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GLACIATED ROCK SURFACES NEAR LINN AND NEAR
QUARRY, IOWA, WITH A TABLE OF THE BEARINGS
OF GLACIAL STRIAE IN IOWA.

BY W. H. NORTON.

Linn is a junction of the Chicago, Rock Island and Pacific Railway, situated four miles northwest of Cedar Rapids. About one mile west of this station a rock cut, formerly used by the Chicago, Milwaukee and St. Paul Railway, scarps the bluffs bordering the Cedar River. At the extreme north end of the cut, 14 feet above the trackway, and about 75 feet above the level of the river, there is exposed by the retreat of a cover of yellow till and loess a surface of less than two feet square, developed on glaciated limestone belonging to the *Acervularia davidsoni* zone of the Cedar Valley stage of the Devonian. Although rubbed down to a fair degree of smoothness the rock was not planed level and retains something of an original convexity. An initial depression an inch in depth and four inches wide crossing the surface from northwest to southeast is not completely smoothed, and the northwest side of the hollow is less distinctly glaciated than the opposite. The surface of the knob is covered with shallow striae of varying bearings. On the south side they bear (corrected) S. 79° E. On the center and north they bear S. 84° E and E 4° N some striae reaching E. 14° N. The west side of the knob is well rubbed and is evidently the stoss. The south shoulder is not planed. It is worthy of notice that the striae are aligned with the trend of the valley of the Cedar river which here changes its course from east-southeast to south-southwest.

In the spring of 1910 my attention was called by the Division Superintendent of the Chicago and Northwestern Railway to an exceptionally large glaciated surface exposed by recent stripping at the company's quarries one and one-quarter miles northeast of the station quarry in Marshall county. The surface exposed measured about 75 feet in width and 275 feet in length. Over the entire space the level rock floor of the oolitic limestone of the Kinderhook had been smoothed and scored with close-set parallel striae. Little if any plucking had been done, and no knobs had been left above the general level. The only depressions noted

were shallow, and these surrounded pipes opened by ground water along joint planes. Here the granular limestone was slightly decayed and resistant crystalline shells of brachiopods were left in relief. These depressions may be assumed to be post-glacial, since any preglacial hollows as shallow as these would have been scoured as clean of all decayed rock as are the surrounding levels.

Over all this exceptionally large area only one set of striae was developed. None were noted which deviated more than one or two degrees from the uniform bearing of S. 22° E. (corrected). Besides the striae shallow grooves, some reaching a width of three quarters of an inch are not uncommon. One of these grooves measured 18 feet in length.

The movement of the ice was clearly to the southeast. The area is demarked on the northwest by a steep ravine. Here are found stoss abrasion surfaces rising to the general level from one and one-half feet below it. Small cavities show on the southeast side the characteristic rounding of the edge, while the northwest side retains the initial profile. Many examples of chatter marks were noted which were concave to the southeast.

A number of boulders lay on the glaciated surface. The largest, four feet in diameter, of gray granite, was glaciated on one side. Two others were distinctly faceted and scored. One, of reddish gneiss, and strongly unequiaxed, (its diameter being 5, 1½ and 1½ feet) lay with its long axis parallel with the striæ of the glaciated area.

TABLE OF BEARINGS OF GLACIAL STRIÆ IN IOWA.

Locality	Bearing, Corrected	Authority
Northeastern Iowa—		
Johnson County:		
*Clear Creek	S62°E	Calvin
*Hutchinson Quarry, Iowa City.	S62°E	Webster
Marshall County:		
LeGrand	S24°E	Beyer
Timber Creek	S25°E	Beyer
Sec. 8, Timber Creek Twp.	S20°E	Beyer
Quarry, 1¼ mile ne.	S22°E; S23°—47°E; and S35°—64°W ...	Norton
Linn County:		
Linn Junction, 1 mile west.	S79°E—E14°N	Norton
Southeastern Iowa—		
Washington County:		
Eckles Quarry, Crooked Creek..	S67°E	Bain
*Brighton	S4°E and S6°E	Bain
Des Moines County:		
*Kingston	Main set S64°E.	Fultz
Kingston one-half mile from pre- ceding	S70°E	Fultz
*Burlington 2 miles north.	S15°E	White
*Burlington, North Hill	S65°E	Leverett
*Burlington, North Hill	S63°E	Keyes
Burlington, Flint Creek Bluff...	S73°E	Fultz
Burlington, Flint Creek Bluff, one-eighth mile distant	S33°E	Fultz
Burlington, Court and Prospect streets	S72°W	Leverett & Fultz
*West Burlington	S75°E	Fultz
West Burlington	W-E	Leverett
Wapello County:		
Eddyville	S42°E and S70°E	Bain
Northwestern Iowa—		
Lyon County:		
*Granite, 3 miles north.	S53°E	Keyes
Two miles east of nw corner...	S30°—40°E and S10°— 15°E	Shimek
Jefferson County:		
Sec. 23, Penn Twp.	S75°W and S35°E.	Udden
Southwestern Iowa—		
Decatur County:		
Pot Hole Creek	S1°W	Fitzpatrick
Mills County:		
Heaton ½ mile south.	S7°W and S50°W.	Udden
Secs. 10 and 15, Lyons Twp.	S25°W—S34°W	Udden
Sec. 22, Glenwood Twp.	S14°W, S12°W	Udden
*Pacific Junction, 5 miles south..	S10°E and S41°E	White
*Pacific Junction, 5 miles south..	N-S, S2°W, S3°E-S6°E.	Todd
*Pacific Junction, 5 miles south..	S25°E—S50°E	Todd
*Pacific Junction 4 miles south..	S3°W—S12°W.	Todd
*Pacific Junction 3¾ miles south	S5°W, S30°W	Todd

In the above table the localities starred are those listed by Keyes in a table of glacial scorings in Iowa, Iowa Geological Survey, Vol. III, Des

Moines, 1895. At this time the areal work of the Iowa Geological Survey had hardly been begun. Reports on but two counties had been published. The judgment of Keyes expressed in the paper cited that "the apparent rareness heretofore of glacial striations in Iowa is manifestly due not so much to an absence of ice action as it is to a lack of careful observation and examination," may well have been accepted by the entire staff of the survey and they may have entered upon their work with confident expectation that a thorough search would multiply many fold the discovered autographs written by pleistocene glaciers upon the rocks of Iowa.

During the sixteen years which have elapsed since the publication of Keyes' paper, the areal survey of the state has been in progress and is now well nigh completed. Thousands of quarries and outcrops have been examined but the list of glacial scorings complete to date, so far as the writer is able to ascertain, remains a meagre one. Only eleven new localities have been added to the eight of Keyes' paper, and several of these are either in the same district or adjoin localities reported by Keyes.

The rarity of glacial scorings in Iowa is therefore not merely apparent. It is real. Giving all due weight to "the illusory effects due to lack of observation on account of deep drift covering," it still remains that ice-scorings are relatively rare in Iowa. Indeed, it is largely due to the covering of till that the list of scorings is as large as it is, for it is only the cover of impervious clays which has prevented post glacial obliteration.

From the fact that careful search has found glaciated rock surfaces in but ten counties of the state, we may infer that the pleistocene ice sheets which so strongly scoured the rocks of more northern areas here did little abrasive work. The deep residual clays which covered the state with a "terra rossa" in late Tertiary times were partially but not wholly scraped away. Remnants may now be found in almost any quarry resting on rock surfaces more or less decayed and pitted by the solvent action of descending ground waters. That the larger part of this decay is preglacial may be inferred from the thickness of the weathered zone of the rock, from the size of solution pipes, from the depth of geest occasionally found, and from the close similarity of these diagnostic features to the phenomena of weathering to be observed in the driftless area. Still surer evidence of preglacial rock-decay is found in sections showing masses of partially decayed rock with the geest still in place upon them which have been plucked and are now found imbedded in till.

Iowa appears to have been an area of glacial deposition rather than an

area of glacial erosion. It is a part of that wide glacial delta which may be compared with a continental delta, such as that which fronts our Atlantic coast. The Nebraskan ice apparently overrode the rocks of Iowa in the manner of a sled and not as rasp or pick, to use Chamberlin's vivid metaphors. And the later ice invasions not only failed for the most part to remove the ground moraines of earlier ice sheets, but they also added to the pile imbricating deposits of their own.

Addenda. In the discussion of the above paper attention was called by Professor H. S. Conard and by Dr. S. W. Beyer to the fact that at Quarry recent stripping had uncovered another glaciated area, and that here the scorings bore to the southwest. The locality was revisited by the writer in the summer of 1911. The area described was then being rapidly cut away by quarrying operations. But beyond the narrow ravine which bounds it on the northwest, there were found exposed two additional glaciated areas, separated from each other by a narrow ravine. Here the rock surface was considerably more decayed, and the glaciation less complete than on the area described, but many patches of sound rock were covered with well defined striae. On the middle area the striae have the same general bearing as those of the southeastern area. Here a reading of S. 39° E. was noted. But on the northwestern area two distinct glaciations were to be seen, each occupying its own field. On the inner side, that to the northeast, the southeast glaciation was found along a narrow strip about 700 feet in length, which further stripping may widen. Here bearings of S. 47° E., S. 44° E., and S. 23° E. were observed. The larger part of the area is occupied by patches of striae bearing to the southwest. Even on surface of one or two feet square these may diverge as much as the following: S. 64° W., S. 53° W. and S. 46° W. Other striae whose bearings were taken had the compass directions of S. 35° W. and S. 41° W. The striae farthest to the north bore S. 31° W. The two sets of striae, that of the southeast and that of the southwest glaciation, approached in places as near as 10 or 20 feet to each other, but in only one or two doubtful cases was any superposition noted.

Since the meeting of the Academy Professor B. Shimek has generously placed at the disposal of the writer his notes on an area of glacial striae in northwestern Iowa, the locality being situated two miles east of the northwestern corner of the state. The scorings are developed upon the surface of the Sioux quartzite. The prevailing direction of the striae is N. 30°-40° W. Other crossing striae bear N. 10°-15° W. A groove eighteen inches across bears N. 45° W. and in this lay a light granite boulder, fitting the groove to a nicety, but too much decayed to show planings or striae.