

THE LATE-GLACIAL AND POST-GLACIAL HISTORY OF THE CEDARBURG BOG AREA, WISCONSIN

INTRODUCTION

Continental glaciers moving over Wisconsin four times in the last two million years sculptured the underlying Paleozoic dolomites and limestones in the Cedarburg area and deposited vast amounts of debris on the bedrock surface. Since the retreat of the Wisconsinan ice, about 12,000 years ago, mass-wasting, fluvial activity, and weathering have modified the landscape and produced the topography we see today.

The Pleistocene deposits of the Cedarburg area are late Wisconsinan in age, and the earlier history of the area must be inferred from studies done in Southern Wisconsin and the surrounding states. As early as the mid-1800's mention is made of the Quaternary deposits in Wisconsin, but not until 1877, and again in 1883, did Chamberlin discuss the glacial deposits of Eastern Wisconsin in detail. In 1918, Alden mapped and interpreted the glacial geology in the Cedarburg area. Recent studies by myself and students have added to our understanding of the area.

PLEISTOCENE HISTORY

No glacial deposits older than Woodfordian age (see Table 1) are reported from the Cedarburg Bog area. Evidence of early Wisconsinan substages (Altonian and Farmdalian) and pre-Wisconsinan glaciation is found in Southern Wisconsin, south of the maximum extent of the Woodfordian glaciers.

Post-glacial time	the present to 5,000 B.P.
Valderan Substage	5,000 B.P. to 11,000 B.P.
Twocreekan Substage	11,000 B.P. to 12,500 B.P.
Woodfordian Substage	12,500 B.P. to 22,000 B.P.
Farmdalian Substage	22,000 B.P. to 28,000 B.P.
Altonian Substage	28,000 B.P. to 75,000 B.P.

Table 1. Time-stratigraphic classification of the Wisconsinan Stage of glaciation. Suggested dates are in radiocarbon years before present.

Woodfordian Substage

During Woodfordian time, the Wisconsin ice, moving from the Lake Michigan and Erie lobes, reached its maximum extent in Central Illinois between 19,000 and 20,000 B.P. In both Illinois and Wisconsin the Woodfordian drift is composed of deposits from many pulsations of the ice front. Although numerous radiocarbon dates help to establish the chronology in Illinois, none are available from Southeastern Wisconsin where no organic remains are found in the drift. As a result, separation of the Woodfordian glacial fluctuations is based primarily on morphology and directional indicators, both of which are generally better than texture, lithology (clay minerals, carbonates, heavy minerals, etc.), and magnetic susceptibility in separating pulsations in a given sublobe.

We believe that middle and late Woodfordian drift occurs at the surface throughout much of Southeastern Wisconsin. The lack of radiocarbon dates continues to make correlation and dating of specific events difficult.

The most prominent moraines in Southeastern Wisconsin are those of middle Woodfordian time and include the Kettle Interlobate Moraine. Although late Woodfordian events in Wisconsin are poorly understood, radiocarbon dates and morphologic evidence of ice stagnation indicate that deglaciation was time transgressive—being earlier in the south than in the north (Black and Rubin, 1967-68). As ice retreated from the "Kettle Moraine," fluctuations of the ice front occurred forming a series of recessional moraines and ice-marginal drainage channels. In addition, many small lakes and ponds were formed as the ice stagnated and melted. In post-glacial time some of these depressions gradually filled with sediment and vegetation, becoming bogs such as the one at Cedarburg.

Twocreekan Substage

The Twocreekan substage (Frye and Willman, 1960) is named from the Two Creeks forest bed near Two Creeks, Wisconsin. The deposit at Two Creeks was discovered by Goldthwait in 1907, but was not investigated in detail until 1932 when Wilson studied the Two Creeks locality. In 1963 Broecker and Farrand reported on the locality and summarized the radiocarbon dates from the site.

The following outline summarizes the stratigraphy at the Two Creeks locality. At the base of the sequence, overlying the Niagara dolomite, is a dark red to dark gray clayey till deposited by late Woodfordian ice. The till is overlain by lacustrine rhythmites consisting of clays, silts, and sands which vary considerably in thickness. Thwaites and Bertrand (1957) suggest that the extreme irregularity of these deposits is attributed to delta foreset bedding and disturbance by advancing Valderan ice.

Overlying the lacustrine sediments are local deposits of sand and some gravels. The buried forest grew on the lacustrine sediments. Trees in the forest horizon were dated at 11,800 years B.P. and were dominantly *Picea* (Broecker and Farrand, 1963; West, 1961). Above the forest are from several inches to 6 feet or more of sands and/or silts. These are in turn overlain by 2 to 12 feet of dark red clayey till of Valderan age. Soil and wood from the underlying lacustrine sediments are incorporated into the till. Local lake sediments are found on top of the till.

As Black, Clark, and Hendrix (undated—1968) point out:

When it is recognized that the forest bed is established on lacustrine sediments and yet covered by lacustrine sediments all of which in turn lie between two tills, something of the magnitude of the glacial history inferred becomes apparent.

A similar stratigraphic sequence is found at the Ernst Brothers gravel pit a few miles south of Cedarburg. A Twocreekan forest dated at 12,000 190 years B.P. grew on Woodfordian outwash sands and gravels. The forest was drowned by waters from the advancing Valderan ice, and is overlain by pond sediments consisting primarily of algal (*Chara*)-silty-calcareous mud. As the pond dried, peat was deposited and a conifer-hardwood forest, consisting primarily of *Pinus* and *Quercus* developed. Gradually this forest was replaced by the present southern hardwood forest. Both localities suggest the late-glacial and post-glacial sequence of events in the Cedarburg Bog area.

Valderan Substage

The Valderan Substage was named by Frye and Willman (1960) and is based on the Valders till of Eastern Wisconsin (Thwaites, 1943; Thwaites and Bertrand, 1957). At present, the Valderan boundary in Southeastern Wisconsin is not conclusively established. However, it is known that the Cedarburg Bog lies outside all proposed boundaries for the maximum extent of the Valderan ice.

Part of the difficulty is that the Valderan boundary was based on the color of the glacial drift in Southeastern Wisconsin. However, Black (1966) demonstrated that color could not be used to distinguish Valderan deposits in Northern Wisconsin or in Michigan's Upper Peninsula. From my preliminary studies, the same seems to be true in Southeastern Wisconsin.

At present, we do know that there was a glacial advance after Twocreekan time which extended south, at least as far as Two Creeks, Wisconsin. The ice affected drainage systems to the south, and caused flooding or ponding of some forest areas: the site at Two Creeks and the Ernst Brothers gravel pit. With the withdrawal of the Valderan ice the present ponds, lakes, and bogs developed in the depressions formed during the Pleistocene.

Post Valderan

Post Valderan time is arbitrarily defined as starting at 5,000 years B.P. In Wisconsin no radiocarbon dates record the withdrawal of the Valderan ice. The period is distinguished by increasing temperatures and dryness. Pollen profiles indicate a vegetational change from spruce to pine and finally to the hardwood forests with some prairie vegetation. The ice blocks left by the Valderan ice presumably melted over a period of several thousand years depending on their size and amount of burial. Subsequent fluvial erosion, mass wasting and weathering modified the topography, forming the landscape we see today.

CEDARBURG BOG

The Cedarburg Bog basin came into existence as the last ice of the Wisconsinan withdrew from the area about 12,500 years ago. As fluctuations of the ice front occurred, recessional moraines were deposited and ice-marginal drainage systems developed. As deglaciation progressed, the ice stagnated and outwash sediment was deposited around ice blocks. Ponds and small lakes formed in the depressions left in the sediments by the melting ice blocks.

The bog began as a pond formed during late Woodfordian time. With the warmer climate during Twocreekan time a forest was established throughout much of the area. Although the advancing ice never reached Cedarburg, it disrupted drainage in the area, drowning portions of the forest and causing a general cooling of the climate. Pollen profiles from the sites at Two Creeks and Ernst Brothers indicate the change in climate from cold (Woodfordian) to warm (Twocreekan) and back to cold (Valderan) as fluctuations of the late Wisconsinan ice occurred.

In post-glacial time, sediment partly filled the pond, and a warmer climate permitted the growth of vegetation in the area. The continued growth of vegetation gradually encroached on the pond and formed the present-day bog.

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