Proceedings of the Iowa Academy of Science

Volume 58 | Annual Issue Article 34

1951

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Recommended Citation

Meier, Mark F. (1951) "Recent Eskers in the Wind River Mountains of Wyoming," *Proceedings of the Iowa Academy of Science, 58(1)*, 291-294.
Available at: https://scholarworks.uni.edu/pias/vol58/iss1/34

Recent Eskers in the Wind River Mountains of Wyoming

By MARK F. MEIER

INTRODUCTION

The origin of eskers has long been a subject of controversy. These interesting features of the glacial landscape have been studied extensively in the Midwest, New England, Scandanavia, and elsewhere, but nearly all of these studies dealt with deposits left by glaciers which had long since disappeared. Theories of origin of these eskers have, therefore, been based largely on assumption and interence. To the author's knowledge the only published technical description of recent eskers are those of I. C. Russell, who in 1897 briefly described some esker-like ridges in the stagnant margin of the Malaspina Glacier in Alaska, and W. V. Lewis, who described an esker discovered in 1947 at the foot of the Böverbreen Glacier in Norway. The purpose of this paper is to describe some eskers projecting from existing glaciers in Wyoming, and to suggest a mode for their origin.

The Gannett Peak-Fremont Peak area in the Wind River Mountains is a rugged, alpine region which contains the largest glaciers of any area in the Rocky Mountains of United States, including all of Glacier National Park. These glaciers have been generally receeding since at least the early 1900's, but recently the rate of recession has diminished.

ESKER AT FOOT OF MAMMOTH GLACIER

The first esker to be described is located at the terminus of Mammoth Glacier, a valley glacier about 2⅛ miles long located southwest of Gannett Peak. This glacier is sometimes known as the "Green River Glacier" since it is the largest of several glaciers which form the headwaters of the Green River. Although the velocity at the snout is not known, the strongly convex cross-profile, the steep terminal slope, and the clean ice indicate that the glacier is vigorous and not at all stagnant.

A single esker projects from beneath the terminal ice at the northeast edge of the snout, near a high "little Ice Age" lateral moraine. Very recent slumping of this moraine has nearly obscured the esker. This esker is in a low area containing water ponded within the moraine, a rock rib, and the margin of the glacier. The ridge itself is sinuous, flat-topped, and about 15 feet high and about 60 feet wide. The sides slope at the angle of repose of the material, which is mainly sand with some gravel and minor amounts of silt and boulders. This material is quite loose and unconsolidated: an ice axe could be thrust in nearly two feet before meeting much resistance. The whole deposit is well sorted in contrast to the complete lack of sorting of other debris in the vicinity. No definite bedding planes could be seen on the surface of the ridge, although the material forming the sides is arranged in crude layers parallel to the side-slopes. The boulders are not appreciably stream-rounded, but many of the gravel pieces were sub-round. No ice could be detected within the mass, at least to depths of several feet. The esker emerges from a sub-glacial tunnel in clean ice, and there is no concentration of debris on the glacier above the point of emergance of this feature. The sinuous, flat-topped shape of the ridge, and the sorting and water-lain character of the material suggest that this is a true esker.

Esker at Foot of Helen Glacier

Helen Glacier is a small glacier on the east flank of the Continental Divide between Gannett and Fremont Peaks; it is the most northerly of the Bull Lake Glaciers. This glacier is thin and probably not as vigorous as Mammoth Glacier, but it is by no meants stagnant. The ice surface slopes at about 18° at the terminus. Below the ice on the north side of the snout is a pond, caused by blocking of normal outlet drainage by a moraine-covered bedrock rise beyond the glacier. An outlet stream which emerges from a tunnel near a medial moraine flows through this pond, then turns back under the snout of the glacier, finally reversing its course again beneath the ice to flow out as a normal stream. In this pond are several eskers arranged parallel to the flow of water. These are, therefore, nearly perpendicular to the direction of motion of the glacier.

These eskers are more or less flat-topped, curving ridges. They are from 10 to over 15 feet high, and are locally up to 50 feet wide. Instead of being a single ridge these branch and anastamose in the manner of typical glacial streams. The material is mainly gravel, with considerable sand and very few larger rocks. The gravel pieces are notably stream-rounded. A crude sort of top-set bedding is evident, but no trace of fore-set beds could be detected. The sides slope at the angle of repose of the material, about 30°. The tops of these ridges are usually flat, but in places are hummocky. These eskers end abruptly at their downstream ends, possibly due to erosion by later streams. The point of emergance of these ridges was obscured by snow, but collapse crevasses in the ice indicate the presence of a sub-glacial tunnel. The sinuous plan, excellent sorting, water-laid character of the materials, and the parallelism with existing stream courses suggest that these, too, are true eskers.

Origin of These Eskers

Many different theories have been propounded to explain the origin of eskers. Shaler and others have suggested that they originate where outwash streams end in standing water, so that at least part of the esker is deposited as a delta. It has been suggested that eskers were originally deposited in superglacial or englacial stream channels and let down onto the ground below. The drawing out of a kame deposited in a semi-permanent reentrant in the face of a retreating glacier has been suggested as a mode of origin of eskers. Flint (1947) favors the idea of deposition in subglacial tunnels in ice that is stagnant or nearly so.

It seems clear that only the latter explanation can hold for the Wind River eskers; that is, these have certainly been deposited in sub-glacial tunnels. The Wind River eskers, however, have been formed and preserved long enough to be exposed beneath ice that was moving. Presumably this has all taken place in the outer "zone of fracture" of the glacier. These features must have been deposited and exposed in a very short length of time, or they must have been preserved in a mass of stagnant ice concealed and overridden by active ice, or the surrounding ice must have been continuously modified so that the esker could be preserved.

The author suggests that these eskers were formed in the following manner: First, subglacial stream channels are cut into the undersurface of moving ice by streams eroding and carrying a load under hydrostatic pressure. Next, these stream channels are carried down to a point where the subglacial drainage is blocked by morainal accumulation or a high point on the bedrock. This causes ponding of water in the channel and deposition of the load of sand and gravel carried by the stream. This deposition of material may then cause the stream to flow on a higher level, eroding the ice roof over the channel and causing further deposition of material as top-set beds. Erosion of the ice around the moving stream may preserve the esker in spite of slow motion of the glacier. Soon, however, ablation at the terminus must expose the esker as a sinuous ridge having nearly the same course as the original subglacial stream. This process must, of course, take place in a zone near the terminus where the yield point of ice is not exceeded by the weight of the ice above in order that open channels can exist.

This is not to be regarded as an explanation of the origin of all eskers, but is put forth only as a suggested origin of certain eskers discovered in the Wind River Mountains of Wyoming. Extension of this hypothesis to cover other types of eskers in other localities necessitates further study.

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