

## THE TOPOGRAPHY AND GEOLOGY OF THE GRAND PORTAGE<sup>1</sup>

Few areas within the boundaries of Minnesota are of greater historical interest than the region surrounding the Grand Portage, which long before the first white man visited the area had doubtless been used as the best means of reaching navigable water from Lake Superior. Dr. Solon J. Buck has written a most interesting account of the history of the portage,<sup>2</sup> and interest stimulated by this article led the writer to give particular attention to the region over which the portage passes. During the summer of 1924 some of the high bluffs overlooking the trail were climbed and some interesting facts regarding the location of the portage were observed. In 1927 the work of the Minnesota Geological Survey required the detailed mapping of this area. Advantage was taken of this opportunity to study the location of the portage relative to the geologic and topographic features of the region. As a result of this work the accompanying topographic and geologic map was prepared, which brings out various points more clearly than can words alone. The map also locates the trail more accurately than any other published map.<sup>3</sup>

The portage furnishes an interesting example of the effect of the topography and geology of a region upon human activity and thus upon the course of history. A consideration of the facts which determined the location of the trail necessarily takes one back far beyond human history to the history of the rocks of the region, and it happens that the rocks exposed in the

<sup>1</sup> Published by permission of the director of the Minnesota Geological Survey.

<sup>2</sup> "The Story of the Grand Portage," *ante*, 5: 14-27.

<sup>3</sup> The work on which the map is based was done by Dr. Frank F. Grout, Mr. Francis G. Wells, Mr. William T. Pettijohn, and the writer, all of the Minnesota Geological Survey.

Grand Portage region are very old even as geologic time is measured. The Pigeon River, from the location of Fort Charlotte to its mouth, flows practically due east. In detail, however, the stream is exceedingly crooked and the river flows nearly twenty miles to reach a point twelve miles away. This stretch of the river is not only crooked but also very swift, and is interrupted by falls as well as rapids. At places the river flows in a steep-sided canyon with very rugged country on either side. It was thus always out of the question to navigate the river by canoe from the mouth to the site of Fort Charlotte and it was equally impossible to find a good portage along the river.

The shore of Lake Superior trends somewhat southwestward from the mouth of the Pigeon, and the indentation of Grand Portage Bay somewhat shortens the distance between lake and river. The great hills and bluffs along the shore would at first glance seem to form an impassable barrier to transportation over this shorter distance, but investigation shows that there is one gap in this seemingly continuous line of hills and that a rather gradual ascent may be made from the lake level to the river above Cascade Falls, where the stream is navigable by canoe. The Indians doubtless knew the country very thoroughly and were aware that this was the only convenient route to the great inland chains of lakes and rivers. This route was accordingly followed and was called the Grand Portage by the French because of its length of over nine miles.

The region back from Grand Portage Bay is the most rugged in Minnesota and the hills from a distance look like mountains. This rugged topography is the result of complicated processes of erosion acting on rocks of varying degrees of hardness. The two main types of rocks over which the portage passes are known as slate and diabase. The Rove slate, as it is called, received its name from Rove Lake, situated some distance west on the international boundary. The rocks

of this formation actually vary considerably, but may be conveniently referred to as slate. The material was originally deposited as mud mixed with more or less sand and has been changed to slate by heat and pressure. During the period of earth history known as the Pre-Cambrian, but after the formation of the slate, the region was much affected by volcanic activity and great volumes of molten lava were pushed into the slate. At places the molten material forced its way in between the beds of slate and formed sills or sheets. At other places it broke across the beds of slate and formed large dikes, that is tabular masses, in a vertical position. The rock formed by the cooling of the lava is known as diabase. The map shows the location of the dikes and sills crossed by the Grand Portage.

The slate is comparatively soft and, because of its structure, is easily broken. The diabase, on the contrary, is hard and massive and is broken only with difficulty. Consequently the hills are usually diabase and the valleys are underlain by slate. The most prominent ridges of the region about Grand Portage Bay are mainly dikes. Very little is known regarding the geological history of the region from the time of the intrusion of the molten rock to comparatively recent geologic time. Erosion was active at times and the region was worn down so that the intruded rocks were first exposed and then left as hills as the eroding forces cut away the softer slate.

It is obvious from viewing the region or studying the contours of the accompanying map that the valleys have not been developed to any great extent by the streams which occupy them at present. For example, the conspicuous valley followed by the Grand Portage for the first three miles from Lake Superior has no stream in its upper part. Detailed observations of the region show the same thing on both a large and a small scale. There is no doubt that the major topographic features of the area were developed in pre-glacial time; that is, the valleys were cut by streams which drained the region be-

fore the great ice sheets advanced from the north and covered the entire country. As a rule the pre-glacial streams cut valleys in the slate parallel to the sills and dikes of diabase, but some streams of the upper region flowed southward to Lake Superior along the great valley followed by the portage.

The advance of the glacier partially filled the valleys with debris and the hills were scraped nearly bare of soil. When streams began to flow, following the retreat of the glacier, they were forced to follow new channels in places, and some of the prominent gorges and valleys were left without streams.

Grand Portage Bay is the largest indentation of the Minnesota coast of Lake Superior. The village of Grand Portage occupies a relatively low and level area around the bay. To the east is the prominent ridge of Hat Point. This is formed by a large dike and the bay and surrounding lowland is mainly the result of erosion of the softer slate. About one mile up the portage from the bay is a gap where an old valley cuts across two large dikes. The map shows the close relation of the dikes and ridges. The stream which now flows through this gap is very small. About a mile farther on, the trail passes around the nose of a high dike ridge and over a slight crest, then dips across a valley. This is practically the only place on the trail where elevation once gained is lost, but it was impossible to avoid this valley and a loss of elevation of a hundred feet. Beyond the stream the trail follows the gentle rise to the west for three miles.

About midway between Lake Superior and the Pigeon River the trail passes through a narrow gap. It is noteworthy that this is the only break in a ridge which extends far on each side of the trail. One must admire the manner in which advantage was taken of every favorable place in the topography. Beyond the gap the trail turns nearly due west and for the most part follows the dip slope of diabase sills, thus securing a comparatively level route and avoiding the extensive swamps of this westerly area. The broad curve of the trail

to the north about two miles from the river was made to avoid a large swamp. By following the sill a gradual descent to the river was obtained.

The great pre-glacial valley cut through the dikes north of Grand Portage formed, as noted above, the only natural route from Lake Superior to the Pigeon River. Geologic processes are responsible for the erosion which cut the one practical route. This path accordingly was followed by the Indians and later by explorers and traders, and thus the pre-glacial valley carried commerce instead of water. The development of modern transportation has left the old trail without even this traffic, but the historic and geological interest remains. It is sincerely to be hoped that some means may be found to preserve the old route. At least it should be marked in a permanent manner.

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