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The "Boat Place" Burial: New Skeletal Evidence from the 1845 Franklin Expedition

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ABSTRACT. In 2013, a burial feature was excavated at NgLj-3, a Franklin expedition archaeological site on the Erebus Bay coast of King William Island. The feature contained 72 human bones representing a minimum of three individuals. The composition of the assemblage closely matches the description of skeletal remains of members of the Franklin expedition buried by Frederick Schwatka in 1879. Analysis suggests that the remains include those of the two men discovered in a ship's boat in 1859 by the McClintock search expedition.

Key words: Franklin expedition; skeletal remains; Erebus Bay; Frederick Schwatka

RÉSUMÉ. En 2013, un aménagement de sépulture a été dégagé à NgLj-3, site archéologique de l'expédition Franklin sur la côte de la baie Erebus, à l'île King William. Cet aménagement comprenait 72 os humains appartenant à au moins trois personnes. La composition de cet assemblage s'apparente étroitement à la description des restes humains des membres de l'expédition Franklin inhumés par Frederick Schwatka en 1879. Selon des analyses, les restes comprennent ceux de deux hommes découverts dans le bateau d'un navire par l'expédition de recherche McClintock en 1859.

Mots clés : expédition Franklin; restes humains; baie Erebus; Frederick Schwatka

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INTRODUCTION

One of the most important discoveries made in connection with the searches for the 1845 John Franklin expedition was a ship's boat that was found in May 1859 in Erebus Bay on the west coast of King William Island by the McClintock search expedition (Hobson, 1859; McClintock, 1860). The 28-foot boat rested on the sledge on which it had been drawn, and it contained hundreds of artifacts and the skeletal remains of two members of the ship's personnel. The site was reportedly relocated by a group of Inuit in 1861 (Hall, 1869) and again in 1879 by Frederick Schwatka, who carefully examined the debris scatter that was all that then remained of the boat and its contents (Schwatka, 1965).

As a result of errors in the geographical coordinates recorded for the site by McClintock, and because Schwatka did not publish corrected coordinates, the precise location of the boat was lost for more than a century. In the 1980s and 1990s three separate sites containing boat fragments, other Franklin expedition artifacts, and human remains were discovered in southern Erebus Bay (Beattie, 1983; Ranford, 1994, 1995). At one of these sites, discovered in 1993, a partially buried cranium surrounded by what appeared to be a dismantled stone feature was found (Ranford, 1994:84). This discovery was significant because on 22 July 1879, Schwatka buried the human skeletal remains that he found scattered about the wreckage of a ship's boat thought to be the one discovered by the McClintock expedition. On the basis of the 1993 discovery, the site, designated as NgLj-3, was interpreted to be the possible location where Schwatka had buried the human remains he found in 1879 (MacDonald, 1996:6).

Archaeological investigations at NgLj-3 in the 1990s involved the mapping of surface artifacts and human remains and the placement of the surface human remains in a small memorial cairn (MacDonald, 1996, 1998a). No specimens were collected for analysis, and the feature thought to be a grave was not excavated. In 2011 and 2012, Government of Nunavut archaeologists briefly revisited NgLj-3 while participating in Parks Canada's multiyear search for HMS *Erebus* and HMS *Terror*, and in 2013, they remapped the site, collected the surface artifacts, removed the skeletal remains from the memorial cairn, and excavated the buried cranium (Stenton, 2014a). The excavation revealed a large number of human skeletal remains beneath the cranium that appear to match the description of the bone assemblage buried by Schwatka in 1879. This paper briefly summarizes the history of the site and presents the results of the analysis of the skeletal assemblage.

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SITE DESCRIPTION

NgLj-3 is located near the shore of a small bay situated near the southern limit of Erebus Bay, on the southwest shore of King William Island, Nunavut (Fig. 1). The site and the surrounding area are extremely flat, and the local topography is characterized by relict beach ridges, broad expanses of limestone shingle, and innumerable small streams and ponds bordered by wet, boggy tundra. When found in 1993, the site was defined by a thin surface scatter of artifacts clearly linked to the 1845 Franklin expedition, a small number of human skeletal remains, and a partially buried cranium (Ranford, 1994; MacDonald, 1996:4–5).

The buried cranium was found approximately 110 m from the shore, in a low exposure of limestone shingle. It was deeply embedded in a small but thick patch of vegetation around which were ten boulders in a loose configuration (Fig. 2). A 6 cm diameter section of the top of the right parietal bone of the cranium was exposed through the vegetation (Fig. 3).

Schwatka reports that after burying the remains, he erected a stone monument over the grave to mark its location (Schwatka, 1965:89). In the extremely flat landscape of southern Erebus Bay, the monument would have been visible from a considerable distance and drawn the attention of anyone traveling through the area. The boulders found around the exposed bone probably represent the dismantled monument, and their distribution, together with the fact that the human remains had been exposed for 30 years prior to being buried and likely had little or no attached tissue remaining that would have attracted animals, suggests that the feature was disturbed by human rather than by animal activity. However, removal of the boulders would have revealed the contents to be a multiple human burial rather than a cache of food, wood, metal, or other desirable items. It appears that some bones were removed during a cursory search for relics, including two crania. When the site was mapped in 1994, one of the surface crania lay 58 m east of the grave and the second 21 m to the northeast. Their precise locations probably do not derive from the activities of whoever disturbed the grave; MacDonald (1998a:11) noted that between 1994 and 1996 the mapped locations of these two surface crania had changed and suggested that they may have been moved by strong winds.

Lemmings had nested in the feature, and a dense root mat nearly 10 cm thick covered the uppermost layer of the bones. Removal of the sod layer revealed the exposed parietal bone to be part of a complete cranium overlying a large number of other human bones that had been placed in a shallow rectangular pit measuring approximately 40 cm wide, 70 cm long, and 40 cm deep. The bones all appeared to be in good condition and were tightly clustered and intermingled, and the long axis of the deposit was oriented east-west (Fig. 4).

Schwatka stated that considerable time was spent burying the skeletal remains (Schwatka, 1965:89), and the structure of the deposit reveals that the bones had been interred very methodically. The bottom layer consisted of limb bones (e.g., humeri, radii, ulnae, tibiae, fibulae, and femora) laid parallel to each other. These were covered on the east side of the feature with pelvic bones, a scapula, and a mandible. On the west side, vertebrae, including three articulated lumbar vertebrae, ribs, and smaller bones had been arranged (Fig. 5). The last bones to be placed in the grave were the crania. The cranium found in situ was facing west and was situated in the center of the feature with sufficient space on either side to easily accommodate the two crania later found on the surface. Schwatka reports depositing a written record in the grave, but this was not found; presumably, it was removed when the feature was first opened.

Published accounts state that Schwatka's party collected and buried 76 human bones thought to represent at least four individuals (Klutschak, 1987:94). The bones are described as having included three crania, four tibiae, and

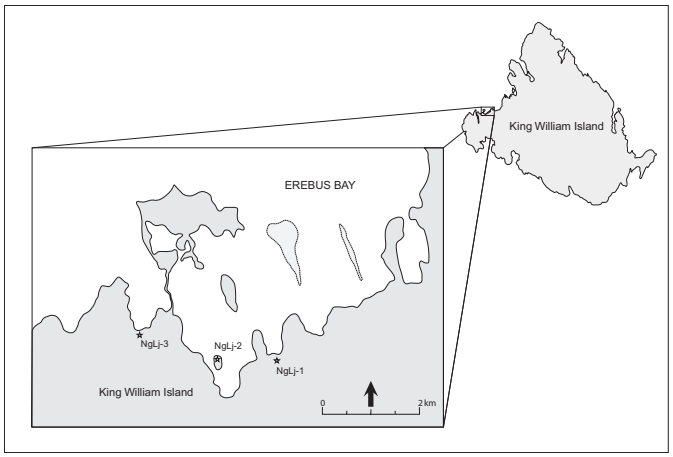

FIG. 1. Map of southern Erebus Bay showing location of NgLj-3 and nearby Franklin expedition sites where human remains have been found.

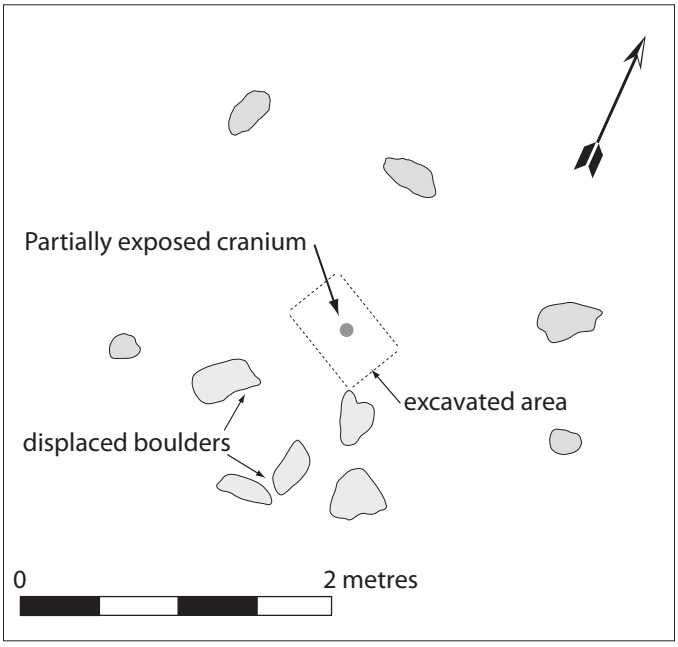

FIG. 2. Plan view of burial feature at NgLj-3.

FIG. 3. Partially exposed cranium in grave.

FIG. 4. NgLj-3 grave contents after excavation.

other large bones, but very few small bones (Schwatka, 1965:88; cf. Gilder, 1881:284). Accordingly, if the NgLj-3 deposit was the one buried by Schwatka and was substantially undisturbed, it would be expected to contain 76, predominantly large, human bones including three crania and four tibiae. Parenthetically, Schwatka's instructions were to bring back any remains of members of the expedition that he found (Gilder, 1881:5), but he did so in only a single instance, the remains of Lieutenant John Irving, evidently because those were the only ones for which the identity was known (Gilder, 1881:289).

Our findings from the NgLj-3 site appear to be consistent with its being the interment made by Schwatka on 22 July 1879. A total of 79 human bones and bone fragments were recovered from the site. Seven were found on the surface and 72 were recovered through excavation. Of the 79, six are small, unidentified fragments (one found on the surface and five in the grave) that probably detached from larger elements during or after the burial and, presumably, were not included in Schwatka's count. For the purposes of the present analysis, this leaves a total of 73 bones. Note also that although the femur found on the surface is included in the total, some uncertainty exists about whether it was

FIG. 5. Upper, middle, and lower levels of burial showing layered structure of deposit. The caribou mandible fragment in the bottom level of the deposit can be seen in in the lower photograph.

among the bones buried in 1879. It was found within 3 m of the burial feature, but all of the long limb bones recovered through excavation had been intentionally placed at the very bottom of the burial. The removal of a femur, the longest bone in the human body, would have displaced the three crania, the pelvic bones, and many other bones, yet no evidence of such disturbance was found.

Unexpectedly, the excavated portion of the assemblage included four animal bones: a seal femur, a seal metatarsal,

the distal portion of a caribou mandible, and a shaft fragment from a caribou leg bone, possibly a tibia. It is evident from the published accounts that Schwatka treated all of the human remains that he found with reverence, and it seems impossible that he would intentionally include non-human remains in a human burial. There are several conceivable explanations. We first considered the possibility that the non-human elements might be intrusive. However, the seal femur was found beneath two vertebrae on top of which the cranium rested. Had it not been buried at the same time as the other bones, the location of the seal femur within the assemblage would have required the deliberate removal and repositioning of the vertebrae and the cranium. Moreover, the other three animal bones were recovered from within the lower levels of the deposit, and the caribou mandible fragment was found at the very bottom, signifying that it was among the first bones to be placed in the burial pit. We therefore conclude that the non-human remains are not intrusive.

The probable explanation is that they were included as a result of misidentification, although the exact scenario by which this might have happened remains puzzling. To a non-expert, the bone shaft fragment and the seal metatarsal might easily have been misidentified as human. However, given its unusual shape, the presence of the seal femur is less easily explained as misidentification, and it seems reasonable to expect that any of the adult Inuit accompanying Schwatka could have informed him that the bones were not human. Most perplexing is the caribou mandible (containing three teeth): it bears no resemblance whatsoever to a human mandible, and it is inconceivable that it could have been misidentified as human. Furthermore, by Schwatka's own count, his party killed more than 500 caribou during their two-year journey (Schwatka, 1880:252), so they could hardly have been unfamiliar with the animal's skeletal anatomy. Finally, it is worth noting that Schwatka was also a trained medical doctor (Anonymous, 1893; Davis, 1988; Savitt, 2008). For these reasons, it is conceivable that Schwatka himself did not personally inter the remains.

The combined total of human and non-human bones recovered from NgLj-3 is 76, or possibly 77 if the femur found on the surface is included. This figure closely matches the 76 bones reportedly placed in the burial and suggests that the non-human remains were included in the 1879 bone count. Accordingly, we conclude that the NgLj-3 interment originally contained at least 76 or 77 bones and is indeed the one made in 1879 by Schwatka.

MATERIALS AND METHODS

Inventory

All skeletal and dental remains recovered from the site were inventoried and catalogued, and the degree of completeness and preservation was recorded. The total number of bones recovered from the site is 79 (Table 1) representing a minimum of three individuals, based on the presence of three crania and three right humeri, radii, and ulnae. As noted, 72 of the 79 bones were recovered through excavation, and seven were found on the surface of the site. Included within the maxillae and mandible found in the burial were 15 teeth.

TABLE 1. Inventory of NgLj–3 human remains.

	Position			
Bones	Left	Right	?	Total
Cranium				3
Maxilla	1	1		1
Mandible				1
Atlas				2
Axis				1
T1–12				5
L1–5				5
Sacrum				1
Pelvic Bone	1	1		2
Clavicle	2	1		3
Scapula	2	2		4
Humerus	2	3		5
Radius	1	3		4
Ulna	–	3	1	4
2nd metacarpal	–	1		1
4th metacarpal	–	1		1
5th metacarpal	–	1		1
Proximal phalanx	–	–	2	2
Unidentified phalanx	–	–	1	1
Middle phalanx	–	–	1	1
Metacarpals/metatarsals	–	–	2	2
Ribs 1–12	8	2		10
Rib shaft fragment	–	–	1	1
Femur	2	1		3
Tibia	2	2		4
Fibula	1	2	1	4
3rd metatarsal	1	–		1
Unidentified fragments			6	6
			Total	79

The seven surface remains consisted of two crania, a left femur, a left scapula, a 12th thoracic vertebra, an unidentified phalanx, and an unidentified fragment. All exhibited bleaching, weathering, and moss or lichen growth, reflecting long-term exposure to the elements. Cranium #80 (Fig. 6c) was intact and complete (minus the mandible) and exhibited bleaching and weathering on its ectocranial surface. Some postmortem damage had occurred to the right maxilla. The left second molar was present, the right first molar had been lost antemortem, and the remaining 14 teeth had been lost postmortem. Cranium #79 (Fig. 6b), the least well preserved of the three crania recovered, is represented by the left and right parietal and temporal bones, the frontal and occipital bones, and a partial sphenoid. It also exhibited considerable bleaching and weathering.

Excluding the six bone fragments, the 72 human bones from the burial included one cranium (#35), one mandible (#34), articulated partial left and right maxillary bones with no teeth remaining in the sockets (#7), 23 long bones, three clavicles, three scapulae, 12 pre-sacral vertebrae, two pelvic bones, 11 ribs, and nine hand or foot bones. Evidence of animal scavenging was observed on a number of bones. Ten of the long bones (3 humeri, 2 radii, 2 ulnae, 1 femur, 1 tibia, 1 fibula) were missing their proximal and distal ends, and three of these bones (in addition to two others)

(a) Cranium 35

(b) Cranium 79

(c) Cranium 80

FIG. 6. Crania from NgLj-3 burial.

TABLE 2. Possible matching element pairs, NgLj–3.

Element	Catalogue # (L)	Catalogue # (R)
Scapula	78	19
	4	26
Humerus	50	40
	69	70
Ulna	62	60
Pelvis	25	6
Femur	75	73
Tibia	72	74
Fibula	66	71

exhibited furrows. As noted by Byers (2011:331–332), the furrows result from the movement of teeth across the cortex during chewing and are usually associated with considerable destruction to the ends of bones. Cranium #35 (Fig. 6a) was remarkably well preserved, with all bones intact and in excellent condition. Seven teeth were present in the maxilla and the remaining nine teeth had been lost postmortem. The cranium was found completely buried with the exception of a small section of the right parietal bone, as noted earlier. Mandible #34, which contained six teeth, the remaining having been lost postmortem, was also very well preserved, and its appearance suggested initially that it belonged with cranium #35. An attempt to articulate the two indicated that this was not the case; however, the mandible articulated well with cranium #80. The left and right partial maxillary bones (#7) may belong with cranium #79, as both of the other two crania had intact maxillary bones. One loose tooth found in the burial cairn, a right first molar, was found to belong to the right maxillary bone. Ten teeth had been lost postmortem, and the remaining teeth and sockets were unobservable because of postmortem damage.

An examination of the size and appearance of the postcranial remains recovered from the site indicated a number of possible matching pairs, listed in Table 2. In addition, a number of bones were found to articulate with one another. These included the following: 1) atlas #58, which was found to articulate with axis #11; 2) five lumbar vertebrae (#22, 23, 24, 8, and 61), the first three of which were found articulated within the grave and may have been held together by connective tissue when buried, and a first sacral vertebra (#9), which articulated with lumbar vertebra #61, and pelvic bones #6 and #25, which articulated with the sacral vertebra; and 3) four thoracic vertebrae (#15, 10, 5, and 2) which articulated with one another. Atlas #13 was found to articulate with cranium #35, but postmortem damage to the occipital condyles of crania #79 and #80 prevented an assessment of which of these crania articulates with atlas #58.

RESULTS

Sex Determination

Sex determination was based on standard morphological criteria of the crania and pelvic bones (Buikstra and Ubelaker, 1994) and on cranial and postcranial metrics

TABLE 3. Discriminant function[1] analysis of crania #35 and #80.

Cranium	Measurement (mm)		Coefficient	Value	
	35	80		35	80
Maximum length (ML)	177	181	3.107	549.94	562.37
Maximum breadth (MB)	143	140	−4.643	−663.95	−650.02
Basion - Bregma (BaBr)	127	130	5.786	734.82	752.18
Basion - Nasion (BaNa)	99	97			
Bizygomatic breadth (BB)	131	135	14.821	1941.55	2000.84
Basion - prosthion (BaPr)	95	98	1.000	95.00	98.00
Nasion - alveolare (NaAlv)	71	74	2.714	192.69	200.84
Palatal breadth (PB)	63	60	−5.179	−326.28	−310.74
Mastoid length (ML)	31	28	6.071	188.20	169.99
				Sum 2711.97	Sum 2823.46

[1] Discriminant Function #: 1 Sectioning Point: 2672.39 Sex: Male.

(Byers, 2011). All three crania exhibited features characteristic of males. Cranium #35 had large supraorbital ridges, relatively blunt supraorbital margins, and very large mastoid processes. Cranium #80 had large supraorbital ridges, blunt supraorbital margins, a moderately pronounced occipital protuberance, and moderately large mastoid processes. Cranium #79 was more gracile in appearance than crania #35 and #80, but its pronounced occipital protuberance indicated that it was also likely male. Discriminant function analysis of crania #35 and #80, using the discriminant functions developed by Giles (1970) for Caucasians, confirmed both to be male (Table 3). Finally, mandible #34 had a square chin, a characteristic feature of males.

Postmortem damage to the two pelvic bones (#6 and #25) recovered from NgLj-3 meant that the majority of morphological criteria typically used to determine sex were unobservable. Both pelvic bones exhibited relatively wide sciatic notches. The traits of Phenice (1969) could not be examined on the right pelvic bone (#6) because the pubis was missing. Postmortem damage to the left pubis also hindered observation of these traits on this bone, but the body of the pubis was very narrow and there was no ventral arc. This observation, when combined with the fact that both pelvic bones had a very large acetabulum, suggests that these bones belonged to a male.

In the absence of associated crania and pelvic bones, measurements of bones of the postcranial skeleton are sometimes used for sex determination, although with a lower degree of accuracy than morphological features of the crania and pelvic bones. Table 4 provides a list of all measurements that could be taken from the postcranial remains. A comparison of these measurements (specifically the glenoid fossa heights of scapulae #4, #19, and #78, the vertical head diameter of humerus #69, and the maximum head diameter of radius #3) with those taken from a sample of Caucasian individuals of known sex (Stewart, 1979) revealed all to be male.

Age Estimation

Estimates of the ages of the individuals were based on macroscopic examination of a number of different elements. Application of the ectocranial suture closure method of age estimation (Meindl and Lovejoy, 1985) to the three crania yielded the composite scores and age estimates shown in Table 5. No age estimate could be obtained based on pubic symphysis morphology of the right pelvic bone (#6) because the pubis was missing. Postmortem damage to the superior half of the pubic symphysis of the left pelvic bone (#25) hindered an assessment of age based on the morphology of this feature; however, the inferior half exhibited faint traces of billowing consistent with Suchey-Brooks phase 1, which corresponds to an age estimate of approximately 15 to 23 years (mean = 18.9 years) (Brooks and Suchey, 1990). Examination of the auricular surface of both pelvic bones revealed evidence of billowing and striae on 25%–49% of the surface, fine granularity on 50%–89% of the surface, microporosity on one demiface, no macroporosity, and little to no apical activity. These observations point to an age estimate of 17–69 years (mean = 38.6 years) based on Falys et al.'s (2006) revised method of auricular surface age estimation.

A number of skeletal elements had incompletely fused epiphyses. These consisted of a 4th and a 5th lumbar vertebrae (#8 and #61, respectively) and four thoracic vertebrae (#15, 10, 5, and 2), all with incompletely fused epiphyseal rings on their bodies, and two left ribs (#20 and 67) with an incompletely fused epiphysis on the proximal end. The epiphyseal rings on the vertebral body are normally completely fused by the age of 25, indicating that these vertebrae belong to a young adult. Similarly, the epiphysis on the head of the rib normally fuses between 17 and 25 years of age (Scheuer and Black, 2004), again indicating a young adult.

Assessment of Ancestry

Ancestry was assessed for the two complete crania using both morphological and metric criteria. The majority of morphological features of crania #35 and #80 indicate European ancestry for both individuals (Byers, 2011), as shown in Table 6. Similarly, discriminant function analysis (Giles and Elliot, 1962) reveals that cranium #35 falls within the Caucasian range for both sets of functions, while

TABLE 4. Postcranial measurements (mm).

Element	Element catalogue number (#) and measurement (mm)				
Scapula	**#4**	**#19**	**#78**		
Glenoid fossa height	38	42	42		
Glenoid fossa breadth	25	28	28		
Humerus	**#40**	**#50**	**#64**	**#69**	**#70**
Epicondylar breadth	–	–	–	–	67
Vertical head diameter	–	–	–	49	–
Minimum head diameter	–	–	–	44	–
Lower articular surface breadth	–	–	–	–	53
Maximum deltoid diameter	22	21	24	23	25
Minimum deltoid diameter	17	16	21	20	21
Radius	**#3**				
Maximum length	258				
Physiological length	241				
Maximum head diameter	29				
Anterior-posterior diameter	13				
Medial-lateral diameter	17				
Breadth of distal end	36				
Ulna	**#47**	**#48**			
Maximum length	260	–			
Physiological length	236	–			
Anterior-posterior diameter	18	–			
Medial-lateral diameter	15	–			
Minimum circumference	43	41			
Sacrum	**#9**				
Anterior-superior breadth	123				
Femur	**#73**	**#75**	**#77**		
Epicondylar breadth	90	90	–		
Anterior-posterior subtrochlear diameter	30	31	30		
Medial-lateral subtrochlear diameter	34	34	36		
Tibia	**#21**	**#63**	**#72**	**#74**	
Maximum length	–	–	386	388	
Physiological length	–	–	364	364	
Maximum proximal breadth	–	–	81	82	
Maximum distal breadth	–	–	58	58	
Maximum diameter at nutrient foramen	36	34	34	35	
Medial-lateral diameter at nutrient foramen	25	24	24	24	
Circumference at nutrient foramen	100	93	94	96	
Fibula	**#66**	**#71**			
Maximum length	386	384			
Maximum midshaft diameter	14	14			

cranium #80 falls within the African-American range for the first set of functions and the Caucasian range for the second set (Table 7).

Stature Estimation

Stature was estimated using the formula for European males provided by Trotter (1970). Estimates calculated from four of the six major long bones range from 170.2 ± 4.32 cm to 176.5 ± 4.32 cm (Table 8). There has been some confusion about the way in which Trotter measured the tibia. According to Jantz et al. (1995), she appears to have omitted the medial malleolus from her measurement, yet her definition of this measurement indicates that it should be included. Jantz et al. (1995) recommend that if the tibia is to be used for stature estimation, the malleolus should be excluded from the measurement (i.e., the physiological length should be used instead). An estimation of stature from tibia #72 and #74 using physiological length (36.4 cm for both) yielded an estimate of 170.3 ± 3.37 cm.

Two pairs of bones (tibiae #72 and 74, and fibulae #66 and 71) had almost identical maximum length measurements. As noted earlier, the overall size and appearance of these bones suggest that the left and right of each bone belonged to the same individual (see Table 2). The stature estimates derived from these bones provide additional support for this assessment, and the estimate derived from radius #3 suggests that it, too, belonged to this individual.

It is interesting to speculate on which of the bones recovered from the site belong to each of the three individuals represented. As noted earlier, a number of bones belong to a young adult, including five lumbar vertebrae, one sacral vertebra, two pelvic bones, four thoracic vertebrae, and two left ribs. These bones may all come from the same individual. Cranium #35 or #79 may also belong to this individual judging by the degree of ectocranial suture closure and resulting age estimate derived from them.

Because of their large size and appearance, it is reasonable to suggest that scapulae #19 and #78, humeri #69 and #70, femora #73 and #75, tibiae #72 and #74, and fibulae #66 and #71 all belong to the same individual. Right radius #3, right ulna #47, and possibly cranium #80 and mandible #34 may also belong to this individual. The fact that this individual appears to be significantly more robust than the

TABLE 5. Age estimation based on ectocranial suture closure.

	Vault score	Lateral-anterior score	Age estimate (years)
Cranium #35	0	1	Age range = 21–42 (mean = 32)
Cranium #79	0	0	Age range = < 44 (no mean reported)
Cranium #80	14	5	Age range = 31–65 (mean = 45.2) for vault; 28–52 (mean = 41.1) for lateral-anterior

TABLE 6. Assessment of ancestry of crania #35 and #80 based on morphological traits.

Cranial trait	European		African		Asian		Indeterminate	
Cranium	35	80	35	80	35	80	35	80
Nasal root	X	X						
Nasal bridge	X							X
Nasal spine	X					X		
Lower nasal border					X	X		
Nasal width	X	X						
Facial profile		X			X			
Shape of face	X					X		
Shape of orbits	X	X						
Lower eye border		X			X			
Vault sutures	X	X						
Postbregma	X	X						
Palatal shape	X	X						

TABLE 7. Assessment of ancestry of crania #35 and #80 using discriminant function analysis.

Cranial measurement	Measurement (mm)		Discriminant functions for: African Americans	Native Americans	Values for African Americans		Values for Native Americans	
Cranium	35	80			35	80	35	80
BaPr	95	98	3.06	0.10	290.70	299.88	9.50	9.80
Maximum length	177	181	1.60	−0.25	283.20	289.60	−44.25	−45.25
Maximum breadth	143	140	−1.90	−1.56	−271.70	−266.00	−223.08	−218.40
BaBr	127	130	−1.79	0.73	−227.33	−232.70	92.71	94.90
BaNa	99	97	−4.41	−0.29	−436.59	−427.77	−28.71	−28.13
Bizygomatic breadth	131	135	−0.10	1.75	−13.10	−13.50	229.25	236.25
NaPr	71	74	2.59	−0.16	183.89	191.66	−11.36	−11.84
Nasal breadth	23	26	10.56	−0.88	242.88	274.56	−20.24	−22.88
Sum					51.95	115.73	3.82	14.45
Sectioning points			89.27	22.28				

other individuals represented in the assemblage may be relevant in identifying the source of the assemblage (see below).

Pathological and Non-Pathological Features

A macroscopic examination of all of the bones recovered from NgLj-3 revealed very little evidence of pathology. One left rib (#20) exhibited a partial break in the midshaft region. It is difficult to say, however, whether the break occurred perimortem or postmortem. Left tibia #63 exhibited healed periostitis on the medial surface of the midshaft, and tibiae #72 and #74 had healed periostitis on the medial and lateral surface of the midshaft, respectively (Fig. 7a). Periostitis in human skeletal remains from the Franklin expedition has been cited as evidence of possible scurvy (Beattie, 1983; Beattie and Savelle, 1983), but a variety of other disorders, including infection and trauma, may also have caused these lesions (Mays et al., 2013). One atlas (#58) had significant lipping around the superior margin of the facet for the dens of the corresponding axis, and the latter (#11) had significant lipping of the superior margin of the dens (Fig. 7b). Moderate lipping was observed along the margins of the trochlea and capitulum of right humerus #70. As noted above, tibiae #72 and 74 and humerus #70 may belong to an individual significantly more robust than the other individuals represented in the assemblage. The presence of lipping on the distal articular margins of

TABLE 8. Stature estimations calculated from intact long bones.

Element	Maximum length (cm)	Stature estimate (cm)
Radius #3 (R)	25.8	3.78(25.8) + 79.01 ± 4.32 = 176.5 ± 4.32
Ulna #47 (R)	26.0	3.70(26.0) + 74.05 ± 4.32 = 170.2 ± 4.32
Tibia[1] #72 (L)	38.6	2.52(38.6) + 78.62 ± 3.37 = 175.9 ± 3.37
Tibia[1] #74 (R)	38.8	2.52(38.8) + 78.62 ± 3.37 = 175.1 ± 3.37
Fibula #66 (L)	38.6	2.68(38.6) + 71.78 ± 3.29 = 175.2 ± 3.29
Fibula #71 (R)	38.4	2.68(38.4) + 71.78 ± 3.29 = 174.7 ± 3.29

[1] Including the medial malleolus (if excluded, the physiological length of each tibia is 36.4 cm).

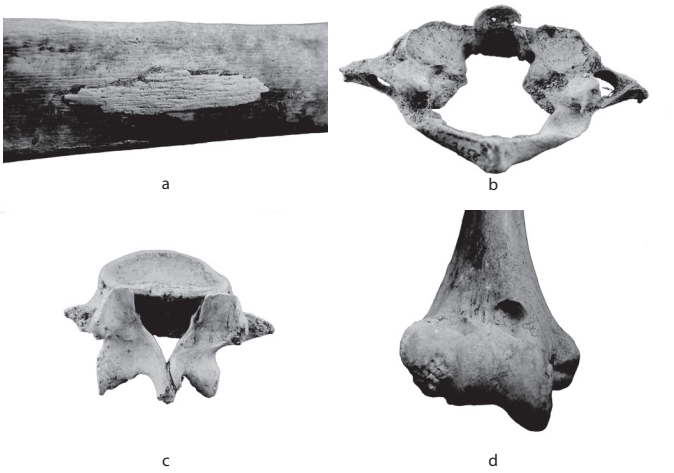

FIG. 7. (a) periostitis on midshaft of right tibia; (b) atlas vertebra showing lipping; (c) fifth lumbar vertebra with cleft neural arch; (d) right humerus showing septal pitting from impingement of ulna.

the humerus further suggests that he was older than the other individuals. It is possible that atlas #58 and axis #11 also belong to this individual judging by the degenerative changes seen in these elements.

A fifth lumbar vertebra (#61), which articulated with the other lumbar vertebrae recovered from the site, had a developmental malformation of the spinous process characterized by incomplete fusion of the two halves of the vertebral arch, commonly referred to as cleft neural arch (Fig. 7c). As well, the left inferior articular facet was noticeably larger than the right inferior articular facet. The expression of cleft neural arch in contemporary populations ranges from failed fusion of the vertebral arches with or without spinous process aplasia to spina bifida cystica, the most severe form, characterized by the protrusion through the defect of the meninges, the spinal cord, or both. Typically affecting only one or two vertebrae, clefting usually involves the lumbosacral vertebrae. Clefting of the neural arch without associated neural tube defects is usually asymptomatic since the two halves of the arch are connected by tough fibrous tissue, which protects the underlying tissue (Barnes, 1994:119). Therefore, most clinicians do not consider the condition to be abnormal (Barnes, 1994:49). Cleft neural arch was previously documented in an atlas vertebra from NgLj-2 (Keenleyside et al., 1997).

Dental pathology observed in the remains included antemortem loss of the right first maxillary molar of cranium #80 and slight calculus deposits on the right second and third molars of mandible #34. Examination of all observable dentition in crania #35 and #80 and mandible #34 revealed minimal tooth wear.

One unusual feature, recorded in right humerus #70, consisted of a round pit measuring 11 mm in diameter located directly superior to the trochlea (Fig. 7d). This may be a case of impingement of the coronoid process of the ulna (in this case, ulna #47), which results when hyperflexion of the elbow brings the coronoid process into contact with the humeral septum so that bone resorption occurs. Such impingement may, in some individuals, lead to the formation of a septal aperture in the distal humerus (Mays, 2008).

Cut Marks

Four bones displayed cut marks. A first sacral vertebra (#9) had four cut marks, two large and two small, on the superior surface of the right ala (Fig. 8a). A right scapula fragment (#26) had six cut marks on the spine running parallel to one another and perpendicular to the spine (Fig. 8b), and two tibiae exhibited one cut mark each, located on the posterior surface of the distal shaft (#21) and on the lateral surface of the proximal shaft (#72). The latter cut was located adjacent to a small puncture mark (Fig. 8c).

DISCUSSION

The number of bones and the composition of the human bone assemblage from NgLj-3 closely match the description of the bones buried by Schwatka in 1879. The collection includes three crania and four tibiae, although the anatomical positions of the tibiae, and thus, the initial estimate of the minimum number of individuals represented (i.e., four), were incorrect (e.g., Schwatka, 1965:88). The collection also contains relatively few small bones, with only 12% of the assemblage consisting of small bones of the hands and feet. The results of the analyses indicate that the burial at NgLj-3 contained the partial remains of three individuals, all males, one of whom was a young adult.

Source of the Assemblage

Having identified the NgLj-3 human remains as the ones buried by Schwatka, and since Schwatka found them around the wreckage of a ship's boat, it is logical to ask whether the bones we describe in this study derive from the human remains observed by Hobson and McClintock.

Schwatka assumed that the boat near which he found the skeletal remains was the same one described in 1859 by Hobson and McClintock (Schwatka, 1965:88), and the boat's stem, which Schwatka removed from the wreckage and sent to England, bore the same markings as the one described by McClintock. Thus, having been found in association with the wreckage of the same boat, the human remains buried at NgLj-3 by Schwatka might be expected to include the ones described by Hobson and McClintock. Unfortunately, although Hobson and McClintock inventoried and described in considerable detail the artifacts they found in the Erebus Bay boat, their documentation of the human remains they found was by comparison superficial.

In the boat, Hobson found the remains of two individuals, identified by two mandibles and two discrete sets of postcranial elements. One mandible was described as being of great size, as were the associated postcranial remains. Because of its smaller size and the good condition of the teeth, the second mandible was thought to be that of a

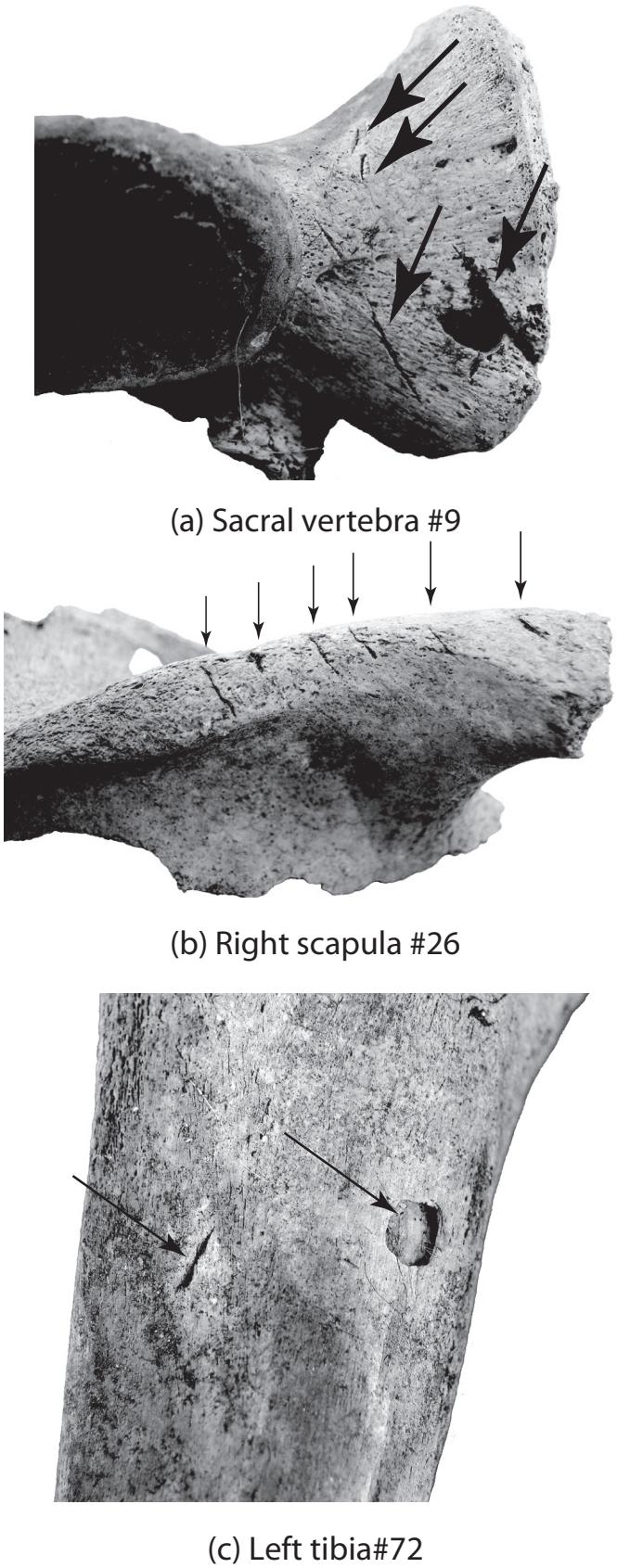

FIG. 8. (a) Cut marks on right superior surface of first sacral vertebra; (b) spine of right scapula showing six cut marks; (c) left tibia with cut mark and small oval puncture.

younger individual. The smaller skeleton was found in the bow of the boat, and Hobson noted that the bones had been disturbed (scattered) by animals, possibly by foxes (Hobson, 1859). McClintock (1860:265), who did not see the bones in their original state and relied on Hobson's report as a source, attributed the disturbance (perhaps for dramatic effect) to "large and powerful animals, probably wolves." The larger skeleton was found in the stern of the boat, surrounded by clothing and pieces of blanket and bear skin. Apart from the missing cranium, it was essentially complete, with the small bones of the hands and feet still in the mitts and stockings (Hobson, 1859:16). Hobson speculated that these remains might have been those of an officer. A typical adult human body contains 206 bones, and assuming that animals had removed some of them, it is reasonable to conclude that several hundred bones remained at the site when McClintock left it in late May 1859. McClintock expressed surprise about finding the remains of just two individuals (1860:269), although he and Hobson both recognized that the deep snow cover probably concealed additional elements.

Little is known about specific events impacting the boat and its contents between May 1859 and July 1879, when Schwatka rediscovered it. In an 1869 interview with Charles Francis Hall, a Netsilik Inuk named In-nook-poo-zhe-jook told Hall that he had visited the site in the spring of what Hall calculated to be 1861 (Hall, 1869:109). In-nook-poo-zhe-jook indicated that the boat was empty and that bones of white men were seen outside of it; specifically, several crania had just begun to show through the ice (Hall, 1869:111). Unless the crania were the only bones seen by In-nook-poo-zhe-jook, the fact that they were only beginning to show through the ice raises questions about the visibility of other bones that might have been present, unless the Inuit had uncovered them in the course of their search for relics. Because In-nook-poo-zhe-jook also claimed that he and his group were the first Inuit to visit the site since McClintock, his description implies that the human remains and relics had been left on the ground and not placed back into the boat when McClintock departed the site. Particularly intriguing is In-nook-poo-zhe-jook's specific mention of seeing several crania, which neither Hobson nor McClintock reported from their very thorough search. Hobson and McClintock focused their searches in and around the boat, but the extent of the area they cleared around the boat is unknown, as are the locations relative to the boat of the crania reported by In-nook-poo-zhe-jook. In any case, by 1879, the boat and sledge had been destroyed, and the artifacts and human remains that Schwatka collected were found scattered over an area of approximately half a square mile (Schwatka, 1965:88; Klutschak, 1987:94).

The NgLj-3 remains exhibit some specific attributes consistent with observations made about the human remains found at the boat site by Hobson, McClintock, and In-nook-poo-zhe-jook. Although in 1859 Hobson and McClintock saw the remains of only two men in the boat, without skulls, in 1861 In-nook-poo-zhee-jook reported

seeing "several" crania outside the boat (Hall, 1869:111), and Schwatka found three crania at the site. Further, some of the remains exhibit attributes noted by Hobson about one of the skeletons. The human mandible found in the burial is relatively large, and it and several matching pairs of large bones, including humeri, femora, tibiae, and fibulae, would thus be consistent with the large individual Hobson discovered in the stern of the boat. However, some of the attributes of the NgLj-3 remains—particularly the cut marks—are more difficult to reconcile with the accounts of Hobson and McClintock.

Previous studies of skeletal remains from members of the Franklin expedition, including a large collection from site NgLj-2 in Erebus Bay, have revealed cut marks consistent with oral historical reports that Franklin's men had engaged in survival cannibalism (Beattie, 1983; Beattie and Savelle, 1983; Keenleyside et al., 1997). The relative frequency of bones exhibiting cut marks is quite low (5%) in the NgLj-3 assemblage, as is the number of elements affected, but the earlier studies have demonstrated that the presence of cut marks would not be surprising in an assemblage of this type from Erebus Bay. The NgLj-3 collection differs, however, from the other Erebus Bay collections in that a historical description (albeit superficial) exists of two individuals whose remains may be part of the present study, and it provides a context that raises questions about the presence of cut marks on the bones. Hobson's (1859:16; Stenton, 2014b) description of the skeletal remains, all of which were found inside the boat, is worth quoting in extenso:

> In the stern sheets, just abaft the after thwart on the port side was a human jaw bone of great size. Other bones of corresponding magnitude lay near. The leg bones were more forward on the starboard side. The man appeared to have been lying transversely across the boat with his head under the after thwart at the time of his death, parts of a bear skin and pieces of blanketing were found about him; also a large quantity of remains of clothing. These latter were so frozen together that they had to be dug out with the pickaxe and were consequently torn to pieces. I cannot say what clothing he wore. The small bones of the hands and feet remained in the mitts and stockings. The mass of clothing that lay about the bones must have belonged to several men. A chronometer bearing the name of Parkinson and Frodsham &c. was found near his remains, and much in the position it would have been had he worn it in the waistband of his trousers in a watch pocket. From this I think it likely the deceased may have been an officer, but I cannot pretend to say that there was anything else to lead to that conclusion. Under the second thwart from forward a second jaw bone was found. It, as well as the bones near it, was of much smaller size than the other. The remains appear to be those of a young man, the teeth being remarkably sound. These bones appear to have been disturbed. They were considerably scattered, probably by foxes.

From Hobson's description, at least one, if not both men (cf. McClintock, 1860:265), had apparently died in the boat, and apart from some scattering by animals of the bones of one man, disturbance of the remains appears to have been minimal. Hobson's report to McClintock contains no other observations about the condition of the bones and no reference to anything that might be construed as evidence of cannibalism. Although McClintock viewed Inuit accounts of cannibalism among Franklin's men as both repugnant and unsubstantiated (e.g., McClintock, 1881), Hobson's views on this highly controversial subject are unknown. There is nothing in the NgLj-3 assemblage, however, to suggest that Hobson or McClintock had found evidence of cannibalism and suppressed it. It is clear from Hobson's report, for example, that the bones in the boat were given only a cursory inspection (e.g., unlike the artifacts, the bones weren't even inventoried), and at the time of their discovery and removal from the boat, the bones were embedded in ice and snow. Given that recovery context, and the fact that small cut marks were found on just four bones in this study, we consider it unlikely that Hobson or McClintock observed the cut marks, or that if they did see the marks and interpreted them as possible evidence for cannibalism, they intentionally omitted the information from their reports.

Thus, there would be no reason to expect cut marks from cannibalistic behaviour on the skeletal remains of the two individuals found in the boat. One possible explanation involves the composition of the bone assemblage collected and buried by Schwatka. At least some of the postcranial bones derive from a third individual, whose body was not in the boat when it was discovered by Hobson; one or more of the bones from that individual's body may have been subject to modification related to cannibalism. Also, and because Schwatka collected bones from a large area, it is possible that some of the bones bearing cut marks originated from other nearby locations. Alternatively, given the unusual locations of some of the cut marks, we cannot discount the possibility that the marks on some of the bones might have occurred during the process of their removal from the boat. As noted above, when found by Hobson, the contents of the boat were frozen solid, and he used a pickaxe to remove a quantity of frozen clothing that surrounded the skeleton found in the stern of the boat. Hobson noted that this resulted in the clothing being torn to pieces, and it is conceivable that some of the bones may have been damaged through the use of the pickaxe (e.g., tibia #72 and sacrum #9 both have puncture marks close to the cut marks) or by the use of other (possibly bladed) implements.

These all appear to be plausible scenarios that might account for the cut marks. Nonetheless, and although the historical and archaeological data suggest that the remains of the two individuals observed by Hobson and McClintock are included in the NgLj-3 assemblage, on the basis of the skeletal findings alone it is impossible to state this with absolute certainty. The authors hope to resolve this question with a forthcoming detailed study of the boat place sites in Erebus Bay.

The results of the present study build on previous analyses of Franklin expedition human remains from Erebus Bay. The excavation of the burial also underscores the importance of new investigations of previously documented Franklin expedition sites and reflects the continued research potential of Erebus Bay, which in the last two decades has yielded more than 800 artifacts and hundreds of human skeletal remains representing approximately 20 members of the expedition.

Approval obtained from the Government of Nunavut and the Inuit Heritage Trust for the removal and analysis of the skeletal remains from NgLj-3 was granted on condition that the remains be reburied in 2014. In September 2014, they were returned to the site and placed in a new memorial cairn constructed for that purpose.

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