

University of Wisconsin-Extension
GEOLOGICAL AND NATURAL HISTORY SURVEY
3817 Mineral Point Road
Madison, Wisconsin 53705

M.E. Ostrom, State Geologist and Director

TERRACES OF THE WISCONSIN RIVER - A PRELIMINARY SURVEY

by

S. Judson [and R.C. Murray?]

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1950

UNIVERSITY OF WISCONSIN
MADISON 6

DEPARTMENT OF GEOLOGY

January 20, 1950

Mr. E. F. Bean, Director
Wisconsin Geologic & Natural History Survey
University of Wisconsin
Madison, Wisconsin

Dear Mr. Bean:

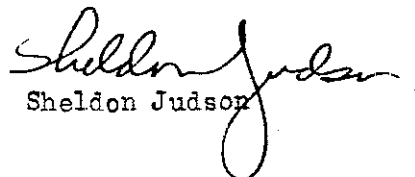
Herewith is a summary statement of the summer's investigation of the Terraces of the Wisconsin River. I had started a more ambitious paper, but abandoned it for various reasons not the least of which was the need of additional detailed mapping in the Wausau-Merrill area.

This report represents in no way a final report on the problem. The final manuscript will emphasize two phases touched on here.

1. The detailed Pleistocene stratigraphy in the Wausau Merrill Area.
2. A discussion of the use of "fossil frost soils" in Pleistocene stratigraphy.

I believe that underpoint 1 a definite pre-Cary ice advance separated by a considerable time interval can be demonstrated. The second point is very interesting to me because I believe for the first time in this country the stratigraphic value of "frost soils" can be illustrated.

Sincerely yours,


Sheldon Judson

SSJ:ac

UNIVERSITY OF WISCONSIN
MADISON 6

DEPARTMENT OF GEOLOGY

January 19, 1950

To: E. F. Bean, Director, Wisconsin Geologic and Natural History Survey.
From: Sheldon Judson, Department of Geology, University of Wisconsin
Subject: Terraces of the Wisconsin River - A Preliminary Summary.

General Statement

A detailed reconnaissance of the terraces of the Wisconsin River from its headwaters at Lac Vieux Desert to its mouth at Prairie du Chien, was carried on during July and August and parts of June and September 1949. The main purpose of the investigation was to determine the age, extent and genesis of the various terrace levels of the Wisconsin River with particular emphasis on the information that they might yield on the glacial and post-glacial history of the Valley of the Wisconsin River.

Salary support for the months of July and August was provided through Grant 49:366 of the Wisconsin Alumni Research Foundation. Field expenses for a period of approximately 10 days in the latter part of June were paid by funds made available by the Wisconsin Geologic and Natural History Survey.

Method of Investigation

Approximately 10 days were spent along the Wisconsin River from Prairie du Sac to Prairie du Chien re-examining the terrace sequence reported by Alden (1918) and MacClintock (1922). A total of 35 days were subsequently spent in the field examining the sequence from Prairie du Chien north to the headwaters of the Wisconsin. Detailed work was confined to the stretch of River from just south of Wausau to north of Merrill. The writer was assisted in the field during June by James Novotny, University of Wisconsin and in the field and office during July, August and September by Joseph Roberts, University of Wisconsin.

Work to be done

Approximately three weeks additional field time is needed to complete the detailed mapping begun in the Merrill-Wausau area.

A considerable amount of drafting remains to be done in the office before a final manuscript will be ready.

The statement which follows is intended merely as a summary. The final manuscript will in all probability have a different approach and emphasis.

THE TERRACES

The following discussion of the terraces is handled geographically along specific stretches of the Wisconsin River from its mouth to its headwaters.

From Prairie du Chien to Prairie du Sac

MacClintock (1922) describes and maps terraces of this section of the river and Alden (1918) discusses and maps the terrace deposits from Prairie du Sac to about 6 miles west of Arena. The writer is in agreement with both authors on major points. He believes in the following interpretation of the terraces as listed from oldest to youngest.

Post-Cary Terrace (Low Terrace): A low terrace averaging 8 to 10 feet above the modern river flanks the Wisconsin from Prairie du Sac to the Mississippi. Upstream from the mouth of the Wisconsin River to a point east of Boscobel this terrace is a well-defined feature of considerable areal extent. From Sauk City downstream to the west the terrace is expressed by natural levees separating the river from large back swamps. The swamps disappear downstream as the levees expand into true terraces.

The terrace and levees are composed predominately of sand-sized particles and carry an oxidized zone 2 to 4 feet thick. In places wind-blown material overlies this terrace. Where it does the oxidized zone is present in its upper portion but no weathering is evident in the underlying terrace illustrating a contemporaneity between wind activity and the final stages of terrace deposition.

The terrace differs in lithology, topographic position and topographic expression from the Cary Terrace described below. This points to a difference in conditions prevailing at the times of deposition of the two terraces. The soil on the low terrace is much less well-developed than that of the Cary Terrace, suggesting a considerable lapse in time between the formation of the two terraces.

The Cary Terrace: West and south of Prairie du Sac a broad, relatively flat glacial outwash plain stretches away from the Johnstown moraine of Cary age. At its junction with the moraine the Wisconsin River has cut its bed approximately 90 feet into this outwash plain. The plain slopes downward away from the moraine until it is 30 to 40 feet above river grade. The terrace deposits are well-stratified and locally strongly cross-bedded calcareous sands and gravels. The grade size of individual particles varies rapidly both vertically and horizontally. In a general way average grade size decreases away from the moraine front.

Extensive remnants of the outwash plain are preserved in what is known as Sauk Prairie west of Prairie du Sac and Sauk City. A large remnant lies to the south of Sauk City just north of Black Earth Creek. Downstream the original outwash level is found almost exclusively in the mouths of valleys tributary to the Wisconsin Valley. Presumably the valley was once choked with outwash which has since been largely removed by erosion except where the material lay in protected spots.

The presence of intermediate terrace levels between the Cary terrace and the low post-Cary terrace may bear on the time of removal of this material. A weathered zone up to five feet in depth and characterized by reddish-brown iron oxides and the absence of calcareous material is found at the upper limit of the Cary terrace. The intermediate terraces, best developed in the vicinity of Sauk City have a similar weathered horizon. It is developed on sediments similar to those which make up the Cary Terrace. The similar lithology suggests that the intermediate terraces have been carved from the Cary terrace. The similar soil

zone suggests that the Cary terrace and the intermediate terraces have been in existence for a similar length of time. From this it may be argued that the intermediate terraces were cut down from the original Cary outwash level during the retreat of the Cary ice. The waters which accomplished this erosion must have been torrential. The waters of such a torrent could have been derived not only from the melting ice front of Cary time but also from the glacial lakes in the valleys of the Fox and Wisconsin Rivers. Similar torrents have been suggested for similar erosional features in Illinois (Willman and Payne, 1942).

Pre-Cary Terrace Deposits

MacClintock (1922) describes terrace deposits higher and older than the terrace of Cary age. Remnants are present from Prairie du Chien eastward to Orion. The eastward slope of their surface and the eastward dip of the bedding led MacClintock to suggest that the waters which laid down the sediments flowed from west to east up what is now the Wisconsin River Valley, a difficult concept to accept. The deposits are certainly older than Cary, however. They are composed chiefly of silicious gravels deeply stained with iron oxides. The deposits are non-calcareous except where secondary lime carbonate has been introduced from above.

At Wauzeka a gravel pit in these deposits shows them to be overlain by calcareous wind borne material. The upper portion of the older gravels is characterized by wedges up to five feet deep and extending downward from the original surface of the gravels. These wedges are filled with calcareous wind-blown material from above. These wedges are considered the result of frost-wedging in a climate more rigorous than that of the present. Wind action must have been pene-contemporaneous as attested by the infilling of the wedges by slumped wind-blown deposits. This periglacial climate may have been attendant upon the Cary maximum.

Prairie du Sac to Wisconsin Dells

The Cary Terrace: Between Prairie du Sac and Wisconsin Dells the Wisconsin River flows through country previously covered by the Cary ice. The high Cary terrace is not present as such although discontinuous patches of Cary outwash are found at varying elevations above the river.

Post-Cary Terrace: Above Prairie du Sac the low, post-Cary terrace is flooded beneath Lake Wisconsin for a distance of approximately 17 miles. From this point to Portage it is present discontinuously. In the low-lying swampy country through which the Wisconsin River flows from Wisconsin Dells to Portage the terrace takes the form of natural levees on either side of the river. These slope away from the river almost imperceptibly to the back swamps.

Evidence of post-Cary frost action near Dekorah: At the Poynette Cement Block and Products Company along the east bank of the Wisconsin River in the NW $\frac{1}{4}$, NE $\frac{1}{4}$, Sec 13, T. 11 N., R. 8 E. is striking evidence of a period of intense frost action subsequent to Cary time and separated from Cary time by a period of temperate climate and soil formation. The section is as follows:

- 6 - Surface
- 5 - 8" sandy humus grading into
- 4 - 1'6" silty sand stained by reddish iron oxides
- 3 - 8' - 10' fine, buff, non-calcareous wind blown sand with occasional ventifacts at base.
- 2 - 0" - 8" dark brown, clayey soil
- 1 - 15' gray calcareous Cary outwash slightly oxidized to 1 $\frac{1}{2}$ ' - 2' Upper surface is marked by a polygonal pattern involving soil (#2) In places gravels are interrupted by wedge-like bodies lined with soil and filled with the non-calcareous sand (#3). These run from top of gravel to depths of over 8' with a maximum width of 1 $\frac{1}{2}$ ' at surface.

The sequence of events thus recorded from oldest to youngest

is:

<u>Event</u>	<u>Climate</u>
1. Deposition of Cary outwash	glacial
2. Formation of soil on Cary gravel	temperate
3. Frost-wedging and formation of polygon soils	rigorous (periglacial)
4. Deposition of windblown sand presumably derived from Wisconsin River bed 100 yards to west. Closely associated with frost soil formation.	Same
5. Formation of modern soil	present temperate

Wisconsin Dells to Wisconsin Rapids

Post-Cary Terrace: Much of this section of the river has been impounded behind a series of power dams. However, the low terrace is present in unflooded section 8 to 10 feet above the modern river grade. Downstream from Nekoosa it is related to a series of abandoned meanders.

Cary Terrace: The upper terrace is not present unless the bottom of ancient Lake Wisconsin be considered its correlative. At Wisconsin Rapids, however, the Cary outwash plain is again found and can be traced northward as far as the terminal moraine at Merrill. At Wisconsin Rapids the outwash plain slopes rapidly down to the level of the bottom of glacial Lake Wisconsin and is probably in part deltaic.

Wisconsin Rapids to Wausau

Post-Cary Terrace: The low terrace persists along this stretch of the river although it has been flooded in places behind such dams as Biron Dam, Jackson Dam, Knowlton Dam, Mosinee ^{Dam} and Rothschild Dam.

Cary Terrace: As stated above the high Cary terrace is present almost continuously upstream to Wausau and beyond. It becomes coarser toward Wausau but is in general composed predominately of sand-sized particles.

Wausau to north of Merrill

Post-Cary Terrace: This terrace is present at Wausau at an elevation

of averaging about 10 feet above the river and is found at various points along the river in the gorge between Wausau and Merrill as well as somewhat north of Merrill.

Cary Terrace: This terrace is well-developed at Wausau and levels are found throughout the Wausau Merrill gorge. The terrace may be traced north of Merrill. It appears to grade into what is thought to be the terminal moraine of the Cary ice approximately 10 miles upstream from Merrill. The surface is approximately 30 to 40 feet above present river grade but increases rapidly to about 75' as it approaches and joins the Cary moraine.

The "Third Drift": Weidman (1907) maps an area between the Cary moraine (His "fourth drift") and Wausau as "third drift". Hole (1943) questions the validity of this division and tentatively suggests that this section of the so-called "border drift" as well as that to the south mapped by Weidman as "first" and "second Drifts" may all be related to the Cary ice. The writer believes that Weidman's third drift at least is valid for the following reasons:

1. The ground moraine. The ground moraine of this area has a topographic expression which differs markedly from that developed on unquestioned Cary till. The slopes are gentle as compared with those of the Cary. Undrained depressions, present in the Cary, are absent in the area of Weidman's "third drift." The soil, although bouldery, is arable as witnessed by a prosperous rural population. This prosperity is in strong contrast with ^{that of} the area within the border of the unquestioned Cary till.

2. The Pre-Cary terrace. At various protected spots gravel deposits higher than the Cary Terrace and of different lithology are present. The terrace remnants are as much as 70 feet above the river. Extensive deposits of this age are present along County Line Creek in northern Marathon County, in an unnamed valley in NW $\frac{1}{4}$, Sec. 36 T. 30 N., R. 6 E, just west of Wausau in SW $\frac{1}{4}$ Sec. 30, T. 29 N., R. 7 E, and along the west side of the Wisconsin River south of County

Line Creek. They are more heavily stained than the deposits of Cary age. In some places involuted remnants of an ancient soil are found within the deposits. The soil is considered to represent a more equable climate following the deposition of the gravels. The involutions indicate an intense frost action at a later date, probably during the maximum of the Cary ice.

A gravel pit in Cary terrace deposits in North Merrill shows that Cary gravels are overlain by Cary outwash and separated from the Cary deposits by a soil zone which has been frost-wedged.

3. Glacial Lake Merrill. Various lines of evidence suggest the existence of a glacial lake in the Merrill area during the waning stages of Weidman's "third drift ice". The lake, here called glacial Lake Merrill, had an outlet at just less than 1200 feet (map elevation) located in SE $\frac{1}{4}$, Sec. 36, T. 31 N., R. 7 E, which emptied into what is now County Line Creek. Extensive terrace deposits are present south of this outlet along County Line Creek. The dam for this lake apparently lay across the Wisconsin river about two miles east of the outlet south of Pine River. This dam may have been made of either till or ice or both. It has now been completely removed. Lake deposits consist largely of horizontally stratified sand, some silt and clay.

The "first and second drifts" of Weidman. Not enough field work has been done to evaluate this subdivision by Weidman. Nevertheless the writer is confident that the "third drift" as defined by Weidman is essentially correct, and that at least one and perhaps more glacial advances took place in this area prior to the advance of the "third drift-ice".

Merrill to Lac Vieux Desert

Within and north of the terminal moraine developed by the Cary ice the low terrace is present but not well developed. Discontinuous deposits of Cary outwash having varying elevations above the River replace the Cary terrace.

No deposits due directly to an ice advance younger than those laid down by the Cary ice were seen between the terminal moraine of the Cary ice and the headwaters of the Wisconsin River at Lac Vieux Desert.

Summary

The following events can be reported from the survey of the Wisconsin River terraces:

1. One or more early ice advances of unknown age recorded by the "first" and "second drifts" of Weidman in north central Wisconsin and perhaps by the high terrace deposits described by MacClintock near and east of Prairie du Chien.
2. Advance of a continental ice sheet into north central Wisconsin which reached to a point close to Wausau. Outwash deposits laid down by meltwaters from this ice are now preserved at favorable places in the Wausau-Merrill area as terrace remnants. During the initial stages of retreat of this ice a glacial Lake Merrill, probably fairly short-lived, was formed.
3. Retreat of this ice and a period of soil formation in a presumably temperate climate. A relatively mature soil formed on the glacially derived material.
4. Advance of the Cary ice, one lobe of which reached a point just north of Merrill. A second lobe of this ice moving down the Green Bay lowland splayed west and south changing the course of the Wisconsin River in its middle reaches between Stevens Point and Prairie du Sac. Broad outwash plains from this ice advance are now preserved as terraces along much of the unglaciated portion of the river. The rigorous climate produced by this glaciation beyond its farthest advance is recorded today in ancient frost soils.
5. Retreat of the Cary ice and onset of a climate presumably similar to that of the present. This is attested to by soils buried beneath later deposits or contorted by a later peri-glacial climate.

6. The last major ice advance of Wisconsin age was that of the Valdres (Mankato) which reached as far south as the southern end of Lake Winnebago along the Green Bay-Fox River Valley and somewhat farther south along the Lake Michigan trough. It did not enter the Valley of the Wisconsin. Nevertheless the changing climate attendant upon this ice advance was rigorous and is expressed in the Valley of the Wisconsin by

- (a) the contortion of soil formed in the preceding Cary-Valders interval.
- (b) Windblown sands at various points along the Wisconsin River.
- (c) The low or post-Cary terrace which is here considered a periglacial terrace.

7. The onset of the present temperate climate recorded by the most recent soils.

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