



## *Glaciation in the Sangre de Cristo Range, Colorado*

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# GLACIATION IN THE SANGRE DE CRISTO RANGE, COLORADO

by

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Glaciated summits of the Sangre de Cristos.

Looking eastward from any vantage point within the San Luis Valley one may observe some of nature's most spectacular sculpture. The rugged Sangre de Cristo Range, with towering Blanca Peak, elevation 14,363 feet, attest to the relentless work of the glaciers during that period that was the Pleistocene.

Although the results of the glaciation may be readily observed, surprisingly little has been written concerning this phase in the development of the range. Endlich (1875) made perhaps the earliest mention of glacial action in the range. Stevenson (1881) remarked about the evidence of the existence of glaciers above 10,000 feet in the Culebra

and Taos ranges and in the east side of the Sangre de Cristos of the Wet Mountain Valley area. He stated (p. 434), "the eastern slope of the Sangre de Cristo Mountains is literally gashed to the central line by universal glacial gorges which are closed by enormous moraines extending hundreds of feet into the valley." Siebenthal (1907 and 1910) has made the most extensive report on the glacial aspects of the west side of the range. Upson (1938) included a short note on the glaciation in his study of the physiography of the Culebra reentrant. Ray (1939 and 1940) discussed, in detail, selected areas within the east side of the range. Authors of several theses written on the mountains have very briefly commented on the glacial history. In all, no one has made a study of the physiography and Quaternary geology of the Sangre de Cristo Range as complete and as thorough as Atwood and Mather (1932) did in the San Juan Mountains.

What follows here is a brief summary of the current knowledge regarding the glacial history of the Sangre de Cristo Range.

The east side of the mountains had perhaps the longest period of glaciation or perhaps the record of the glacial epoch is better preserved on this side. At least five substages of the Wisconsin Glacial Stage have been recognized in such areas as the Huerfano River Valley, West Spanish Peak, and Trinchera Peak in the Culebra Range (Ray, 1940).

Substage I is recognized by terminal moraines at elevations ranging from 8,800 feet in the Huerfano River Valley, 9,000 feet in Wahatoya Canyon on West Spanish Peak, to 9,900 feet on the east side of Trinchera Peak between Cuchara Camps and Blue Lake.

Substage II is usually marked by smaller moraines which in the case of the Culebra Range are plastered against the sides of the higher and larger substage I moraine. Wisconsin II moraines are located at 8,800 feet in the valleys northeast of Blanca Peak, at 9,800 feet on West Spanish Peak, and at approximately 9,900 feet at Bear Lakes in the Culebras where the lakes are impounded by the moraine. The second glacial advance of the Wisconsin had as great an extent as did the first in the main part of the range. However, on West Spanish Peak the second substage fell 800 feet short of the first glaciation. Ray (1940) admits that the evidence for the substages in Wahatoya Canyon is not complete. Perhaps the second substage glaciers did extend farther down the canyon, only additional field work will tell.

Ray (1940, p. 1885) also notes that in the valleys of the

Huerfano River there is evidence of uplift and stream incision in the interstadial interval between Wisconsin I and Wisconsin II. He also noted the similarity to the incision of streams in the San Juan Mountains and commented, "this is the only area in the Southern Rocky Mountains where this marked canyon cutting during the Wisconsin stage was seen."

Substage III is marked by terminal moraines found farther up in the canyons. The Huerfano River Valley again witnessed the lowest glacial advance where moraines are found at 9,100 feet. On West Spanish Peak the Wisconsin III moraine is at 10,500 feet. In the Culebras, "below the lip of the three cirques north of Trinchera Peak are large masses of hummocky moraine material interpreted as deposition during Wisconsin III when glaciers evidently only moved a short distance," (Ray, 1940, p. 1887).

Substage III obviously had a lesser extent than did I and II, and substage IV was of even lesser span reaching only as low as 10,200 feet on Blanca Peak and 11,500 feet in Wahatoya Canyon. In the Culebra Range, most of the Wisconsin IV moraines occupy areas at the lip of the cirques.

Protalus ramparts of varying sizes developed in all areas after the final disappearance of the glaciers. In the Blanca Peak region, the protalus ramparts, if formed during Wisconsin V, "have been obliterated by rock glaciers which either buried or swept them away," (Ray, 1940, p. 1884). Ray also states (1940, p. 1885), "A rock glacier was probably initiated during the rigorous climate of the fifth Wisconsin substage. The present climate is such that additions to the talus are sufficient to keep the rock glaciers in motion." There seems to be a question as to whether protalus ramparts ever existed in the Blanca Peak area.

In contrast to the rather well documented five substages of the Wisconsin on the east side of the Sangre de Cristo Range, there are only isolated and incomplete reports of glacial activity on the west side. Upson (p. 197) reports a glacier that extended down the North Fork of Rio Culebra to a locality near the contact between the Precambrian and softer basin sediment deposits. "Here, two high ridges, whose crests are about 400 feet above the present stream bed and flanking the valley on each side, extend downstream from higher hills." These are lateral portions of terminal moraines which Ray (1940) correlates with the second Wisconsin substage. However, since both the first and second substages extend to the same elevation on the opposite side of the range, and since the first glaciation built larger moraines, it would seem that perhaps the moraine described by Upson is in reality representative of the first substage rather than the second.

Siebenthal (1910, p. 37-38) summarizes the glaciation of the west side of the Sangre de Cristo Range from Blanca Peak northward as follows:

*"The various stream valleys heading against the crest of the Sangre de Cristo Range all held Pleistocene glaciers, the morainic remains of which fall into two systems showing the existence of two periods of glaciation. The moraines ordinarily reach down to*

*about 9,500 to 9,000 feet above sea level and crown the summits of the great alluvial cones that spread out from the mouths of the stream canyons. The moraines of both systems are comparatively fresh looking, and the outer, older ones are not noticeably more eroded than or different topographically from the inner, later ones.*

*Black Canyon, just east of Orient, has lateral moraines on either side of the valley, 100 to 200 feet high and reaching to the alluvial slope at the mouth of the canyon. A prominent moraine juts out from the Willow Creek canyon, east of Crestone. Behind the moraine is the park or meadow, the bed of an extinct glacial lake. Two existing glacial lakes are found in the U-shaped valley above the park, as well as striae, roches moutonnees, and other evidences of ice occupation. South Zapata Creek Valley, heading in the Blanca massif, exhibits the same evidences of ice occupation, together with a double crescentic moraine crowning a great alluvial fan at the height of 1,500 feet above the level of the valley. The inner moraine formerly inclosed a small lake, the outlet of which cut through the moraine where it adjoined the canyon wall on the north side and, once incised in the rock, has continued to cut back a narrow winding cleft, through which water pours, forming the picturesque Zapata Falls. Middle, Bear, Little Bear, Blanca, and Ute creeks, the circle of radiating streams flowing down the west and south sides of Blanca Peak, each held a glacier which came down to and terminated upon the apex of its alluvial fan."*

The author speculates that the terminal moraines that are found at the 9,000 foot elevation are probably related to the first or second Wisconsin substage and those at the 9,500 foot level correlatable with the third substage. The only reason for this speculation is the similarity in elevations of morainal material on opposite sides of the range.

Furthermore, the author theorizes that the large well-displayed alluvial fans at the base of the west side of the range are underlain by extensive outwash plains. What would be more natural than to have outwash associated with terminal moraines? The present fans are merely a present day modification of the Pleistocene outwash.

Within the Sangre de Cristo Mountains of southern Colorado there are two relics of the Pleistocene that are worthy of mention in this paper.

At the head of the Huerfano River, on the northeast side of Blanca Peak, two small glaciers exist today. The width of the larger glacier is about 800 feet, its greatest length is about 1,000 feet, and its vertical thickness over 80 feet (Siebenthal, 1907, p. 20). The size and shape naturally vary with annual snowfall and temperature. As Siebenthal (1907, p. 22) says, "The Blanca Glaciers possess an added interest in being the southernmost existing glaciers yet reported in the Rocky Mountains, and, so far as known to the writer, the southernmost in the United States."

On Mount Mestas, 8½ miles east of Blanca Peak, are excellently displayed rock glaciers or rock streams. The two

most spectacular streams are on the west slope at elevations between 8,500 and 10,000 feet (Johnson, p. D217). Ice which forms the matrix of the rock stream was encountered at depths ranging from 10 to 30 feet. The interstitial ice appears blue on the outcrop but is crystal clear in the hand. Below the troughs the ice is locally granular as if structurally crushed during movement. Rock fragments incorporated into the streams range in size from rock flour to blocks more than five feet in maximum dimension. According to Johnson (p. D220), the fronts of the rock streams have moved forward only a few feet in 25 years. Movement may be due largely to the deformation of the interstitial ice, but some movement may be initiated by the seasonal freezing and thawing of this ice. Because of the absence of cirques on Mount Mestas and the low latitude and elevation of the Mount Mestas rock streams, probably the original source of the ice was not a true valley glacier. The ice more likely was derived from the freezing at depth of downward moving rainwater and melted snow. These interesting features may be seen when traveling eastward along old U.S. Highway 160 on La Veta Pass.

In summary, it is apparent that at least five substages of the Wisconsin Glacial Stage are observable in the Sangre de Cristo Range. These substages are correlatable from valley to valley on the east side (Ray, 1940), but due to the lack of data on the west side nothing conclusive may be said regarding substages or correlation with the east

side. This interesting facet of the history of the range is certainly worthy of investigation. Perhaps in the future some inspired geologist will undertake a study of the physiography and Quaternary geology of the Sangre de Cristo Range.

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