The Terms Névé and Firn

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Glacier Tunnel Observations in Alaska

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reprints from:
Journal of Glaciology
Vol. 2, No. 11 pp. 69-70
Vol. 2, No. 12 pp. 150-151
1952

Reprinted from Journal of Glaciology, Volume 2, Number 11, March 1952, pages 69—70

CORRESPONDENCE

The Editor,
The Journal of Glaciology

SIR,

Glacier Tunnel Observations in Alaska

In view of the recent emphasis on glacier tunnelling and englacial studies of the mechanics of ice movement, the following notes which I gathered in 1941 while returning by steamer from Alaska may be of interest. They represent descriptive information, without alteration, which I wrote down during a lengthy discussion with Dr. John Reed, who at that time was Chief of the Alaskan Branch of the U.S. Geological Survey. Dr. Reed had obtained this information a few weeks earlier in conversation with one L. Thornton, a prospector and miner, who had occasion to do a considerable amount of tunnelling into an unnamed glacier near Hyder, Alaska. The location is near the head of Portland Canal, on the extreme south-eastern boundary between Alaska and British Columbia, and lies approximately at lat. 56° N., long. 130° W. Unfortunately many details which would be of further interest to the glaciologist are lacking.

Intermittently between 1931 and 1941, Mr. Thornton had driven about 1830 m. of tunnels, adits, caves and pits into a small "ice cap" glacier south of Texas Glacier. The bulk of this work was distributed between 10 to 15 different tunnels, some of which were driven horizontally south-eastward from the steeply sloping face of the glacier, and upstream in a direction roughly parallel to the movement of ice. The tunnels penetrated to bedrock. According to Dr. Reed, Mr. Thornton, although not a trained observer, is a reliable person and one keenly interested in the scientific significance of what he saw. He therefore made a point of noting whatever aspects of interest he could. Since he was cutting these tunnels in search of ore minerals in a lode beneath the glacier, some of his observations were of practical value to his own operations. He worked in these tunnels throughout all seasons of the year. The cutting was done by pick and shovel.

Concerning temperature conditions within the longer and deeper tunnels, he noted that temperatures were the same both in summer and winter. (It is assumed that his tunnels were therefore far enough in so that the surrounding ice was little affected by surface atmospheric influences in winter. Since this is in a relatively temperate section of Alaska, this observation does not seem out of line.) He further reports that on many occasions cracked ice in buckets left in the tunnels developed no water but slowly evaporated. He also noted that running water and water trapped in caverns—and in the bottom of crevasses in summer—did not freeze. The floors of larger openings or caverns were dry. There was, however, considerably more water in the glacier in the summer months than in winter.

Regarding glacial motion, his observations are of further interest, especially those made at some distance along the tunnels and at depths well beneath that reached by crevasses. He saw that irregularities in the rock floor caused disturbance of ice flow. For example, a bedrock hump would "gouge" a deep groove in the base of the overriding ice mass. And after "moving for a distance above the floor in the lee of the hump, the ice would again impinge on the rock floor, and with particular pressure if the bedrock surface happened to be flatter." This left basal caverns down-glacier from these hummocks. "Loose blocks of rock held in the ice at these places would be given a rolling or rotational movement."

Occasionally the glacier roofs of such caverns would fall off and the resulting chunks of ice would eventually disappear, both by melting and evaporation. Some of the larger chunks, after falling into such a cavern would themselves seem to "flow plastically," just as this portion of the main glacier did. (At least, after many weeks of observation, Thornton had this impression.)

Huge caverns within and at the base of the glacier apparently impounded quantities of water. One of these "holes" when punctured by Thornton created such a flood of water that it washed him clear out of the tunnel in which he was working.

The basal ice in the glacier was observed to penetrate "plastically" as much as two feet into bedrock wherever there were open fractures in the rock or other narrow or confined openings. Sometimes actual "ice veins" were formed in this way.

Those tunnels driven into the glacier parallel to its flow, would "fill" within several months time. His observations indicated that at first the bottom would begin to bulge up, then the sides, and then the back. The effect would decrease toward the portals.

Ice tunnels driven across the glacier's down-valley flow were seen to close much more rapidly. This closure was largely accomplished by "bulging" from the upstream side. On one occasion, when Thornton had been ill for some weeks, he found it difficult to resume his work in places due to such obstruction within the tunnel.

Some light was seen to penetrate through the glacier—an estimated distance of 30 m. into solid ice. Only the blue rays would get through.

It was Thornton's impression that the lower portion of the glacier seemed to move farther (faster?) than the upper layers, as estimated from the displacement of his workings in relation to rocks on the surface of the glacier. (Perhaps this was an impression due simply to a mass rotation of ice on its bed or to some other factor not clear in this case since there is no dimensional and quantitative record.)

Along the walls of several adits and tunnels, he observed that loose material (debris) was picked up from the rock floor by the ice as it moved down slope. This debris did not move along the lower layers of the glacier but migrated slowly upward to higher levels along distinct lines. Dense and bubble-free ice could be seen at the very bottom of the glacier between the zone of transported debris and the bedrock floor below. Similar detritus appeared at the surface of the glacier nearer its edge and down-glacier from the point of tunnel observations.

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20 *November* 1951

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PRINTED IN GREAT BRITAIN BY WILLIAM CLOWES AND SONS LTD, LONDON AND BECCLES

Reprinted from the Journal of Glaciology, Volume 2, Number 12, November 1952

The Editor,
The Journal of Glaciology

SIR, *The terms "Névé" and "Firn"*

On page 68 of Vol. 1, No. 11 of the *Journal of Glaciology*, Dr. Brian Roberts draws attention to the confusion introduced by the synonomous use of the terms *névé* and *firn*. Certainly these terms, when used interchangeably in the same publications in English might cause one to ask whether they should in fact connote a difference in meaning.

The word *firn* is derived from the German adjective *fern* which means "of last year" (also "far" or "distant"), and thus in its most usual application is used to refer to glacier snow from the preceding year or years.* The French word *névé* by definition means "a mass of hardened snow of glacier origin."† In English we have no single descriptive word but would probably use a phrase such as "consolidated, granular snow not yet changed to glacier ice." Therefore a similar connotation exists in each language.

Several French and Swiss glaciologists, with whom I have discussed the matter recently, consider that *névé* is a more or less dense and settled, although permeable, aggregate of medium to large individual grains formed and welded together by frequent alternations of melting and freezing on original snow crystals, and in which one often finds numerous layers of ice. More generally, they use the word to refer to the overall snow cover which exists during the melting period and sometimes from one year to another.‡

The definition of *firn*, adopted by the Eidg. Institut für Schnee- und Lawinenforschung, and included in the latest "Draft on an International Snow Classification" suggested by the Committee on Snow Classification of the International Association of Scientific Hydrology, is as follows: "old snow which has outlasted one summer at least (transformed into a dense heavy material as a result of frequent melting and freezing)."

Since all of our scientific nomenclature cannot practically be reduced to one language, it should be acceptable to use the French, or German or even an appropriate English equivalent, according to the dictates of one's training or one's particular native tongue. We English speaking persons actually bear the burden because we are more willing to employ either of the foreign terms than to use a phrase of our own. This is due to the advantage of brevity and also, of course, since each has become well-ensconsed in the mass of glaciological literature which has been written in French and in German.

If any differentiation is warranted, it should certainly not be one which eliminates all synonymity. On the other hand, it might be useful for publications in English more universally to adopt the word *névé* as a geographic term, *e.g.* the Taku Glacier *névé*, meaning the highland area of the Taku Glacier covered with perennial snow and thus lying entirely in the zone of accumulation. Then the word *firn* could be more usually applied in reference to the material itself. In this way the original meaning of both terms would be left intact and the confusion introduced by indiscriminate use of them interchangeably would be eliminated. This would also be in accordance with the view taken by some British glaciologists including Mr. Gerald Seligman, who as long ago as 1936 published the following suggestion:

"If we take 'Firn Snow' (I prefer this word to Firn) and use it for snow particles in the befirned condition and 'Névé' to indicate the accumulation area above a glacier, we give the two words distinct meanings and have neater and conciser terms for the two things than exist in either French or German." (§)

* *German-English Science Dictionary*, Louis De Vries, McGraw-Hill Book Company, Inc., 1946. Also see Cassell's *German and English Dictionary*, 1951.
† *Nouveau Petite Larousse, Dictionnaire Encyclopédique*, 1951.
‡ Roch, André. "Précisions sur quelques termes de langue française concernant le neige et les avalanches," *Die Alpen, Jahrg. 20, 1944, p. 21.*
§ Seligman, Gerald. *Snow Structure and Ski Fields*, MacMillan and Co., London, (1936) p. 110.

Concerning application of these terms to snow cover in high polar glaciers, a modified or qualified nomenclature may prove advisable. This is suggested by the fact that percolating melt water is not present in sufficient quantity in high polar firn to create the complicated and irregular diagenetic ice structures, and to help induce other characteristics which are more common to temperate firn. Such consideration may best await the progress of further field research on possible differences in physical character and genesis of polar firn, which recent as yet unpublished studies have suggested.

Weissfluhjoch,
Davos, Switzerland
30 *March* 1952

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NOTE.—Had not Mr. Miller cited what I wrote in 1936, I should myself have quoted this in answer to Dr. Roberts, for I still think, after these many years, that that is the correct solution. (Incidentally, I now think that the term should be just "Firn" and not "Firn Snow.")

Mr. Miller's point that the characteristics of the firn in high polar glaciers may be somewhat different to that in temperate glaciers is a new and interesting one. Whether or not this will need the introduction of an intermediate stage between firn and true ice (Specific gravity 0·82–0·84) is not yet clear; this points to the need for further research on the subject.

Finally, Dr. Robert's remark about the confusion between "firn" and "firm" seems to me to be rather a matter for editors than terminologists.—G. SELIGMAN.