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CYCLES OF EROSION IN THE CENTRAL BLACK HILLS

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While inspecting some placer gold deposits in the Central Black Hills during the Spring of 1933, the author noticed that the erosional history of this area appeared to differ from that of the Northern Black Hills as described by Dr. Louise A. Fillman.[1]

The location of the area is in T. 1 N., R. 3 E.; T. 1 N., R. 4 E.; and the southern one-third of T. 2 N., R. 4 E. along Castle Creek, Slate Creek, and Rapid Creek, and the divides between Rapid and Castle, Castle and Slate, and Slate and Spring creeks.

The area is underlain by a pre-Cambrian complex of schists and slates. There seems to be no beds of sufficient resistance to erosion to control the topography.

In order that the reader may have a clearer picture of the region under discussion the usual procedure will be departed from in that the present drainage will be first considered. From the present drainage the cycles of erosion from younger to older will be discussed, being taken up in reverse order of their occurrence.

Present Drainage

Rapid Creek flows in a general east by southeast direction. Castle Creek, which is tributary to Rapid Creek, flows in a east and northeast direction. Slate Creek, which is also tributary to Rapid Creek, flows northeast and north. Flowing in youthful valleys, the streams have a gradient of a little over 50 feet to the mile, although that of Slate Creek is higher than either of the other two. The courses of the streams are quite crooked and irregular, that of Castle Creek being especially so. Although in a youthful cycle of valley development, the streams are at grade within this region.

The reduction of the region as a whole is in late youth.

First Terrace

At many places terraces are found about 50 feet above present drainage level. These terraces are well devloped, and at some places are found on both sides of the valley. Cut into the bedrock,

1 Fillman, Louise A. Cenozoic History of the Northern Black Hills. Univ. of Iowa Stud. in Nat. Hist., Vol. XIII, No. I, 1929.

the first terrace, at all places observed, is capped with from 10 to 20 feet of gravel.

The height of the terrace above present drainage decreases up the streams.

SECOND TERRACE

A second set of terraces is developed along Rapid, Castle, and Slate creeks about 100 feet above the first terrace and 150 feet above present drainage. The second terrace, being older and occupying a higher level, is more dissected and fragmentary than the first terrace.

It appears that the streams at the time of the formation of the second terrace were not as crooked as they now are. The reason for this statement is that these terraces do not closely follow the present valleys. In some places the second terrace grades into saddles or gaps cutting across the spurs and curves of the present valleys. However, the first terrace seems to follow quite closely the present valleys.

Like the first terrace, the second terrace is cut into the bedrock, but is capped with a much thicker deposit of gravel. The gravels are commonly 30 feet thick, and at one place a prospect shaft was sunk into the second terrace to a depth of 80 feet without reaching bedrock.

The height of the second terrace above present drainage also decreases upstream.

PLEISTOCENE (?) VALLEYS AND GRAVELS

Standing about 250 feet above the second terrace and 400 feet above present drainage there are old stream valleys. These valleys lie in a general north by northwest to south by southeast direction. They are almost at right angles to the present drainage lines and cut across the divides. By observing the differences in elevation of the bedrock of these old valleys it was definitely determined that the flow was from north to south. It is possible that these deposits were formed by a stream or streams that were tributary to a east by southeast flowing stream of Pleistocene age about 7 miles south of this area as shown by Darton.[2] However, the elevation above sea level of the old valleys in this area are between 5300 and 5400 feet, whereas portions of the valley of the master stream as shown by Darton stand at elevations between 5700 and 5800 feet.

These high-level valleys have been subjected to so much erosion

2 Darton, N. H. Preliminary description of the Geology and Water Resources of the Southern Half of the Black Hills and adjoining regions in South Dakota and Wyoming. U. S. Geol. Survey, 21st Ann. Rept., pt. 4, plate xcv, 1900.

and dissection that in some places the only remaining evidence of their existence are aligned saddles of nearly equal elevation. Well defined valleys are nevertheless still intact at a few places.

In the N. ½ of Sec. 3, T. 1 N., R. 4 E. cutting across the divide between Castle Creek and Slate Creek is the largest remnant observed. This remnant is about 2500 feet long and from 200 to 500 feet wide and slopes to the south. Shafts sunk to bedrock along this valley indicated that the slope of the valley floor is about 35 feet to the mile. The actual gradient of the stream that formed this valley might have been much less than this, as it was probably at grade as shown by the thickness of the stream deposits. Warping during uplift might have modified this slope of the bedrock.

The old valley just mentioned, which is locally spoken of as "The Old River Bed," has a valley fill which reaches the depth of 41 feet. On the average, the upper 10 feet of the fill is composed of locally derived sidewash material which is of clay intermixed with sharply angular pieces of schist and slate. The remainder of the fill is mostly composed of rounded, sorted, and stratified gravels. The term gravels being used for materials ranging in size from fine sands to large cobbles and boulders. There is a considerable amount of locally derived angular fragments of vein quartz, schist, and slate intermixed with the gravels.

In Sec. 33, T. 2 R. 4 E. there is another old high-level valley cutting across the divide between Castle Creek and Rapid Creek and standing about 400 feet above present drainage. Although gravels are present in this valley similar to those of the "Old River Bed" the writer has no data concerning their depth nor as to the slope of the bedrock. This remnant is also about one-half mile in length.

Two other places where gravels at this elevation may be observed are in Sec. 7, T. 1 N., R. 4 E. at Cheese Hill and at the head of Hoodoo Gulch. The gravels on Cheese Hill, which is a great spur extending out into the valley of Castle Creek in the northern portion of the section, have been greatly dissected. However, the water-worn character of the bedrock, which slopes off to the southeast, is well shown at this point.

Of especial interest is the 50 foot valley fill at the head of Hoodoo Gulch. Underlying about 10 feet of local side-wash is 35 feet of a fine blue clay. This clay is massively bedded and shows no bedding planes or varves. It is so free from sand and coarse material that it may be placed between the teeth with but little grittiness. Underlying the clay is about 5 feet of well sorted and

rounded gravel which rests on a waterworn bedrock which slopes to the southeast.

The writer does not know whether these old high-level valley remnants in this area represent portions of a once continuous valley of a single stream or the valleys of several streams.

OLDER PLEISTOCENE (?) OR PRE-PLEISTOCENE EROSION

Standing about 150 feet above the Pleistocene (?) valleys are a set of saddles or gaps that may be aligned in a northwest to southeast direction. This alignment obliquely cuts across the Pleistocene (?) valleys. Rounded gravels were found in some of these gaps. Although the evidence for there ever being a set of streams at this level is almost entirely eroded away, it seems probable that these aligned saddles or gaps standing at approximately the same elevation are all that is left of a stream or set of streams that flowed across this area to the southeast.

SUMMIT LEVEL

At an elevation of 5700 to 6000 feet there are wide expanses of fairly level areas. These undissected portions of the region occupy the divides between the major streams.

In Sec. 36, T. 1 N., R. 4 E. at an elevation of about 5800 feet there is a valley which is cut into the summit level. At this place which is on the divide between Slate Creek and Spring Creek and near the head of Marshall Gulch, there is a remnant one-third of a mile long of an old valley. The trend of this valley is almost due west to east. There is a fill in this valley composed of local side-wash, clay, and gravel. The clay is the most dominant type of material in the fill, there being about 15 feet of yellow and blue clay present, with the entire thickness of the fill being about 25 feet.

Darton [3] connects this old valley remnant with the Pleistocene (?) valley remnants to the north. The fact that there is about 400 to 500 feet difference in elevation between the valley on the divide between Slate Creek and Spring Creek and the Pleistocene (?) valleys to the north seems to indicate that they were not formed at the same time unless certain portions of the area were elevated more than others.

RECAPITULATION

By way of summary the cycles of erosion will be listed chronologically in the order of their occurrence.

[3] Darton, N. H. *Op. cit.*

1. Channeled summit levels possibly representing a peneplane. Uplift of 250 to 300 feet.
2. Development of a drainage system with the streams flowing to the southeast. Uplift of about 150 feet.
3. Well developed valleys formed by south flowing streams. Valleys probably reached a state of maturity. Uplift of 250 feet.
4. A drainage system established with the streams flowing to the east and northeast. Streams followed much the same course as the present ones only not as crooked. Up-lift of 100 feet and the formation of a terrace.
5. Drainage much the same as in 4 only more crooked and closely following present drainage lines. Uplift of 50 feet with the formation of a terrace.
6. Present cycle of erosion in which the drainage lines are to the east and northeast.

The total amount of uplift in this area is between 850 and 900 feet.

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