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The Dahlen Esker of Grand Forks and Walsh Counties, North Dakota

by

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THE DAHLEN ESKER OF GRAND FORKS AND WALSH COUNTIES, NORTH DAKOTA[1]

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INTRODUCTION

A spectacular ridge of glacial origin was studied by the North Dakota Geological Survey during a Grand Forks County geologic and ground-water investigation in 1964 and 1965. The ridge, interpreted as an esker, is about three miles northeast of Dahlen, North Dakota and is here named the Dahlen esker. An esker is a sinuous, narrow ridge of rudely stratified gravelly or sandy sediments deposited by a stream in contact with glacial ice. Eskers also contain unsorted debris of all grain sizes called till, deposited directly from the adjacent ice.

The Dahlen esker has attracted local interest from both the layman and the geologist because of three reasons: first, the landform has a rather anomalous appearance, that of a conspicuous, high-relief sinuous ridge adjacent to an area of relatively low-relief topography; second, its excellent preservation, as it is virtually unmodified by man —many eskers are destroyed in the process of mining for gravel; and third, it is easily accessible as well as noticeable, for it is next to North Dakota highway 32. The purpose of this report is to provide a description of the Dahlen asker and to briefly discuss its origin and geologic setting.

ESKER LOCATION AND DESCRIPTION

The esker is in secs. 5 and 6, T. 154 N., R. 56 W. in northwestern Grand Forks County, and in secs. 31, 32, and 33, T. 155 N., R. 56 W., and in secs. 25 and 36, T. 155 N., R. 57 W. in south-central Walsh County, North Dakota.

Physiographically, the esker lies upon the Pembina escarpment in the Drift Plains district. This escarpment, an eastward-facing relatively steep slope, forms the boundary between the Drift Plains and the Agassiz Lake Plain districts in northeastern North Dakota. In the Dahlen vicinity the escarpment is a conspicuous rise in land surface of about 300 feet in seven miles.

Field observations of the esker were conducted in seven areas or sites on the ridge (Figure 1). The sites consist of exposures along section line trails, ridge crests, and roadcuts. Two of the sites contain five small gravel pits in a third of a mile ridge segment. Excellent exposures of the esker sediments occur within the gravel pits. The observed characteristics of the Dahlen esker are summarized in Table I.

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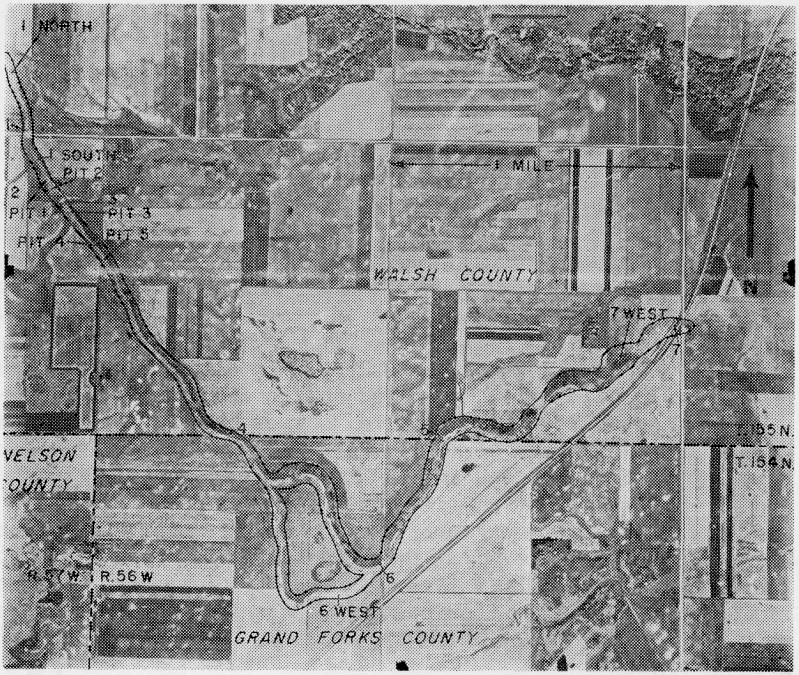

FIGURE 1—Aerial photo of the Dahlen esker in Grand Forks and Walsh Counties.

As seen on the aerial photo in Figure 1, the Dahlen esker is V-shaped in plan view with the apex to the south and branches to the northwest and northeast. The apex has an adjoining subdued ridge segment, sort of a double apex, which is looped around a kettle, an undrained depression. The length of the esker is about four miles, and it is about 400 feet wide. The entire esker is sinuous, but the northwest branch is straighter as compared to the strongly curved apex and the northeast branch.

Elevations of the northeast branch range from 1250 feet above sea level near the base of the ridge to 1330 feet at the ridge crest. In cross-section the Dahlen esker is steep-sided and asymmetrical; the slope is steeper and higher on the north of the ridge. The ridge height at the apex is 53 feet on the north slope and 39 feet on the south slope. About a half a mile northeast of the apex the height of the ridge is 63 feet on the north side and 29 feet on the south side. The maximum relief of the ridge is 80 feet.

The ridge generally has an accordant crest level, but the crest appears irregular because of numerous minor gaps (Figure 2). These gaps, accentuated and modified by present ephemeral stream erosion,

TABLE I

OBSERVED CHARACTERISTICS OF THE DAHLEN ESKER

SITE NO.	EXPOSURE					COMPOSITION					SORTING		BEDDING		RELIEF	
	RIDGE CREST	TRAILCUT	ROADCUT	GRAVEL PIT NO.	CUT SIZE (Feet)	SAND	GRAVEL	TILL	SILT	BOULDERS	POOR	GOOD	HORIZONTAL	CROSS-BEDDED	NORTH SIDE (Feet)	SOUTH SIDE (Feet)
1			X		7	X	X	X			X					24
1 NORTH	X									X					44	
1 SOUTH	X							X		X						
2 (PIT 1)				1	7	X	X	X	X	X	X	X	X			
2 (PIT 2)				2	15	X	X	X			X					
3 (PIT 3)				3	7	X	X				X					
3 (PIT 4)				4	12	X	X	X		X	X		X			
3 (PIT 5)				5	16	X	X	X		X	X	X	X		39	29
4		X			6	X	X			X	X		X		45	
5		X					X			X	X				63	29
6		X			14	X	X	X	X	X	X				53	39
6 WEST	X						X	X	X	X	X					
7			X		34	X	X	X	X	X	X	X	X	X	34	
7 WEST	X					X	X	X	X	X	X	X	X	X	80	

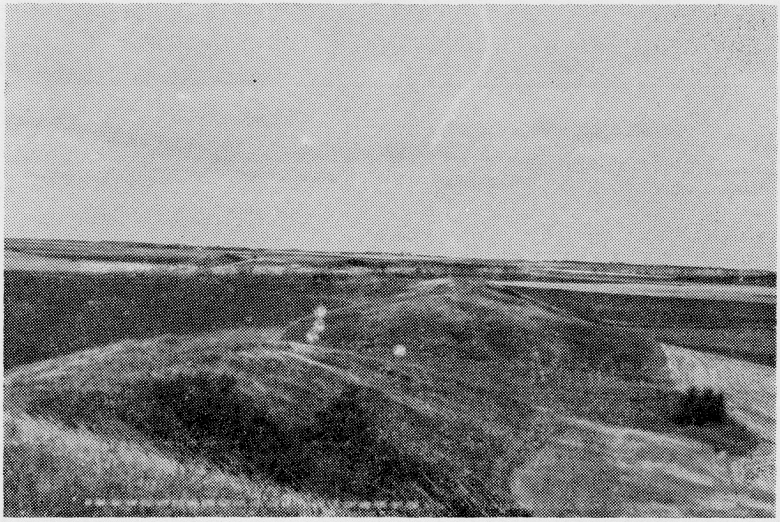

FIGURE 2—Northwest branch of the Dahlen esker. View toward the northwest and site 4.

probably were formed during the deposition of the esker. The gaps could have formed by sediment collapse as the underlying glacial ice melted. The accordant crest level is interrupted by a small hill near the terminus of the northeast branch. This hill has the form of a kame, a moundlike accumulation of outwash.

The ridge consists of two main types of sediments: (1) outwash, the meltwater stream deposits of bedded and non-bedded sand, gravel, and silt; and (2) till and boulders deposited directly by glacial ice.

The sands of the ridge are generally brown (oxidized), range in size from very coarse to fine-grained, and are usually associated with gravel. They are poorly sorted where the bedding is not apparent, and poorly to well-sorted where the bedding is developed. The shale content of the sand in some areas is very high, and where the shale particles are abundant the sand is dark gray. Horizontally-bedded sand was observed in five exposures, and cross-bedded sand was observed in one exposure.

The till of the esker is a stony loam because of an abundance of pebbles in a loamy sediment. The till is very light olive-gray to buff, oxidized, calcareous, unsorted, and unstratified. It is a heterogeneous material, the particle size of which ranges from boulders to clay. Scattered free boulders generally are abundant on the crest of the ridge. The boulders are of various sizes; boulders four feet in width were commonly observed and one measured seven feet across.

Till and boulders generally occur beneath, adjacent to, and upon

the outwash. However, in some areas outwash is exposed at the crest of the ridge without any overlying till or boulders. A mixture of sand, gravel, till, and boulders was observed in several of the gravel pit exposures. The mixing probably was caused by sediment collapse and slump as the adjacent ice melted.

ESKER ORIGIN AND GEOLOGIC SETTING

Approximately 12,000 radiocarbon years B. P. (before present) the Wisconsin glacier, the main ice mass, was mostly in Canada, but an ice lobe projected into the broad Lake Agassiz basin of North Dakota and Minnesota. During the waning stages of this lobe and while the ice margin was on the Pembina escarpment in the Dahlen vicinity, the Dahlen esker was deposited.

The Dahlen esker was deposited by a meltwater stream in an ice-walled channel, most likely a tunnel, near the base of a stagnant zone of the ice lobe. The stream flow probably was from east to west, toward the margin of the ice lobe. The flow direction, although suggested mostly by the position of the ice lobe, may be indicated by a kame near the terminus of the northeast branch. Kames differ from eskers by forming in a surface opening in the ice rather than in a tunnel or ice-walled channel. The possibility exists that the water entered an opening in the ice and then flowed through an ice-walled channel or tunnel. The meltwater stream deposited outwash in the surface opening and within its stream course now marked by the esker ridge.

Subsequent ablation of the adjacent ice resulted in the deposition of ablation till and boulders upon the stream sediments. Sediment collapse and slump also occurred as the adjacent ice, especially the underlying ice, ablated. Contemporaneously with the deposition of the esker, a low-relief till plain called ground moraine, was deposited in the area adjoining the esker.

Following the deposition of the Dahlen esker, ablation continued until the margin of the ice lobe had retreated five miles east. The glacier, because of an increase in activity, attained a stable position or stillstand. During this stillstand and along this active ice margin a till ridge, the Edinburg end moraine, was deposited. Meltwater flowed along the ice margin in a channel formed between the end moraine on the east and the Pembina escarpment on the west. Within this channel in the Dahlen vicinity an outwash plain was deposited, and to the south where the channel extended into an inlet of glacial Lake Agassiz, a delta-lake plain was deposited.

CONCLUSIONS

It is evident, as a result of the geologic mapping of Grand Forks County, that the ridge in the Dahlen vicinity is glacial in origin and can be designated an esker because of its landform and composition. This esker was deposited by a melt-water stream within the marginal zone of an ice lobe of the Wisconsin glacier.

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