GEOLOGY OF CENTRAL PLAIN AREA OF JUNEAU, JACKSON, ADAMS, WOOD, PORTAGE, WAUSHARA, AND MARQUETTE COUNTIES

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A brief geological history of this area presents four pictures. (1) At the close of the pre-Cambrian. (2) Prior to Wisconsin glaciation. (3) During the Wisconsin glaciation. (4) Today.

1. Close of the Pre-Cambrian

At the close of the pre-Cambrian the surface rocks were igneous, such as granite, basalt and porphyry or metamorphic - dominantly gneisses with some quartzite. From well records and outcrops we conclude with a fair degree of accuracy that the surface was a peneplain sloping gently southward. It was quite like that of the peneplain around Wausau today. There was a comparatively level area above which rose monadnocks. The quartzite range in northeastern Adams County (Hamilton Mounds) rose some 445 feet above the granite surface near Friendship. In the southwestern part of the county there is a granite outcrop which probably had a local relief of 480 feet. The quartzite mound at Necedah was nearly 500 feet above the adjacent plain. Near Babcock was another quartzite mound some 250 feet high. Near Montello and Red Granite were conspicuous granite knobs. It is quite likely that there were numerous other hills, all of which are now concealed by sandstone. There is such a concealed quartzite ridge between Mauston and New Lisbon and a second possibility near Wonewoc. The local relief was greater than at present, and the general slope was southerly.

II. Cambrian to Lake Glacial Time

During the ensuing period of about a half billion years the area had an interesting history, beginning with inundation by the sea and a long period of deposition.

The first of the sediments was a group now called the Cambrian (Potsdam). This consisted of some 800 feet of sandstone, shaly sandstone, and sandy limestone, of particular interest because these sandstone dominate the present topography and soil. The monadnocks were not all buried during this period of deposition. The Lower Magnesian dolomite next to be deposited reached a thickness of about 250 feet. The area then emerged from the sea, and for a long period was exposed to erosion. Valleys were cut into the Lower Magnesian, in some places deep enough to expose the underlying Cambrian. The St. Peter sandstone which succeeded this period of erosion varies greatly in thickness because it was deposited upon a very irregular surface. The quartzite and granite monadnocks were completely buried. It is likely that other still younger formations were deposited in this area and later eroded.

The modern geological map of the State furnishes a fairly accurate picture of the distribution of formations just prior to glaciation. The shield-shaped area of pre-Cambrian crystalline rocks in the north is surrounded by sedimentary rocks - sandstones, limestones, and shales, arranged like the shingles on a roof of very gentle pitch and dipping away from the pre-Cambrian shield. Unlike shingles, however, the butts project up the roof. The edge of each resistant formation forms an escarpment encircling and facing the pre-Cambrian shield. Proceeding outward, one crosses in succession the edges of younger (and stratigraphically higher) beds.

The Plain Area appeared much as it does now - a great level plain with probably a greater number of prominent sandstone buttes and mesas. These isolated mounds or patches of sandstone lying far inside the present main outcrop prove that this formation once had a greater extent. The former greater extent of the Lower Magnesian limestone is shown by isolated outliers in southern Juneau County and the hill west of Liberty Bluff. The latter butte is nearly 30 miles west of the main Lower Magnesian escarpment. Further evidence of erosion and the recession of the escarpment is the occurrence of chert pebbles at least as far north as Vesper, some 45 miles from the escarpment edge near Tomah. The quartzite and granite mounds were exhumed and again

were prominent topographic features - not as prominent as in pre-Cambrian time, for they were still partially buried in Cambrian sandstone.

The valleys of the Yellow and Lemonwier were 100 to 200 feet deeper than at present. It is almost certain that the Wisconsin River flowed southward from Stevens Point past Westfield to enter the Baraboo Range at the Lower Narrows and emerge from the Range through the Devils Lake Gap. Then, as at present, the generally level surface was modified by sand dunes. There were no lakes nor swamps.

III. Glaciation

The Wisconsin glacier advanced into the area from the east to a line extending from near Stevens Point to Wisconsin Dells. The area covered by ice was changed in topography, drainage, and soil. Fragile sandstone mesas and buttes were demolished. Soil and talus was removed. Valleys were filled to a maximum known depth of 365 feet. The drainage pattern was changed and lakes and swamps created. In detail, the topography was rendered more irregular by deposition of drift. The drift was sandy but had acquired considerable limestone and clay in crossing the eastern counties.

Perhaps the most striking change was the creation of a temporary lake - Glacial Lake Wisconsin. This lake, held in between the ice and the higher land to the west and south, had an area of about 1825 square miles, or about the same as Dane and Green counties and eight times the area of Lake Winnebago. As might be expected, its shore line was exceedingly irregular. One long arm extended up the Baraboo valley above Elroy. For the most part the lake was shallow. Islands and shoals were numerous. The maximum elevation to which the waters rose was about 980 feet, apparently controlled by the elevation of the east fork of the Black River. This broad valley is quite out of keeping with the small stream now occupying it. Glacial streams from the north deposited coarser material near shore. From the ice front to the east streams built the outwash plains which are such a conspicuous feature along U.S. High-

way 51. In some cases the outwash plains were built into the lake. Finer sediment was carried out in suspension and deposited in the deeper parts of the lake. As a result, there are extensive deposits of fine grained, laminated, red clay in Adams, Monroe, and Juneau counties. Since some of this sediment is finely ground limestone, these clays are an important source of agricultural lime. The thickness of the clay deposits is variable indicating deposition upon an irregular floor ($^{\text{and}}_{\text{or}}$) subsequent erosion. At Shennington the thickness is 26 feet; at Necedah, 70 feet. In Adams County the maximum known thickness is 20 feet. Streams draining the driftless area contributed much sediment to the lake.

During the existence of the lake, waves undercut the base of the sandstone islands, thus producing the steepened slopes so conspicuous near Friendship, Camp Douglas, and elsewhere. Submerged mounds were probably smoothed. Where shallow water covered dune covered areas, the waves and currents tended to produce a smoother surface. The old shore line is marked in a few places by beach gravel. Elsewhere beach deposits are probably covered by talus or dune sand. The conditions were not favorable to development of striking beaches since the shore material was sand. At Necedah there is a gravel deposit, largely local quartzite, with some erratics.

Ice rafted bowlders are not of common occurrence. The ice cliff was rather thoroughly masked by outwash deposits during the latter part of its existence and bergs were not common. The lake was not long lived. As the ice receded, a new outlet was was found in a low spot in the terminal moraine southeast of Kilbourn. As this outlet was lowered by erosion, the lake was drained and the Wisconsin River began the process of cutting a narrow channel in the broad, low ridge of sandstone which lay athwart its path at Kilbourn. This narrow gorge thus cut gave rise to the Dells, "the most famous and beautiful feature of the Wisconsin Valley". The lake plain became a swamp area dotted with sandstone mounds. The swamps were in part due to impervious clay, but to a considerable extent were due to the poor drainage on exceedingly flat topography.

During the glacial period fine dust (loess) was deposited on the uplands south and west of this area. There is but little loess within the plain area. Much dust drifted in was lost in the drifting sand or was deposited in the lake. The new Wisconsin river received a large supply of sand and gravel from the waning ice sheet far upstream and built a valley train.

IV. The Area at Present

The glaciated area has undergone slight modification. Some lakes have been filled with marl or peat (or both). There has been some stream erosion of the ground and terminal moraine and of the outwash plain. The Wisconsin River valley train has been terraced.

In the bed of Lake Wisconsin area streams have entrenched themselves slightly, disclosing clay in some places, sandy gravel along the Wisconsin, and sand and sandstone elsewhere. The wind with sand as a cutting tool has etched the sandstone mounds. Wind drifted sand has been piled in dunes and mantled many clay deposits.

The flat lying Cambrian sandstone still domates the landscape. The plain slopes gently southward at the rate of four feet per mile. Locally the sandstone rises above the plain in mounds which range in height from a few feet to over 300 feet. The quartzite and granite mounds are still conspicuous features. From the summit of one of these mounds one gains the impression that he is on an island in a great lake. The monotonously even plain extends eastward to the terminal moraine and westward to the limestone escarpment. Scores of similar islands dot the surface of the lake-like plain. Its flatness is shown by the elevation of ten cities and villages. The maximum elevation is 975 feet, the minimum 861 feet, and the average 907 feet.

Closer examination shows that the plain is not perfectly level. There are numerous areas of low sand dunes. Vast slightly lower areas are occupied by marshes

made discontinuous by almost imperceptible sandstone or sand dune divides.

Since glacial time bog ores have accumulated at the water table. The ground water carries ferrous iron in solution. At the water table oxygen oxidizes the iron and causes the precipitation of limonite (hydrated iron oxide). Older deposits found in marshes and creeks refelect an earlier higher water table. In parts of the area drainage ditches show lowering of this table within the last quarter century. The yellow, clay-like deposit in the bottom of some marshes is probably an accumulation of iron ore and colloids.