THE SIGNATURE OF GLACIER ICE: NO. 1

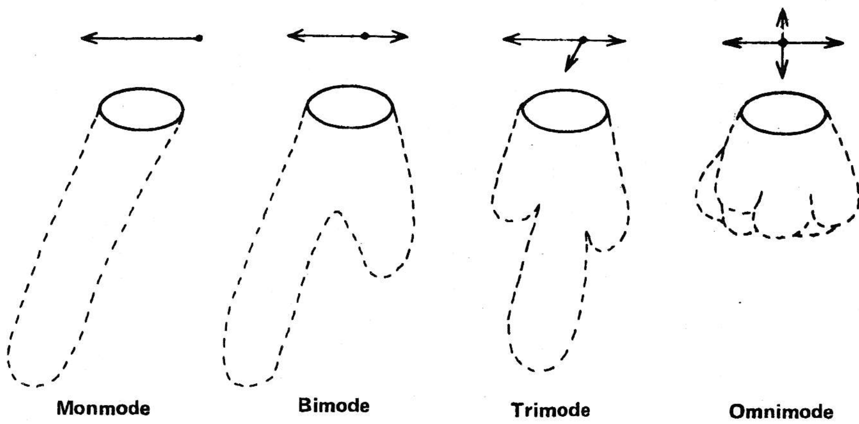

Figure 1. First, second, and third order tubes (left to right). the omnimode is a special case involving little or no wind, or omnidirectional winds. First, second, and third order prevailing wind directions are shown by the lengths of the arrows, respectively. Each is also related to respective tube depth.

By John Splettstoesser

In a related (No. 2) article,[1] I reviewed the subject of solid, human excrement that is preserved in glacier ice. The following account is concerned with urinary wastes.

Field living in Antarctica provides primitive conditions at best, with toilet facilities while traversing amounting to a hurriedly dug hole in the snow, or simply a quick stop for bladder relief.[2] When a camp might be occupied for some time, say a few weeks or more, an outhouse--type structure is often built for comfort and relief from the wind. Bladder relief would still amount to a place to stand and, depending on the wind, a direction to face. It is this latter phenomenon that has provided the irreproducible results that are the subject of this article.

In general, when traveling in the field in Antarctica, or anywhere else for that matter, it is wise to choose the location for the camp water supply so that it is a safe distance from the camp latrine, as well as upwind, upstream, etc. In snow-covered terrain, the prevailing wind direction (s) can be fairly easily discerned, and a suitable latrine is laid out on the safe side of the camp. For a camp of even short duration, a 'pee-hole' (or 'pee-tube'; hereafter called, simply, the tube) is developed rather quickly due to multiple use by all camp members.

At camps of long duration, and especially when the field party size is large, the occupants will invariably use the same tube, thus producing occasional unusually deep tubes. There are even contests, as it were, to attempt deeper tubes than were produced at previous camps, simply as a diversionary activity to pass the time.

Each tube is unique, of course, and truly irreproducible, being lost to the snows and glaciers when the camp is abandoned. Some are lost during blizzards, when blowing snow fills them and destroys the handiwork of several days. In order to record these important features, and provide a baseline for future studies of this kind, the following classification is proposed for tube:

Tube	Characteristics
A	0 - 0.20 meter deep
B	0.20 - 2.0 meters deep
C	More than 2.0 meters deep

Tubes B and C may have subdivisions, as a result of changing wind directions. For example, a second-order prevailing wind may force the subject to stand in a different position, thus initiating a new angle of descent with respect to the primary tube (resulting in a bimodal tube). Third-order tubes (trimodel) have been observed, but are rare.[3] The B and C subdivisions are shown schematically in Figure 1. It should be noted here that an unusually deep C-tube, deeper than 12 ft (3.7m), the length of the longest bamboo pole in camp, was plumbed at one location.[4] Figure 1 also shows an omnimodal tube.

Tubes from several Antarctic expeditions have been graphed in ogive form, or cumulative distribution, in Figure 2. It can be seen that the form of the curve also approximates the profile, or deflection, of a C-tube, thus lending support to the significance of the data. In all tubes measured, diameter does not appear to be related to depth, reaching a maximum of about 15-20 cm.

It is worth mentioning as a precaution, in the same context as in another article, that buried tubes may be encountered at some future time while drilling for ice cores. Material from fossil tubes should not be confused with the amber-colored ice, found near the base of an Antarctic glacier and possibly occurring in others, that contains a concentration of salts.[5]

* * *

References

[1] Splettstoesser, J.F. 1979, The signature of glacier ice: no. 2: J. Irreproducible Results, v. 25, no. 1, p. 12-13.

[2] "Don't eat yellow snow." (Also applies to icebergs towed to Saudi Arabia.)

[3] The art of successfully relieving one's bladder during times of high velocity winds comes only with experience. The leeside turbulence and backwash can be devastating. No attempts are made to use the tube during such winds. The similarity in appearance between the trimodal tube (Figure 1) and the object that created it is coincidental.

[4] Guinness Book of Records, take note.

[5] Holdsworth, G. and C. Bull, 1970, The flow law of cold ice; investigations on Meserve Glacier, Antarctica: Internatl. Symp. on Antarctic Glaciological Exploration (ISAGE) Hanover, N.H., Sept. 1968, p. 204-216.

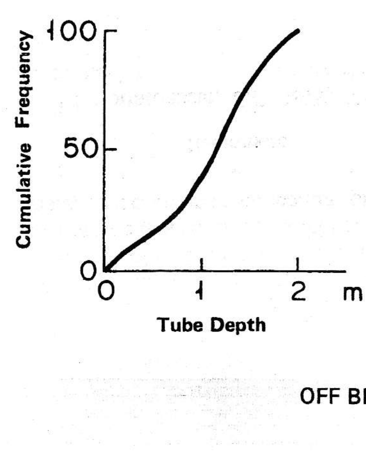

Figure 2. Cumulative distribution of tube depths. Note similarity to Figure 1, left.

THE SIGNATURE OF GLACIER ICE: NO. 2

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Geologists study mainly old materials and features, such as rocks, fossils, landforms, etc., and must often calculate the ages of those materials and features. Furthermore, terminology can often be a problem because not enough time may have elapsed for material to be properly identified geologically. For example, when does sediment become rock? When does a dead animal or plant become a fossil? One of the related questions in this context concerns fecal material or solid excrement. When does it become coprolitic? The following account summarizes preliminary results of my research on this pressing issue, as it relates to the study of foreign material in glacier ice.

There are several obvious sensory tests that can be applied in order to resolve the latter question. The touch test and the smell test would settle the matter quickly, in many cases, but the issue becomes more complex when other factors are involved. For instance, the excrement of polar explorers has been preserved for more than 75 years in Antarctica in a sort of deep-freeze environment, particularly when buried by snowfall and incorporated in glacier ice.[1] In other cases, on bare rock, it may be exposed and have become merely desiccated and is not a coprolite.[3] Aside from the question of definitions, when buried in glacier ice or left exposed on rock, a more basic problem in Antarctica is that of longevity. Excrement is not treated as sewage usually is in temperate and tropical climates, and, because of the low temperatures, bacteria cannot function in order to convert it into something else. Paucity of soil and the permafrost make burial in snow-free areas essentially impossible; e.g., in places like Wright and Taylor Valleys,[4] west of McMurdo Sound. However, frozen into a glacier and thus buried as in rock, has it then been transformed from excrement into coprolite? Even if 75 years is not enough of a time requirement, time is not pertinent to the question because the material would stay essentially unchanged from the moment it became frozen until it melted out of the glacier, perhaps thousands of years later. At a future time, then, geologists and glaciologists, drilling into the Antarctic ice sheet and attempting to recover ice cores tens of thousands of years old in an effort to study past climates,[5] could feasibly encounter human excrement (coprolites?) of the same age as the ice surrounding it. It would have become trapped in the ice soon after deposition, and moved slowly downward through time as later accumulation buried it. Presumably, if the excrement was thawed, its identity would become known immediately through the touch and smell tests mentioned earlier,[6] but the correct name for the material would be problematical. Could excrement have been transformed into coprolite, and then back to excrement?

Another test, of course, is the presence (in excrement) or absence (in coprolites) of viable organisms. This test has been applied to the excrement of explorers from Antarctic expeditions of 1907-09 and 1910-11.[7] Samples were taken from camp latrines in 1961 at the expedition's camps on Ross Island, and analyzed for organisms. Several kinds were found, and the smell test verified that the samples were indeed from the latrine (there was no odor until the samples had been thawed). An independent study (unpublished) of similar specimens shows the same kinds of organisms found by Meyer *et al.* The results are graphed in Figure 1, a normal distribution curve (which, coincidentally, is also the vertical cross-sectional form that the material assumed as it was being deposited —see Figure 2). However, this time period is insignificant when compared with the age (early Pleistocene) of active bacteria-like microorganisms (presumably not from human excrement) that were found in rock cores recovered from Antarctic permafrost a few years ago.[8,9] If bacteria can survive in a dormant state for as much as 1 million years, think what this could mean to the unwary glaciologist studying particulates

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from ice cores several thousand years from now when paleo-excrement is thawed from his samples. Because of a loss of immunity through time, the resultant bacteria might decimate the world's human or animal population with a plague.[10]

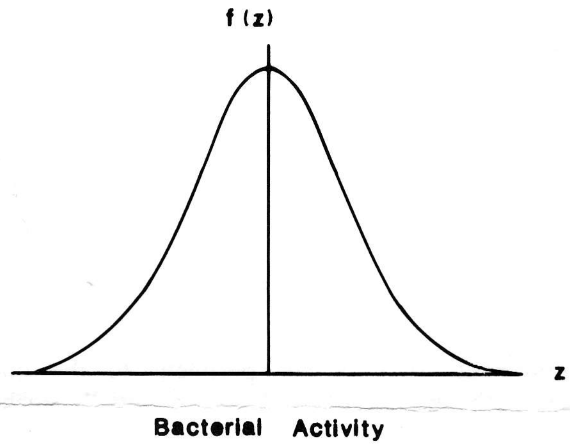

Figure 1. Normal distribution curve of bacterial activity in thawed feces.

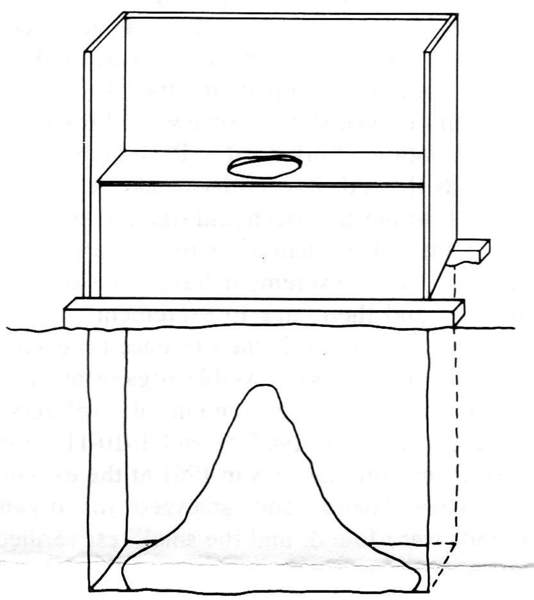

Figure 2. Cutaway diagram of camp latrine used by polar expeditions.

In later independent studies (unpublished) on the 1910 samples, also worth noting is the discovery of what was thought to be sperm in some of the feces.[11] Aside from its value as a good party story, the latter discovery has led to a proposal for a feasibility study of Antarctica as a sperm bank, due to the deep-freeze conditions available for storage.[12]

A complicating factor of this research has also added to the problem of definitions. Many of the earlier polar expeditions, as well as a few modern ones, have used dogs for transport of field parties. Unless tethered away from the site of the field party latrine, sledge dogs will occasionally eat human feces (coprophagy), as well as their own, because of the contained undigested fat that the dogs crave in their diets.[13] This amounts to recycled excrement, complicated by the fact that the end[14] product is a mixture of human and animal excrement; hence, what to call it? Furthermore, regardless of the mixture question, does additional alimentary time and processing change the characteristics of the material.[15]

Further research is expected to shed light on this problem of semantics, although continuation of the project is dependent on the success of a research proposal that is now being prepared,[16] to be submitted to NSF's Program Manager for Glaciology (or Geology? Microbiology? Sanitary Engineering?).

Useful Vocabulary of Research Terms and Expressions:

No ———.	Are you ——— me?
Oh, ———.	———.
Tough ———.	Oh ———, oh dear.
——— on a shingle.	Get your ——— together.

REFERENCES

[1]The related human (urinary) waste product, covered in a companion (No. 1) article, is not considered here, but is important to remember when doing polar field work.[2]

[2]"Don't eat yellow snow."

[3]*Glossary of Geology,* American Geological Institute, Wash., D.C. 1972, p. 156.

[4]"Watch where you walk," and "There's one under every rock."

[5]Orheim, O., C. Bull and V. Schytt, 1972, Glaciological studies of past climatic variations in the South Shetland Islands: Antarctic J. U.S., v. 7, no. 4, p. 99-100. (This significant work, done by a team of glaciologists, has shown an anticorrelation between summer temperatures in middle to high latitudes of both the northern and southern hemispheres—commonly known as the Orheim-Bull-Schytt effect.)

[6]The taste test was not considered here because of the lack of willing and experienced experimenters.

[7]Meyer, G. H., M. B. Morrow and O. Wyss, 1963, Viable organisms from feces and foodstuffs from early Antarctic expeditions: Can. J. Microbiol., v. 9, no. 2, p. 163-167.

[8]Cameron, R. E., and F. A. Morelli, 1974, Viable microorganisms from ancient Ross Island and Taylor Valley drill core: Antarctic J. U.S., v. 9, no. 4, p. 113-116.

[9]Mudrey, M. G., Jr., and L. D. McGinnis, 1974, Antarctic drilling scheduled: Geotimes, v. 19, no. 11, p. 14-15.

[10]Spirakis, C. S., 1975, Pleistocene plagues?; Geology, v. 3, no. 7, p. 372.

[11]Not entirely unexpected—the explorers were away from civilization for a long time.

[12]As well as a plentiful supply of eager customers.[11]

[13]Orr, N. W. M., 1965, Food requirements of dogs on Antarctic expeditions: Brit. Antarctic Survey Bull., No.7, p. 53-67.

[14]Puns in this kind of an article are unavoidable.

[15]Recall the often-quoted story about the human body taking about 32 hours to convert food into excrement, but an Army cook being able to do it in 20 minutes.

[16]With a subject like this, I can't seem to think of a proposal title that will escape the "Golden Fleece Award."