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DESCRIPTION OF THE RIPON, WISCONSIN, QUADRANGLE

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Ripon 3300 ft lands

Introduction.

The main scenic attraction of the Ripon quadrangle, aside from the rolling upland prairie south and east of Ripon, is Green Lake, one of the most beautiful of Wisconsin's many lakes. The spring-fed water is deep and clear, and along its wooded shores are many cottages and beautiful homes, making it a very popular summer resort. Of educational importance are the schools at Berlin and other places and the college at Ripon. Of economic importance are the granite quarries at Berlin. The area has also its historic features. It is very interesting to go back to the time of Joliet and Marquette and follow their canoe as it traverses the winding course of Fox River in search of a passage through the area to the southern sea.

Later came the dredging and construction of locks to convert the sluggish stream into what was expected to be an important inland waterway, the Wisconsin-Fox River canal, connecting the Great Lakes and the Mississippi. Far back of all this stretch the ages of geologic and physiographic history through whose processes the present natural features were developed.

The surface features.

The configuration of the surface of the land in the Ripon quadrangle is shown on the map as it would appear if level contour lines were drawn around all the slopes and hills at intervals of 20 feet, one above another, and the land thus contoured was looked down upon from above. Thus on the nearly flat areas the lines would be far apart, on gentle slopes they would be closer together, and on steep slopes or bluffs they would appear so closely crowded as nearly to lie one up against another. Figures show the elevations above sea level.

With these facts in mind a glance at the map shows that a large part of the area is flat, much is marsh land through which Fox River and its tributaries flow sluggishly. Above the flat lands rise ridges and hills of moderate height. Some tracts are marked by little hills or knolls, among which are inclosed depressions or "kettle holes", as shown by short marks or hachures attached to the contour lines.

Along a line extending from northeast to southwest on the southeast side of Green and Rush lakes, the surface rises, in places by an abrupt bluff or escarpment and elsewhere by more gentle slope. From the crest a broad, gently undulating upland plain extends southeastward.

The rocks.

The configuration of the surface is largely dependent on the character of the underlying rocks. Most of the rocks exposed to view in this region are of kinds known as sedimentary, limestones and sandstones and shales being composed respectively of consolidated limy or calcareous muds, beds of sand, and beds of clay, which were deposited in the waters of great seas which ages ago covered large parts of the North American continent (fig. 1). Beneath these are still older rocks, such as are popularly grouped together under the name "granite". These are rocks which once were molten but which when they cooled became crystallized and consolidated. Such rock is now exposed in the granite quarries at Berlin. As shown by well borings, the surface of the granite is very uneven, being marked by hills and valleys of hundreds of feet relief. So thick, however, were the deposits of marine sediments that even the highest points, such as the hill at Berlin, were deeply buried beneath the bottom of the sea.

Finally, the sea bottom was elevated, the waters drained away, and new land emerged as a nearly flat or gently sloping plain. The rock thus exposed at the surface began to disintegrate as soon as it emerged and to form a soil. On this land spores and seeds, floated by the waters, borne by winds, or carried by animals, found lodgment and grew.

The center of the new land by made was probably where what is now north-central Wisconsin. From this center the rock formations beneath the plain sloped away radially to the southwest, the south and the southeast, and east. In this area the slope of the beds is toward the eastward. In eastern Fond du Lac County there are some thick beds of sedimentary rock (the Niagara limestone and the Cincinnati shale) underlying the upland east of Lake Winnebago, which may once have extended over ~~the area~~ of this quadrangle. A well drilled in the southeastern part of the

about 35 miles southeast of Green Lake
county penetrated the following sedimentary rocks:

Log of Mr. Ulrich Legler's well, Elmore, Wis.

	Feet.
Clay glacial drift	50
Niagara limestone	300
Cincinnati shale	140
Galena and Trenton limestone	210
St. Peter sandstone	102
Lower Magnesian limestone	240
Potsdam sandstone (U. Cambrian)	206
Granite at bottom of well	0
Total	1,248

Generally speaking, the limestones are harder and more resistent than the shale or sandstones, and the "granite" is hardest of all. It thus appears that the newly emerging plain was underlain by an alternating series of harder and softer rock formations and ~~this structure~~ which came to have a marked effect on the ~~surficial configuration.~~ surface forms

Sculpturing of the land surface.

No sooner does new land emerge from beneath the sea than it is attacked by natural agents working to destroy it and to carry the material back again to the sea. A part of the rain falling on the land soaked into the ground and, being more or less charged with acids, attacked and dissolved some of the limestone and carried the lime to lower levels, or reissuing as springs carried off the material in solution. Much of the rain water gathered into rivulets, brooks, and rivers, which flowed across the gently sloping plain. Grains of sand and fragments of rock loosened by the rain water, the roots of plants, and frost action, served as

abrasive material which swept along by the rushing waters, and thus wore away the solid rock so that slopes were gullied and gulleys were enlarged to ravines and valleys.

The surface of the new land thus did not remain featureless for long after its final emergence from the sea. It soon came to be diversified by ridges and valleys, as the result of stream erosion. When the land remained stable for a very long time valleys were broadened to low land plains, and intervening ridges were narrowed and finally cut into isolated hills. At intervals further elevation of the land occurred, and as a result thereof the gradients of the streams were increased so that they carried on their work of dissection with renewed activity.

From the alternation of harder and softer rocks and from their gently sloping positions have resulted the main topographic features of the region. The rock formations have been beveled off and their margins have been worn back southeastward. Where a protecting cap of harder rock was removed, the softer rocks were exposed to more rapid erosion and broad plains were developed on them. As the softer rock was removed the exposed edges of the overlying limestones broke away, forming lines of bluffs, or escarpments, which gradually receded eastward. We find thus in eastern Fond du Lac County the Niagara limestone escarpment (known as "the ledge"), overlooking a second plain to the west in the lower parts of which are Lake Winnebago and the Horicon Marsh. This second plain rises gradually westward on the surfaces of the Galena and Trenton limestones until it becomes the upland, which ends in a second escarpment, the Trenton and 2 that which extends southwest through Ripon (figures 1). As the St. Peter sandstone varies greatly in thickness, its edge and hills of the Lower

Magnesian limestone are also combined with the edge of the Trenton limestone to form this escarpment which faces northwestward and overlooks the basins of Rush and Green lakes and the surrounding marshes. Beyond the lakes is an upland underlain by the Lower Magnesian limestone. So much had the limestone been dissected that the surface of this third plain is rather uneven and its edge, which forms the magnesian escarpment, is very irregular (fig. 2). The hill in the eastern part of Berlin is the partly uncovered top of a very ancient "granite" ridge which was, in pre-Cambrian time, more than 600 feet in height (fig. 1).

The process of sculpturing the surface of the land which has been so briefly outlined extended over millions of years, so long, in fact, that had nothing interfered the topography should show a very mature or old stage of development. Evidently some thing interrupted this process for the topography of the area is, in the main, very youthful. Lakes and marshes are generally evidence of extreme topographic youth. The mature development of branching valleys by erosion inevitably results in the cutting away of barriers and the drainage of all lakes, marshes, and swamps. Even before their artificial obstruction by locks and dams the streams here were doing little toward the drainage of the wet lands.

A study of the general character and relations of the rocks and the unconsolidated clay, sand, and gravel, and of the records of many wells drilled in the region shows that a mature drainage system was developed, but that it was later buried in glacial drift. The main feature of this drainage system was a deep river valley whose position is marked by the basins of Green and Rush lakes (figs. 1 and 2).

shows that the buried valley bottom lies 200 to 300 feet or more below the levels of the lakes and marshes. When this valley, which was probably tributary to Wisconsin River, was open, the escarpment along the south side was more than twice its present height, or 400 to 600 feet (fig. 1).

Work of great ice sheets.

The close of the long period of rock sculpturing was brought about by a climatic change such that so much snow fell in the winters that it was not melted away in the summers. Year after year it kept piling up, and as it became thick it consolidated to ice. This continued hundreds and thousands of years until nearly half the North American continent was covered with a great sheet of ice such as now covers The northern Greenland.

Where snow and ice accumulates thus as glaciers in mountain valleys, or as an ice cap spread over plateaus or plains, a sort of flowing motion is set up in the ice. There were three great centers of accumulation in Canada, and from one of these, that on the Labrador peninsula, the ice spread southwestward until, at the maximum stage, it covered Michigan, nearly all of Indiana and Illinois, and much of other States. It spread over northern and eastern Wisconsin and in this latitude extended across Fond du Lac, Green Lake, and adjacent counties westward into Adams County (see fig. 2). There is evidence showing that ice sheets invaded Wisconsin several different times. Each stage of advance was followed by a warmer stage, during which the ice melted away, new soils were developed, and vegetation grew on the surface of the land. When the climate again became cold the ice readvanced and the soils and

plants were partly destroyed and partly buried in the rock debris, or drift, carried by the ice. Mr. H. F. Wilkie, in drilling a well east of Green Lake, encountered a bed of black vegetal material containing leaves beneath 100 feet of drift clay. Possibly this may be a remnant of one of the old interglacial forest beds.

At the last, or Wisconsin, stage of glaciation, one great glacier moved south along the basin of Lake Michigan, and a smaller lobe occupied the trough in which lie Green Bay and Lake Winnebago (fig. 3). The ice of the Green Bay glacier spread westward over the area of Ripon and Neshkoro quadrangles. This moving ice probably had a thickness of a thousand feet or more, so that it completely overwhelmed all the hills and valleys. The base of the moving ice was set with rock fragments of various sizes so that it acted like a flexible rasp wearing down the hills, smoothing irregularities, and scratching the surface of the rock. The trends of such scratches or striae (photo?) seen at many places in this region show the directions of the ice movement here to have ranged from southwest to somewhat north of west (see arrows, fig. 2). Such being the directions of movement, it is probable that part of the depth of the ancient valley in which lie the three lakes is due to the scouring action of the basal ice.

The limit reached by this movement was about 30 miles west of Green Lake, in eastern Adams County. At the glacial margin the ice melted away releasing the included drift as it was brought forward. The drift thus piled up in a great ridge or terminal moraine, which is now the range of wooded hills extending from north to south near Kilbourn. Drift which lodged beneath the ice formed the ground moraine which covers the

solid rock all through this region. In places the surface of the drift was fluted or moulded into parallel ridges or smoothly rounded elliptical hills known as drumlins (photo?). There is one of these about 4 miles north of Ripon in sec. 30, Nepeuskin township, and another 4 miles northeast of Green Lake, in secs. 2 and 3, Brooklyn township.

As the climate became warmer toward the end of the long glacial winter, the west front of the glacier was gradually melted backward toward the east and all the included drift was let down upon the surface of the ground. Many of the pebbles and bowlders had been carried a long ways. Some of them, including most of the granite bowlders, came from Canada. At intervals the ice readvanced again, but generally to less extents than previously and at the limits of these oscillations marginal accumulations of drift, or recessional moraines, were formed. These moraines thus mark positions of halt of the margin of the dwindling glacier (see dashed lines, fig. 3), and it is, in large measure, these accumulations of drift which blocked the ancient Fox River Valley and obliterated the former drainage system. The first of these moraines to affect this area is a great accumulation of drift (part of the Lake Mills morainic system) which blocks the valley in the region of Montello, west of Puckaway Lake. The second is the great dam of drift at the west end of Green Lake (fig. 2). From its prominence here it is named the Green Lake moraine. This moraine is about a mile wide and the highest points rise about 130 feet above the marsh to the west. On the east these points stand 450 feet above the bottom of the Green Lake basin. It is thus a very considerable obstruction, completely blocking the ancient valley and inclosing the lake basin. The considerable depth of the western part of Green Lake (more than 240

feet) indicates either that the ice was melted back from the moraine so rapidly that there was not time to fill the basin with drift, or that a great mass of ice remained buried here for a time while the main ice front receded to the position of the next moraine. The eastern half of the basin was either originally much more shallow or received much more filling as it gradually shallows to the head of the lake.

Some less conspicuous morainal deposits are spread out broadly on the upland south of Ripon, and some nearly block the valley northwest of Ripon. These are parts of the Waupun moraine, with which goes also the drift ridge just west of Berlin. As shown by the hachures on some of the closed contours, the surface is pitted with irregular depressions and adjacent to these are knolls. These kettle holes are probably the result of the melting of great masses of ice which were buried in the drift. Some of the surface irregularities may be due to forward crowding of the ice, pushing the drift into knolls and ridges (photo?).

The next drift dam blocks the ancient valley west of the south end of Rush Lake (whence comes the name Rush Lake moraine). This is traversed by the wagon road and railway south of the village of Rush Lake. This moraine is traceable southeastward across the upland and in places east of Ripon knolls and kettle holes are well developed.

A small sinuous ridge of gravel (an esker) in secs. 18 and 19, Rosendale township, marks the position of a stream which flowed in a tunnel under the ice and discharged at the front of the glacier when it stood near the point where the railway crosses the west township line.

When the ice walls of the channel melted, the gravel in the stream bed was left as a ridge (photo?).

A fifth morainal dam is crossed by the railway and cut through by Rush Creek near Waukau and extends thence west to Eureka. The moraine here is largely engulfed in filling the ancient valleys, so that it does not show typical morainal topography. Farther east it is a well-marked ridge. This is one of the most important land marks in the glacial succession. It is composed of red clay, whereas the rest of the drift clay is principally buff, bluish, or gray in color. It is distinctly traceable southeastward about the head of Lake Winnebago, across the Niagara limestone escarpment and down the west side of Lake Michigan to Milwaukee.

Glacial lakes and post-glacial drainage.

As the ice front retreated eastward there was no outlet for the glacial waters in that direction, so they ponded over the low areas and overflowed the low divide to Wisconsin River near Portage. This divide has an elevation of about 790 feet above sea level. The irregular lake thus formed was extended eastward over the low lands, as the ice barrier melted away, until finally an outlet was opened to the Lake Michigan basin. Near and northeast of Green Lake the ancient valley was so blocked by the series of morainal dams that Fox River was located in its present course, winding through the low lands, and Green and Rush lakes were left undrained. With the growth of vegetation, much of the wet lowlands were transformed into extensive marshes. Vegetation is even now encroaching on the shallow waters of Rush and Puckaway lakes. Following

the settlement of the region by white men, the level of Green Lake was raised a few feet and maintained by a dam at the outlet , and developing water power, and Fox River was controlled and made an inland water way by dredging and the construction of a series of dams and locks. These artificial obstructions have, since that time, impeded the efforts of the streams to cut new channels, clear out the valleys, and drain the lakes and marshes, but even before that time the natural drainage had been able to accomplish but little since the disappearance of the ice. The small amount of modification of the surface of the glacial deposits and the presence of the lakes and marshes are in themselves evidence that the time since the disappearance of the ice, though measured in thousands of years, is almost insignificant when compared with the ages which elapsed between the consolidation of the granitic rocks of the area and the on coming of the Glacial Period.