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RESEARCH ARTICLE

The 'Burgundian' hat from Herjolfsnes, Greenland: new discoveries, new dates

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In 1921, during Poul Nørlund's excavation at the Norse farm Herjolfsnes, Greenland, a tall hat was recovered from the burial grounds surrounding the farm's church, where a substantial collection of medieval garments had been recovered. This unusual hat came to symbolize not only the end of the Greenland Norse colony but also its enduring cultural links with continental European fashions, following a comment to this effect published by Nørlund himself. In 1996, the hat was dated to the early fourteenth century by Arneborg, a century earlier than Nørlund's dating, based on stylistic comparisons with European examples. Recent research on North Atlantic textiles led to a reexamination of the hat, with different sections sampled and resubmitted for accelerated mass spectrometry dating. The results suggest that the body of the hat and its crown are of different periods with *c.* 100 years between them. This reanalysis of the Herjolfsnes 'tall brimless hat' or 'Burgundian' hat suggests that a considerable amount of cloth recycling took place in these North Atlantic colonies, that cloth was a valued and cherished commodity, and raises questions about the role this item of material culture role should play in discussions of identity and enduring links between Greenland and the continent.

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1. The site, the history of the hat and the demise of the Greenland Norse

In 1921, a major excavation was undertaken at Ikigaat (Herjolfsnes), near the southern tip of Greenland, by Poul Nørlund in order to recover and establish the nature of the Norse farm and church within the confines of the Eastern settlement of Greenland (Figure 1). Constant erosion was occurring on the site, and over the course of approximately 100 years prior to Nørlund's excavations, items of clothing, coffins, and skeletal remains had been recovered, as well as a funeral stone with runic inscriptions (Nørlund 2010, p. 194; Lynnerup 1998, p. 19). Nørlund was able to excavate 110–120 burials, despite there being more identified in the surveyed area, although preservation and the way the burials were closely 'packed' together rendered much of the material unrecoverable (Lynnerup 1998, p. 20; Nørlund 2010, p. 59).

The textile remains are the most unique finds from the site and constitute among the finest and most complete garments in existence for the late medieval period, having been preserved for 600 years in permafrost. Else Østergård carried out an in-depth reanalysis of textile finds from Greenland, (Østergård, 1998, 2004, 2005) with a focus on the Herjolfsnes material. Within this corpus was the famous 'Burgundian' hat (Figure 2). This item of personal adornment was considered unusual within the corpus of Greenlandic textiles and received its designation not only because of the particular shape of the hat (item DNM D10608) but also from the custom of wearing a hood over a cap that Nørlund noted in another of the Herjolfsnes burials. Nørlund drew specific parallels between the Herjolfsnes hat (DNM D10608) and 'weepers' on the sarcophagus of the Duke of Burgundy (1425) where one character is depicted wearing a small cap and another is shown with a hood over the cap (Østergård 2004, p. 134).

Over time, this hat has come to be considered an icon of the demise of the Greenland Norse. Nørlund's statement in 1924 that 'it will then be one of the specimens serving to give the latest date for the find and the interruption of the intercourse with Europe' (Nørlund 2010, p. 182) was generally accepted and the hat came to symbolize the end of the Greenland colony, the end of contact with the European mainland, and the latest date for the burials in the churchyard (Arneborg 1996, Østergård 2004).

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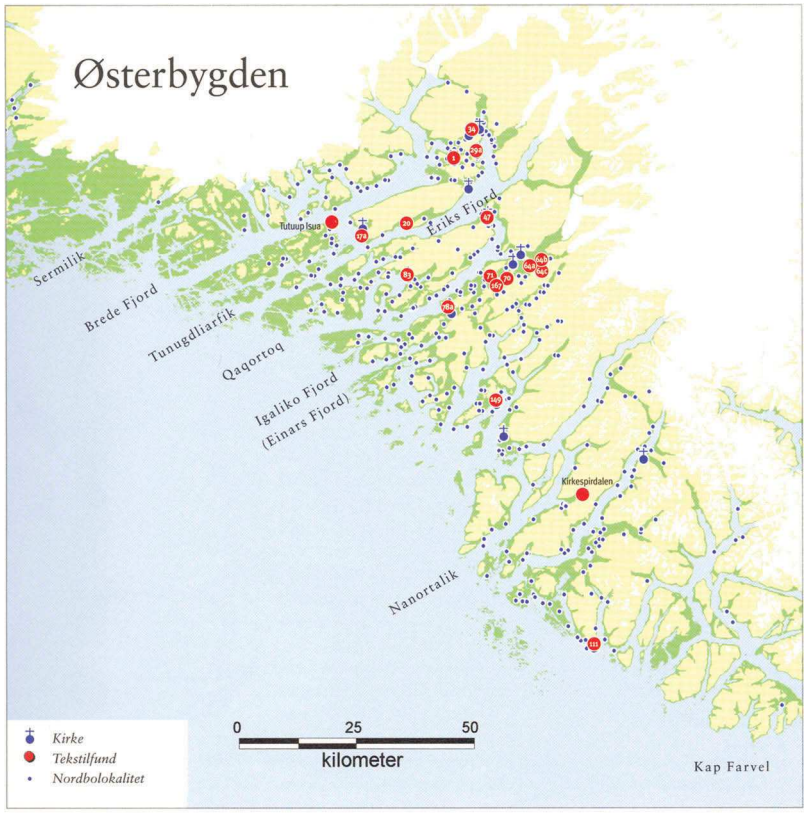


Figure 1. Map of the eastern settlement of Greenland (courtesy of the National Museum of Denmark). Red dots identify Norse sites from which textiles have been recovered. The southernmost of these red textile-producing sites, closest to Kap Farvel, is Herjolfsnes.

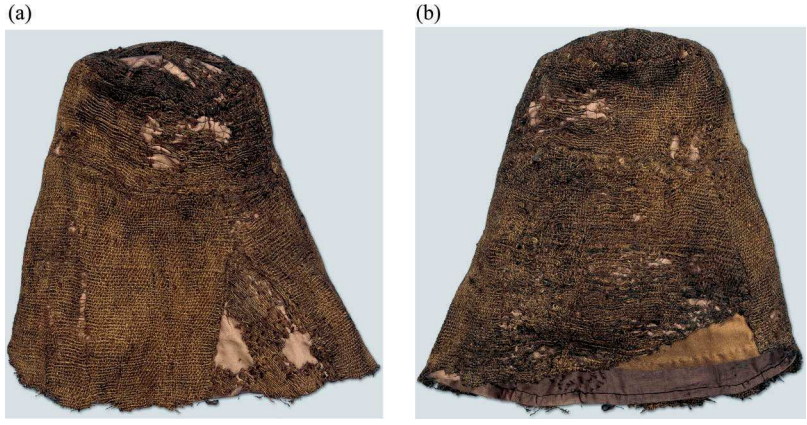


Figure 2. (a and b) The 'Burgundian' tall hat from Herjolfsnes (National Museum of Denmark).

For 70 years, a major implication of this attribution lay in its suggestion that the Greenlanders, despite their marginality, continued to be tightly connected to continental European culture and constructed their identities in reference to the latest trends in western European fashion, right up to point at which the Greenland colony disappeared.

As Gwyn Jones wrote (1986, p. 110):

> Poul Nørlund found dead Greenlanders buried in exactly such costumes as were current in continental Europe throughout the fourteenth century, and even a few examples of the latest fashions of the second half of the fifteenth. . .Now if any doubts should be entertained that these small caps can be given a fairly exact dating, there remains one about which there cannot be much discussion. It is 25-30 cm high, rather conical, standing steeply up from the forehead but widening out at the

> back of the neck. It is one of the high caps shown us on the paintings of Dirk Bout, Memling, and other Flemish painters, worn in the time of Louis XI and Charles the Bold, in the latter half of the fifteenth century.

After Nørlund's thorough analysis, the hat took on a life of its own and came to be known in the literature as the 'Burgundian' tall hat. It was described as such by Krogh (1982, p. 166), McGovern (1985), Martensen-Larsen (1987), McGhee (2003) and used by them to reference contacts with the external world. In 1996, Seaver mentioned the 'Burgundian' hat, specifically in reference to merchants traveling to Greenland to sell their wares, arguing that such a hat would have been impractical at sea but that its height might have served to impress local inhabitants (Seaver 1996, p. 230–31). Fagan (2006) mentions the hat in *Fish on Friday: Fasting and the Discovery of the New World*, inferring that the Burgundian style of tall hat was worn by the Norse as a symbol of sporadic contact after Norwegian trade with Greenland faltered (Fagan 2006, p. 213). However, despite such long-lasting academic interest in this hat and its meanings, there was no certainty that the hat was actually made to reflect Burgundian influence, since the hat itself had never been directly dated, nor evidence to demonstrate whether it was an element of a man's or a woman's attire, since Nørlund was unable to associate it with a specific skeleton.

This idea that this hat could be used as a symbol of the end of the Greenland colony was challenged in 1996 when Arneborg (1996, p. 83) published a suite of C^{14} dates from Herjolfsnes including one on the hat. This date suggested that the hat was made at least a century earlier than assumed and probably had no correlation with southern Europe but shared more in common with Icelandic and Nordic clothing traditions. Recent reanalyses of the hat, as part of a long-term project on textile production in the North Atlantic,[1] led the authors to resample and verify whether all sections were contemporary with the 1996 date. These most recent radiocarbon dates on the Herjolfsnes hat confirm that the body of the hat is contemporary with the earliest end of Arneborg's date and suggest a late-thirteenth century date for the hat's construction. However, the textiles used for the crown of the hat are earlier than this, by approximately 100 years, suggesting that the Greenland Norse were involved in significant textile recycling as has been observed in other Norse colonies of the North Atlantic, such as Iceland.

This paper presents these new dates and uses their distribution to examine the reuse, or recycling, of basic resources in the construction and maintenance of material culture within these far-flung North Atlantic Norse colonies. It also reconsiders whether Herjolfsnes's so-called 'Burgundian' hat provides evidence for the close integration of the Norse colony of Greenland into contemporary continental European culture, whether it reinforces suggestions of the colony's marginality, or, alternatively, whether it speaks to Greenland's involvement within a specifically North Atlantic medieval European culture area that developed through interaction and adaptation as the colonies established during the ninth–tenth century westward Norse expansion grew and adapted to local conditions.

2. Archaeological context of the 'Burgundian' hat and description

Five caps were recovered from the Herjolfsnes site during Nørlund's excavations, not including other hoods and headdresses, and while most of these are similar in shape – cylindrical with a round crown – the 'Burgundian' or 'tall brimless hat' stands out, being double the height of the others (Østergård 2004, p. 221; Nørlund 2010, p. 12). It was found in the southwestern part of the churchyard resting upon a piece of cloth that Nørlund thought was another part of the same headdress. Inside this second piece were teeth that disintegrated during conservation (Østergård 2004, p. 133; Nørlund 2010, p. 180). Compared to all of the other caps from Herjolfsnes, the tall hat was the only one lacking in clues about its absolute age (Nørlund 2010, p. 182), presumably because Nørlund had difficulties identifying parallels in Europe. A second tall hat was found on the site, but was in such a poor state of preservation that it was discarded (Nørlund 1923).

Construction of the hat

The hat (Nørlund no. 87, DNM D10612) was made using both a tabby weave and a 2/2 twill (Østergård 2004, p. 221). Its body was constructed with a wide lower portion, measuring 190 mm, having an additional gusset of 130 mm × 130 mm that gave a flare to the bottom half (p. 221). A separate 70 mm wide band of tabby was sewn to the top of the main

portion, and the crown was added to this by sewing two pieces together–a piece of tabby and a 2/2 twill (Østergård 2004, p. 221) (Figure 2).

Østergård remarked that the hat originally had a particular color arrangement with black and dark brown warp threads crossed by white or light tan wefts. Furthermore, the warps on the main body of the hat ran crosswise and were spun with possible goat hair, while the wefts were made from the undercoat of the northern short-tailed sheep (Østergård 2004, p. 221). This would have produced an interesting striped effect that Østergård noted in three places: on the bottom portion of the main section, on the top narrow band, and on the crown of the hat. The hat today is very worn and decayed but beyond that its textiles were unevenly woven, in areas displaying warp threads in pairs. The thread count obtained on different parts of the hat range from 6 warp yarns per centimeter to 9 - 13 weft yarns per centimeter the tabby weave sections, while the 2/2 twill found on half of the crown piece was 8/9 suggesting that the cloth was slightly weft-dominant.

3. Dating the Herjolfsnes hat

Stylistic analyses

Following the discovery of the tall hat, Nørlund tried to date it on the basis of typological similarities with headdresses documented from other parts of Western Europe. His main impression was that this hat, like the other caps recovered at Herjolfsnes, belonged to male attire. To support this assertion, he provided examples from European art of the fifteenth and sixteenth century, such as Hans Memlin's *Portrait of a Man* (1480) and details taken from the altarpiece of the Broby church (*c.* 1500) in Funen, where a man is depicted wearing a similar hat to the Greenlandic examples. He stated:

> Its impressive height and broad back part point to the middle and the latter half of the 15th century and most probably it is a man's though the women of that period wore similar erections usually covered with a veil of lawn. (Nørlund 2010, p. 182).

Østergård (2004) also thought that the Herjolfsnes hat bore a significant resemblance to small portraits created by local Inuit people that have been interpreted as representations of Norse Greenlanders, whom Thule Inuit pioneers had seen in the thirteenth or fourteenth centuries, and in part based on these images, she thought the hat was worn with the rim folded over the forehead (Østergård 2004, p. 135).

However, Nørlund also mentioned its potential similarity to Icelandic woman's headdresses of the sixteenth century, the *faldur* – tall conical headdresses that underwent a series of transformations and variations and are today worn as part of the National costume of Iceland (Guðjónsson 1978, Østergård 2004, p. 133, Helgadóttir 2013). Based on Falk's (1919) review of Nordic dress, Arneborg (1996, p. 79–83) argued that the Icelandic women's tall hats were also mentioned in the sagas of the thirteenth and fourteenth centuries, although no images of these exist.

Two Icelandic hats relevant to this discussion were discovered within the context of research for this paper at the Skógar museum in southern Iceland. Both of these hats (F1 and F2) were recovered from the same site, Fornusandur, on the southern Icelandic coast, and both were sampled and dated for this project. F2 (Figure 3) is the closer match to the Greenlandic tall hat, while the former, with a more peaked appearance, has equivalents in Icelandic medieval and post-medieval illustrations; however, both are dated later than our hat and also postdate Memlin's and Nørlund's 'Burgundian' models. Two identical accelerated mass spectrometry (AMS) dates on these hats, calAD 1530–1795 (one-sigma calibration, with highest probabilities at 1619–1670 [53.1%]) are consistent with historical documentation for this farm's occupation and, together with Falk's interpretation of the sagas' references to tall hats, suggest such items of dress remained 'in style' for many centuries in the North Atlantic.

AMS dating, 1996–present[2]

Most of Nørlund's dating of the clothing from Herjolfsnes was done on the basis of style and typology, and despite not having access to absolute methods he was relatively accurate for several pieces but off by more than a century for the tall hat. Nørlund thought it belonged to the late 1400s, while Arneborg's AMS dating (AAR-2201; 685 ± 50 bp) produced a two-sigma calibrated age of calAD 1250–1410. Based on the calibration curve used at the time of her publication, this date was reported with a nearly even bimodal probability distribution. At one standard deviation, there was a 37.3% internal probability that its actual age was calAD 1270–1320 and a 30.9% probability that the wool was

Figure 3. Hat from Fornusandur, Iceland, stored at the Skógar museum in southern Iceland (Courtesy of Skógarsafn Museum, photograph by G. A. Gisladóttir).

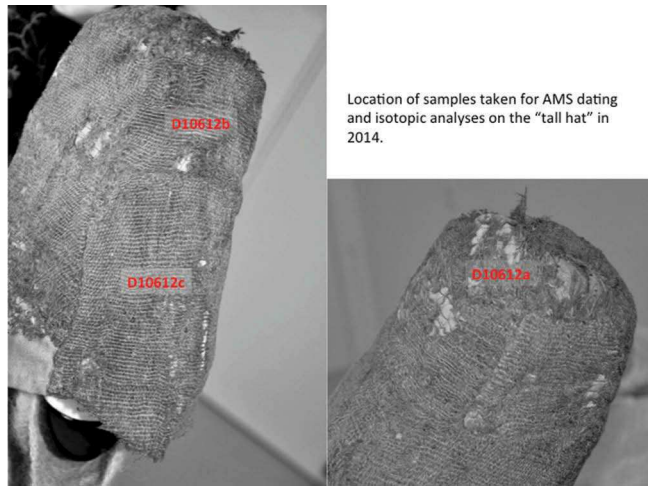


Figure 4. Locations where samples were taken for AMS dating (photograph by Hayeur Smith 2014).

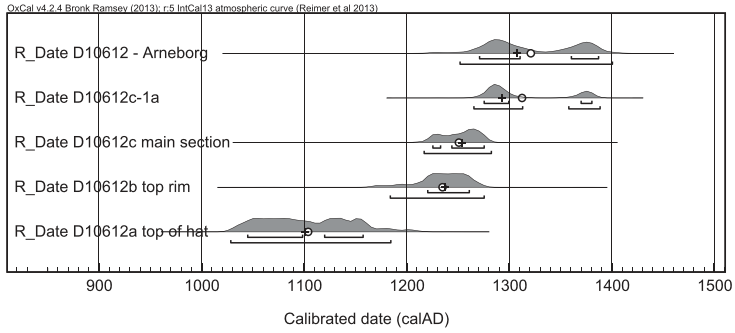
sheared somewhat later, calAD 1350–1390. Favoring the two-sigma range, Arneborg and Østergård placed its age generally between 1300 and 1400 (Arneborg 1996, p. 81; Østergård 2004, p. 133)[3]. The sample that was dated came from the main body of the hat, and while both authors mentioned the possibility of recycling in its construction (Arneborg 1996, p. 79 and 81; Østergård 2004, p. 135), the possibility that different sections of the hat might produce different dates was not explored at that time (Figure 4).

In 2014, as part of a larger project on textiles and gender it was determined by the authors that the hat in question might benefit from further analysis and, specifically, dating of different sections. A sample was collected from the larger lower portion of the hat, a second was obtained from the narrower top band portion, and a third sample was taken from the most worn part of the crown – the tabby weave section (Figure 4). These samples consisted of small fragments of cloth, each with 3–5 warp and weft threads. These were removed under the supervision of curatorial staff from the National Museum of Denmark; loose fragments that were, nonetheless, still physically attached by at least one thread to the adjacent body of the hat were prioritized for sampling. This selection process minimized damage to the hat itself while assuring that the samples selected were actually from the hat's woven structure. All three samples were submitted to Beta Analytic in Miami, Florida for AMS dating.

The dates received from separate parts of the hat are considerably different from one another. Two are essentially contemporary with the earlier end of the date previously reported by Arneborg (1996), and one is considerably earlier than any of these. Importantly, however, all were earlier by at least 200 years than Nørlund's estimated age for the hat. Figure 5 shows the four new AMS dates, as well as the earlier one published by Arneborg (1996). All are now calibrated using OxCal v4.2.3 (Bronk Ramsey *et al.* 2013) and the r:5 IntCal13 atmospheric curve (Reimer *et al.* 2013), under the assumption that the sheep from which the wool was gathered had a primarily terrestrial diet (see below, p. 9).

The sample from the crown of the hat (DNM D16012a; Beta-383360: 920 ± 30 bp) provided a calibrated two-sigma AMS age range of calAD 1028–1184. This date's probability distribution is relatively continuous; yet at one-sigma there is a slightly higher probability (41.9%) that the wool's true age is calAD 1045–1098 and a slightly lower probability (26.3%) that it actually fits into the interval calAD 1120–1157. The sample from the upper rim (DNM D16012b; Beta-383361: 800 ± 30 bp) provided a calibrated age at two standard deviations of calAD 1184–1275, with a unimodal probability peak and a one-sigma range of calAD 1220–1261. The AMS date from the lower section (DNM D16012c; Beta-383362: 770 ± 30 bp) provided a calibrated two-sigma age of calAD 1217–1282. At one-sigma this date's probability distribution was slightly bimodal, with a higher probability peak (57.8%) spanning the range calAD 1244–1275, and a lower probability peak (10.4%) in the early thirteenth century, calAD 1225–1233.

(a)



(b)

	Crown DNM D16012a	Upper body DNM D16012b	Lower body DNM D16012c	Lower body, re-run* DNM D16012c-1	Hat, body DNM D16012
	Beta-383360	Beta-383361	Beta-383362	Beta-426839	AAR-2201
Standard Radiocarbon Age	920±30 bp	800±30 bp	770±30 bp	690±30	685±50 bp
2σ calibration internal probabilities	1028-1184	1184-1275	1217-1282	1265-1388 1265-1313 (p=0.689) 1358-1388 (p=0.265)	1252-1400
1σ calibration internal probabilities	1045-1157 1045-1098 (p=0.419) 1120-1157 (p=0.263)	1220-1261	1225-1275 1225-1233 (p=0.104) 1244-1275 (p=0.578)	1275-1380 1275-1299 (p=0.542) 1370-1380 (p=0.140)	1271-1387 1271-1310 (p=0.429) 1360-1387 (p=0.253)
Median *Adjusted median*	1101 *1139*	1237 *1275*	1254 *1292*	1292	1307
$^{13}C/^{12}C$	-23.1 ‰	-22.7 ‰	-24.2 ‰	-23.9 ‰	-22.6 ‰
$^{15}N/^{14}N$	+3.1 ‰	+3.5 ‰	+3.7 ‰	--	--

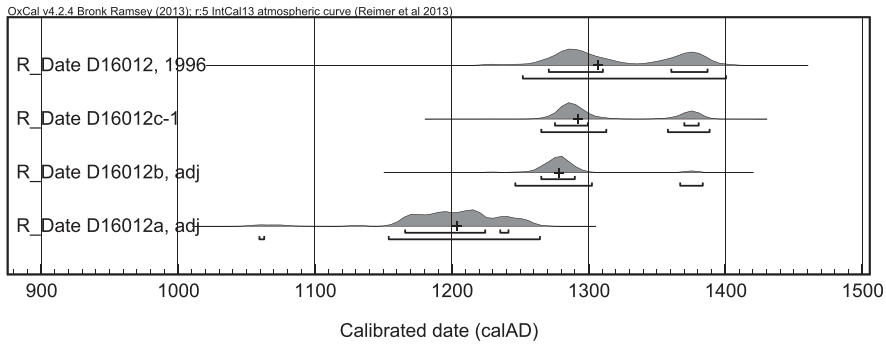
Figure 5. (a [chart], b [table]): New AMS dates combined with Arneborg's (1996) date; all have been calibrated using OxCal v4.2.4 (Bronk Ramsey *et al.* 2013).

Testing for contamination from past conservation practices

To assess whether conservation treatments done in the 1980s and earlier at the National Museum of Denmark could have contaminated the samples, leading to erroneous ages, one sample (DNM D16012c) was rerun with a separate solvent extraction pretreatment process at Beta Analytic's laboratories.[4] This pretreatment was designed to remove residual chemicals containing either modern or 'fossil' hydrocarbons that could have swayed the samples' dates to appear younger or older, respectively, than their true ages. The date received for this split sample (DNM D16012c-1), following the additional pretreatment cycle, was 80 radiocarbon years younger than the pre-calibrated age received from the portion of the sample that had not received the additional solvent extraction pretreatment. At one standard deviation, DNM D16012c-1's calibrated age is calAD 1275–1380, with a 54.2% probability that the true age falls in the range calAD 1275–1299 (and a 14% probability that its age could be calAD 1370–1380). At two standard deviations, calAD 1265–1388 (with a 68.9% probability that its age is calAD 1265–1313), D16012c-1 just barely overlaps the youngest part of the date range for the sample that had not received the solvent extraction pretreatment. However, this is virtually identical to Arneborg's earlier date (AAR-2201).

Adding the solvent extraction pretreatment routine shifted the standard radiocarbon age for sample DNM D16012c by 80 years. Given that all of the new samples collected for this study came from locations no more than 25 cm apart, we feel that it is reasonable to assume that all were similarly affected by past conservation practices. Applying this idea heuristically, the standard radiocarbon dates received for the two remaining samples were shifted by 80 years to account for similar effects of past solvent contamination and these adjusted dates were then recalibrated. Figure 6 presents the results of this exercise,

(a)



(b)

	Crown DNM D16012a	Upper body DNM D16012b	Lower body DNM D16012c-1	Hat, body (1996) DNM D16012
	Beta-383360	Beta-383361	Beta-426839	AAR-2201
Standard Radiocarbon Age	840±30 bp	720±30 bp	690±30	685±50 bp
2σ calibration internal probabilities	1059-1264 1059-1063 (p=0.004) 1154-1264 (p=0.950)	1246-1383 1246-1302 (p=0.905) 1367-1383 (p=0.049)	1265-1388 1265-1313 (p=0.689) 1358-1388 (p=0.265)	1252-1400 (median: 1307)
1σ calibration internal probabilities	1166-1241 1166-1224 (p=0.635) 1235-1241 (p=0.047)	1265-1290	1275-1380 1275-1299 (p=0.542) 1370-1380 (p=0.140)	1271-1387 1271-1310 (p=0.429) 1360-1387 (p=0.253)
Median	1204	1278	1292	1307
$^{13}C/^{12}C$	-23.1 ‰	-22.7 ‰	-23.9 ‰	-22.6 ‰
$^{15}N/^{14}N$	+3.1 ‰	+3.5 ‰	--	--

Figure 6. (a [chart], b [table]): AMS dates from the Herjolfsnes hat, adjusted heuristically for conservation contamination, and re-calibrated with OxCal v4.2.4. Arneborg's (1996) date (AAR-2201) has not been adjusted for conservation effects, as it went through different pretreatment processes than those initially undertaken at Beta Analytic. DNM D16012c-1 is the redated split sample from the upper rim of the hat, with additional solvent-extraction pretreatment.

which tightens the correspondence of dates from the body of the hat. With this adjustment, the two new dates from the body of the hat clearly overlap and are consistent with Arneborg's previously run date. Together, these suggest that the main body of the hat was made from wool shorn and spun in the last half, and most likely the last quarter, of the thirteenth century. The age estimate obtained for the crown of the hat, however, is clearly much different, suggesting that this wool was gathered in the early thirteenth century.

Testing for marine-carbon contamination

Radiocarbon ages can also be affected by marine-carbon effects. Due to the long periods of time during which C^{14} absorbed into seawater circulates and mixes through the water column, near-surface marine plants and animals can produce radiocarbon dates apparently hundreds of years older than the organism's known age (Bowman 1995, p. 24–27; Cronin 2010, p. 35). Terrestrial animals, such as sheep, when grazed or foddered seasonally on seaweed, can also absorb limited amounts of this 'old' marine carbon, resulting in artificially old radiocarbon dates for these animals. Assessing the degree to which wool was gathered from sheep that had a partially marine diet or were fed a fully terrestrial diet can be estimated by plotting the ratios of two nitrogen isotopes (N^{15}/N^{14}) and two carbon isotopes (C^{13}/C^{12}) in the dated samples and comparing these to reported values for these ratios from living animals and archaeological recovered

faunal remains. Nelson *et al.* (2012) have recently published such nitrogen and carbon isotope ratios for Greenlandic fauna, including sheep. Given that the site of Herjolfsnes is located on the coast, the C^{13}/C^{12} ($\Delta^{13}C$) and N^{15}/N^{14} ($\Delta^{15}N$) ratios of these samples were calculated as part of the AMS dating routine in order to determine whether the sheep whose wool was spun to make the Herjolfsnes hat might have grazed, or been foddered on, seaweed.

Figure 7 plots the carbon and nitrogen isotope values for the samples from the Herjolfsnes hat against known values for the $\Delta^{13}C$ and $\Delta^{15}N$ values of Greenlandic terrestrial and marine animals and plants. Arneborg obtained a 'terrestrial' $\Delta^{13}C$ value of −22.6‰ for the sample of the hat dated in 1996 (AAR-2201); however, no nitrogen isotope analyses were run then. The newly dated samples from the upper rim and the lower body of the hat provided fully terrestrial $\Delta^{13}C$ values of −22.7‰ and −24.2‰, and $\Delta^{15}N$ values of +3.5‰ and +3.7‰, respectively. The sample from the hat's crown provided comparable isotopic ratios of −23.1‰ ($\Delta^{13}C$) and +3.1‰ ($\Delta^{15}N$), ruling out a marine-carbon effect as the reason for its earlier radiocarbon age.

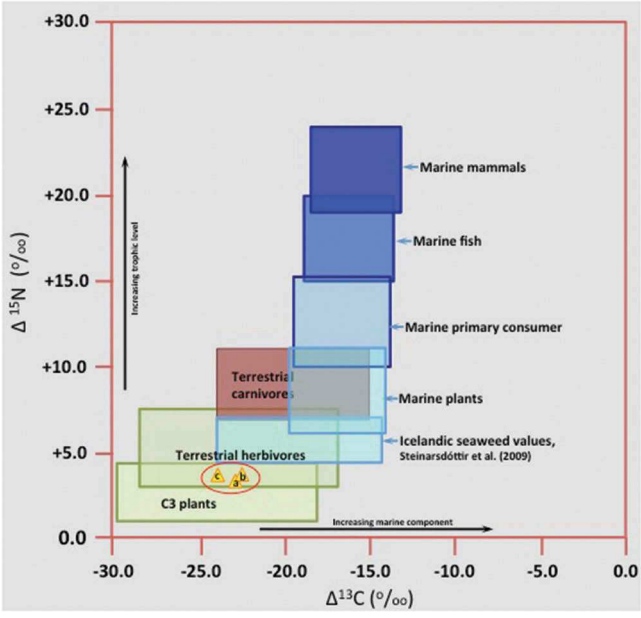


Figure 7. Carbon and nitrogen isotope ratios for samples from the Herjolfsnes tall hat: DNM 16012a (a), DNM 16012b (b), and DNM 16012c (c).

These new $\Delta^{15}N$ values on archaeological sampled wool are fully consistent with recently published baselines of +4.1±1.1 for archaeologically recovered Greenlandic Norse sheep/goat faunal remains (Nelson *et al.* 2012, p. 82). The $\Delta^{13}C$ values (−22.6 to −24.2‰) are also fully consistent with a terrestrial diet. However, it is interesting that they are considerably lower than $\Delta^{13}C$ values reported for sheep and goat remains from Greenland's Eastern (ave.: −19.8±0.5, sheep; −19.0±0.2, goat) and Western Norse Settlements (−19.8±0.3, sheep; −19.7±0.3, goat). Whether this difference reflects regional variance (e.g. Herjolfsnes was not included in the samples analyzed by Nelson *et al.* 2012), differential isotopic fractionation within bone and wool, or the acquisition of the wool from which this hat was made from some location other than Greenland is currently uncertain.

Regardless, all of these samples' isotopic compositions indicate that the wool from which the Herjolfsnes hat was made was shorn from sheep that fed on a fully terrestrial diet of grasses, sedges, and other C3 plants. There is, thus, no evidence for any marine component, such as seaweed fodder, in their diet. This allows marine-carbon reservoir effects to ruled out as an explanation for the 'older' ages of all these dates, whether compared to Nørlund's expectations for the hat's age or to the older age of the cloth used on the crown, relative to the rest of the hat.

4. Discussion

While the overall shape of this hat is similar to hat styles worn by both males and females in Flemish paintings, those hats are too late to be its inspiration, since the Flemish painting tradition flourished between the fifteenth and seventeenth centuries. The hat also resembles Icelandic counterparts of the sixteenth and seventeenth centuries, such as those reported here from Fornusandur. However, by dating the textiles directly, rather than assuming the validity of stylistic cross-dating, we have demonstrated that this is a thirteenth century hat, at least 150 years older than the 'Burgundian' style, known from continental European imagery, and cannot have been influenced by the emergence of that style. The Herjolfsnes hat cannot, therefore, be used to represent close cultural connections between

continental Europe and Greenland in the last generations of that colony's existence.

Similarly, past attempts to date the hat's style based on Thule Inuit carvings of presumed Norse individuals, or to date the age of those carvings based on the presumed stylistic age of the 'Burgundian' hat cannot be easily assumed without directly dating the carvings themselves. Although recent dates from the site of Sandhavn raise the possibility that early Thule Inuit pioneers may have penetrated nearly as far south as Herjolfsnes by the thirteenth century (Golding *et al.* 2011), the vast majority of archaeological evidence for early Norse/Inuit contact supports limited written sources indicating that Norse hunters first encountered Inuit in the Disko Bay region and further north during the mid-thirteenth century (Arneborg 1993). If such hats are, indeed, represented on Inuit carvings from Sermermiut and Inussuk (Østergård 2004), they may imply that hats, such as the Herjolfsnes tall hat, were relatively common in Greenland, or at least were of interest to the Inuit. However, the dates of these carvings and the accuracy of their representations of headgear remain unresolved issues that cannot provide independent support for dating this example.

In addition, the different dates obtained from separate sections of the hat suggest culturally specific textile uses in Greenland that have previously been noted in Iceland. Given that the crown of the hat dates to the early thirteenth century and is much earlier than the other samples from the hat's body, it is possible that cloth was a sufficiently important commodity that it could be preserved for generations and reused in garment construction over and over again. This suggests that the frequently deteriorated conditions of these textiles may not be solely post-depositional, or the result of decay over time, but may rather be related to intense recycling. This also raises interesting questions about how long the hat could have been in use after its thirteenth century creation.

Similar degrees of cloth recycling are common in the Icelandic corpus, where approximately 70% of textiles show some kind of cloth reuse.[5] Analyses of textiles by Hayeur Smith from the site of Bergþórshvoll in southern Iceland resulted in the discovery of a box of previously unknown textiles that had escaped conservation since their archaeological recovery some 90 years ago. After the textiles were cleaned, it was found that the box included many heavily patched garments and fragments, including a footless stocking or garter of a type worn over trousers and shoes and said to be common among fishermen, along with a possible hood.

The hood, currently under analysis, resembles several of the Herjolfsnes hoods, such as D10604 (Nørlund, No. 74). The Bergþórshvoll example appears to lack the long liripipe, familiar from the Herjolfsnes example, but does have a very short one at the back of the head (Østergård 2004). It has not yet been dated but is similarly made up of 12 patches. The stocking was a nearly complete piece put together from many patches that included different types of vaðmál and knits. Like the Herjolfsnes tall hat, the stocking was sampled and dated on two different locations; in this case both produced calibrated dates in the range calAD 1451–1513. A knitted patch was also present on the stocking. While this piece was not dated, it is well documented that knitting first appeared in Iceland during the 1500s (Robertsdóttir 2008).

A funerary shirt from a dated grave of 1783–1845 at Búland, Eastern Iceland (Gestsdóttir and Gisladóttir 2006), was similarly constructed from both knits and woven cloth. This type of shirt was common in Icelandic burials of the late-eighteenth century and similar examples have been identified at the sites of Bessastaðir and Reykholt. The Búland shirt was patched and mended with 17 different pieces of knitted or woven cloth. While this degree of cloth reuse seems to be more intense in Iceland – and sewn scraps from domestic middens similarly testify to the habitual reuse of cloth – recycling appears, nonetheless, to have been a common cultural practice across these North Atlantic islands, despite the seeming abundance of wool produced on Norse pastoral farmsteads.

These examples demonstrate that attempting to date a piece stylistically on the basis of a single C14 date may in some cases provide false information since the date will reflect the age of the piece of cloth sampled, rather than date when the garment was made. If we had only one AMS date drawn from the crown of the Herjolfsnes hat, for example, we might have assumed it was from the late-twelfth century rather than the late thirteenth. Having four

dates of the thirteenth century, on the other hand, allows us to suggest that the older cloth used for this hat's crown reflects the use of recycled cloth. If all four dates had been randomly distributed, and of different ages, we might have argued that this hat *could have* been made in the fifteenth century from a group of swatches of extremely old cloth, thus preserving Nørlund's view. However, the consistent agreement of three dates from the hat's body argues more clearly for the late-thirteenth century being the age when the hat was made, while the difference in age for the fourth sample points methodologically to the need for dating multiple samples from objects that were patched together in order to understand their stories.

By the same token, dating on the basis of style clearly presents its own problems. The 'Burgundian' hat surely does resemble hats depicted in fifteenth century Flemish paintings. However, now with four thirteenth-century dates from different parts of the same object, and with seventeenth century dates on similar Icelandic hats from Fornusandur, we believe the Herjolfsnes tall hat may simply be a Greenlandic creation, not necessarily attached to any continental European cultural tradition but perhaps loosely inspired by Greenland's closest neighbors, the Icelanders, and having more to do with female Icelandic *faldur* or similar hats worn by men. In this case, the Herjolfsnes 'hat', as an item of material culture, may simply be a 'North Atlantic hat' of a type fashionable there – with variations – for several centuries, not 'Burgundian' at all, and the product of a marginalized but culturally coherent society at the end of the western hemisphere with roots in a local, North Atlantic textile and dress tradition.

If this is, in fact, a 'North Atlantic' or 'Greenlandic' hat, then trying to identify external origins for its style or to determine what gender its wearer was may be pointless exercises and a more profitable one may be to focus on the cultural uses of textiles and what these can inform us of wool and resource management in the North Atlantic colonies. Farms in Iceland recycled cloth and bestowed upon it multiple existences, with examples making many transitions – from currency to clothing and ending up incorporated into household furnishings or put to other domestic uses (packing material, saddle cushions, etc.) – before finding their ways into the midden (Hayeur Smith 2014a; 2014b). It suggests that textiles, despite their abundance, were greatly valued and never wasted. In Greenland, the integration of fibers other than sheep's wool in textiles may document people's attempts to survive the harsh Greenlandic environment by selecting species, such as goats, that may have been more adapted to the climate (Østergård 1998, p. 64).

Similarly, the intensive cloth recycling noted on the tall hat from Herjolfsnes suggests concerns for managing and curating resources by reusing and preserving textiles as long as possible, perhaps 100–150 years or longer. What is certain is that the hat and its style do not reflect the date of Greenland's depopulation, which 21 AMS dates suggest took place around AD 1450 (Arneborg *et al.* 2012a, 2012b), and it is not 'one of the specimens serving to give the latest date for the find and the interruption of the intercourse with Europe', as Nørlund hoped. Rather, the hat and the different-aged textiles from which it was made reflect desires, aspirations, and hurdles encountered by these people living marginally at the end of the medieval European world.

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Notes

1. 'Weaving Islands of Cloth, Gender, Textiles and Trade Across the North Atlantic from the Viking Age to the Early Modern Period' National Science Foundation funded project (Polar Programs, Arctic Social Science Award no. 1303898).
2. Libby (1952), Suess (1970), Mook and Waterbolk (1985), Taylor (1987), Aitken (1990), Bowman (1995), Eriksson Stenström *et al.* (2011), and Taylor and Bar-Yosef (2014), among many others, provide excellent reviews of the fundamentals and history of radiocarbon dating,

calibration, and the statistical analysis and interpretation of standard and AMS dates. Readers unfamiliar with these subjects are referred to these and to the journal *Radiocarbon*. For those unfamiliar with statistical terminology used in reporting and discussing radiocarbon dates, the one-sigma range represents the statistical spread of possible ages at one standard deviation around the mathematical mean date reported by the laboratory. The one-sigma range has a 68.2% probability of containing the actual date of the material analyzed; while the two-sigma range (two standard deviations around the mean), has a 95.4% probability of containing the actual age of the sample. Radiocarbon dates calibrated against standards of known age, using programs such as Oxford University's OxCal, are conventionally reported as calAD or calBC. See Taylor and Bar-Yosef (2014) for additional information on calibration and Bronk Ramsey *et al.* (2013) and Reimer *et al.* (2013) for discussion of the calibration program and curves used in this analysis.

3. Østergård (2004) dates were based on Arneborg's (1996) dates. No additional dates were run in 2004.
4. All of the new dates reported here were run after Beta Analytic's standard acid/alkali/acid pretreatment process. Subsequently, conservation records were located at the Danish National Museum that indicated the Herjolfnes hat may have been treated between the 1920s and 1980s with lanolin and a hydrocarbon solvent to remove glue that had been used to adhere the textiles to a fabric or paper backing. The solvent extraction pretreatment process undertaken at Beta Analytic on sample DNM D16012c-1 was configured to remove both the modern lanolin and possible old carbon from the hydrocarbon-based solvent.
5. Research currently being carried out by Hayeur Smith on Icelandic textiles as part of the 'Weaving Islands of Cloth' project suggests intense recycling of textiles identified by seams, stitching, patching, and partially assembled fragments of textiles.

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