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Foyers et habitations des Paléoesquimaux

Ulla Odgaard

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Résumé de l'article

Le présent article propose une approche méthodologique concernant l'étude des foyers en général. Les foyers de la tradition paléoesquimaude sont souvent assez bien conservés, ce qui permet d'interpréter les processus de combustion utilisés et comment ces derniers affectaient le climat à l'intérieur de l'habitation. Pour obtenir ces informations, il est important de recueillir des données concernant les pierres fracturées par le feu. Les Paléoesquimaux utilisaient une pyro-technologie versatile, s'ajustant aux conditions les plus extrêmes dans des régions où l'accès au bois de chauffage était limité. Une reconstitution expérimentale combinée à des calculs de la combustion hypothétique des matières grasses démontre qu'il était possible pour les Indépendanciens I de l'Arctique septentrional de passer confortablement l'hiver dans des tentes. Enfin, les aspects symboliques des foyers sont abordés dans le texte.

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Ulla Odgaard*

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Abstract: Hearth and home of the Palaeo-Eskimos

This article offers a methodological approach to study hearth features in general. The hearths of the Palaeo-Eskimo tradition are often well preserved, which makes it possible to interpret which heating processes took place, and their effects on the indoor climate of the dwelling. To obtain this type of information, recording of fire-cracked rocks within and in connection to hearths is of special importance. The Palaeo-Eskimos made use of a versatile pyrotechnology, adjustable to the most extreme conditions in areas where access to firewood was limited. An archaeological experiment in combination with calculations of hypothetical combustion of fat shows that it was possible for the Independence I people to live through the High Arctic winter in tents with a reasonable degree of comfort. Also, the symbolic aspects of hearths are discussed.

* SILA - The Greenland Research Centre, Frederiksholms Kanal 12, DK-1220 Copenhagen, Denmark. ulla.odgaard@natmus.dk

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Introduction

Nomadic people of the Arctic and Subarctic lived for thousands of years with clothes and tents of skin as their only protection against the weather. A nomadic way of life in these areas required a transportable dwelling possessing qualities of lightness and strength. If ancient hearths could speak, they might tell stories that people once were telling each other sitting around the open fire. Those stories are gone forever and the hearths are mute, but we can still learn something from them by asking the right questions. The questions could be related to fuel, heat, light and cooking, and maybe also concern design and meaning in a more ideological sense. Hearths are one of the most abundant traces of human presence and activity in the Arctic. They are in many instances well preserved and literally in the same condition as when they were left by their prehistoric users. Arctic hearths are also interesting because of the circumstances under which they functioned. The dwelling was often a tent rather than a house construction, firewood was often scarce, and outdoor temperatures were very often bitter cold. Under these conditions, there must have been focus and attention on the pyro-technology. Often we find traces of the dwelling structure, enabling us to consider the character of the indoor climate and indoor life around the hearth.

Terminology and description of hearths

To be able to interpret the function of a hearth, it is necessary that all elements are sufficiently described. At the colloquium *Nature et fonction des foyers préhistoriques* in 1987, it was agreed upon that archaeologists should concern themselves with hearths and activities related to it as much as they are concerned with analysing the technical and economic consequences of flint production (Olive and Taburin eds 1989). It was further stated that even though the hearth is an evident feature, archaeological descriptions are often inexact and limited to an overall interpretation. This implies the need for using a descriptive and precise vocabulary without ambiguities in order to establish solid basis for comparative studies (*ibid.*). It is, for example, important to be able to distinguish between the overall "hearth/fireplace" and the more precise "combustion area," since even though a feature is described in the archaeological literature as "hearth" or "fireplace," it is not always obvious where the actual combustion process took place. To comply with these demands, hearths should be regarded as structures composed of different elements, which can be described separately, hence making it possible to interpret their interrelated function. The elements a hearth can be composed of are: 1) traces of combustion: ash, charcoal, burned bone or fat; 2) movable rocks, possibly fire-cracked; and 3) a feature with an area of combustion, which can be a fixed stone construction.

Traces of combustion

A combustion process that includes firewood will always leave traces of charcoal and/or ash. The probability of washing out or of other factors which may have removed charcoal from a feature should be considered already during the excavation.

Charcoal should be quantified. The measure can be given by volume, making it possible to figure out the amount in relation to other hearths, to estimate different intensities of use (*e.g.*, Soffer 1985).

Fire-cracked rocks

Within Arctic archaeology, there is a large — yet still relatively unexploited — potential in analysis of stone material from hearths with moveable rocks. The documentation of fire-cracked rocks can be carried out on different levels. Firstly, one should do a simple recording of whether fire-cracked rocks are present or not, their location at the site, and in connection to which features. Secondly, weighing of the fire-cracked rocks can be done in order to provide quantification, which can be compared to other features and sites (Olsen 1998). This kind of documentation will, however, not be precise enough to estimate the length or intensity of the use of a site, since different types of rocks have different capacities and will be worn down at different rates when used as heating elements. This has been clearly illustrated by Buckley (1990) (Table 1), whose rock-type schema shows that sand and limestone (*i.e.* sedimentary rocks) produce more debris after the same number of heatings and dowsings than basalt and gabbro (*i.e.* igneous rocks). Arkose and agglomerate are only half as quickly worn down (into less than 5 cm pieces) as the sedimentary rocks, but twice as quickly as the igneous rocks.

Table 1. Number of heatings a rock needs to disintegrate into pieces smaller than 5 cm and become unsuitable for more heatings. First two columns are from Buckley (1990).

Rock type	**No. of heatings/dowsings**	**Rock**
Micaceous Sandstone	5	Sedimentary
Limestone	6	Sedimentary
Agglomerate	10	Metamorphic
Arkose	12	Metamorphic
Basaltic	20	Igneous
Vesiculated Basalt	>25*	Igneous
Gabbro	>25*	Igneous

* Experiments discontinued since no visible upper limit seemed foreseeable.

To be able to tell whether the rocks collected for heat treatment were selected meticulously or picked randomly, it is necessary to investigate the frequency of rock types found in the vicinity. At the Head-Smashed-In Buffalo Jump site in Alberta, Canada, it was demonstrated that effort and time were spent on importing rocks, since the great majority of the fire-cracked rocks were not local (Brink and Dawe 1989, 2003; Brink *et al.* 1986).

Typology

Contemporary research into hearths has pointed out that to compare hearths one needs a preliminary classification which includes a hierarchic organisation of the descriptive traits of the features. However, a descriptive approach may not cover the full sequence of uses and functions a hearth had in the dwelling. What we find at the sites are hearths in a final state, where acts and activities have modified their original state. If the function of hearths remains unidentified, a classification based solely on the morphological traits can only establish formal distinctions. Consequently, a typology showing different types of hearths and not different states of use can only be established based on an understanding of the use and function of the hearths (Coudret *et al.* 1989).

For the Arctic hearths, we already use a kind of typology by talking about "box-hearths" and "typical Dorset hearths" (*e.g.*, Schledermann and McCullough 1988). These descriptions are based on stylistic traits, which do not fully cover the function of hearths. Yet, within demarcated geographical and cultural areas, these can be meaningful in defining cultural and chronological relations. One should know, however, that a box hearth can contain fire-cracked rocks and/or charcoal, or that it can be empty; all this evidence reflecting different combustion processes. Every hearth should in principle be looked upon and interpreted within its own context. As a starting point, I present here a simple typology with implications regarding the interpretation of the use of hearths, based on my work with hearths in general (Table 2).

Table 2. Hearth typology

HEARTHS	**WITHOUT ROCKS**	**WITH ROCKS**	
		Fixed rocks	**Movable rocks**
PROCESS	Open combustion Radiation	Open combustion Radiation Convection	Closed combustion Convection
RESULT	Light and heat	Light and heat	Heat
CULINARY OPTIONS	Broiling/grilling Boiling/cooking in pot	Broiling/grilling Roasting Boiling/cooking in pot	Roasting Boling/cooking in pot Boiling with rocks

Hearths without rocks: A hearth where rocks are neither part of the construction nor form part of it as movable fire-cracked elements, can only transfer radiant heat to a dwelling (since it does not contain heating elements), and the combustion process requires good ventilation. The process will yield light, but culinary options are limited to broiling or grilling while direct boiling would be possible only if a fireproof container was available.

Hearths with fixed rocks: A combustion area situated on/within a construction of stone — beyond the radiant heat produced by the open fire — can afford convectional heat from the stones when the combustion process has come to an end, and it is possible to shut off the ventilation of the dwelling by closing the smoke-hole and/or the entrance. The first part of the process will provide light while the second part will leave the dwelling in darkness unless other sources of light are in use. In addition to broiling, grilling and boiling in a pot, in hearths with fixed rocks it is also possible to roast by placing the food directly on the hot rocks.

Hearths with movable rocks: Hearths with a content of movable rocks should be interpreted after considering the relation of the rocks to charcoal. Rocks that are not in context with charcoal could have been transported from the heating source into a dwelling where all air-channels are tightly closed. The process of heat transmission would be convection, affording an even temperature in the room. Fire-cracked rocks that are clean and found outside the context of sooth and charcoal could moreover have been used for boiling liquid in a not necessarily fireproof container. Rocks that are mixed with charcoal were probably heated on the spot in an open fire. When the fire died out, the rocks continued to function as heating elements, affording moderate heat for a longer time than the embers. During this process, it would have been possible to boil/heat liquid in a fireproof container put directly on or among the rocks, and flat rocks could have been used as frying pans.

Experimentation and other analyses

Experimentation plays an important part in the ongoing research on hearths, as do studies of ethnographically documented hearths. Experiments can control the efficiency of different hearth arrangements and can throw light on given conditions (*i.e.* technology and materials available) and on cultural choices. Experimental models can be developed in connection to specific archaeological contexts to distinguish between technological/material conditions and cultural choices.

As demonstrated primarily by French archaeologists (see Olive and Taburin eds 1989), more sophisticated technical analyses should be applied to the study of the hearth. It is an obvious area for archaeometric methods, and technical analysis of the construction and content of hearths will bring information that could support the interpretation of ancient hearths. Modern research includes lipid analyses, micro-morphology, and charcoal analyses. However, without archaeological interpretation, which includes analogy, research provides just more accurate descriptions of hearths. We need to synthesize, as will be done in the second part of this article by presenting interpretations of a few Palaeo-Eskimo hearths.

Palaeo-Eskimo dwellings and hearths

The preferred dwelling of the Palaeo-Eskimos was the tent, and what is left of tents is actually limited to the floor and outline. The outline is either a tent ring (ring of rocks) or a low wall of either gravel or turf. A tent is never just a bundle of poles covered with a skin. Tents are also designed. Tents of the historic nomadic people in the Arctic and Subarctic regions were noted for their strength and stability. The demanding conditions in the Arctic suggest that prehistoric tents were just as refined and specialized as tents known from ethnography. Ethnographically known tent types of the northern hemisphere are few but widely distributed, and all testify to be of great age (Faegre 1979). Strong similarities can be seen between the floor plan of prehistoric and ethnographically known tents from the Arctic and Subarctic areas. This suggests that the architectural design of the prehistoric tent dwellings was much alike or even identical to types of tents still in use among nomadic peoples in the Arctic and Subarctic during the 20th century (Odgaard 1995). When it is possible to deduce from the archaeological remains which kind of superstructure and hearth a dwelling had, one can estimate the indoor climate. In the following sections, I will present examples of interpretations regarding Palaeo-Eskimo dwellings with: 1) a box-hearth from the most extreme situation; 2) a summer hearth; 3) a midpassage with more than 500 fire-cracked rocks; and 4) two hearths.

A box hearth from the most extreme situation

The earliest Palaeo-Eskimos belonged to the Independence I culture (2500–1900 B.C.). The only source of heat in their tents came from the hearth, since no oil/blubber-lamps have yet been found in this early phase. Consequently, the inhabitants must have paid a great deal of attention to the functioning of the hearth. Some of the hearths are box-hearths, built of slabs on edge, and the size is most often around 40 cm x 40 cm, some hearths are in a midpassage (or axial feature), and within a tent ring (Figure 1). The contents of the box-hearths can vary, but I will concentrate on those suggested by Schledermann and McCullough (1988) to be traces from the colder time of the year. "Some of the more well-preserved hearths contain an interior layering of irregular-sized flat stones mixed with charred bone, wood and grease-saturated sand" (*ibid.*: 6). These hearths were perhaps used during the most extreme of the Arctic winter (*i.e.* the two months of total darkness with temperatures below –30°C).

How was it possible to survive during the High Arctic winter in a tent with a fireplace, without either dying from too much smoke or from the extreme cold that sufficient draft would allow in? Schledermann and McCullough (1988: 20) suggest that the tents were abandoned by mid-winter in favour of temporary snow house camps on the sea ice or snow-banked tents on land. But the absence of lamps does not support this hypothesis. Knuth (1967), McGhee (1979, 1996) and Maxwell (1985) suggest that winter was spent asleep in a kind of torpor in a frozen tent. McGhee (1996: 64) writes: "[...] It is difficult to imagine how their winter lives could have been very different from this portrayal. [...] The hard-won fuel resources that they did accumulate must have provided only for small and occasional fires, enough to thaw food and melt ice

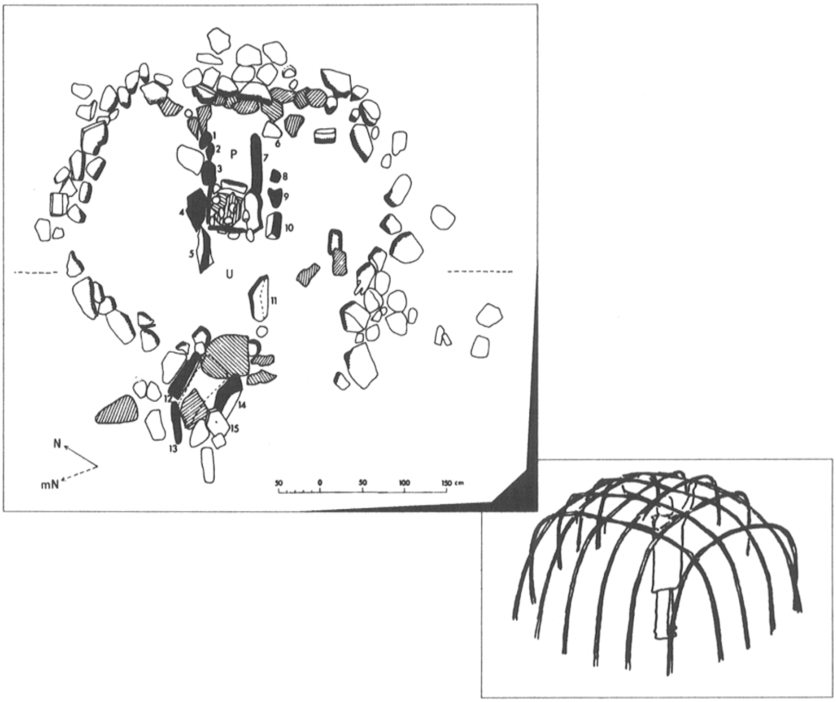

Figure 1a. Independence I dwelling from Gammel Strand Nord, Jørgen Brønlund Fjord, High Arctic Greenland (from Grønnow and Jensen 2003: Figure 5.64, adapted from Knuth 1967). Illustration of suggested reconstruction from Faegre (1979: 134).

Figure 1b. Detail of midpassage with box hearth from Figure 1a (from Grønnow and Jensen 2003: Figure 5.65)

for water but not to provide heat for human warmth." McGhee (1996: 50) considers firewood and muskox bones to be the only fuel sources, but according to Schledermann (1990: 50), the site locations in the Eastern High Arctic point to preference for open water sea mammal hunting, particularly seals. Seal bones were found in Independence I sites both in Ellesmere Island (*ibid.*) and in High Arctic Greenland (Grønnow and Jensen 2003).

The suggestion that the earliest Palaeo-Eskimos wintered in cold tents with only occasional heat from the hearth is often presented. It is however not obvious how the above described hearth arrangement could have functioned and affected the situation in the tent. Since there was no ethnographic analogy to this type of hearth, I carried out a contextual archaeological experiment[1]. An experimental hearth was built following Schledermann and McCullough's (1988) description (fist-size rocks on a layer of gravel/sand inside a box of slabs on edge). Since the tent was quite small, it needed a very controlled combustion process, and the smoke from the fire had to be kept to a minimum to imitate the situation in a tent with a small hole where most of the heat would be kept inside. The experimental hearth was heated with firewood and seal bone (which burned very well together with wood).

In order to understand how and why the gravel inside the archaeological hearths got saturated with fat, I experimented with various methods of melting fat in the hearth. They were all very smoky until I tried to place the fat with a wick of moss (as in a lamp) in the hearth. It functioned quite well when the hearth was warm, but not if it was hot, because then the fat started to fry and send out black smoke. I could not make it function in a cold hearth either. Fifty grams of fat burned for 25 minutes made very little smoke (Figure 2). The experimental hearth with one of the side-slabs removed (Figure 3), resembles the description of the possible winter box-hearths above. A possible explanation for the presence of gravel/sand in archaeological hearths is the convenience of having a sand reservoir for the melted fat, particularly if one has to stay for some length of time close to a hearth where fat is part of the fuel. In a lamp without drainage, the wick will get swamped unless the excess of melted fat is removed by tipping the lamp (Baune 1987).

Following this new interpretation of the Independence I winter box-hearth having a kind of lamp-function, it is possible to estimate the combustion of fat by means of technical standards (Table 3). Since energy loss through ventilation is considerable, two calculations with different ventilation factors are made. Situation 1 presents the lowest renewal of the air necessary for people feeling comfortable. Situation 2 presents the least necessary amount of air for survival (as in submarines, spaceships and the like). Theoretically, the standard situation in an Independence I winter tent[2] might

[1] There are two different experimental approaches in archaeology: the "controlled" and the "contextual." The controlled archaeological experiment is related to the way experiments are made in natural sciences with a basic rule of changing one parameter at the time and keeping the others constant. The contextual archaeological experiment does not claim to control the variables, but searches for identical situations (Rasmussen 2001: 6). "Its main contribution is the supplying of an interpretative framework, rather than providing proofs. Having gained new insights, the experimenter will be able to go back to the archaeological record" (*ibid.*: 8).

[2] This interpretation is inspired by an Independence I dwelling in Gammel Strand, Jørgen Brønlund Fjord, High Arctic Greenland (see Grønnow and Jensen 2003: Figure 5.64).

Figure 2. Experimental hearth with the suggested arrangement in function

Figure 3. Experimental hearth after removal of one side slab

have been as follows: the tent was dome shaped, (diameter: 4 m, max. 2 m high), covered by two layers of caribou or muskox skin and the same for the floor (Figure 1a). If six people occupied the tent with an outdoor temperature of -30°C, the indoor temperature was +8°C, which is a temperature reported ethnographically to be pleasant, if the inhabitants are wearing skin clothes, and it is also warm enough for ice to be melted for drinking water.

Heat is lost through the tent cover and floor. There is necessary ventilation, air for combustion and melting of ice for two litres of drinking water per person. In the first column, the energy loss is calculated at a situation with comfortable ventilation, while in the second column, it is with minimal ventilation like the situation in submarines. Heat is gained through body heat and through the combustion of fat in the hearth. In situation 1 (being the most probable), the energy gained is close to the energy lost. This situation would result in a fat combustion of 120 g per hour, 2.88 kg per day, or for the two dark months, 175 kg altogether. In situation 2, less fat is required; only 740 g per day, or 45 kg for the two dark months. If the box-hearth had a continuous function in the way I have suggested, the Independence I people did not have to experience severe frost in the tent during winter, since 175 kg of seal fat (around 12 seals) would be an easy task for a skilled hunter, and when stored, amounted to only around 0.175 m^2. For this experiment and calculations, seal fat was chosen because of its qualities as fuel (Baune 1987), and because seal bones have been found at Independence I sites (Schledermann 1990), but fat from other animals (*e.g.*, muskox) could be used as well. Physico-chemical analyses of residue samples from the archaeological hearths could throw light on this question.

Table 3. Energy calculations*

ENERGY OUT	Situation 1. Loss of heat at "normal" ventilation (in Watt)	Situation 2. Loss of heat at minimal ventilation (in Watt)
Tent cover	669	669
Tent floor	70	70
Ventilation	1186	165
Air for combustion	15	15
Melting of ice	46	46
Total of energy out	1986	965

ENERGY IN	Watt
Heat from people	648
Burning of fat (120 g per hour)	1250
Total of energy in	1898

*The numbers refer to energy in Watt (= j/second). Calculations by Ulrik Henriksen, Associate Research Professor, Technical University of Denmark. The full calculations are in Odgaard (2001b).

An argument against the Independence I people having wintered in tents in the High Arctic is the small size and low number of meat caches (Schledermann and McCullough 1988: 20). However, even though the Independence I people are often described as highly mobile, they were not necessarily opportunists relying exclusively on fresh meat. Many ethnographic examples are known of meat being dried for later use — either by air or sun or by drying over fire or smoke (*e.g.*, Driver and Massey 1957: 243). Both Knuth (1967) and Plumet (1989) point out the possibility that the stone built midpassages may have functioned as meat caches. The meat could have been preserved the same way as the Plains Indians' "jerky" (meat cut in very thin slices). It has the advantages of taking up less space than fresh meat, being light weight, keeping longer, and yet still having a high nutritional value (Laubin and Laubin 1989: 149). Among others, the Coast Salish Indians lived during the winter on dried food that was boiled for soup or stew by the use of hot rocks (Batdorf 1990: 27). It is however unlikely that the box-hearths, with their content of fat-saturated gravel and sooty rocks, were used for heating rocks to boil soup. Schledermann and McCullough (1988: 6) mention the possibility of roasting in the hearths by placing the meat directly on the hot rocks. The Plains Indians ate the dried jerky as it was, but they preferred it cooked. One of the cooking methods was to roast it until the fat began to show and the meat became a brown colour like broiled fresh meat (Laubin and Laubin 1989: 153).

A summer hearth

The example of a summer hearth is also from the Independence I culture: Feature 30 of the Lakeview site on Ellesmere Island in the Canadian High Arctic (Schledermann 1990: 26-29; Figure 4). The hearth is composed of small, round stones put directly on the exposed bedrock surface. The tent ring (of gravel) is oval (4.5 m x 3.5 m), suggesting a Sami kåta or a so-called "purlin tent" with a frame of two cones connected by a purlin pole lengthwise, which would make enough room for an open fire. The fire would provide sufficient light for different kinds of handicrafts, which is reflected by the finding of microblades, burin spalls, flake knifes and points within the tent ring.

Now and then, an open fire on a flat surface requires cleaning out. In this instance, charcoal and ashes were occasionally scattered outside the fireplace itself. The combustion area of this fireplace was placed directly on the rock, and the combustion process was an open fire heating the tent by radiation. Most of the heat vanished together with the smoke up the smoke hole, suggesting that this dwelling was used during a warmer period of the year. The cooking options were broiling over flames, grilling over embers, and boiling. The small round and flat stones in the hearth and in a small pile nearby indicate that cook-stone technology was applied for boiling (Schledermann 1990).

Rocks were used as heating elements through out the Palaeo-Eskimo tradition, but the method and intensity vary. Cook-stone technology in culinary practices is known from different ethnographic sources, like the Coast Salish Indians (Batdorf 1990). Round volcanic rocks were heated in the coal of the fire and put in water in a basket or a box of cedar, where the rocks would bring the water to the boiling point. Their fireplaces for heating rocks are described as small and simple, and it was necessary to use hard wood for creating the intense heat, which only glowing embers produce. The Coast Salish Indians placed the rocks close to the fire and on top of other large and flat rocks in order to keep the boiling stones as free from the ashes as possible. The rocks were constantly rotated and moved around for steady heating, thrown into the basket and removed again to be heated in the fire after cooling. Before putting the rocks into the basket, they were quickly dipped in another basket with clean water, without reducing their heat considerably (*ibid.*).

This method of using rocks for boiling fits well with the round hearth from the Lakeview site with its small and round rocks. The rocks being round suggest that they were not fractured by repeated heatings, and that they were probably selected for their present size. Their smallness indicates the heating of liquid as smaller rocks are effective for this purpose due to their quick absorption and liberation of heat. Large rocks absorb and liberate heat slower, which makes them more suitable for other culinary purposes and for room heating (Markström 1996). There are however no traces of cooking pots from the Independence I culture. The small rocks suggest instead the use of organic containers — which were not preserved — made of skin or weaved plant material. A closer study of the small rocks, interpreted as "boiling rocks," could identify the type of rocks, which would make us able to estimate the intensity/length of use of the hearth.

A midpassage with more than 500 fire-cracked rocks

At the Qeqertasussuk site in Disko Bay, Greenland, there are several features containing fire-cracked rocks. Feature A8, a midpassage hearth from the Saqqaq culture (2400-800 B.C.) was particularly carefully documented (Grønnow 1994: Figure 5). During the excavation, the rocks were numbered and their position in groups photographed. Levels were taken for every numbered rock and the amount and position of charcoal registered. In total, 578 rocks (some belonging to the frame) were brought back for further analysis which I undertook in connection to my Ph.D. research (Odgaard 2001b). My work on fire-cracked rocks was inspired primarily by Markström (1996) and Buckley (1990).

The type of rock is very important for its suitability as heating element. The rocks of Feature A8 consisted mostly of granite, an igneous rock, which in contrast to other igneous rock types acts heterogeneously when heat-treated. Hard and dense granites are just as durable as other volcanic rocks, while other granites will break after one single heating. For this reason, when the archaeological material consists of granites, it is important to examine the quality of the local granites. One method of doing so is to carry out experimental heatings and dowsings of rocks collected in the area around the archaeological feature. Markström's (1996) experiments showed that granites behave differently according to whether they were fine-grained or coarse-grained, and depending on their quartz content. Breakage did not seem related to whether they were cooled in water or in air. Coarse-grained granites with a high content of quartz broke during the initial heating, and after cooling were filled with micro cracks making them useless for re-heating. Fine-grained granites were almost uninfluenced after heating and cooling, typically exhibiting only a few thin cracks. On the other hand, examinations of the rock's ability to accumulate heat have proved that fine-grained

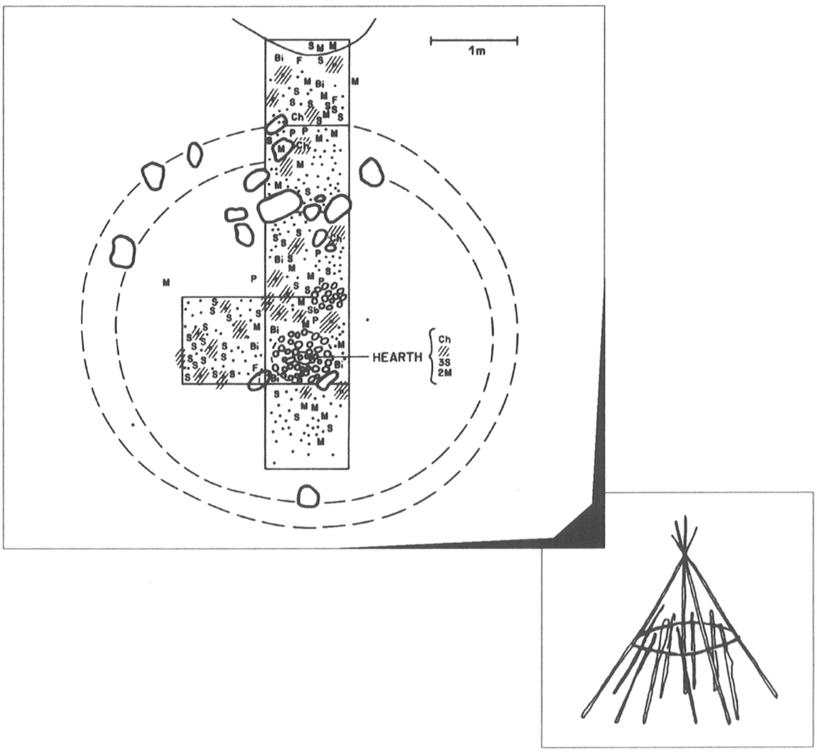

Figure 4. Independence I dwelling from Lakeview Site, Ellesmere Island (from Schledermann 1990: Figure 10). Illustration of suggested reconstruction from Faegre 1979: 132).

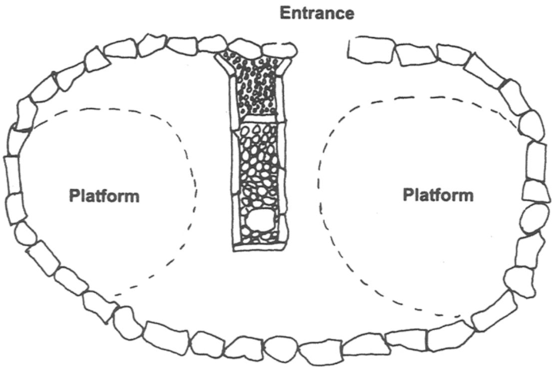

Figure 5. Reconstructed ground plan of Saqqaq dwelling with midpassage Feature A8 from Qeqertasussuk, Disko Bay, Greenland (from Grønnow and Meldgaard 1991: 17)

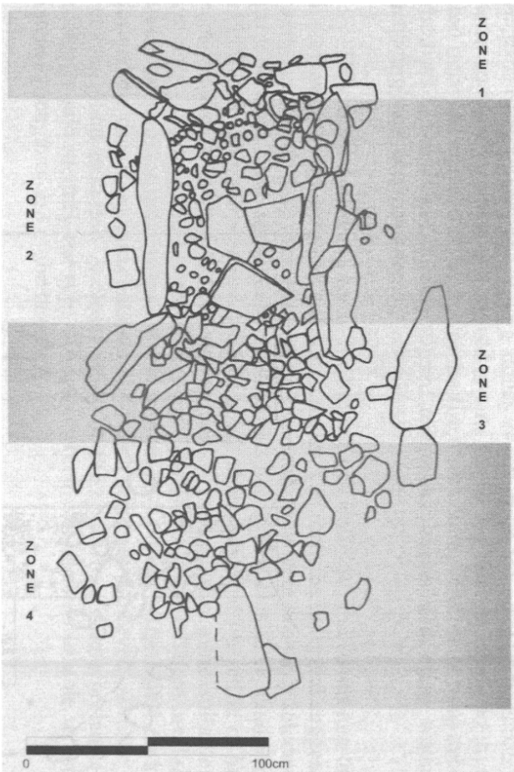

Figure 6. Midpassage Feature A8 (from Grønnow and Meldgaard 1991: 17) with four zones according to excavator Erik Brinch Petersen (1987)

granites loose their heat considerably quicker than coarse granite. It is also apparent that rocks that develop cracks after repeated reheating lose the ability to retain heat. This is especially true of friable granites.

For the analysis of Feature A8, it was not possible to obtain rocks for experimental heatings from the vicinity of its hearth since this research aspect was not considered when the excavation was carried out. Instead, the rocks from Feature A8 were examined for data (size, rock type), which could be compared with the results of the experiments of Markström (1996) and Buckley (1990). According to Buckley (1990), rocks smaller than 5 cm are not suitable for heating, but since many of the rocks from Feature A8 have an irregular shape, they were weighed instead, and 300 g was considered as equivalent to 5 cm. Markström (1996) proved that the coarseness and content of quartz is important for the durability of the granite, but even with the help of a geologist it was often impossible to estimate the quartz content. This would have required microscopic examinations of thin-cut samples. However, the coarseness of the granite was estimated as fine/medium/coarse. The extent of fire-action was estimated for all rock types considering direct fire evidence (like soot) and cracking. The observations were collected in a database and form the basis to sort the rocks and interpret the use of the feature (Table 4).

The interpretation of Feature A8 relates to the four zones in the uppermost visible layer described by archaeologist Erik Brinch Petersen (1987) (Figure 6 and Table 4): Zone 1 is partly disorganized. In the northern part is a small zone where the feature is eroding. Zone 2 includes *in situ* beach rocks on top of fire-cracked rocks. The sediment under the rocks is filled with charcoal. Zone 3 is a mixture of round and angular fire-cracked rock and fragmented plates encrusted with blubber. Zone 4 is composed by the same three components as Zone 3 and fans out from the central chamber of the hearth. Here, the rocks are lying at a lower level than the rest of the feature.

The examination of the rocks allowed the following interpretation based on the size, position and level of the rocks. The midpassage hearth A8 was used during three episodes that can be summarized as follows:

1. Earliest episode is represented by charcoal at the bottom of Zone 2 and maybe a part of Zone 3 where the charcoal is found in connection with fire-cracked rocks. During this episode, rocks were heated in the structure and spread in all four zones of the midpassage.

2. In this episode, a layer of fresh beach rocks was placed in Zone 2 next to — and partly above — the charcoal area with a layer of fire-cracked rocks from first episode. Fire-cracked rocks continue to be placed in Zones 3 and 4, but not in Zone 1.

3. During the last episode, a couple of slabs/plates were placed on top of some of the beach rocks. One of the slabs is encrusted with charred blubber on the downward side. Between the beach rocks and the slabs is a layer of soil. Rocks may have still been heated in Zone 3.

Table 4. Sorting of rocks based on zone and rock types from Feature A8, Qeqertasussuk site in Disko Bay, Greenland

Zone	Rock type	Number	Weight*	Level	Quality of granites**
1	Granite	31	<300 g	111-131 cm	16/28/8
		20	300-500 g	105-132 cm	
		1	2300 g	124-130 cm	
	Gneiss	3			
	Slate	2			
	Quartzite	1			
Total		**58 (37)**	**20820 g**	**105-132 cm**	
2	Granite	41	<300 g	101-127 cm	24/26/10
		19	300-800 g	107-131 cm	
	Gneiss	12			
	Limestone	2			
	Slate	2			
Total		**76 (66)**	**23385 g**	**101-131 cm**	
3	Granite	67	<300 g	94-117 cm	24/65/36
		56	300-925 g	92-121 cm	
		2	1150-2100 g	111-114 cm	
	Gneiss	45			
	Limestone	23			
	Slate	7			
	Basalt	1			
	Undeterm.ined	4			
Total		**205 (190)**	**76295 g**	**91-121 cm**	
4	Granite	59	<300 g	104-117 cm	36/85/32
		90	300-1050 g	104-117 cm	
		5 slabs	1150-7500 g	109-123 cm	
		1	3500 g	115 cm	
	Gneiss	30			
	Slate	9			
	Limestone	7			
	Undetermined	7			
Total		**208 (202)**	**99145 g**	**100-123 cm**	

* Granite, the dominant rock type, is divided according to weight; 300 g being the minimum weight suitable for (re)use as heating element. Numbers in brackets are rocks showing evidence of heat treatment.
** Numbers of rocks in the categories fine/medium/coarse granite.

Episode 1: A feature with glowing hot rocks could have been used for room heating, but since a number of rocks were greasy and some even encrusted with charred blubber, it is suggested that drying of larger portions of meat or fish had been going on. The process may have been similar to that used in the Scandinavian earth-ovens, where pits contained fire-cracked rocks and charred material. The procedure is interpreted to have been like this: 1) firewood was placed at the bottom of the pit, the firewood was set afire and rocks were placed therein; 2) the meat was placed at a distance above the rocks on a rack of fresh branches and covered by bark and turf (at Qeqertasussuk the rack could have been of driftwood and the cover could have been heather or just the tent cover). After a couple of hours, the heat from the rocks had dried the meat (Mulk 1995). Even though Feature A8 was not in a depression (but in a frame of rocks), the heat — first produced by the flames and then from the heat accumulated in the rocks — would go up, especially if the procedure took place in a tent. Traces of thin poles found at each end of the midpassage (Grønnow and Meldgaard 1991) could have supported an arrangement for a drying rack. According to Wandsnider (1997), a temperature between 40-55°C placed close to the fish/meat is necessary for fire drying. This temperature seems reasonable for the suggested Episode 1, and it could be tested by experiment.

Episode 2: It is possible that Episode 2 followed directly Episode 1. After the process of drying meat was finished, the next episode consisted of boiling liquids using heated beach rocks. These were placed right next to the central fireplace in the midpassage. That so many rocks were collected could reflect the coming of winter, when snow and ice would make it difficult to find suitable rocks. The heating of the beach rocks was carried out in the central fireplace in Zones 2 and 3, and the heating of the room came from this area too. Flat rocks encrusted with charred blubber were found in fragments all over the feature and could have functioned as lamps. Since the dwelling is relatively large (4 m x 7 m) and since there is not much charcoal, it is not likely that the rocks in Feature A8 were sufficient to heat the tent during winter. Therefore, this episode most likely took place during summer/autumn, when the work of preserving winter supply was followed by other activities, as indicated by piles of shavings and split pieces of driftwood mixed with small flakes from resharpening stone tools alongside the midpassage (Grønnow 1994).

Episode 3: Episode 3 probably does not follow immediately after Episode 2, as a layer of soil is found underneath the slabs lying on top of the beach rock layer. Alternatively, soil may have been placed here for creating an even foundation. In this episode, the hearth frame was repaired partly with fire-cracked rocks and blubber encrusted plates. One of the plates is encrusted with a charred layer of fat underneath, which may reflect that it had previously functioned as a lamp which was put out by being turned head down. Many Palaeolithic lamps have been recovered upside down, possibly as a result of the fire being extinguished in this way (Baune 1987). The placing and possible heating of rocks could still have been going on in Zone 3 where the highest level of rocks is about 10 cm above the place of the slabs in Zone 2.

Regarding rocks from Feature A8 in general, the most common rock type is generally granite — both fine, middle and coarse grained. Gneiss is the second most common type, but it occurs most often as "slab." A comparison between the occurrences of loose rocks in the vicinity of the site could have revealed whether rocks had been carefully chosen for their type and/or size, or if the content of Feature A8 represents the natural composition of rocks. However, this was not attempted. The relatively large amount of rocks in the structure does not necessarily reflect a long term use. Granite is not the optimal conductor of heat since fine-grained granite keeps the heat poorly, while coarse granite keeps the heat well but breaks fast. It is possible that new, fresh rocks were supplied during the process, but removal of smaller rocks does not seem to have occurred since rocks weighing less than 300 g (less than 5 cm, and not efficient as heat-accumulators) are found in a larger number than, and spread out among, the bigger and more suitable rocks in Zones 1, 2 and 3. On the other hand, in Zone 4 there is a marked predominance of rocks weighing more than 300 g, which probably reflects that the area had been used as depot for storing rocks still suited for use.

Two hearths

The tradition of having two hearths in the dwelling reaches far back in the Palaeo-Eskimo tradition, where one central and one non-central hearth (which can be a lamp) often occur. But it is not until late Dorset (in Greenland ca. A.D. 750-1300) that we find the second fireplace incorporated in the midpassage as in Feature 1 of the Polaris site in Northern Greenland (Figure 7). The rounded-rectangular shape of the ground plan, the relatively narrow benches (around 125 cm) on the sides, and the location of the hearths in the broad midpassage, all make it likely that the tent was dome-shaped. A lamp-support was found at one end of the midpassage and at the other end a hearth for an open combustion. The lamp-support is a heavy rock of 30 kg with an even surface and an oval depression rimmed with black-crusted blubber. Also along the sides of the rock, the soil was black, probably from overflowing blubber. This could be noted to a depth of 15-20 cm in the soil (Grønnow 1999: 51).

The lamp which stood on the lamp-support represents a prolonged combustion process, which by radiation could provide heat and light, while clothes or other things could be dried above it. If the smoke hole and tent doors were closed, this arrangement would provide the tent with a warmer temperature not only close to the lamp, but also in the whole tent due to convection. When a warm object is placed in a stagnant fluid — as cold air — the reduction of the density in the heated fluid close to the warm object will result in movement. The heated fluid will move upwards and be replaced by colder air, which again will be heated — making a flow of warm air. In other words, heating by convection, a process without smoke (Stewart 1987). If the moveable andirons found close to the structure were placed on each side of the lamp-support, they could have supported a cooking-pot heated by the lamp. The other hearth represents an open combustion facility used for a shorter process in connection with culinary practices with the smoke hole open. Here, the moveable andirons could have functioned as support for spits used in broiling over flames or grilling over embers, or without the andirons for roasting on a flat rock (Figure 8). The two hearths in

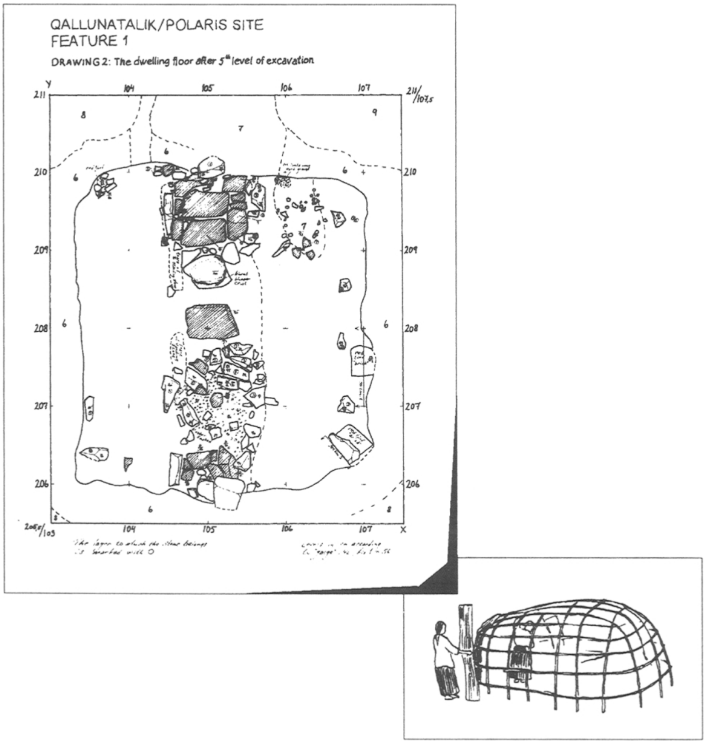

Figure 7. Late Dorset dwelling at Qallunatalik/Polaris site, High Arctic Greenland (Grønnow 1999: Figure 44). Illustration of suggested reconstruction from Faegre (1979: 140).

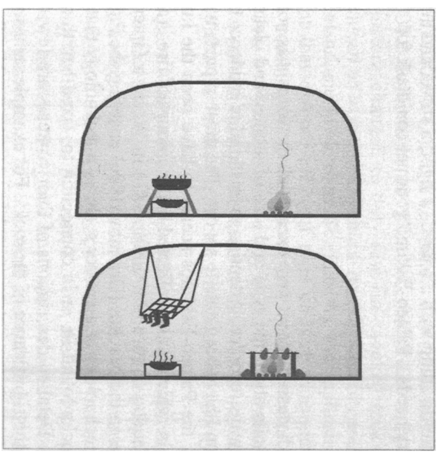

Figure 8. Reconstruction of hearth arrangements in late Dorset dwelling Qallunatalik/Polaris site

combination provided the dwelling with a source of light, a stove, and a multi-kitchen supplying all the culinary needs a Palaeo-Eskimo gourmet could ask for.

Discussion

When the features discussed above were excavated, the focus was not on the pyro-technology. Hence, details about the type and size of stones, and clear evidence of combustion were not always recorded. Attention to this kind of evidence could provide more reliable results than I have been able to set out. The most important innovation in the pyro-technology of the Palaeo-Eskimos seems to have been the introduction of fireproof cooking vessels, which is also reflected in the amount of fire-cracked rocks at the sites. During the Saqqaq culture (2400-800 B.C.) in Western Greenland, lots of driftwood was available on the beaches (Grønnow 1996) enabling the Palaeo-Eskimos to apply stone heating technology at a greater scale — a technology that requires lots of fuel. Fire-cracked rocks found in, or in connection to, fixed hearth-structures are common in this period. Detailed descriptions of their contents are few, but there has been some attention to the significance of the rocks. For example, ashes and a heap of fist-size rocks affected by fire are described from inside the hearth located in a dwelling from Tupersuit in Rodebay, north of Jakobshavn (Larsen 1956). Similar rocks were found at two other locations inside the dwelling where the soil was darkly coloured. The excavator mentions that these could be "fire stones" (*ibid.*: 579). Furthermore, in relation to Saqqaq investigations in Greenland in the 1950s, on several occasions it was observed that rocks in the hearths differed from available rocks in the immediate vicinity (Jørgen Meldgård and Jeppe Møhl, pers. comm. 2000). Similar observations have been made in Northern Quebec; *e.g.*, at the Pre-Dorset Arnapik site of Mansel Island in the northeast part of Hudson Bay, where fire-cracked volcanic pebbles were found (Taylor 1968). The amount of volcanic pebbles at the sites must be a result of deliberate selection, and they must have been transported over some distance since these rock types are rare along the central east coast of Mansel Island (*ibid.*).

According to Jensen (1998: 76), box-shaped and circular hearths with fire-cracked rocks are exclusively a Saqqaq phenomenon, while Dorset heating and cooking activities were closely related to the use of soapstone vessels. Yet, as mentioned by Møbjerg (1999), vessels and lamps of soapstone were already introduced during Saqqaq times. In the Sisimiut area, there are many box-hearths with fire-cracked rocks, but no evidence of vessels or other objects of soapstone from the Early Saqqaq phase. However, in the Late Saqqaq phase, large numbers of fragments and objects of soapstone including vessels and lamps are present (Møbjerg 1999: 462). Møbjerg (1999) suggests that a decrease in availability of driftwood triggered a change to an increased emphasis on blubber for fuel. Indeed, the large amount of driftwood that had piled up on the beaches prior to the arrival of the Saqqaq people was not an inexhaustible source (Grønnow 1996). But the same pattern can be seen in Northern Scandinavia, where thousands of sites with fire-cracked rocks have been reported and where intensive use of fire-cracked rock technology continued through a long period (from ca. 5500-3300 B.C.). The technique was still used, though not to the same extent, ca. 1900 B.C. However, ca. 1300 B.C. (same date as in Greenland [Møbjerg, in press]), the pattern changed to only few fire-cracked rocks and well constructed hearths, which can be associated with the introduction of ceramics (Broadbent 1979). Both in Greenland and in Northern Scandinavia, the application of fireproof cooking vessels meant that a more efficient type of heat transmission process could be employed. A combustion process involving heating of fire-cracked rocks requires much labour. It is unavoidable that energy is lost during transmission of the heat from the fire and the embers through the rocks to the food. If instead the cooking vessel is placed directly above or in the fireplace, both labour and energy are saved.

So far, I have solely touched upon the practical aspects of the hearths, but we should also consider what hearths meant to the Palaeo-Eskimos. Trans-culturally, hearths can be understood as gates to other worlds — the world of the dead and of the gods. Rites of feeding the fire or the spirits are known from many cultures (Odgaard 2001b). Among the historical Siberian Tuvans, the helping spirits could be fed with special spoons (Vajnstejn 1978), and small spoon-shaped devices were also among the Palaeo-Eskimos' possessions (*e.g*., a small spoon found close to a Dorset hearth on Devon Island, Canadian High Arctic [Margaret Bertulli, pers. comm. 1998], may have been such an implement).

Although having been used for different kinds of combustion processes, midpassage hearths share the same stylistic traits through several millennia, which enables us — as it enabled generations of Palaeo-Eskimos — to recognize them as "midpassages." We must assume that this appearance, which does not seem to be tied up to any practical function, signifies a particular meaning. Dwellings with midpassages also occur in Siberia and Scandinavia up to historic times. In a study on the ideology linked to these features, I have earlier (Møbjerg and Odgaard 1999; Odgaard 1995, 1998, 2001a) suggested that the Palaeo-Eskimo midpassages functioned as material symbols of the shamanistic idea of the mythological clan river known from an ethnographic description of a shamanistic séance in Siberia in the 1920s (see Anisimov 1963). Linguistic analysis has earlier suggested that this idea originated among the Tungus speaking people in the Baykal area during the Neolithic period (Vasilevich 1963) and a recent linguistic study supports this hypothesis (Fortescue 1998). An archaeological study of the possible cultural connections between the Palaeo-Eskimos and this particular geographic area during this period would be of interest. Gulløv and Appelt (2001) have recently dealt with the same issue. The link might be tenuous, but religious ideas have a tendency to live through millennia, and I believe it could be a lead worth following in search of the "origins" and mentality of the Palaeo-Eskimos. But, it is at best just one of the pieces of the puzzle. The scenario was probably much more complicated as suggested by Sutherland (2001).

Most numerous among the archaeological features in the Arctic landscape are hearths and dwellings, which in the High Arctic nearly look like monuments and make it a "socialized" landscape that preserves history and meaning (Tilley 1994). The Palaeo-Eskimos made the Arctic their home, and the hearths and the midpassages must have been important symbols and reminders of the technology, clan-connections and spiritual power, whether it was one built by themselves the previous year or by their ancestors thousands of years before. The hearths could have reminded generations of Palaeo-Eskimos about their culinary practices and that they controlled a versatile pyro-technology, which corresponded to the conditions in the Arctic. Additionally the midpassage-dwellings might have reminded them they were members of a clan and had spirit helpers.

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