East Bluff of Devils Lake gorge

Location. Near the junction of the Potholes Trail and the Devils Doorway Trail at the top of the east-west part of East Bluff, in Devils Lake State Park, in the NE1/4 SE1/4 sec. 24, T11N, R6E, and NW1/4 SW1/4 sec. 19, T11N, R7E, Sauk County (Baraboo, Wisconsin, Quadrangle, 7.5-minute series, topographic, U.S. Geological Survey, 1975) (fig. 1). East Bluff can be reached on footpaths from the parking lot on the southeast side of Devils Lake. Follow the path from the north edge of the lot, cross the railroad track, turn left, and follow the Balanced Rock Trail up to the Devils Doorway Trail at the top of the bluff, or cross the track, and turn right and follow the Grottos Trail to the Potholes Trail or CCC Trail up to the Devils Doorway Trail.

Alternatively, park in the lot on the northeast side of Devils Lake and follow the East Bluff Trail to the top of the bluff and south to the Devils Doorway Trail.

Location maps occur at frequent intervals along the trails.

Authors. Lee Clayton and John W. Attig, 1990.

Baraboo Hills. The Baraboo Hills consist of the North Range and the South Range, which join at their ends in the form of an oval. The Baraboo Hills are the surface expression of the Baraboo Syncline. The North Range, 8 km north of here, is less conspicuous than the South Range. The more prominent South Range is 40 km long, from east to west, and is 5 km wide. Devils Lake, in Devils Lake gorge, is near the middle of the South Range (Clayton and Attig, 1990).

Baraboo Formation. The South Range is made up primarily of the Baraboo Formation, which consists of 1.5 km of Early Proterozoic quartzite that dips to the north about 15°. The quartzite consists of cross-bedded and plane-bedded, subrounded to angular, quartzose, very fine to fine sand that has undergone low-grade metamorphism. It is white to dark gray, commonly with a pink, red, or purple tinge. Beds of conglomerate and phyllite are also present in some parts of the formation. Bedding planes with wave ripple marks can be seen in several places along the trails going up the bluff face, indicating a shoreline environment.

Devils Lake gorge. The best views of Devils Lake gorge are from East Bluff and West Bluff. The gorge, which is the only one cutting across the South Range of the Baraboo Hills, is 6 km long and 1 km wide. It is now 150 m deep, but before Pleistocene sediment was deposited in the bottom of the gorge, it was at least 110 m deeper.

The gorge was originally cut through the quartzite of the South Range sometime before the Late Cambrian Epoch (Attig and others, 1990). It was then filled with sediment during the Late Cambrian and the later Paleozoic; remnants of sandstone of the Parfreys Glen Formation can be seen in several parts of the gorge, such as near the southwest shore of Devils Lake. The gorge was later exhumed, perhaps starting during the Mesozoic or Cenozoic. The last surge of erosion occurred when an early version of glacial Lake Wisconsin drained through the gorge (Clayton and Attig, 1989). (Contrary to popular opinion, the preglacial Wisconsin River never flowed this way.) During the Wisconsin Glaciation, and perhaps during earlier ones as well, the gorge was clogged with glacial, fluvial, and lacustrine sediment, which is at least 135 m thick beneath the moraine southeast of Devils Lake. This plug of sediment prevented Lake Wisconsin from again spilling this way, forcing it instead to spill to the northwest, down the Black River (northeast of La Crosse).

Johnstown moraine. Devils Lake occupies a basin created by plugs of material across the gorge north and southeast of the lake. This material is part of a moraine formed during the Johnstown

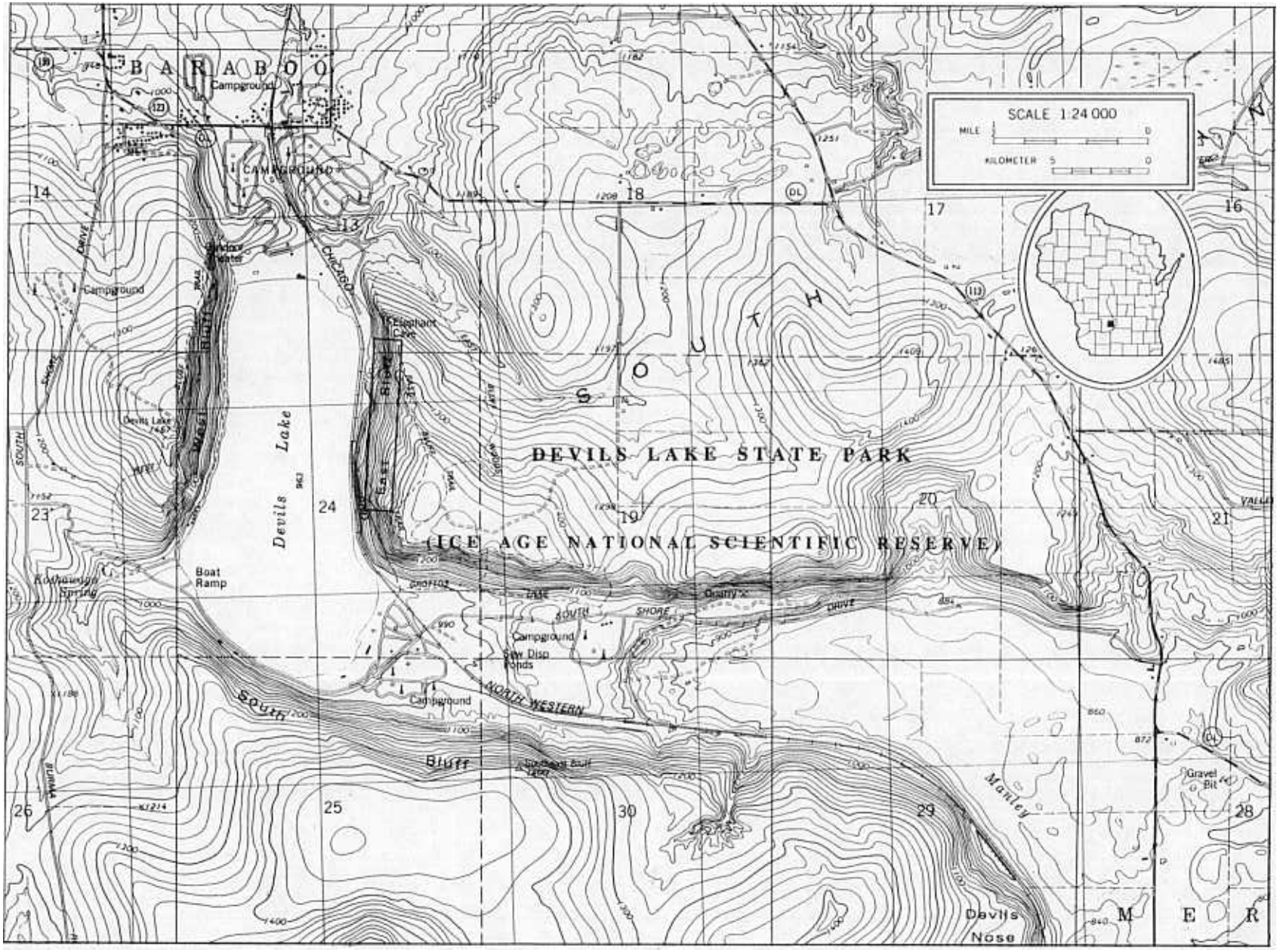

Fig *Location of Eas luff of Devils Lake gor*

Phase of the Wisconsin Glaciation. The Johnstown moraine can be traced from Johnstown in southeastern Wisconsin, then south and west of Madison, to the Badger Army Ammunition Plant south of the South Range. From there it can be traced up around Devils Nose, down the east end of South Bluff, across the floor of the gorge about 1 km east of the southeast shore of Devils Lake, up the east end of East Bluff to the crest of the South Range 6 km east of the lake, then back to the north end of Devils Lake and northwest to West Baraboo. As viewed from the east part of East Bluff, the moraine to the southeast of the lake is a conspicuous ridge across the gorge. Its west side is 20 m high and its east side is 50 m high. The moraine to the north of the lake is 20 m high and has been breached by a channel now occupied by the railroad. Where the moraine crosses the higher parts of the South Range, it is typically only about 15 m high.

Summit plateaus. The highest summits of the South Range are nearly flat plateaus above an elevation of 425 m (1,400 ft). Summit plateaus occur at the tops of East Bluff, West Bluff, and South Bluff. Devils Doorway Trail is at the south edge of the East Bluff summit plateau. Thwaites (1935, p. 395, 401-402; 1958, p. 140-141, 145-147; 1960, p. 36-38) suggested the plateaus were cut by wave action during the Ordovician Period.

Talus. The talus fans along the walls of Devils Lake gorge are up to 100 m high and are composed of angular boulders of Baraboo quartzite, some more than 3 m across. The boulders were eroded from the cliffs at the top of the gorge during the Wisconsin Glaciation and earlier. The abrupt termination of the talus on South Bluff at the west edge of the Johnstown moraine indicates that the talus formed before the moraine formed or as it formed, not after — probably when permafrost was present and frost action was most active in the cliffs (Smith, 1949, p. 199-203). We know of no evidence that the talus is still accumulating.

Potholes. The quartzite surface on the south side of the summit plateau above South Bluff is pitted with a few dozen potholes (Black, 1964; 1974, fig. 66). Most occur within 100 m west of the junction of Potholes and Devils Doorway Trails, but some occur along the Potholes Trail, a few tens of metres below the plateau. They range from several centimetres to about 1 m in diameter and depth. The potholes were cut by stones in eddies at the bottom of a river. In a few places the quartzite surface between the potholes is polished as a result of sandblasting on the river bed.

Black (1964; 1968; 1974) suggested that the potholes were cut by a glacial meltwater river during Pleistocene time; he also suggested that those along Potholes Trail are plunge pools of a meltwater cascade over the cliff rather than potholes, but we know of no evidence that meltwater ever flowed here. More likely, they formed in the bottom of a river flowing here when the South Range was beginning to be exhumed during the Mesozoic or early Cenozoic, as argued by Thwaites and Twenhofel (1921).

Windrow Formation. The Windrow Formation was named after Windrow Bluff, west of Tomah in west-central Wisconsin (Thwaites and Twenhofel, 1921). It occurs as small isolated bodies of stream gravel on uplands in western and southwestern Wisconsin and adjacent areas. "A pint or so" of what would later be called Windrow gravel was observed in one of the East Bluff potholes by Salisbury (1895, p. 657); K.I. Lange, Devils Lake State Park naturalist, collected a pail of Windrow gravel from one of the potholes along Potholes Trail (verbal communication, 1986), but few other observers appear to have actually seen in-place Windrow Formation here. The "Windrow gravel" commonly reported at East Bluff instead consists of scattered loose pebbles on the quartzite surface or pebbles in Pleistocene hillslope deposits that were in part originally derived from the Windrow Formation. The pebbles consist of polished chert; many are well rounded and some contain Silurian fossils.

Black (1964) suggested that the Windrow gravel at East Bluff was deposited by a Pleistocene meltwater stream, but there is no evidence that meltwater ever flowed across the area. More likely it

was deposited by a river that flowed here when the South Range began to be exhumed during the Mesozoic or early Cenozoic, as suggested by Thwaites and Twenhofel (1921).

Andrews (1958) defined an "East Bluff member" of the Windrow Formation, but no type section was designated. However, it seems unlikely that he actually saw any in-place Windrow gravel at East Bluff — more likely he observed the pebbles in Pleistocene deposits that had originally been eroded from the Windrow Formation. For this reason, his "East Bluff member" is considered an invalid stratigraphic name. Andrews correlated his East Bluff member with the Ostrander Member of the Dakota Formation (Early Cretaceous) of southeastern Minnesota, but we know of no evidence that any of the Windrow Formation correlates with the Ostrander.

Quartzite blocks. In the unglaciated part of the South Range, block streams occur on the lower slopes below the summit plateaus. These lobate masses formed when permafrost was present during glaciation (Smith, 1949, p. 203-207). The block streams can be traced up slope to their source, which was commonly a low cliff of quartzite below the edge of a summit plateau. In a few places, angular blocks of quartzite can be seen next to a cliff, caught in the act of being separated from the cliff when the permafrost episode ended.

One much-illustrated quartzite block, upslope from a block field, is next to the service road from Steinke Basin, north of East Bluff. Black (1964, p. 169-171, figs. 1 and 6; 1968, p. 143, fig. 11; 1970, p. 72-73, fig. 15; 1974, p. 106, figs. 65 and 81) thought that it and others like it were glacial erratics. He argued that they are at the crest of the South Range and that no processes other than glaciation could have moved them there. However, this block is at least 10 m below the crest, and all the other large blocks here are also well below the crest, where they probably slid, rolled, or were rafted by solifluction when permafrost was present. Only small quartzite blocks occur on the crest; they lie directly on in-place quartzite or were frost-heaved onto the thin layer of wind-blown silt blanketing the plateau.

Boulders of igneous and metamorphic rock are present on the summit, but they are at the edge of service roads and were removed from the fill used to construct the roads. We have seen no evidence here for glaciation above East Bluff, although the east end of the bluff was clearly glaciated.

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