 years old," Dallman explained.

THE SKELETON itself, however, has been buried for about 10,000 years. Dallman said. Despite the hundred centuries which have passed since the animal died, most of the bones taken from the mud were in beautiful condition.

The discovery and successful recovery of this skeleton were described by Dallman as a million-to-one happening. The specimen was located in 1967 after Dallman had unearthed two partial mastadon skeletons on the neighboring Elmer Schimelpfenig farm near Deerfield.

The partial skeletons were found at the bottom of an ancient, dried-up lake. A series of lakes created by glacial action covered much of southeast Wisconsin after the last glacier retreated from the area about 13,500 years ago. The lake basins provided mastodons with food, shelter, and water. Often, one of these 7-ton beasts died in or near a lake, and its bones were deposited on the lake bottom.

CONSEQUENTLY, there probably are several skeletons beneath the hundreds of acres that are now the Neath and Schimelpfenig corn fields, but the problem is to find them. The partial skeletons were found during plowing operations, but the plow damaged the bones.

After recovering these bones, Dallmen set out to find deeper, more protected bones by probing acre after acre with thin steel rods. And two summers ago, the Wisconsin zoologist detected a mass of bones 8 feet below the surface, just 2 inches shallower than the length of his probing rods.

Unfortunately, recovery was more difficult than simply digging an 8-foot hole and bringing up the bones. A high water table and a nearby drainage ditch meant that an 8-foot hole would quickly fill with 5 feet of water.

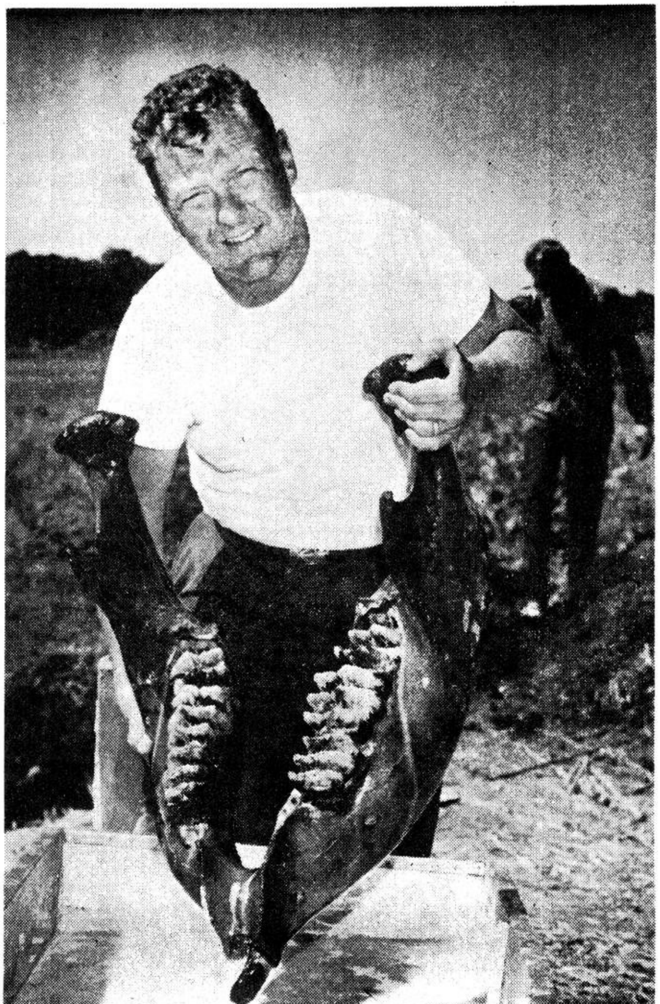
DALLMAN SOLVED this problem by tipping a culvert on end and dropping it into the hole. The water was then pumped out of the culvert, and recovery of the bones continued, with occasional stops to bail more water.

Preliminary digging began Monday. Discovery of the skull soon convinced Dallman and his team that they had an important find.

Most of the bones — including skull, leg bones, segments of the backbone, ribs, lower jaw, shoulder blades, and a tusk--were brought to the surface Thursday.

ONCE EXHUMED, the bones were quickly washed, labelled, and dunked in casein glue. The glue was used to replace strengthening protein that had been leached from the bones over the centuries in their grave.

The whole process fascinated students and professors from the University as well as townspeople and farmers.



Frank Iwen Dips Massive Jawbone into Preserving Glue
—University of Wisconsin Zoology Photos by Don Chandler

And if Dallman has his way, there will be other recoveries of strange animals that lived in Wisconsin after the Ice Age.

Perhaps an even fonder dream of the University zoologist would be to find some relation between the extinction of these huge creatures and the appearance of early human inhabitants of the state.

In fact, the top of the skull of the most recent mastodon is crushed. Even though this damage most likely occurred during the animal's long burial, Dallman and his crew are still hoping to find a stone hammer at the site.

Essential materials that should be ordered to be used with the filmstrip and guidebook.

MAPS

Wisconsin Geological Survey, 1815 University Avenue, Madison, Wisconsin

1. Soils of Wisconsin by F. D. Hole, small map $.10; classroom size $1.00
2. Glacial Deposits of Wisconsin Page-size 8-1/2x11 inches colored map of the glacial deposits of the state with a brief history of the glacial age on the back. Single copies free. Additional copies at the rate of $2.50 per 100.

A. J. Nystrom, 3333 Elston Avenue, Chicago, Illinois 60618

1. Whitewater Quadrangle Wisconsin — raised relief map of glacial features, $5.00.

BULLETINS AND PAMPHLETS

"A Trip On Glacial Geology In The North Kettle Moraine Area" by George Gaenslen, #11 in a series of Lore Leaves — reprinted from Lore — A Milwaukee Public Museum Publication — published by order of the Board of Trustees 1969. 20 pamphlets for $7.00.

Badger History "Wisconsin Geography" The State Historical Society of Wisconsin, 1966 — 816 State Street at $1.00 per issue.

"The Soils of Wisconsin" by M. T. Beatty, I. O. Hembre, F. D. Hole, L. R. Massie and A. E. Peterson — 21-page booklet reprinted from the 1964 Blue Book. Price $.10. Single copies free to instructors only. Wisconsin Geological Survey, 1815 University Avenue, Madison, Wisconsin.

Our Great Lake — A series of articles reprinted from the Milwaukee Journal at $.60 in quantities over 20. Public Service Bureau, 333 West State Street, Milwaukee, Wisconsin.

BOOKS

Glaciers and The Ice Age — Earth and Its Inhabitants During The Pleistocene — Gwen Schultz, Holt Library of Science Series I, Holt, Rinehart and Winston, Inc., New York $1.65 (Paperback).

The First Book of Glaciers by Rebecca B. Marcus published by Franklin Watts, Inc., 575 Lexington Avenue, New York, $1.95.

PRINTS

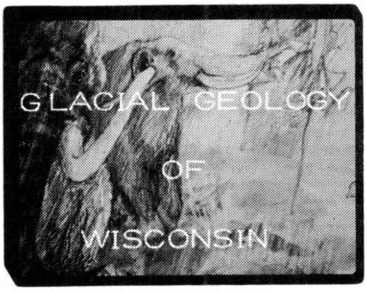
Set of large color Prints Glaciers — Collaborator Daniel S. Turner Ph.D. — Eastern Michigan University — Instructional Aids, Inc. Owatonna, Minnesota — copyright 1967. $6.95 per set.

TRANSPARENCIES

Keuffel & Esser unit on Earth Science

Continental Glaciation Topographic Features; Superposed Tills; Glaciated U. Valley.

1
Colophon



2
Title: Glacial Geology of Wisconsin
The Local Materials Project appreciates the assistance of the following in the evaulation of these filmstrips and the guide:

Dr. Robert Black, U. of Wis. Geology Dept.
Dr. Lowell Laudon, U. of Wis. Geology Dept.
George Hanson, State Geology of Wis.
Joseph Emielity, Acting Curator of Geology, Milwaukee Public Museum

3
Credit Frame
Prepared by Genevieve Bancroft in cooperation with the Local Materials Project, ESEA — Title III Madison Public Schools

Mary Lou Peterson, Director
Ron Austin, Photography
Dona Friedman, Graphic Artist

4
Part I: Introduction

SPECIAL NOTE:

Please do not judge the quality of the beautiful full-color pictures in the filmstrip by the appearance of the black-and-white photos in this guide! Obviously, there is no comparison between full-color and black and white pictures.

5
Since Wisconsin has been above sea level and exposed to weathering and erosion for about 300 million years, you would expect the state to be a series of ridges and valleys with outcrops and no lakes, such as southwestern Wisconsin.

[Driftless Area near Richland Center]

6
But instead most of Wisconsin is referred to as a land of many small lakes.

[Madison Four Lakes]

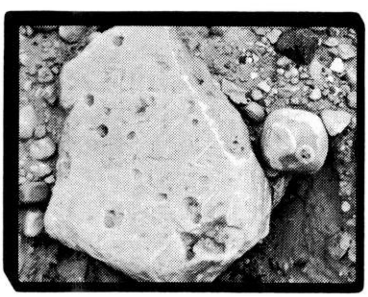
7
Looking closely at the landscape, you would see a gently rolling land with many hills which seem to follow patterns, . . .

8
. . . while other areas are flat.

[A Glacial Lake bed]

9
There are fields of boulders, . . .

[Springfield Corners Area]



10
. . . some of which have scratches called striations.

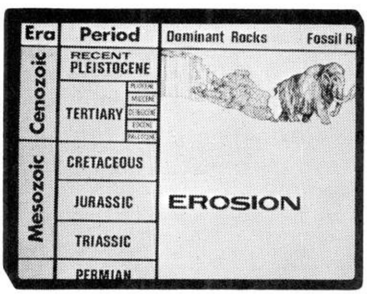
[Boulder with striations]

11
Most of the land has a deep transported soil made up of either sand, mud, clay or gravel, or a mixture of these.

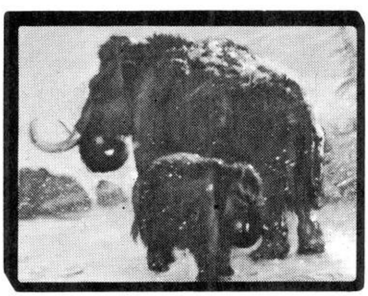
[Transported soil — carried from one place to another by water and ice.
Residual soil — formed in place from the rocks on which it lies.]

12
Wisconsin is bordered by two of the Great Lakes, the largest fresh water lakes in the world. What is responsible for these features?

[Picture is of "The Ridges", Bailey Harbor]



13
About one million years ago during the Pleistocene Epoch, . . .



14
. . . the climate in North America changed. The temperatures were colder and more snow fell and accumulated to great depths.

[Perhaps the climate changed due to variation in the sun's radiation or changes in circulation of the atmosphere and ocean currents.]

15
The snow turned into ice, . . .

[Compacting the snow by pressure turns it to ice.]

16

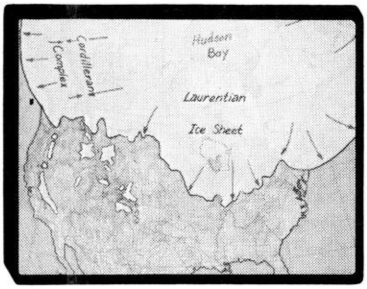
. . . and a continental glacier was formed. Continental glaciers in existence today are the Greenland and Antarctic ice sheet as shown in this picture.

[There is land under most of the ice.]

[Glacier — A mass of ice with definite limits, with motion in a definite direction and originating from the compacting of snow by pressure.]

17

This by comparison is an Alpine Glacier and can be seen in the mountains today.



18

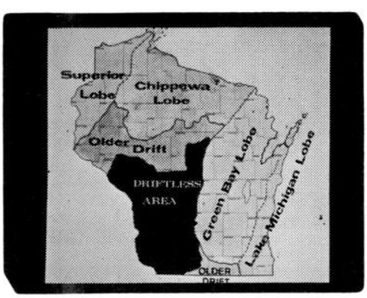
The accumulation center of the Pleistocene Ice Sheet (see Time Chart) was in the Hudson Bay country (Quebec and Labrador). As the glacier grew it spread to the south as far as the Ohio and the Missouri Rivers. Four times the glacier melted back and grew again.

[Ice under pressure becomes plastic and will flow.]

19

The last advance or the Wisconsin Stage is the one that reshaped the surface of much of our state. Four lobes of the glacier spread over Wisconsin during this stage. The lobes were controlled by the topography of the land and accumulation of snow.

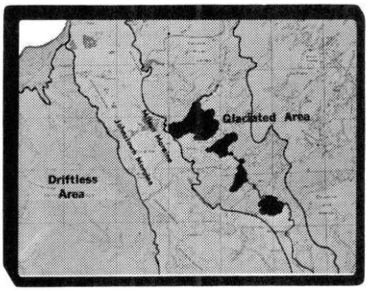
[See Pleistocene History Chart.]



20

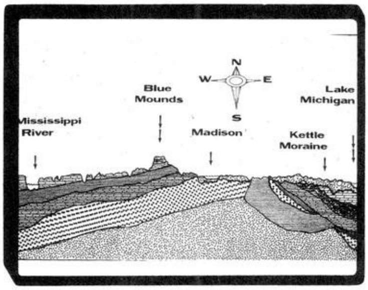
Notice that approximately three-quarters of Dane County was covered by the Green Bay Lobe of the ice sheet . . .

[Wisconsin map showing four lobes and driftless area]

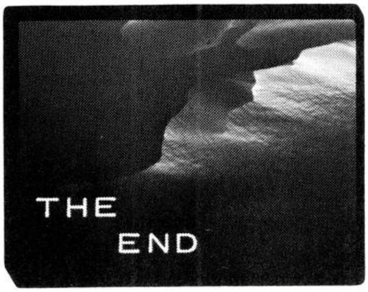


21
. . . but the part which was not covered by ice is called The Driftless Area.

[Dane County Glacial Map]



22
This cross section shows The Driftless Area on the left with its ridges and valleys, and the glaciated land on the right covered with glacial drift. Now let's see how the glaciers reshaped the surface of Wisconsin's landscape.

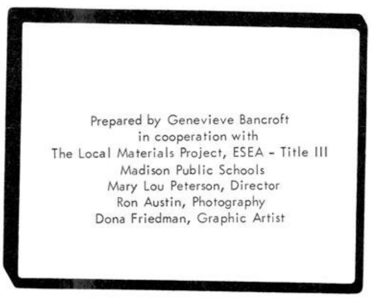


23
The End.

[Picture is of the Sand bars in the Wisconsin River]

1
Colophon

2
Title: Glacial Geology of Wisconsin



3
Prepared by Genevieve Bancroft in cooperation with The Local Materials Project, ESEA — Title III Madison Public Schools
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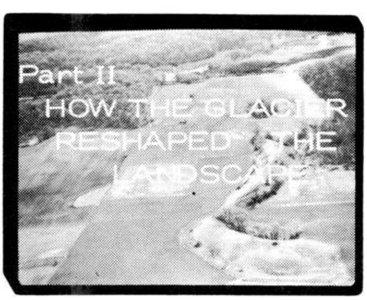
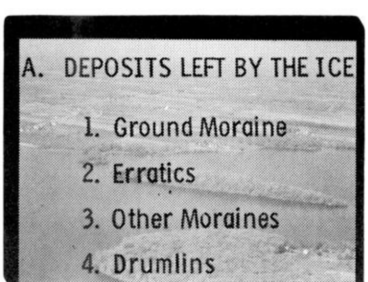
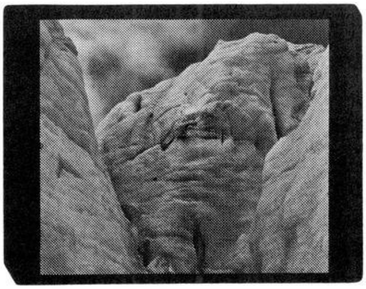


4
Part II: How The Glacier Reshaped The Landscape.



5
A — Deposits left by the Ice.
1. Ground Moraine
2. Erratics.
3. Recessional and Terminal Moraines
4. Drumlins.

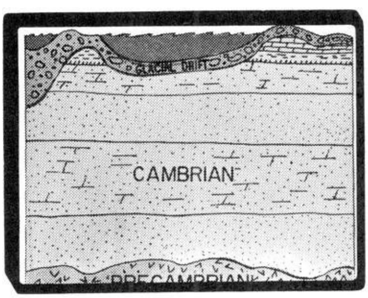


6
As the glaciers moved, they scraped up most of the mantle rock and soil of the Canadian Shield and Northern Wisconsin. The soil and rock became frozen into the Glacier and were moved slowly along with it. The glacier also pushed or bulldozed debris out in front and underneath the ice. All the material transported by the glacier and deposited by the ice or by the water derived from the melting ice is called drift. Material deposited by the ice itself is called till. Till is unsorted and unstratified.

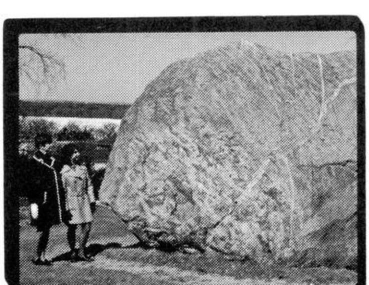
[Drift is made up of soil, sand, clay, gravel, and boulders.]

7
All the glaciated land that has a cover of till but without any particular shape is called ground moraine as shown in this picture. It is bordered by end or terminal moraines. If you see a field in Wisconsin covered with boulders, this would be ground moraine.

Ground moraine near Springfield Corners

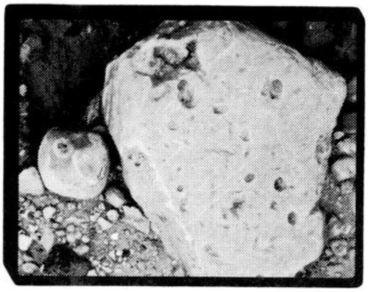


8
The ancient valleys and ridges of the Paleozoic era were filled in and covered with the till, sometimes as deep as 200-300 feet. The nearby hills were rounded off by the ice, so that much of the debris moved by the ice included local rocks.

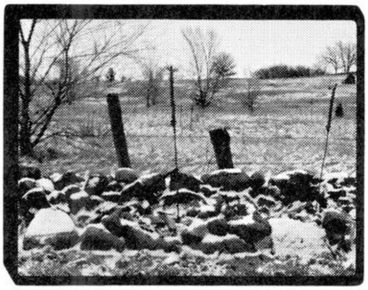


9
Glacial boulders like this one are called erratics. Since these boulders are composed of rocks foreign to this region, they can be used in deciphering the direction of the movement of the ice. This rock was once part of the bedrock of either Northern Wisconsin or Canada and today can be seen on top of Observatory Hill where it has been saved as a memorial to a glacial geologist, T. C. Chamberlain — once president of the University of Wisconsin.

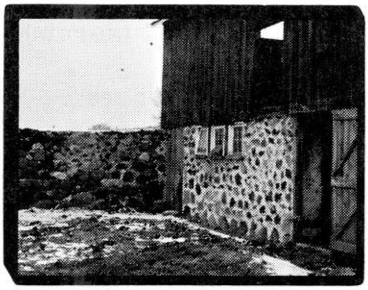
[Remember — this rock was placed on this hill by The Glacial Ice.]



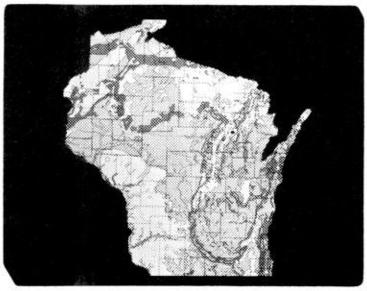
10
Rocks transported or passed over by The Glacier may have scratches on them called striations. If the rock is in its original place — you can tell the direction of movement of the ice by these parallel scratches. The scratches were scoured by means of sharp angular fragments of rock embedded in the ice. Notice that the rocks transported by the glacier have corners that are rounded. Rocks moved by water are even more rounded.



11
In some parts of Wisconsin, the glacial boulders are so thick they must be cleared from the fields. They are usually piled up to form fence rows.



12
When used in building foundations, these glacial boulders are referred to as "field stones".



13
The red areas on this map are the terminal and recessional moraines formed by the glaciers. The terminal moraines mark the furthest advance of the Wisconsin stage of the glacier.

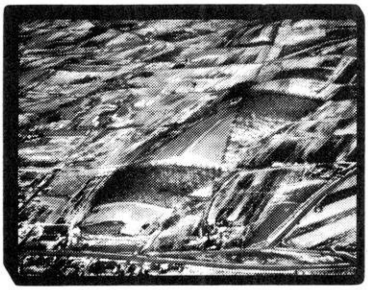
[Glacial Map of Moraines by Wisconsin Geological & Natural History Survey after Thwaites]

14
The moraines are ranges of hills of glacial drift extending for miles over the surface of the country; they mark the positions where the ice-front halted for a time, . . .

[Aerial view of Termainal Moraine]

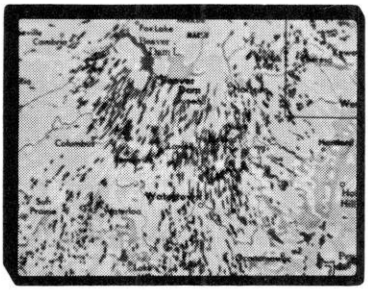
15
. . . while ice from the rear advanced, melted, and dropped its load of drift made up of unsorted and unstratified boulders, sand, and clay.

[Terminal Moraine at Verona]



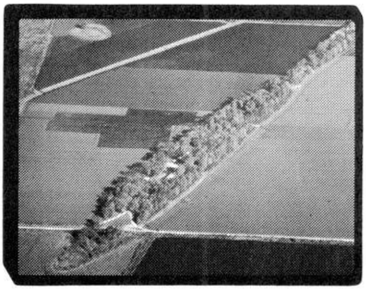
16
In Wisconsin, there are more than 5,000 oval shaped hills of glacial drift, called drumlins.

[Glacial Map by Prof. Kathryn Nelson]



17
The dark green markings on this map locate the drumlins. They are located in the ground moraine area behind the terminal moraines.

18
From the air, drumlin country has an undulating look.



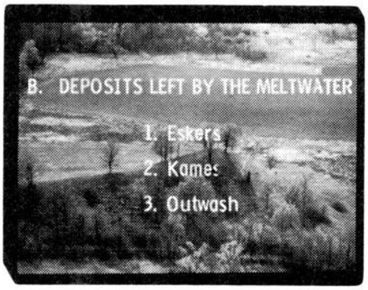
19
The longer axes of the drumlins are always parallel to the direction of the ice movement so we can tell the direction that the continental glacier moved. (Notice the road cut through the drumlin.) Drumlins formed under the ice at places where the glacier could no longer move all the materials under it. The ice overrode the till to form streamlined hills with long, tapering ends. Wisconsin is famous for its drumlins.

[There are only a few other places in the United States where you can see drumlins — Northwest New York, eastern Massachusetts, and Michigan.]

20

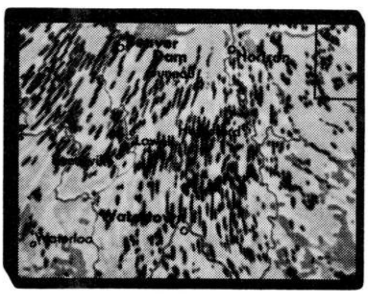
Cuts into the drumlins show they are a mixture of unstratified glacial drift.

[The cut was made by excavating equipment that removed the gravel to be used in building and construction. Drilled wells also are good sources of information.]



21

B. Deposits left by melt water.
   1 — Eskers.
   2 — Kames.
   3 — Outwash.



22

The red intermittent curving lines are eskers.

23

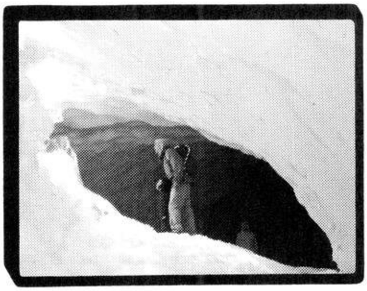
Viewed from above the eskers are narrow, winding ridges, . . .

[Parnell Esker in North Kettle Moraine Park]

24

. . . and are a result of melt water glacial streams flowing beneath the ice. The streams made meandering tunnels under the ice which were filled with stratified gravel.

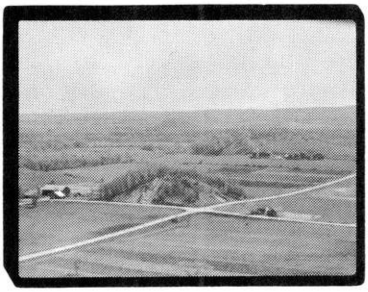
[Esker in North Kettle Moraine Park]



25

This is an ice cave or tunnel formed by a stream in a glacier. During glacial times water and sediments under pressure flowed through similar tunnels in the glaciers.

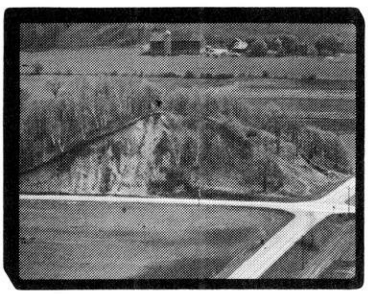
[Ice Cave in Mt. Rainier Glacier]



26

As the streams emerged at the front of the ice they lost their pressure and velocity. The sediments were then dropped in mounds of gravel called Kames.

[Aerial of The Kettle Moraine Country — Kames]



27

The conical or gumdrop shape is characteristic of this glacial feature.

[Close-up of Kame]

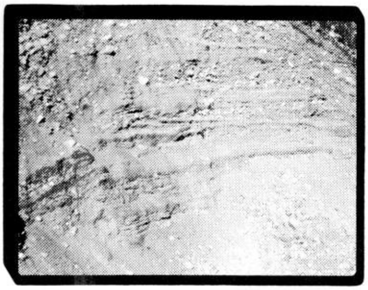
28

The outwash gravel plains in yellow are found beyond and in between the moraines which are pink on this map. (See slide #13 in part 2 also.)

29

The outwash is drift that is sorted, and deposited in layers by the melt water streams beyond the active glacier. The outwash plain is very flat as seen in the middle of this aerial picture. The moraine is the area of tree covered hills in the foreground.

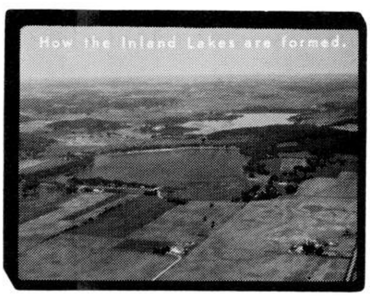
[Aerial of Sugar River Outwash Plain West Dane County]



30
Most of our gravel is taken from quarries in the outwash plains. Looking closely at the outwash you can see the sorted and stratified sediments, which is evidence they were laid down by water.

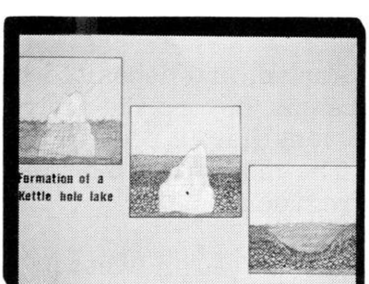
31
Another sediment deposited during glacial times is called <u>Loess.</u> It was carried and deposited by the wind, and commonly it is unstratified and unconsolidated. Loess is composed mainly of silt-sized particles and sometimes clay and sand. Most of our best soils are derived from loess deposits.

[The loess is rock "flour" produced by one rock grinding against another that was picked up by the wind during the dry "season."]

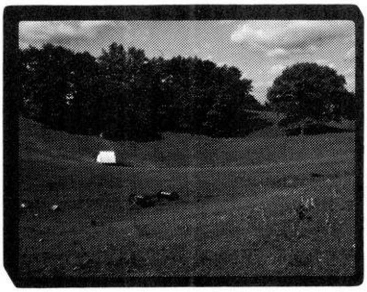


32
C. How the Inland Lakes are formed.

33
The lakes in Canada were gouged out of the bedrock, but the numerous inland lakes and swamps of Wisconsin are due to glacial deposits which interfered with the pre-glacial drainage. They are all <u>Kettle Hole Lakes</u> of one sort or another. (The examples in the slide are Fish and Crystal Lakes in Northwestern Dane County.)

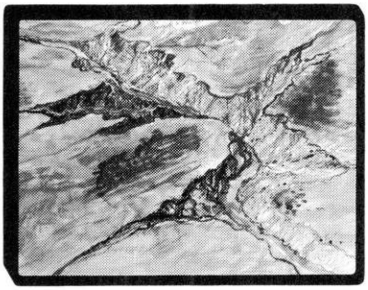


34
The Kettles were formed when icebergs became stranded in the shallow water out in front of the ice. The icebergs were then buried by the sediments carried in by the melt water. As the ice melted the sediments settled to form depressions. These filled up with water to form a lake. Usually such lakes have steep slopes and are round.



35

Not all of the depressions are filled with water. In the North — many are bogs.



36

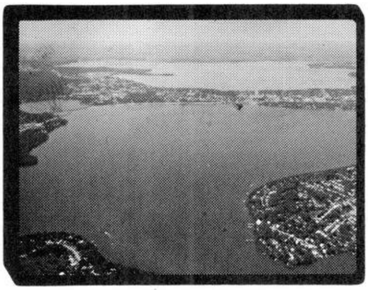
The four lakes in the Madison area are due to two factors —

1 — The erosion by the stream that produced the broad pre-glacial Yahara River Valley 4-500 feet deep, . . .

37

. . . and

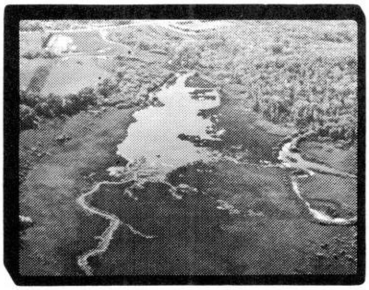
2 — The modification of this valley by the glaciers. Ice filled the valleys, but probably did not erode them any deeper, instead it kept them from becoming completely filled in with glacial debris. When . . .



38

. . . the terminal moraines formed they dammed up the old valley. These dams now impound the waters of the lakes.

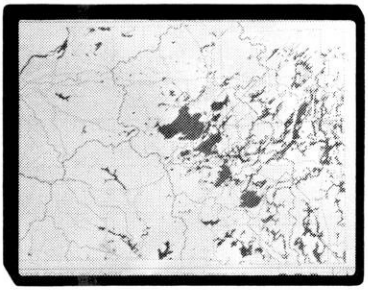
[Four lakes of the Madison area]



39

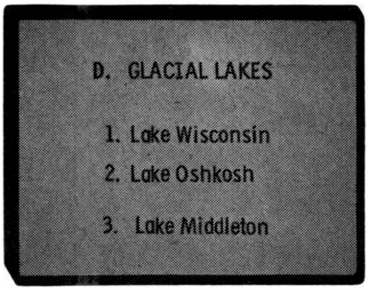
This lake was formed when masses of ice were buried by irregular deposition in the ground moraine and terminal moraine areas. Many of these depressions may have been shallow and were soon filled in by vegetation and animal remains. All stages of the aging process of lakes can be seen in Wisconsin.

[See instructional set on Lake Pollution.]



40
Over 70% of these natural wetlands in Dane County have been destroyed by being filled in or drained by man.

[Areas in brown have been destroyed.
Areas in light blue are marshes still existing.]

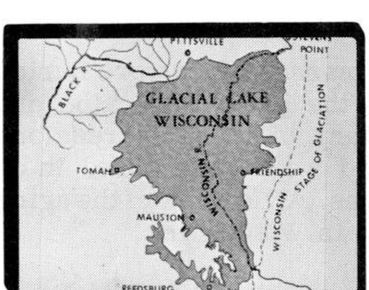


41
D — Glacial Lakes
1 — Lake Wisconsin
2 — Lake Oshkosh
3 — Lake Middleton

42
At the borders of the retreating ice sheets were temporary lakes shown here in light blue, many of them held in between the higher drift deposits and the retreating ice. Deposits were accumulated in these lakes which now form swampy tracts. These lakes were in the driftless area as well as the glaciated area.

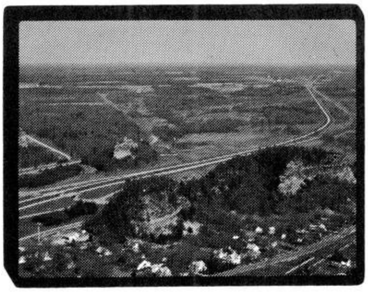
43
Areas once covered by these lakes are very flat. The sediments clay, silt and sand were laid down in layers in water, and covered in places by glacial outwash, sand, peat, mud or alluvium.

[Alluvium — sediments laid down by running water]



44
The largest area of lake deposits in Wisconsin is the bed of Glacial Lake Wisconsin, a temporary body of water in the driftless area, dammed at the glaciers margin.

45

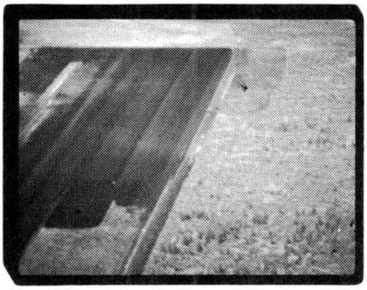


Rising above the flat Wisconsin Glacial Lake bed plain are numerous castellated ridges and hills. These erosional remnants of the Cambrian sandstones are pinnacles formed by the melt water during Pleistocene times.

46

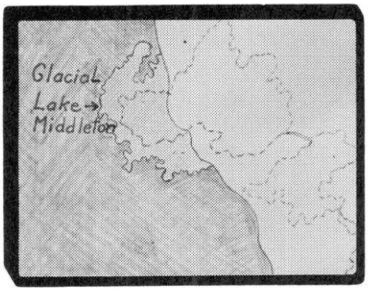
To the west and north of Oshkosh was the Glacial Lake Oshkosh. This is in the area glaciated by the Green Bay lobe. Notice again the flat land due to the lake deposits.

47



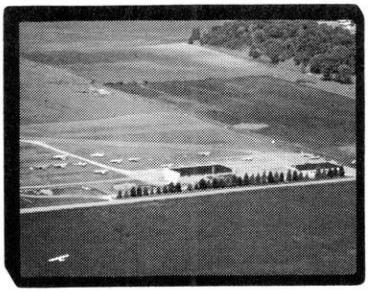
Lake sediments make fertile soil — which is used for muck farming. The natural vegetation shown on the right is a bog.

48



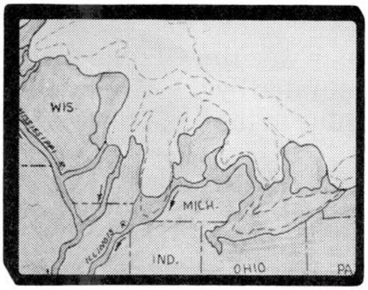
In the Madison area when the ice front retreated a recessional moraine blocked the drainage and Glacial Lake Middleton was held between the ice and the upland to the west. This lake was 110 feet higher than the present Lake Mendota and discharged its water to the west through a low spot in the divide west of Middleton.

49

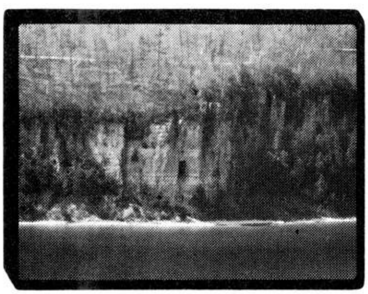


This flat area near Middleton is the old lake bed.

50
E — The Great Lakes



51
Prior to the Ice Age, the Great Lakes did not exist. The basin of Lake Michigan was a river valley that was later deepened and broadened by glacial erosion of the Lake Michigan lobe of the glacier. The Green Bay lobe passed through and eroded the valley in which Green Bay and Lake Winnebago now lie. As the glacier receded the basins filled with water.

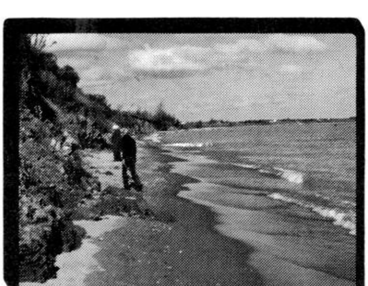


52
Evidences of different levels at which the surface of Lake Michigan has stood are seen in wave-cut cliffs with sea caves, . . .

[Wave-cut cliff and sea-cave at Peninsula State Park]

53
. . . and the long sand and gravel beaches extending parallel to the present lake.

[This picture of the ridges is near Bailey's Harbour.]



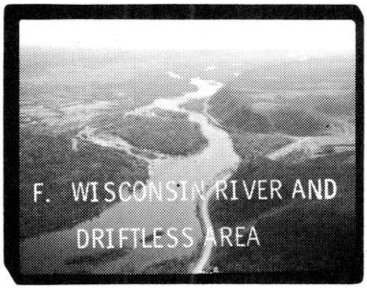
54
An important landmark in geologic history of the Great Lakes is a buried forest on the shore of Lake Michigan near Two Creeks, Wisconsin.

55
The fallen trees of the ancient forest can now be seen in the wave-cut cliffs of Lake Michigan.

Retreat of the ice allowed a lake to flood the area and deposit clays and silts. Drainage of this lake was caused by further retreat of the ice which opened an outlet maybe near the Straits of Mackinac. A Forest grew on the silts and clays.

Readvancement of the ice caused flooding of the forest. Then the ice advanced over the area breaking off trees and depositing till.

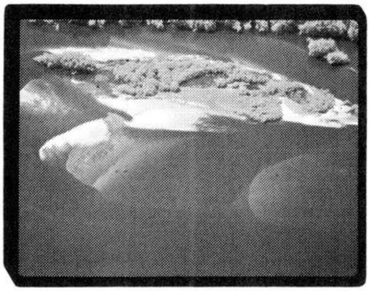
Spruce, mosses, water mollusks, mites, fungi, and wood boring beetles have been found. The wood has been dated by the radiocarbon method to be 11,800 years old.



56
F. The Wisconsin River and Driftless area.

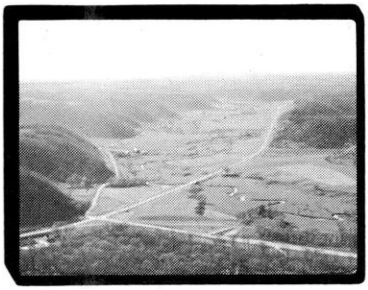
57
During the Ice Age the Wisconsin River was much larger due to the tremendous amount of melt water; so the ancient valley was 2-4 miles wide in places and 3-400 feet deep. After making this large valley the river then deposited alluvial material in the valley; thus forming the broad flood plain seen in this picture. The present river is shallow and shifts its course across the ancient flood plain, . . .

[Wisconsin River Valley]



58
. . . downcutting into the materials it deposited when the ice was melting.

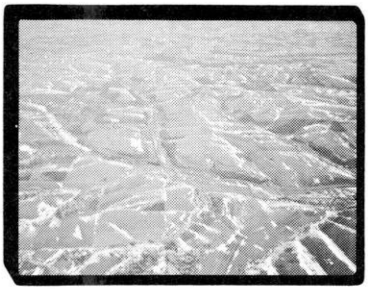
[These are sand bars in the Wisconsin River that are shifting their position constantly]



59

The driftless area of Wisconsin is famous because it is completely surrounded by glaciated territory. Here you see more valleys and ridges than you do in the glaciated area. The valleys were made deeper by the melt water and also filled in with alluvial deposits. Since the retreat of the glacier, these valleys no longer carry the water their size would indicate; instead a small stream meanders down the valley.

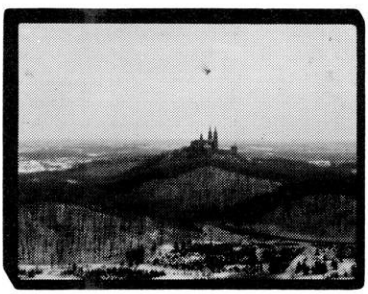
[Abandoned river valley in Driftless area]



60

This area has a dendritic drainage pattern and it is well drained. Because of this there are no natural lakes and very few wetlands in contrast to the glaciated area.

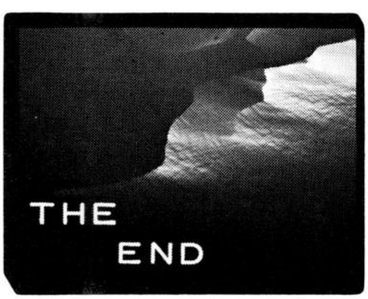
[Dendritic pattern — tree-like branching — of Driftless area]



61

But more important to the viewer is the beauty of the land reshaped by the glacier. In 1964 Congress appropriated the money to study the possibility of interpreting and preserving an Ice Age Scientific Reserve in Wisconsin.

[Sunday Picture Journal — Milwaukee Journal Feb. 16, 1969 "Hopeful Thaw in Wisconsin — Ice Age Park." Check newspapers for current developments on this Ice Age Reserve in Wisconsin.]



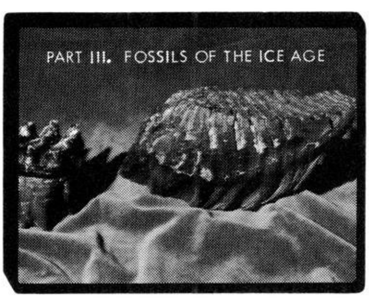
62

The End.

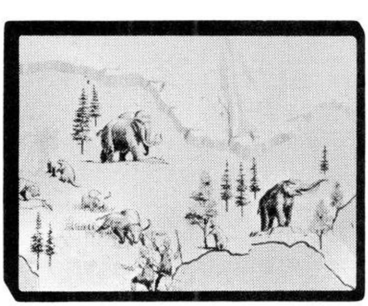
1
Colophon

2
Title: Glacial Geology of Wisconsin
Parts III and IV

3
Credit Frame

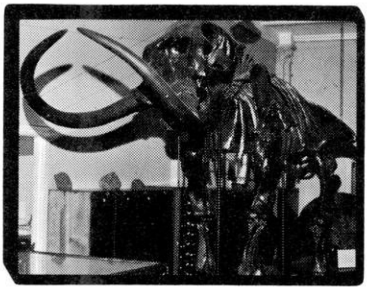


4
Part III: Fossils of the Ice Age

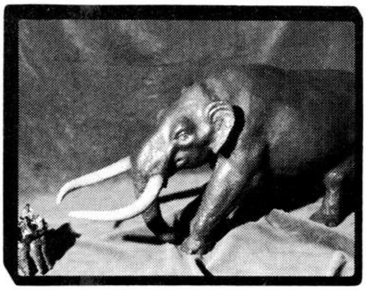


5
This simple map of glacial times shows some of the Pleistocene animals and early man. All except the Sabertooth Tiger are found in Wisconsin.

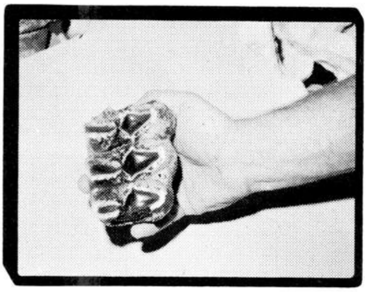
6
The glacial drift and the contemporary deposits of the driftless area yield the bones and tusks of the huge Mammoths and Mastodons which inhabited Wisconsin during the Ice Age.



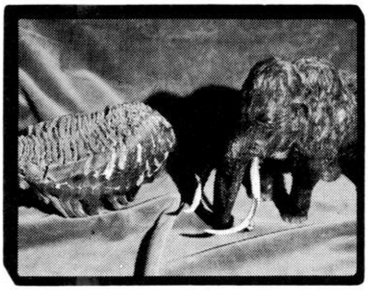
7
This skeleton of a mastodon in The Geology Museum at the University of Wisconsin and was found in a bed of black mud in a creek near Richland Center.



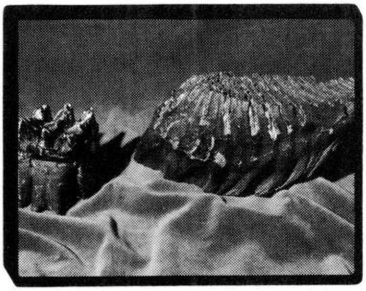
8
Mastodons browsed in great herds throughout the forests.



9
Mastodon teeth are often found in the gravels of the Wisconsin River.

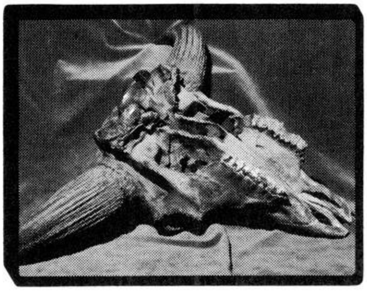


10
A model and fossil tooth of the mammoth are used by the Milwaukee Public Museum to show students the characteristics of these animals. The tall Imperial Mammoth of the Great Plains stood nearly 14 feet high at the shoulders.



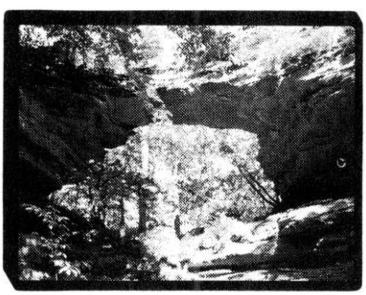
11
Here you can see the difference between the teeth of these "elephants."

12
Buffaloes roamed the plains as they did when white man first reached America. Some of the buffaloes in Pleistocene times had a horn-spread of fully 6 feet.

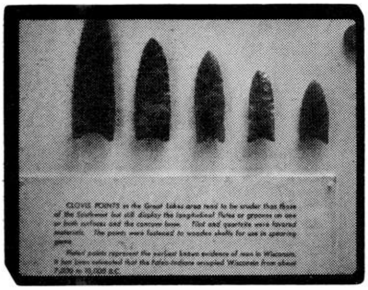


13
This Buffalo skull was found in Wisconsin.

14
Compare the larger skull of the Pleistocene beaver with the skull of today's beaver. The beaver of glacial times weighed 500 pounds, and was an aquatic plant eater.



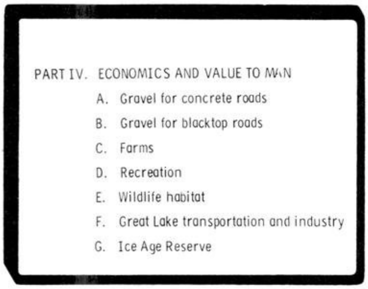
15
A charcoal fire was found by Professor Black of the University of Wisconsin beneath the natural bridge. It was carbon dated to be 11,600 years. So early man roamed Wisconsin during Two Creekian Times (the late Ice Age).



16

Additional evidence that man lived in Wisconsin are these clovis points which date back 11,900 years. Exciting places to view this part of the past are museums. This display is part of the Geological Division of the Milwaukee Public Museum.

[Clovis points are made of quartzite and flint. Why?]



17

Part IV:
Economics and Value to Man of Glacial Features

A — Gravel for Concrete
B — Gravel for Blacktop Roads
C — Farms
D — Recreation
E — Wildlife Habitat
F — Great Lakes transportation and industry
G — Ice Age Reserve

18

The most important "mineral resource" in Wisconsin is its glacial gravels.

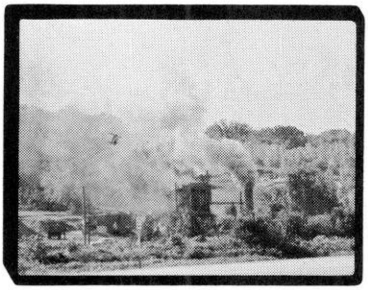
19

This gravel is responsible for the superior road system in Wisconsin, . . .

20

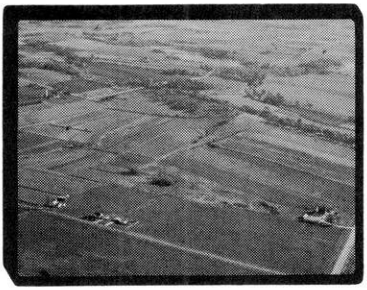
. . . especially concrete roads.

[The demand for gravel is threatening the preservation of the special landforms shaped by the glacier and its melt water. This would be a good "conflict of interests" illustration for discussion.]

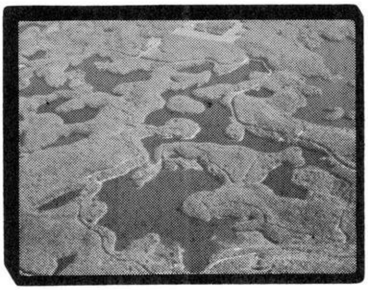


21
It is also important in making blacktop roads especially in a cold climate.

[Blacktop roads can absorb more heat and therefore melt off the ice and snow.]



22
The soils derived from the deep, mineral rich glacial deposits and loess are some of the best in the world for farming. The glacial drift also supplies much of our state with water especially in rural areas.

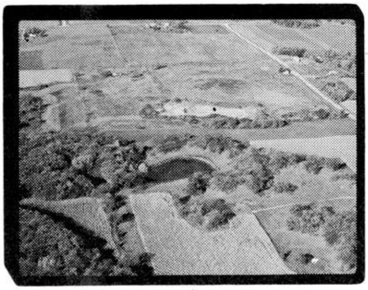


23
The thousands of lakes in Wisconsin just naturally make it one of the best states for recreation, . . .

24
. . . as well as one of the best for wildlife habitat.

25
The Great Lakes provide cheaper transportation to get industrial products to the central markets, and raw materials such as iron ore and coal to industry.

[This type of land also makes it easy to construct roads and railroads.]



26
But more important to the eye than all the economic value, is the beauty of the land shaped by the glacier. Congress is studying the possibility of preserving this landscape as an exciting new national park.

[Keep a newspaper clipping file on the Ice Age Scientific Reserve Park]

27
The End.

2999
3000
3001