Geological history found
in Minnesota's parks

The Geology of Jay Cooke State Park

G. M. SCHWARTZ

Jay Cooke State Park consists of 3,000 acres of wooded and rugged land on both sides of the St. Louis river, from the village of Thomson to the Duluth city limits at the pioneer village of Fond du Lac.

The St. Louis river has eroded a considerable gorge through the glacial lake sediments and glacial drift, and into the slates. The slate belongs to the Thomson formation named from its abundant exposures at and near the village. They are very old and belong to the great assemblage of rocks referred to in a general way as pre-Cambrian.

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To just what portion of the pre-Cambrian the Thomson formation should be assigned is a matter of debate; but perhaps we may compromise and say that the sediments were deposited in the early part of the last half of the pre-Cambrian — or perhaps 800,000,000 years ago. The formation consists of slate and graywacke. They are easily distinguished as the slate is thin-bedded and has well-developed slaty cleavage whereas the graywacke is massive. The slate was originally deposited as a mud; the graywacke as an impure sand. Both have been converted to their present state after deep burial by the deposition of cementing material and the action of heat, pressure and movement. The original material has partly recrystallized to form a very fine-grained minerals table under the conditions prevailing at depth. Long erosion has worn away the rocks above and exposed to view the rocks which were changed by deep burial.

The effects of pressure and movement caused the slate and graywacke beds to fold and fracture so that the beds are rarely horizontal. Sometime after the original deformation masses of molten rock forced their way into fractures, or pushed the beds aside and on cooling, formed the black dikes that may be observed at places, particularly in the river bottom when water is not flowing over the dam.

In the lower portion of the St. Louis River valley, within the park. and at the village of Fond du Lac, beds of sandstone lie on the eroded edges of the slate beds. These sandstones have not been changed much by heat and pressure and are, therefore, younger than the Thomson for-

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mation but still a part of the pre-Cambrian. Between the deposition of these beds and the glacial period there is no record of events in the region except the gradual wearing away of the rocks.

In the last big event preceding the present, the glaciers scoured off the rocks and left scratches and grooves to indicate the direction of movement of the ice. On melting, the ice deposited a considerable load of clay, sand, and boulders in the low places. During the late stage of the last glaciation of the Superior area, a large lake was ponded in front of the retreating ice of the Superior basin and filled the valley of the St. Louis and overflowed past Carlton and southwest to join the Kettle river, and then to the St. Croix and Mississippi. A great deal of clay was deposited by the glacial lake and now forms steep banks along the St. Louis river. These banks often become unstable when wet, and form landslides into the river or even across the park roads.

Perhaps the most useful information for the visitor to the park is a description of specific phenomena with their location. There are so many details of geologic interest that only a few can be described within the available space. Careful observation will reveal many others. Slate always has a well-developed parting or cleavage. This cleavage is a result of parallel orientation of the minute mineral grains that formed when the rock was under pressure. This may be observed in most outcrops. Cutting across the cleavage at many places is a series of parallel fractures known as joints. These are particularly well developed in the railroad cut just east of the river near the west entrance, but may be seen in a less diagrammatic fashion in most exposures.

Another feature shown in many beds of the slate are rounded concretions composed mainly of calcium carbonate. These have often dissolved out leaving rounded depressions in the rocks. It is probable that the concretions developed in the mud on the sea bottom.

Folds in the slate and graywacke beds may be easily observed in the gorge from the bridge at the west entrance to Jay Cooke Park to the dam about 700 feet to the north. Directly beneath the bridge on the west cliff is an open fold in the graywacke beds best seen from the east bank. Between the bridge and dam the beds alternate in dip from north to south, thus showing folds, but the crests have been eroded so that the complete fold is not well shown. About 100 feet above the bridge is a large white quartz vein which evidently filled a shear zone in the slate.

The dam above the bridge diverts all of the water in normal times to the canal and powerhouse some distance downstream, thus leaving a long stretch of the river bed nearly devoid of water. This permits observ-

ation of many features that would otherwise be inaccessible. The diabase dikes may be best observed in the vicinity of the park footbridge across the river. One extends from beneath the north end of the bridge somewhat west of south, across the river bed just east of the rock island. A double dike crosses the river bed about 400 feet east of the bridge. The west dike is 65 feet wide and the other, about 50 feet to the east, is 10 feet wide. About 250 feet farther east is another dike about 100 feet wide. Several other dikes occur downstream around the bend.

The channel of the river becomes much wider at the bend below the main park building and wooded islands appear on the higher portions. Between the south end of the first large wooded island and a series of islands in the broadest part of the channel, is a somewhat narrower channel that is crossed by a confusion of dikes and irregular intrusions of diabase. At this wide place in the channel the outcrops thin out and end altogether near the southern tip of the islands. The last exposure to the south shows a small outcrop of conglomerate and sandstone lying nearly horizontally on the eroded beds of slate. Beyond this point the river is entrenched in red lake clay to the east boundary of the park, and landslides are a fairly common feature along the steep banks in the dissected glacial lake plain.

In following the river from the west entrance downstream, it may be noted that at most places the river tended to flow parallel to the strike of the slate and graywacke beds which form a series of reefs in the abandoned river channel. This tendency is clearly a result of the ease of erosion of some of the beds forming reefs and channels that guided the water parallel to their trend. Cross joints guided erosion of narrow channels from one depression to another.

On the upland in and near the park, it may be noted that the rock outcrops occur as ridges elongated in an east-west direction because of the prevailing strike of both bedding and cleavage in that direction. These ridges usually slope off gradually at each end and such outcrops are called "roches moutonnées," a term used by the French to describe the fact that the ridges look like the backs of a flock of sheep lying in a pasture.

The value of a man's life cannot be computed. But the attitude which one takes toward his life is often reflected in the attitude he takes toward his environment.

—Rev. Loren Bowman in *Virginia Wildlife*