



Wrecks of HMS Erebus and HMS Terror
National Historic Site of Canada

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*Underwater Archaeological Survey of HMS Terror and
Excavation of HMS Erebus in 2019*



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*UNDERWATER ARCHAEOLOGICAL SURVEY OF HMS TERROR
AND EXCAVATION OF HMS EREBUS IN 2019*

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UAT Projects: 89M and 90M

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SUMMARY

This report presents the results of archaeological research undertaken by Parks Canada's Underwater Archaeology Team (UAT) in 2019 at the wrecks of HMS *Erebus* and HMS *Terror*. The main archaeological objectives for 2019 were to continue the non-intrusive evaluation of the *Terror* site, mostly through the use of a micro-remotely operated vehicle. For *Erebus*, the goals were to initiate test excavation of specific areas of the lower deck, meanwhile exploring other undocumented spaces deeper inside the hull. Mainly on account of exceptionally good weather conditions, most of the 2019 objectives were successfully completed.

SOMMAIRE

Ce rapport fait état du résultat des travaux archéologiques réalisés par l'Équipe d'archéologie subaquatique de Parcs Canada (EAS) sur les épaves de HMS *Erebus* et HMS *Terror* en 2019. L'un des principaux objectifs de 2019 était de continuer l'étude non intrusive de *Terror* à l'aide d'un véhicule sous-marin téléguidé. Les autres objectifs, visant l'*Erebus*, consistaient à débiter la fouille de secteurs spécifiques du pont inférieur tout en explorant d'autres espaces non documentés plus loin à l'intérieur de l'épave. La plupart des objectifs de 2019 ont pu être réalisés notamment grâce à des conditions météo exceptionnellement favorables.

ACKNOWLEDGEMENTS

The UAT acknowledges first and foremost the Inuit Heritage Trust, Franklin Interim Advisory Committee, Canadian Coast Guard and Government of Nunavut. Special thanks to the crew of the CCGS *Sir Wilfrid Laurier* for their logistical support to refuel the RV *David Thompson*, transport equipment and artefacts, and install two moorings at the *Erebus* site.

The UAT also wishes to acknowledge Parks Canada staff from Conservation Science and Preventive Conservation for their dedicated analytical work on the recovered artefacts, and from Conservation Services for artefact treatment. Thanks to Tamara Tarasoff and Aaron Skoblenick of the Nunavut Field Unit, as well as members of the Erebus and Terror Guardian Program. Special thanks to Jonathan Puqignak who joined the project as a Research Assistant. Matthew Betts kindly shared his reconstruction plan drawings of *Erebus* and *Terror* and provided many insightful comments and suggestions regarding research at the wrecks. Finally, a thank you to material culture specialists Phil Dunning and Charles Bradley for so generously sharing their immense knowledge regarding some of the artefacts recovered.

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1. PROJECT DESCRIPTION

1.1 INTRODUCTION

This report describes archaeological fieldwork conducted by the UAT at the wrecks of HMS *Terror* and HMS *Erebus* between August 8 and September 14, 2019. This work was the latest step in a multi-year research project undertaken by Parks Canada (that began in 2014 at *Erebus* and 2016 at *Terror*) to study Sir John Franklin's 1845 expedition vessels (Dagneau 2020; 2018; Dagneau and Moore 2017; Moore 2020; Moore et al. 2017).

1.2 DEFINITION OF THE STUDY AREA

The wreck of HMS *Erebus* is located in 12 m of water in Wilmot and Crampton Bay, on the western shore of the Adelaide Peninsula. HMS *Terror* is located in 24 m of water in Terror Bay, off the southwest shore of King William Island. Both wreck sites are within the Kitikmeot Region of Nunavut, Canada. HMS *Erebus* is approximately 125 km from Gjoa Haven and 250 km from Cambridge Bay, the two nearest communities in Nunavut. HMS *Terror* lies some 70 km north of the wreck of HMS *Erebus* (Figures 1.2.1–1.2.3).



Figure 1.2.1: Locations of the wrecks of HMS *Erebus* and HMS *Terror*, Kitikmeot Region, Nunavut (Map: C. Dagneau, Parks Canada; Imagery: Esri / Earthstar Geographics, TerraColor).

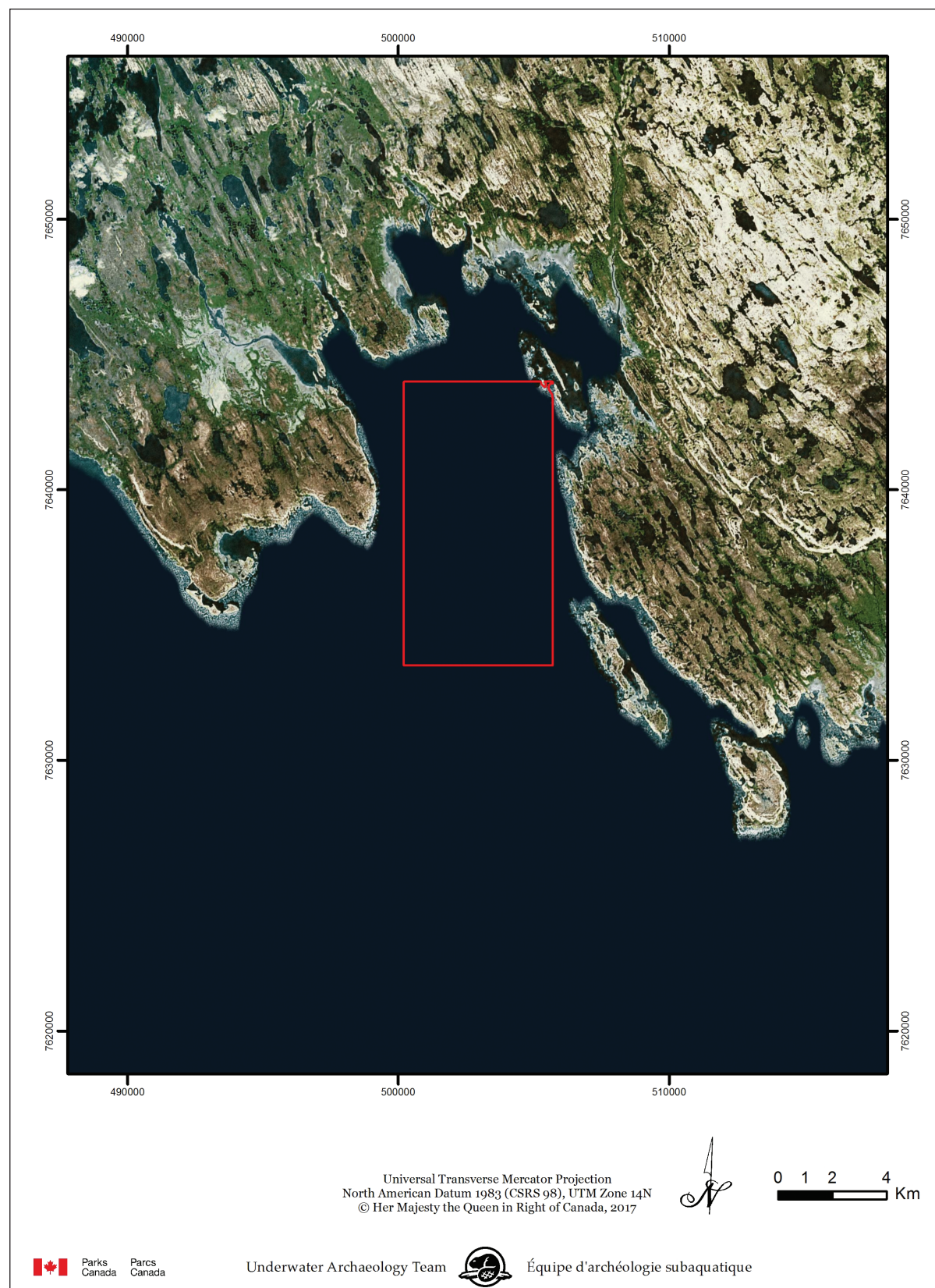


Figure 1.2.2: Wrecks of HMS Erebus and HMS Terror National Historic Site protected area around the *Terror* wreck site, Terror Bay, Kitikmeot Region, Nunavut (Map: C. Dagneau, Parks Canada; Imagery: Esri / Earthstar Geographics, TerraColor).

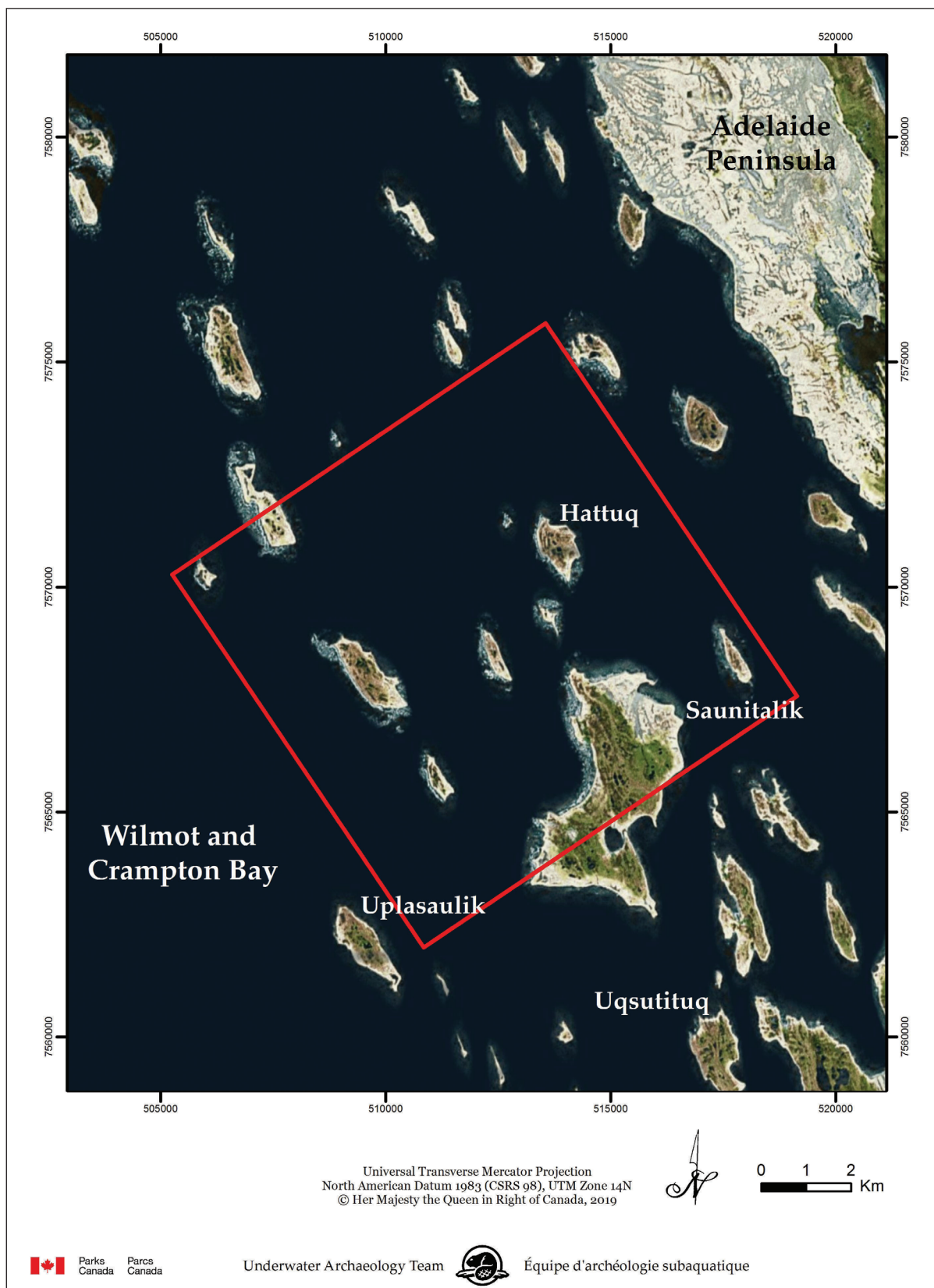


Figure 1.2.3: Wrecks of HMS Erebus and HMS Terror National Historic Site protected area around the *Erebus* wreck site, Wilmot and Crampton Bay, Kitikmeot Region, Nunavut (Map: C. Dagneau, Parks Canada; Imagery: ESRI World Imagery / Earthstar Geographics, TerraColor).

1.3 OBJECTIVES

The archaeological research carried out in 2019 was broadly framed by both a research design and commemorative integrity statement for the national historic site (Parks Canada 2019a; Underwater Archaeology Team and Inuit Heritage Trust 2020). The main archaeological objective for 2019 was to continue the underwater archaeological investigation of the wrecks of *Erebus* and *Terror* to better understand the events of the 1845 Franklin expedition.

For the wreck of *Terror*, where the archaeological study commenced in 2016, the aim was to continue the evaluation of the site. The specific objectives were as follows:

1. Continue remote-sensing surveying in the approaches to Terror Bay and at the wreck;
2. Continue exterior visual survey of the wreck;
3. Commence interior photo and video reconnaissance of the wreck; and
4. Possibly recover selected artefacts.

Following the completion of a site evaluation in 2016 and limited observations and excavation in 2017 and 2018 at *Erebus*, the 2019 field work aimed to initiate excavation and study of the wreck site. The specific objectives were:

1. Continue exterior and interior documentation of the wreck;
2. Commence excavation of selected areas on the upper deck and lower deck, including the stern cabin area and officers' accommodations spaces; and
3. Continue mapping and documentation of the debris field around the hull.

1.4 FIELDWORK DESCRIPTION

The 2019 archaeological fieldwork at the *Erebus* and *Terror* wreck sites took place between August 8 and September 14 and was staged from the RV *David Thompson* (with the addition of the barge *Qiniqtiryuaq* at *Erebus*). The RV *David Thompson* travelled to the Arctic from British Columbia, arriving at Cambridge Bay, Nunavut on August 8. There the UAT team embarked on the ship and left Cambridge Bay on August 9, and began archaeological work on the site of *Terror* on August 10 (Figure 1.4.1). The ship departed on August 15 en route to Gjoa Haven to retrieve the barge *Qiniqtiryuaq*. The ship and barge arrived at *Erebus* on August 20 where work on site continued until September 14, 2019 (Figure 1.4.2). During this period, the ship made a brief return trip to Gjoa Haven for a crew change and, for one week, had to take shelter from a storm south of O'Reilly Island. The first crew that brought the ship to Cambridge Bay included: David Badior (Captain), Neil Anderson (Engineer), Robert Steer



Figure 1.4.1: RV *David Thompson* with barge *Qiniqtiryuaq* in tow leaving Gjoa Haven (Photo: J. Moore, Parks Canada; 89Mo9864EF).



Figure 1.4.2: Support barge *Qiniqtiryuaq* being positioned over the *Erebus* site (Photo: T. Boyer, Parks Canada; 89Mo9878EF).

(First Officer), David Gilbert (Deckhand), Brandon Mainwaring (Deckhand) and Mark Hutcheson (Cook). The ship's crew during archaeological fieldwork comprised: Matt Thirkell (Captain), Justin Bergeron (Chief Engineer), David Gilbert (First Officer), and Jenny Moffat (Cook). The 2019 UAT fieldwork team included: Marc-André Bernier, Ryan Harris (Project Lead), Jonathan Moore, Charles Dagneau, Thierry Boyer, Joe Boucher, Brandy Lockhart, Alexandre Poudret-Barré, and Jonathan Puqignak.

Despite the week-long storm, the weather experienced during 2019 field season was very good overall. The first two weeks of work, encompassing all of the time at *Terror* and the first few days upon arrival at *Erebus* were characterized by a flat sea state, little to no wind and remarkably good through-water visibility. Thereafter the weather was more variable with at least one week-long period of strong winds which precluded fieldwork, as noted above.

The work on the *Terror* met all of the 2019 objectives. An access corridor to the site was surveyed using multi-beam echosounder (MBES) which allowed the RV *David Thompson* to reach the site safely; this corridor will be expanded upon in the future. The area surrounding the wreck of the *Terror* was also surveyed with MBES to gain a better understanding of the site and debris field. A total of 46 individual scuba dives were completed on the wreck equalling 16.3 hours of bottom time. During these dives, video and photographs were collected, and more than 2 hours of interior ROV video were acquired. No artefacts were recovered from *Terror* in 2019.

The work on the *Erebus* met most of the 2019 objectives. After installing the first two of four mooring anchors in 2018, the final two mooring anchors for the support barge *Qiniqtiryuaq* were installed with assistance from the CCGS *Sir Wilfrid Laurier* on August 21. Four sub-operations – or 2m by 2m excavation units – were partially excavated, with a fifth subject to surface artefact recovery. The areas excavated included fitted furniture pieces within the suspected Captain's Steward's pantry and the Third Lieutenant's cabin, both on the port side lower deck of the wreck. The wreck site and debris field were inspected briefly. No remote-sensing survey work was undertaken. A total of 93 individual scuba and surface-supply dives were completed on *Erebus* resulting in 109.5 hours of bottom time on site.

At the time of writing, 395 artefacts (355 records) were recovered in 2019, which brings the total of artefacts recovered from the site to date to 527 (434 records). The number of records is smaller than the number of artefacts, as some records in the database are used for batches of objects. These numbers continually evolve as the study and excavation of artefacts continue in Parks Canada's laboratory as part of the conservation treatment process. Some 50–80 artefacts from 2019 remain to be catalogued at the time of writing.

1.5 PUBLIC OUTREACH

Parks Canada (through its National Office, Nunavut Field Unit and the Underwater Archaeology Team) has developed a series of outreach initiatives in the broader context of the development of the Wrecks of HMS *Erebus* and HMS *Terror* NHS. The following is a non-exhaustive list of outreach events and initiatives that took place in 2019:

- Between 2016 and 2019, Parks Canada has trained and funded members of the Gjoa Haven Hunters and Trappers Association to act as site Guardians and interpreters near the sites of *Erebus* and *Terror*. Inuit Guardians were present on site intermittently from July to September 2019;
- The Hamlet of Gjoa Haven, the Nattilik Heritage Society, and Parks Canada hosted the 2019 installment of the Umiyaqtutt (Shipwreck) Festival in Gjoa Haven. The festival took place from late August to early September and featured community feasts, cultural performances, artistic programming and public presentations related to Inuit knowledge and the Wrecks of HMS *Erebus* and HMS *Terror* NHS;
- Elders from Gjoa Haven, accompanied by family members and Guardians visited Terror Bay on August 9, 2019 and carried out a blessing ceremony in Terror Bay. They were also welcomed aboard the RV *David Thompson* for a tour and project discussions;

- The UAT welcomed community members aboard the RV *David Thompson* in Cambridge Bay on August 8, 2019 (70 visitors) and in Gjoa Haven on August 18, 2019 (420 visitors);
- The Adventure Canada cruise ship *Ocean Endeavour* completed the first tourist visit to the Wrecks of HMS *Erebus* and HMS *Terror* NHS. Passengers had the opportunity to witness firsthand the work of the UAT from the barge *Qiniqtiryuaq* over the *Erebus* wreck site, visit the RV *David Thompson* and learn about Inuit life from the Guardians; and
- Parks Canada released two highly popular narrated videos on YouTube: *Parks Canada Guided Tour Inside HMS Terror* (2019b), and *Parks Canada Explores the Wreck of HMS Erebus* (2019c; also in French and Inuktitut).

2. HISTORICAL AND ARCHAEOLOGICAL BACKGROUND

This report describes the 2019 fieldwork and its results and is not intended to be a full-scale research report; herein the aim is not to duplicate content in other recent publications and reports. For historical accounts of the Franklin expedition, refer to Geiger and Mitchell (2015), Woodman (1991), Cyriax (1939) and the historical summaries in previous UAT reports (for example: Dagneau and Moore 2017; Moore et al. 2017). For descriptions of and results from previous underwater archaeological investigations at *Erebus* and *Terror*, as well as further context for the present report, the reader should also refer to previous reports by the UAT (Dagneau 2020; Dagneau 2018; Dagneau and Moore 2019; Dagneau and Moore 2017; Harris et al. 2015; Moore 2020; Moore and Dagneau 2017; Moore et al. 2017). Recent terrestrial archaeological work by Douglas Stenton, Robert Park and their colleagues is described in journal articles (Stenton and Park 2020; Park and Stenton 2019; Stenton 2018; Stenton 2014; Keenleyside et al. 1997).

3. METHODOLOGY

The following section provides a summary of the methodology and equipment used at *Erebus* and *Terror* in 2019. For additional contextual information, please refer to the 2015–2016 field report (Moore et al. 2017:23–48).

3.1 VESSELS AND LOGISTICAL CAPACITY

Although the UAT methodology for 2019 remained largely unchanged from previous years, especially regarding photo, video, and ROV exploration work, it evolved significantly with regards to surface platforms and diving and excavation capacity. For the first time, in 2019 the UAT deployed all of the logistical elements it has been working to build over the years in order to safely and efficiently excavate *Erebus* (and potentially *Terror*). First and foremost, Parks Canada used its 30-m research vessel *David Thompson* as the main operational platform for accessing the national historic site, to act as living quarters, and to tow Parks Canada's diving and excavation support barge *Qiniqtiryuaq* to *Erebus*. The RV *David Thompson* also conducted MBES surveys and transported its tender, *Broad Arrow*. This 7-m rigid hull inflatable boat was used both as a diving platform at *Terror*, and as a tender and chase boat at *Erebus*.

Parks Canada's 15-m support barge *Qiniqtiryuaq* acted as the diving and excavation platform at the *Erebus* site, while anchored over the wreck using a four-point mooring system (see Figure 3.1.1). Over the years since 2016, it was gradually equipped with three modified 20-ft shipping containers, plus a hydraulic crane and dive stairs. A dive container comprises all dive controls for surface supply and scuba diving, as well as emergency communication and first aid equipment, including a hyperbaric recompression chamber. Air and treatment gasses are stored outside in high-pressure K-bottles in adjacent cages. An equipment container is used for general equipment storage, and to house the main electrical power generator and low pressure compressor(s) for surface supply diving. UAT's high pressure air compressor and hydraulic power unit are also stored in this



Figure 3.1.1: Diving and excavation support barge *Qiniqtiryuaq* over the *Erebus* site (Photo: T. Boyer, Parks Canada; 89M09958EF).

space when not in use. Lastly, an inventory container is where UAT staff store, clean, catalogue, photograph and package recovered artefacts.

3.2 PROVENIENCE SYSTEM

Parks Canada employs an alphanumeric coding system to identify and record archaeological data. This provenience system is outlined in the *Parks Canada Archaeological Recording Manual: Excavations and Surveys* (Parks Canada 2005). After their discoveries in 2014 and 2016, site numbers 89M and 90M were assigned to the *Erebus* and *Terror* wreck sites, respectively. All field data and site records linked to these sites are therefore classified under these provenience designations.

No formal spatial provenience system has yet been established for *Terror*. This report uses the vessel's existing physical spaces to identify specific zones and rooms, with the exception of the officers' cabins on the lower deck identified by an alphanumeric code (see Figure 4.0.1). For *Erebus*, following UAT's standard practice, a provenience grid system was superimposed over the wreck and its immediate surroundings, based on 2-m by 2-m

sub-operations (see Figure 5.0.1). Every excavation unit is therefore identified by an alphanumeric code formed by the operation and sub-operations, for example "38J". Lots are used to differentiate stratigraphic units on different decks. For example, lot 200 is used for the lower deck. For a detailed description of this system, please refer to the 2015-2016 field report (Moore et al. 2017:6–9).

3.3 EXCAVATION AND RECORDING

The work on *Terror* was conducted chiefly from RV *David Thompson*'s tender *Broad Arrow*. All dive operations including ROV video recording inside the hull were conducted from the *Broad Arrow*, while the RV *David Thompson* was at anchor nearby. Archaeological documentation was primarily accomplished through the use of photo and video recording, and direct observation. There was no excavation work per se on *Terror* and no artefact retrieval.

The work on *Erebus* included non-intrusive video recording of interior spaces such as the hold and orlop deck, but consisted mainly of surface mapping

and excavation of two distinct cabin spaces on the lower deck (in sub-operations 38J/K and 40J/K). This work involved a variety of recording techniques ranging from hand mapping to the Direct Survey Method (DSM), video recording and photogrammetry. Given the three-dimensional nature of the wreck site and the difficulty of installing a rigid excavation grid, UAT archaeologists relied on a combination of DSM measurements and temporary baselines for detailed horizontal (XY) mapping. DSM reference points—REF6 in particular—provided accurate benchmarks for elevations (Z) (Moore et al. 2017:37–41).

Photogrammetry coverage and limited hand mapping of the excavation area were undertaken before the excavation was started in sub-operations 38J/K and 40J/K. This allowed for updating *Erebus*' site plan before UAT archaeologists dismantled a layer of large intertwined structural elements (upper deck beams and planks, lower deck bulkhead components) approximately 1 m thick. A hydraulic-powered chainsaw was used for that purpose. Timber tags (hot stamped, PVC cattle ear tags) were used to identify diagnostic timbers, before they were mapped and moved to timber "Storage area A", south of the hull. The excavation work proper was conducted using two 3-in. water induction dredges powered by a single Stanley TP3 hydraulic submersible pump slung below the *Qiniqtiryaq*.

As the excavation progressed down towards the lower deck planking, artefacts were mapped, retrieved and brought to the surface as they were uncovered, following standard practice. Excavation progress, including features and artefacts discoveries were documented periodically using scaled hand drawing, photo and video recording.

3.4 ARTEFACT MANAGEMENT

Artefacts recovered in the course of the excavation on *Erebus* were raised by hand using a variety of containers and supports, including elastic bandages, Ziploc bags, and plastic food storage containers. Lift bags were used to recover one of the Massey pump heads (89M38K200-3). Despite initial plans to recover one of the ship's two propellers

(89M100A1-1) located north of the wreck on a shoal, the work had to be postponed to another year due to lack of time.

Once on the surface aboard the *Qiniqtiryaq*, each artefact was gently cleaned using pumped seawater. Artefacts were handled with disposable latex gloves and stored in plastic bins in the inventory container, where they were catalogued and sketched using inventory paper forms, then photographed. Desalination of artefacts was initiated in the field where possible, although most objects were kept in seawater. Prior to leaving the site, artefacts were carefully packaged in resealable bags, plastic food containers, foam and bubble wrap. They were grouped by material in plastic bins and then shipped together within a large collapsible skid/container (48 x 45 x 42 in.) suitable for airfreight shipping. On account of its size and weight, the Massey pump was shipped in a separate custom-built wooden crate.

At the end of the project the artefacts were transferred to the CCGS *Sir Wilfrid Laurier* and transported to Cambridge Bay; the ship's helicopter expediently transferred the artefacts to the airport. The artefacts were shipped by airfreight the same day to Parks Canada's conservation facility in Ottawa, via Edmonton. This shipping process had been carefully planned to avoid any overnight stay in an area where temperatures would drop below 0°C. Parks Canada is grateful to the assistance rendered by the Canadian Coast Guard to make this shipping possible.

Artefact cataloguing was initiated in the field and completed back in Ottawa, using the Microsoft Access "HMS *Erebus* Artefact Database" created in 2015. In Ottawa, controlled laboratory excavation, routine material identification, conservation treatment and specific material culture research are still ongoing at the time of writing this report.

3.5 DIVING

The underwater work on *Terror* in 2019 was carried out solely using scuba diving. Each dive team included: two divers; a dive supervisor and a stand-by diver. Scuba gear included: an OTS Spectrum full face mask with Apeks regulator; buoyancy compensator and backpack; 100-119 cubic ft. main air tank; 30 cubic ft. bail-out tank



Figure 3.5.1: Underwater Archaeologist Alexandre Poudret-Barré equipped with lightweight surface supply gear on, prior to diving (Photo: J. Moore, Parks Canada; 89M10362EF).

with regulator; and a drysuit. An OTS Magnacom wireless underwater communication system was used by the divers to communicate with the surface and with each other. Most of the dives were made at a depth of 21/24 m for 35/25 minutes of bottom time. Only no-decompression dives were performed and dive times adhered to the *DCIEM Diving Manual: Air Decompression Procedures and Tables* (1992).

The work on *Erebus* was carried out primarily using lightweight surface supply diving methods, although scuba was also used on occasions, following the same configuration as for *Terror*. In surface supply diving configuration, the dive team comprised a minimum of seven persons: two divers; two dive tenders; a dive supervisor; and stand-by diver and tender. In a few cases, an additional third diver would work on scuba. Each surface supplied dive employed the following equipment: a 3-person OTS dive panel; OTS Aquacom MK2 surface communications box; OTS Spectrum full face mask with Apeks regulator; hardwired 3-way communications system; AXSUB video camera and dive light; buoyancy compensator and backpack; 100 cubic ft. bail-out tank feeding both the main and a back-up second stage regulator; and finally a hot-water suit or drysuit (Figures 3.5.1 and 3.5.2).

Diving umbilicals were composed of an air hose, pneumofathometer hose, communication line, video/light cable, and hot water hose.



Figure 3.5.2: Diving Systems Technologist Joe Boucher supervising a dive on *Erebus*, from within the dive container (Photo: T. Boyer, Parks Canada; 89Mo9964EF).

Breathing air was supplied from a low-pressure diesel compressor with an associated volume tank. Banks of high-pressure breathing and treatment gases were stored in large K-bottles on the barge adjacent to the dive control container, as a back-up air supply and to run the hyperbaric chamber, if need be. The dives were carried out from the support barge *Qiniqtiryuaq* moored directly over the wreck of *Erebus*. Most dives were made using hot water suits fed by a Monkey Heater hot water system on the surface. This system helped to maximise bottom time for each dive given the cold water environment. Only no-decompression dives were performed and dive times adhered to the DCIEM tables (1992). Given the shallow depth of *Erebus*' lower deck and the comfort provided by the hot water system, the amount of bottom time for a single dive could often reach 2 hours, sometimes 3 hours.

For both *Erebus* and *Terror*, dive operations were conducted in accordance with the Parks Canada Dive Directive (2018), Canada Labour Code Part II - Section 18, and DCIEM tables (1992).

3.6 PHOTO, VIDEO, AND REMOTELY OPERATED VEHICLE

The UAT used a combination of still photo equipment, video cameras and a remotely operated vehicle (ROV) for site documentation, as well as 2D and 3D photogrammetry (Boyer and Lockhart 2020). For still photos, Nikon D4 and D4s cameras with Aquatica housings and Ikelite DS161

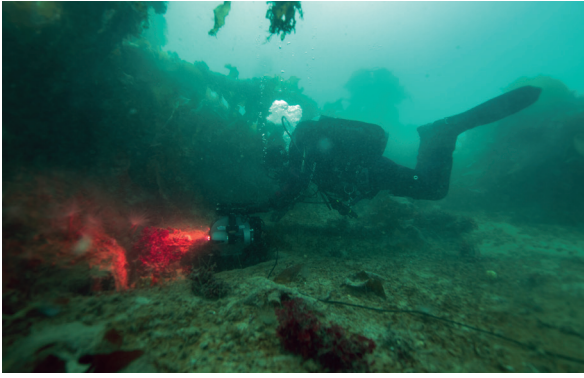


Figure 3.6.1: Underwater Archaeologist Jonathan Moore deploys the Deep Trekker DTG3 micro-ROV near *Terror*'s main hatch (Photo: A. Poudret-Barré, Parks Canada; 89M1997EF).

strobes were used in most instances. The main underwater video system consisted of a Sony PMW-F55 UHD camera with Raw 4K recorder and Duclos 11-16 mm PL-mount lens in a Gates housing, and four Keldan Luna-4X lights. The UAT also used a Panasonic HVX-200p camera in a Gates housing, as a back-up, with two Keldan Luna-8 lights. Interior video on both *Erebus* and *Terror* was acquired chiefly with a Deep Trekker DTG3 micro-ROV equipped with an HD camera (Figure 3.6.1). However, a Panasonic HMR10 point of view camera with AG-HMR10 Recorder (with their respective Gates housings) were also used for interior reconnaissance video at each point of entry of *Terror* before ROV insertion.

3.7 MULTI-BEAM ECHOSOUNDER

Seafloor bathymetry data were acquired in *Terror* Bay in 2019 both to survey a provisional navigational corridor to more safely access the site location, and to generate a detailed 3D topographical baseline model of the wreck site. The intention here was to expand and improve upon the limited multi-beam coverage from 2016. An R2Sonic 2024 MBES system was used for this purpose, this installed in a hull-mounted configuration with both projector and receiver arrays permanently affixed to the bottom of the RV *David Thompson*. This broadband echosounder system offers variable 170–450 kHz frequency selection, with the option for an ‘ultra high resolution’ imaging mode at 700 kHz, the latter being particularly attractive for detailed archaeological documentation of complex seafloor structures such as shipwrecks. The

wreck and its surroundings were surveyed principally at 450 and 700 kHz (in both cases adopting the system’s ‘ultra-high density’ imaging mode which generates 1024 discrete acoustic soundings per transmission cycle, with ping rates approaching 60 Hz).

Precise real-time position, heading, attitude, and heave information were recorded for the RV *David Thompson* using an Applanix POS MV 320 survey-grade inertial navigation system. Vessel navigation and raw multi-beam data were co-registered using QPS QINSy acquisition software. Predicted tide values from a CHS tide station at Seal Bay were imported into the software to compensate for changing tide state throughout the survey period (though final bathymetric products were instead height referenced to ellipsoid). Real-time correction for localised variations in the ambient speed of sound in water, required for initial receiver beam steering, was achieved using a retractable Valeport SVS thru-hull sound velocity sensor mounted close to the multi-beam pod. Full water column sound velocity profiles were in turn recorded via periodic casts using an AML MinosX direct-measure sound velocity profiler, as required for accurate correction of the sounding data. This in turn was performed in QPS Qimera multi-beam post-processing software. Raw survey navigation was post-processed using Inertially-Aided Precise Point Positioning mode in Applanix POSPac MMS software, yielding an absolute data positioning accuracy in the order of +/- 8 cm.

3.8 CURRENT PROFILER

In 2016, the UAT deployed a Teledyne RD Systems Sentinel V Acoustic Doppler Current Profiler (ADCP) on loan from ArcticNet 11 km northwest of the *Erebus* site to gather further information on the site’s environment. The unit was recovered in 2019 but the data acquired has not yet been fully analyzed at the time of writing.

4. HMS TERROR RESULTS

This section presents a preliminary description of some of the key features observed and documented on *Terror* in 2019. The work focused on the non-intrusive study of the wreck, chiefly through the use

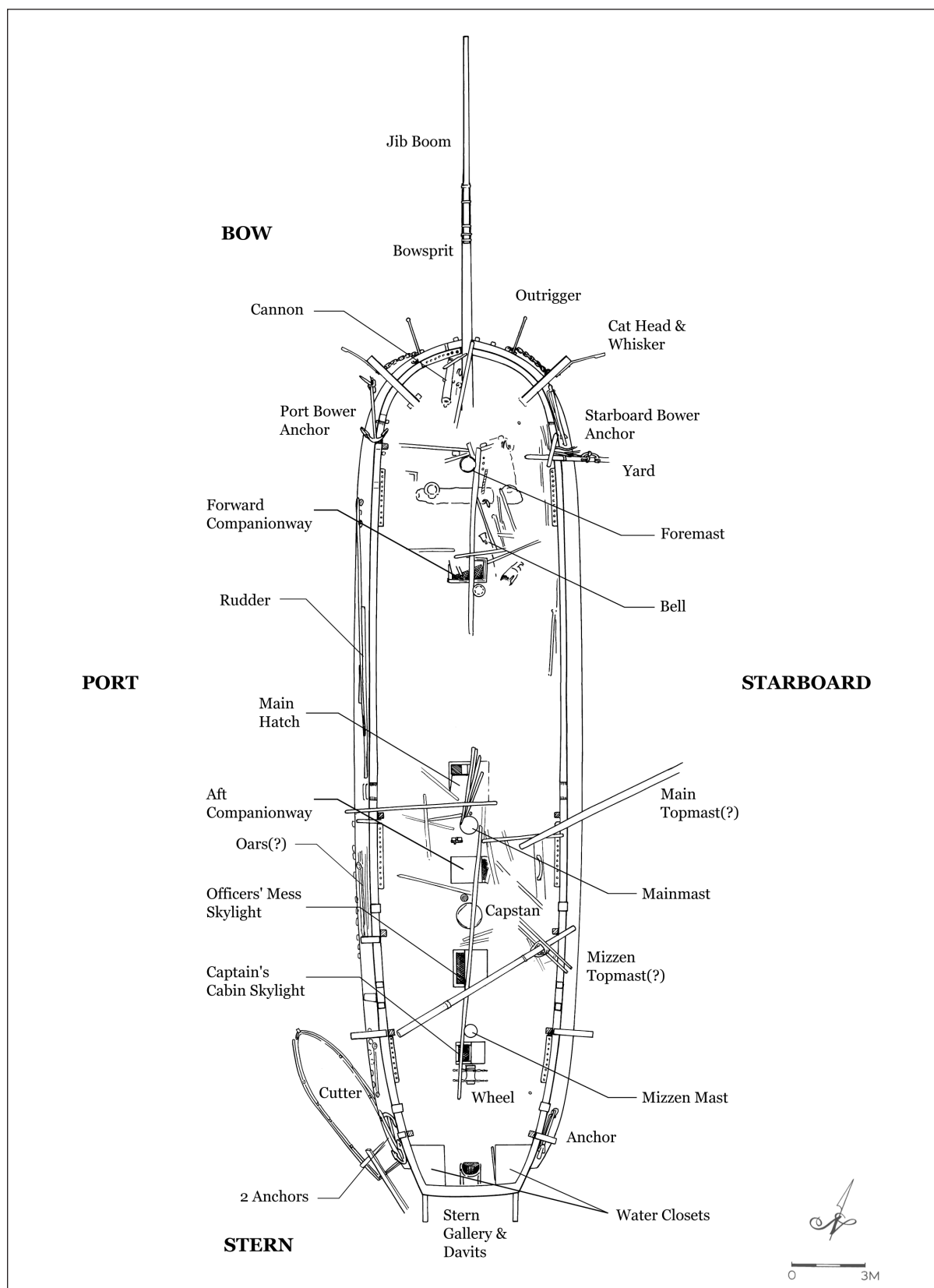


Figure 4.0.1: Site sketch of *Terror*, 2017. The outline of the vessel is based on the *Terror* upper deck plan (Betts 2016) (Drawing: C. Dagneau and C. Pillar, Parks Canada; 90M-2017-101-2).

of photo and video cameras, including a micro-ROV for lower deck interior spaces. Given that a general description of *Terror*'s upper deck and the overall site were provided in a previous report (Dagneau and Moore 2017; Figure 4.0.1), this section will only discuss new information concerning a few important features from the upper deck and hull. That being said, the bulk of this section deals with the interior spaces observed in 2019.

Before going further, the following general archaeological observations on *Terror* can be made. The wreck is in an excellent, nearly unparalleled, state of preservation. The underwater visibility at the site in 2019 was significantly better than previously experienced. The interior of the wreck contains rich, amazingly well-preserved features and artefacts, including individual cabins segregated by standing bulkheads.

4.1 UPPER DECK AND HULL

Most of the 2019 fieldwork focused on exploring *Terror*'s lower deck, and as a result little work was carried out on the upper deck and on the hull per se. However, photogrammetric coverage of the upper deck was initiated, covering the area between the bowsprit and the main mast, and most of the aft deck. The resulting 3D photogrammetry model is currently being processed, and will be valuable for updating *Terror*'s site plan in the near future.

The *Terror* wreck site and its surroundings were surveyed with MBES in 2016 and 2019 (Figure 4.1.1). The resulting data from 2019 have been processed and will be instrumental for scaling and georeferencing any future site plan and 3D digital model of *Terror*, as was the case for *Erebus*. Although no major undocumented features were observed on the hull, upper deck or debris field through the MBES survey work, the survey provides accurate 3D positioning for the hull and all related structural components. A few selected features were documented on *Terror*'s upper deck and hull, including the propeller, davits, and rudder. This work was done primarily through direct observation after cleaning, and/or photo and video recording.

PROPELLER

One of the most important observations from 2019 concerns one of the ship's two propellers (each vessel carried a spare). Despite what was previously believed (Dagneau and Moore 2017:15), it appears that one of *Terror*'s Smith-type propellers is in its working position within the stern aperture (Figure 4.1.2). While its two blades and hub are covered with a thick layer of mud and molluscs, its shape and its associated rail system are consistent with an 1845 stern drawing (National Maritime Museum [hereafter NMM] 1845). Most of the aperture is filled, a fact that may explain why a 2016 side-scan sonar survey did not detect it.

RUDDER

The rudder stored on the port-side ice channel, previously observed in 2017, is stowed with its leading edge (and pintles?) facing down. Its general shape fits with the 1845 rudder drawing, although it was not cleaned and is mostly covered with mud and growth (NMM 1845). The top of the rudder, square in section, is fitted with a wide mortise to accept the tiller. This artefact seems to be made in one piece, and so is likely the main rudder, as *Erebus*' and *Terror*'s spare rudders appear to have been made of two or more parts, in order for them to fit into, and be stowed in, their respective



Figure 4.1.2: *Terror*'s propeller in its working position within the propeller aperture (Photo: M.-A. Bernier, Parks Canada, 90M02819EF).

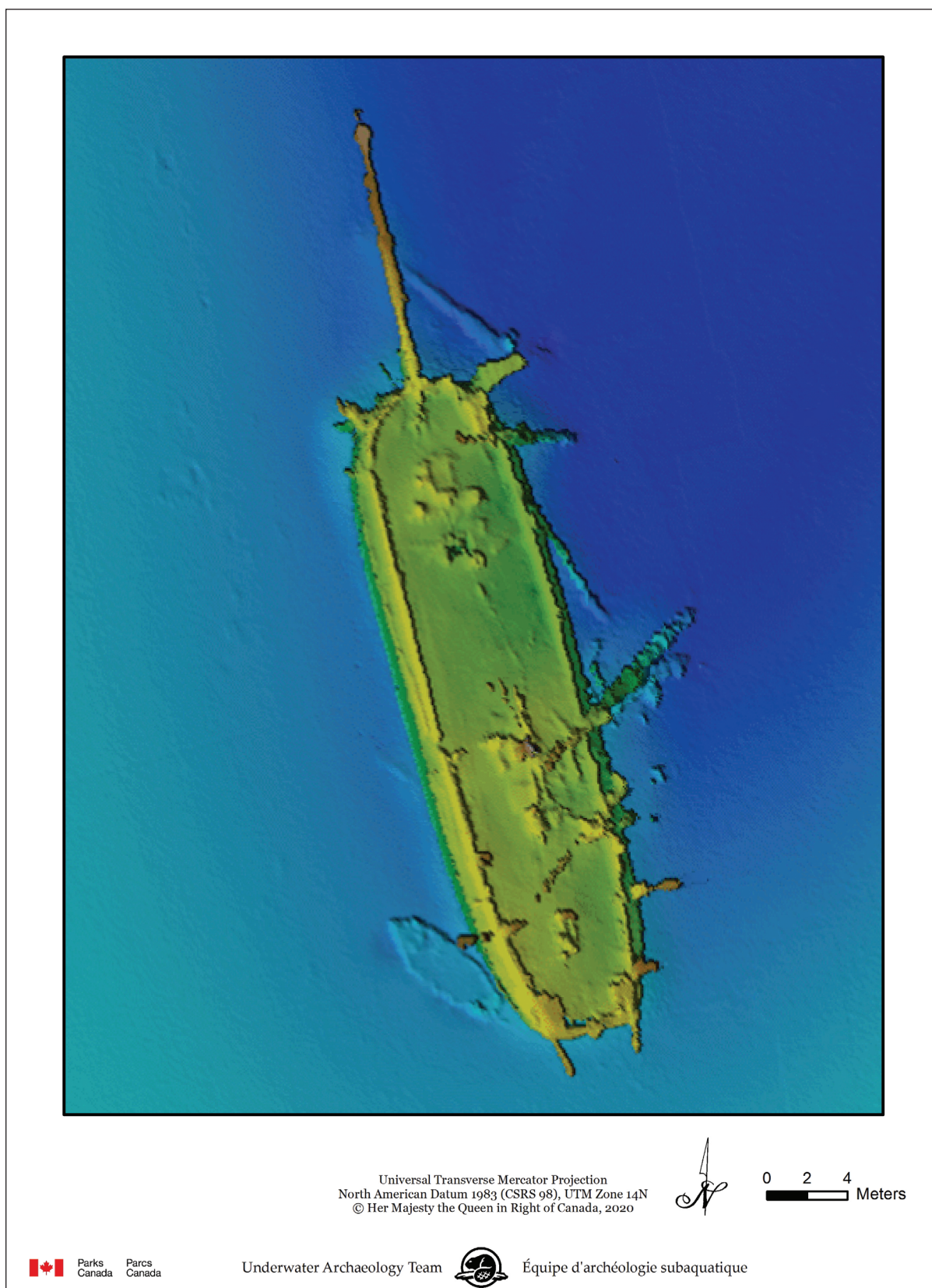


Figure 4.1.1: Multi-beam echosounder imagery of the *Terror* site, 2019 (Image: C. Dagneau, Parks Canada; MBES: R. Harris, Parks Canada).

scuttles. However, the spare rudder does not appear to be in its stowage position as shown on *Terror*'s upper deck plans (NMM 1839a).

DAVITS

There are two pairs of boat davits on each side of the wreck, as well as one pair at the stern. As noted in 2017, the side davits are not of a type depicted in the midship section plan of *Terror* and *Erebus* from 1839 that have straight uprights; rather they have curved heads as observed in multiple examples of artwork depicting *Erebus* and *Terror* during the first weeks of the expedition, and in a later 1848 midship section of HMS *Investigator* (NMM 1848; Stanley 1845; Figures 4.1.3 and 4.1.4). However, their locations are consistent with the *Terror*'s 1837/1845 upper deck plan (NMM 1839a). Each side davit is composed of a curved davit post affixed to the exterior of the bulwarks and an associated davit stanchion fitted inside the bulwark.

A mostly complete davit on the starboard side abreast the mizzen mast was cleaned, and all surviving davits were documented further in 2019. The top ends of the curved davits are each fitted with three sheaves, the third one being on a cheek block. The davit stanchions are fitted with a knob at their heads, a sheave underneath, as well as a horn cleat at mid-height. The heels of the davits and their stanchions could not be assessed due to sediment accumulation on the upper

deck. The four davit stanchions located between the main and mizzen masts are also fitted with chocks on their fore-and-aft faces, presumably to support the conning plank and boat cradle.

FLAG LOCKERS

Two possible flag lockers were observed, recessed behind the water closets on both sides of the poop deck. This fitted furniture is made of multiple square niches with a roof on top, curved down towards the taffrail. They appear to have been fitted with doors as well, as a door hinge was observed on the starboard side example.

UPPER DECK ARTEFACTS

Little time was devoted to the recording of artefacts on the upper deck. However, a few important objects and the features were observed either directly or through the upper deck photogrammetry. The bronze 6-pounder at the bow and the bell next to the forward companionway were both further observed and documented using still photos. Although covered in sediment, one or two long arms were also noted on the open space on the upper deck between the forward companionway and main hatch, off to the port side. More time will be needed to process and analyze the photogrammetry that will be used to locate new artefacts and update the upper deck sketch.



Figure 4.1.3: Mostly complete davit on the starboard side of the upper deck, abreast the mizzen mast (Photo: A. Poudret-Barré, Parks Canada; 90M2129EF).

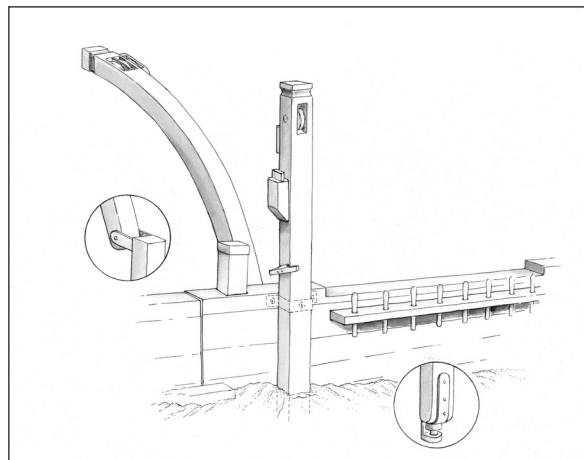


Figure 4.1.4: Preliminary reconstruction drawing of a *Terror*'s davit based on archaeological observations and period illustrations (Drawing: Carol Pillar, Parks Canada; 90M-2020-103-1).

STERN GALLERY

Terror's taffrail, transom and stern gallery were cleaned of kelp in order to be further documented by photo and video. Their configuration is in general consistent with *Terror's* ship plans and period illustrations (NMM 1837a; Stanley 1845), as described in a previous report (Dagneau and Moore 2017).

HATCHES, COMPANIONWAYS AND SKYLIGHTS

The hull openings on *Terror's* upper deck were described in detail in the 2017 field report (Dagneau and Moore 2017). While most of the work in 2019 focused on the lower deck using a micro-ROV, archaeologists still had to act as underwater tenders near the openings used for penetration. During these dives, a few observations could be made. The main hatch was observed in more detail and appears to be covered by a four-piece cover. Two separate cover pieces are visible, although only one of them is open enough to allow ROV penetration. Further aft, a glass pane from the Captain's cabin skylight has fallen down from its frame and sits almost vertically embedded in the seabed. Detailed recording of these openings will be completed in future.

4.2 LOWER DECK

Terror's 1845 lower deck configuration is documented in the form of ship plans, namely the *Plan of the Terrors Lower Deck* and *Profile of the Terror* (NMM 1837a; NMM 1837b). These key documents primarily show modifications to *Terror* dating from 1837–39. On account of research by Matthew Betts (2016) and others, we also know that these same documents show pencil drawings and annotations displaying modifications from 1845, including the division of living space on the lower deck, and the cabin layout and assignments by rank (Figures 4.2.1 and 4.2.2). As indicated in these ship plans, and as illustrated by Betts' (2016) reconstruction drawings, *Terror's* lower deck was organized into separate zones (from bow to stern): the sick berth (used as an extension of the forecabin); the forecabin; the officers' mess or

gunroom; the officers' cabins distributed on both sides along two-thirds of the vessel's length, and the Captain's cabin (Figures 4.2.1–4.2.4).

Following the practice of the day, *Terror's* commissioned officers (military and civil) were assigned individual bed cabins; they worked and ate in the officers' mess, if not invited to the Captain's table. Between 1836 and 1843, *Terror's* mates and lieutenants had distinct messes; these were combined in 1845 to allow for an engine to be added below on the orlop deck which in turn required air scuttles that took up lower deck space. The warrant officers (boatswain, carpenter, and engineer) shared the same cabin and a separate, small mess room. All of the other seamen onboard slept in the forecabin (including the sick berth) and took their meals on a series of mess tables along both sides of the vessel (Betts 2016; NMM 1837b).

In the following section, the lower deck configuration, as observed through the lens of the ROV's video camera, is described and compared with the "Plan of the Terrors Lower Deck" (NMM 1837b).

LOWER DECK DESCRIPTION

Parks Canada documented *Terror's* lower deck for the first time in 2019, using a combination of the pole-mounted point-of-view camera and the micro-ROV during a series of seven penetration dives on August 12 and 14, yielding more than two hours of interior video (Table 4.2.1). The ROV dives in particular allowed for a remarkable and near-complete survey of the lower deck spaces, including all cabins with the exception of the Captain's bed cabin. These penetration dives were conducted using four of the upper deck openings: the forward companionway; main hatch; officer's mess skylight; and Captain's cabin skylight. The aft companionway was too obstructed and could not be used (Figure 4.0.1).

The following sub-sections are a summary of *Terror's* lower deck configuration based on a preliminary review and analysis of the available video record. This report does not provide a detailed systematic description of every space documented with all of their artefact contents, but rather only some of the most noteworthy features and artefacts. Lower-deck artefacts and furniture have been inventoried, and a sketch plan was also completed (Figure 4.2.3). Also note that no attributions of cabin

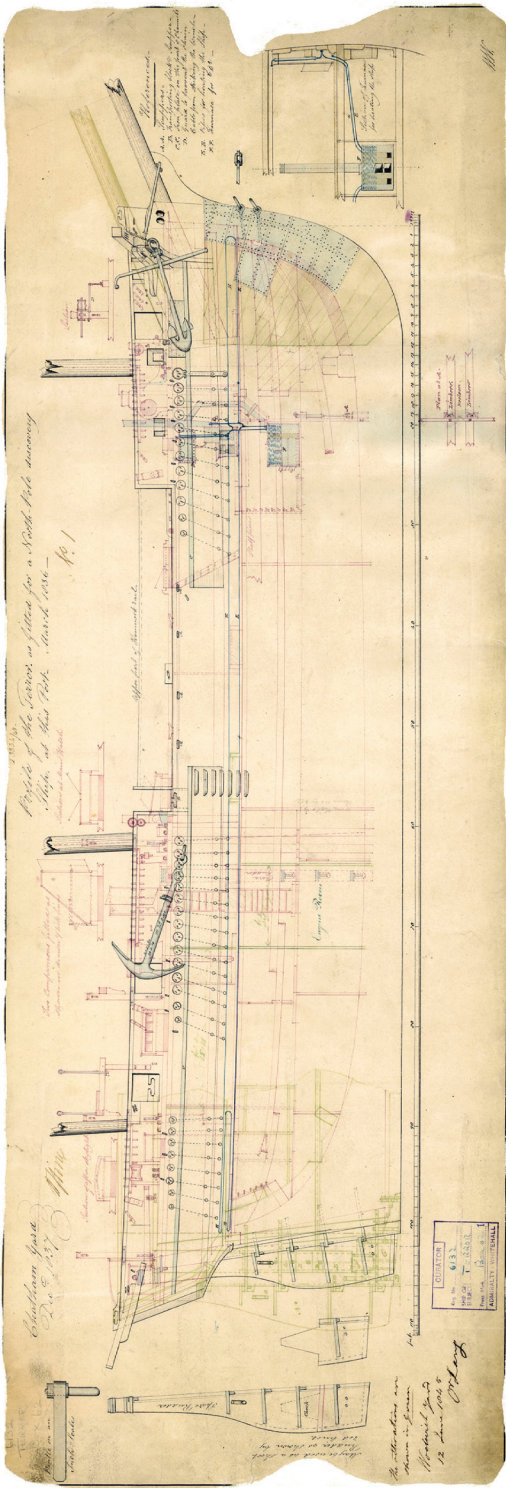


Figure 4.2.1: "Profile of the Terror. As fitted for a North-Pole discovery Ship, at this Port. March 1836", showing modifications from both 1837-1839, and 1845 (National Maritime Museum, Greenwich, London; NMM 1837a).

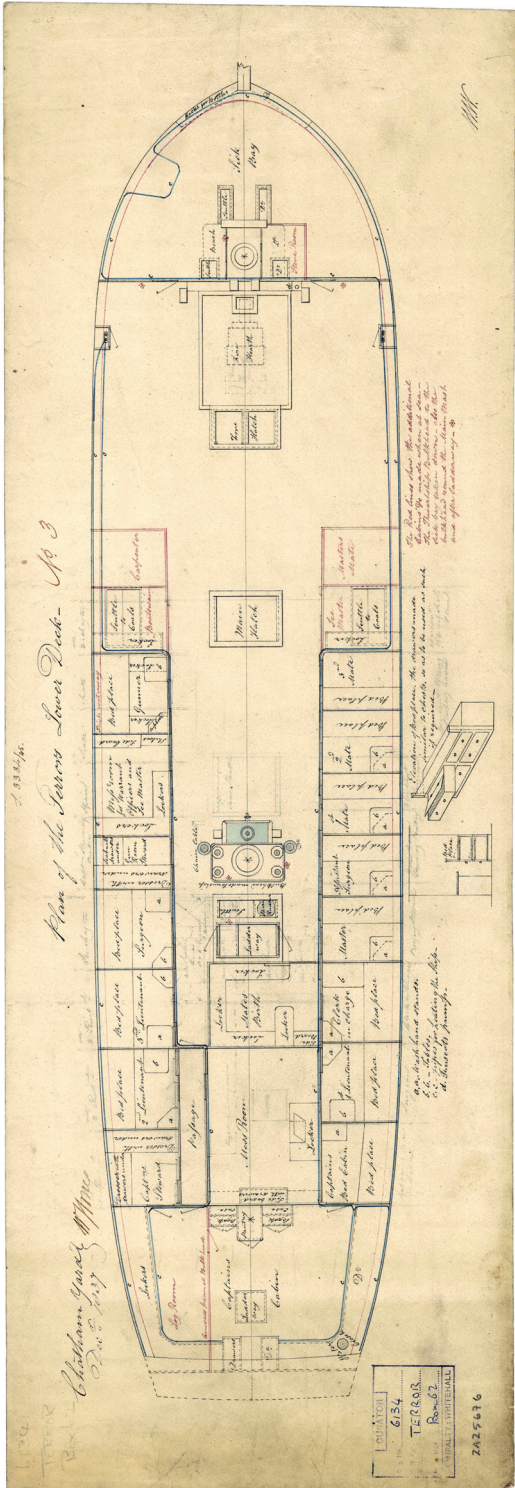


Figure 4.2.2: "Plan of the Terror's Lower Deck", showing modifications from both 1837-1839, and 1845 (National Maritime Museum, Greenwich, London NMM 1837b).

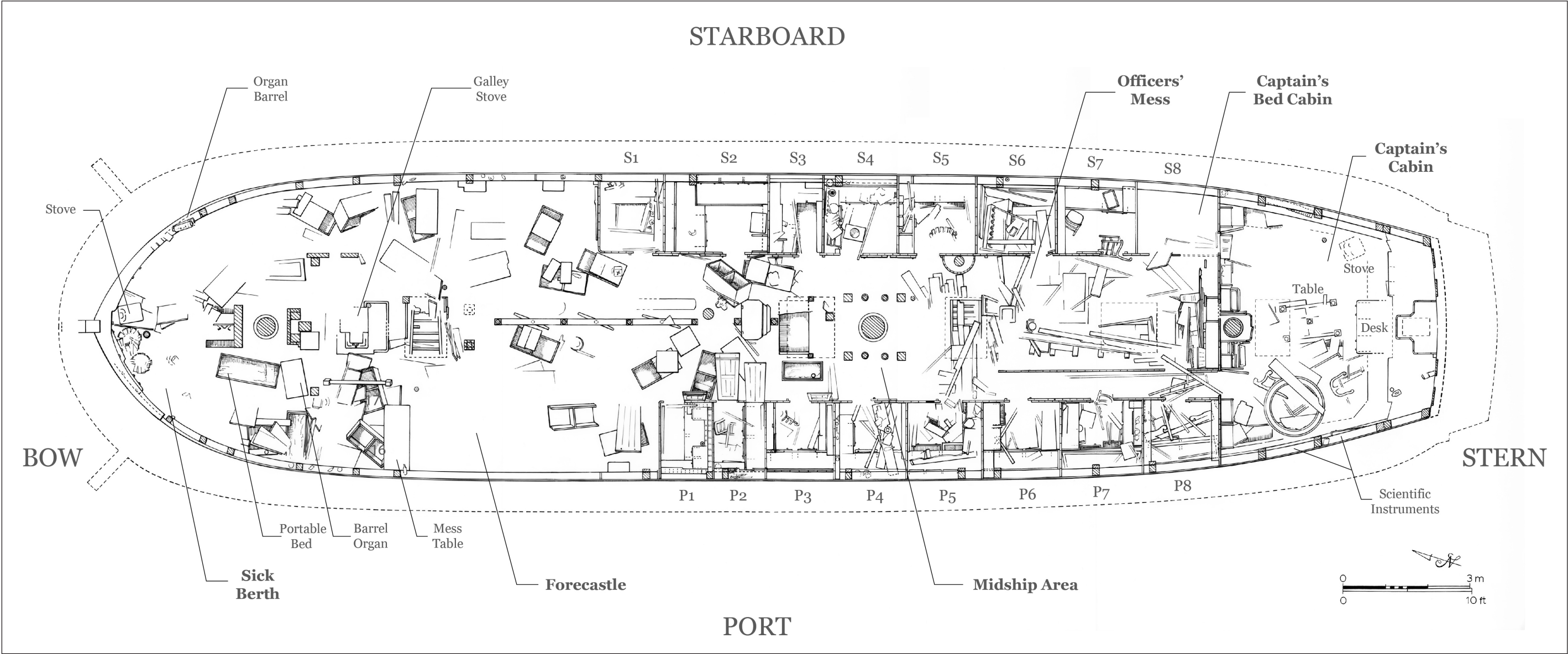


Figure 4.2.3: Site sketch of *Terror* lower deck, 2020. The outline of the vessel is based on the *Terror* lower deck plan (Betts 2016). Features were modified and added based on ROV video coverage (Drawing: C. Pillar and C. Dagneau, Parks Canada; 90M-2020-101-1).



Figure 4.2.4: Top: *Terror's* lower deck reconstruction by Matthew Betts, based on the *Plan of the Terrors Lower Deck*, and *Profile of the Terror*, including modifications from both 1837-1839, and 1845 (Drawing: M. Betts, 2016); Bottom: Key map of *Terror's* lower deck showing ROV video coverage and naming and coding of discrete spaces. The outline of the vessel is based on *Terror's* ship plans (NMM, 1837a; 1837b; Betts 2016). Bulkheads and features are drawn based on archaeological data (Drawing: C. Dagneau and R. Harris, Parks Canada).

Date	Entry Point	Video file	Duration (min:sec)
12-08-2019	Main hatch	90M-2019-R011-HDV	24:43
12-08-2019	Captain's cabin skylight	90M-2019-R012-HDV	22:57
12-08-2019	Officers' mess skylight	90M-2019-R013-HDV	16:13
12-08-2019	Forward companionway	90M-2019-R014-HDV	18:39
14-08-2019	Captain's cabin skylight	90M-2019-R020-HDV	19:52
14-08-2019	Main hatch	90M-2019-R021-HDV	20:50
14-08-2019	Forward companionway	90M-2019-R022-HDV	13:15

Table 4.2.1: Selected interior video of *Terror* recorded by ROV in 2019 used for this report.

occupant(s) by crew member name are made at this stage, with the exception of the Captain's cabins; occupancy may have changed over time during the course of the expedition and future archaeological information may shed further light on this variable.

Terror's lower deck general configuration follows closely the *Terror's* ship plans (NMM 1837a; 1837b) as well as a reconstruction made by Betts (2016; Figures 4.2.1–4.2.4). However, there are a few noticeable dissimilarities worth mentioning. The first discrepancy is that there is no in situ bulkhead between the forecastle and sick berth, as was the case during Ross' 1839–1843 Antarctic Expedition, and as observed on *Terror's* lower deck plan (Betts 2016; NMM 1837b). Indeed, these were designed to be removed. Second, there are only eight cabins on *Terror's* port side, instead of nine on the ship plan, while the number of cabins shown on the starboard side is the same at eight. Lastly, there are no lateral bulkheads and no visible cupboards next to the foremast and galley, and no bulkheads at all around the mainmast and bilge pumps; these partitions were either removed (as they were designed to be) or have collapsed (Figure 4.2.4).

FORECASTLE AND SICK BERTH

As noted above, the forecastle and sick berth are combined and together form the crew's living quarters. Most of this area was documented by the ROV, although not comprehensively. A small area was not documented around the foremast and on the starboard side of the galley stove. The forecastle was originally divided along the vessel's centerline by a sail bin, surrounded by a small, approximately 3-ft.-high railing (Betts 2016; NMM 1837b). However, the sail bin seems to be absent, with only a single railing-like structure in the middle of the forecastle.

The following provides a summary of notable features and artefacts observed to date in the 2019 interior video of these zones. From bow to stern these include (but are not limited to) the following:

- Shelving between deck knees is present throughout, and holds a great number of ceramic dinner plates (at least 16) and soup plates (6), glass bottles of different types (22), and other artefacts in lesser number, such as cups, jars, and potential tin cans (Figure 4.2.5);
- One of the mess tables is still in place, and it is located on the port side next to the galley. At least two mess table supports are visible elsewhere (Figure 4.2.6);
- Between 19–20 seamen's chests are observed, a number that is consistent with the number of mess tables. Many chests seem to have migrated from the forecastle aft towards the main hatch area, possibly during the sinking of the vessel;



Figure 4.2.5 Shelving on the port side of *Terror's* forecastle, containing dinner plates, soup plates, and different types of containers (Video: R. Harris, Parks Canada; 90M02814EF).

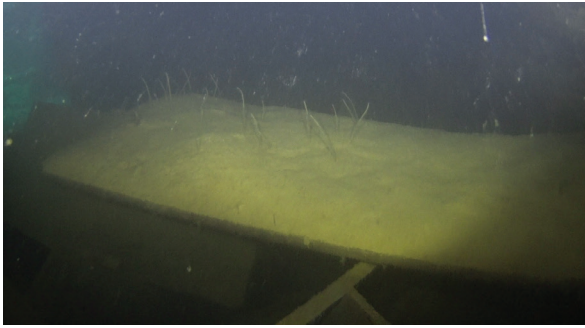


Figure 4.2.6: One of the mess tables for the ratings is still in its working position on the port side of the forecastle, next to the galley (Video: R. Harris, Parks Canada; 90M02791EF).

- There are no lateral bulkheads around the foremast, galley and forward companionway;
- Two long arms with a possible bayonet hang horizontally outside the forward-most starboard cabin bulkhead;
- The port-side scuttle next to the foremast in the sick berth is wide open, thus providing a possible future ROV access point to the orlop deck below;
- A barrel organ is located on port side of the foremast, and an organ barrel is located on the beam shelf, on the starboard side of the sick berth;
- A small stove is located in the sick berth (port side at bow), with its flue extending upwards through the upper deck; and
- The galley stove (Fraser's Patent) is in situ, although it was not recorded in detail.

MIDSHIP AREA

The midship area of *Terror's* lower deck aft of the forecastle includes the main mast, with a cluster of features along the centerline of the vessel, including what should be chain hawse pipes, bilge pump tubes and a few large stanchions. On both sides of this cluster are passageways allowing fore-and-aft crew circulation and access to cabin spaces. The main hatch on the lower deck, located forward of the main mast, gave access to the hold. It is located directly under a corresponding, but wider opening through the upper deck. Aft of the main mast area

is the aft ladderway, largely cluttered with debris (thus not accessible for ROV dives). The dimensions of this space and the location of different features observed are difficult to determine with precision, given the size of the room, and relative lack of spatial reference.

A number of plain, two-person seamen's chests (that also served as benches) are grouped from the main hatch forward, amongst a variety of debris, including collapsed partition walls and cabin doors. At least one of the chests seems to be a smaller one-person type, possibly that of an officer. This ornamented example is fitted with a brass lock plate. A large desk with distinctive truncated corners sits in the middle of the room, forward of the main hatch.

OFFICERS' CABINS

Terror's lower deck cabins have been assigned alphanumeric identifiers (independently from the future site provenience grid) for ease and accuracy of naming (see Figures 4.2.3 and 4.2.4). Thus the forward-most cabin on the port side is P1, the next aft P2, etc. Cabins on the starboard side are identified S1, S2, and so on. Cabin configuration is not entirely consistent with *Terror's* lower deck plans or their annotations (Betts 2016; NMM 1837b).

Moving from bow to stern, the first cabin space on the port side, cabin P1, is a storage room. A furniture piece with four drawers is located on the aft wall. Two smaller and narrower pieces of furniture sit on it (Figure 4.2.7). The port side and aft wall are covered with shelving and alcoves, containing more than 18 bottles of different types, although mostly cylindrical, short-neck bottles. One of them bears a seal on its body and its stopper is



Figure 4.2.7: Port side and aft walls are covered with shelving and alcoves in storage room P1 (Video: R. Harris, Parks Canada; 90M02755EF).

in place. This cabin was likely a service space, such as the Captain's Steward's or the Gunroom Steward's pantry.

Cabin P2 is fitted with a bed place along its aft wall, with an intact lee board (bed rail), and four drawers underneath (Figure 4.2.8). There is a chair in the middle of the space. Part of the starboard (inner) cabin wall has collapsed. A chamber pot is in the forward port side corner of this space. A few bottles, an ink well and a possible epaulette (two buttons at least) are on different shelves. Cabin P3 also shows a possible (relatively short) bed place oriented longitudinally, with four drawers below (Figure 4.2.9). A chair lays in the doorway. Most of the shelving on the aft wall has collapsed, and there are no obvious discernable artefacts. Cabin P4 seems to display the same basic layout as bed cabins P5 to P8, with its possible bed place along the ship's wall (port side) and four drawers underneath (Figure 4.2.10). However, it is not clear if the said furniture is a bed or not. A few bottles, plates, tumblers, and stemware were observed. According to *Terror's* lower deck plan, this space could be the Captain's Steward's pantry, but it could also be a bed cabin.



Figure 4.2.8: Fitted bed with four drawers underneath in cabin P2 (Video: R. Harris, Parks Canada; 90M2761EF).



Figure 4.2.9: Possible bed place (top right) and drawers underneath in cabin P3 (Video: R. Harris, Parks Canada; 90M2759EF).

Cabins P5–P8 are without doubt bed cabins (Figures 4.2.11–4.2.14). They all present the same configuration with slight variations: a fitted bed place with four drawers underneath along the ship's hull side, consistent with *Terror's* lower deck plan; shelving along the hull side between deck knees; and corner shaving tables (which may be hidden in cabins P6 and P7). Fitted furniture resembling desks or dressers are observed along the aft walls of cabins P5, P6, and P7, but not in cabin P8. The latter is probably equipped with a removable table. According to the "Plan of the Terrors Lower Deck", these four cabins, P5–P8, are believed to correspond to Lieutenants' and the Master's bed cabins (Betts 2016; NMM 1837b). The most notable artefact observed through ROV video is a sextant box in cabin P5 (Figure 4.2.11).

Travelling from bow to stern again, this time on the starboard side, cabin S1 is either a storage room or mess place (Figure 4.2.15). Unidentified fitted furniture and shelving are present on the (outer) starboard and forward walls; small shelves are also observed high up on the aft wall. Some of the artefacts include a small cask on deck, a



Figure 4.2.10: Fitted bed (middle) and furniture (right) with drawers underneath in cabin P4 (Video: R. Harris, Parks Canada; 90M2763EF).



Figure 4.2.11: Fitted bed (top), drawers and sextant box (left) in cabin P5 (Video: R. Harris, Parks Canada; 90M2766EF).

serving bowl, and a few dinner plates and bottles on shelves. This space is possibly the Warrant Officer's mess place according to the "Plan of the Terrors Lower Deck" (Betts 2016; NMM 1837b), although there does not seem to be enough floor space for a dinner table. It could also be a pantry.

Cabin S2 is a wide space that allows for two superimposed beds along the long axis of the vessel, and a third, transverse bed along the forward wall (Figure 4.2.16). Large storage drawers are fitted along the starboard and aft walls, over



Figure 4.2.12: Fitted bed place and drawers in cabin P6 (Video: R. Harris, Parks Canada; 90M2769EF).



Figure 4.2.13: Bed place with drawers and wall shelving in cabin P7 (Video: R. Harris, Parks Canada; 90M2770EF).



Figure 4.2.14: Bed place with collapsed bed rail in cabin P8 (Video: R. Harris, Parks Canada; 90M2772EF).

the bunks. A small desk or table is visible on the aft wall. This space could correspond to the Warrant Officers' bed cabin, as indicated on the "Plan of the Terrors Lower Deck" (Betts 2016; NMM 1837b). Cabin S3 is narrow and clearly correspond to a storage space (Figure 4.2.17). A large L-shaped piece of fitted furniture takes most of the floor space up to waist level, with shallower shelves higher up on the walls. No discernable artefacts were noted, other than a cup and collapsed furniture parts. According to *Terror's* lower deck plan annotations, this should be the Assistant Surgeon's cabin. Given the absence of a bedplace, it could possibly be the gunroom Steward's or the Captain's Steward's pantry. Cabin S4 is a bed cabin, with a suspected bed along the hull side and desk/furniture along the forward wall. A large stoneware jar and the remains of a shaving table were observed. According to *Terror's* lower deck configuration, this place should be the gunroom pantry, but it could correspond to the Assistant Surgeon's bed cabin (Figure 4.2.18).



Figure 4.2.15: Cabin S1 is either a storage room or a mess place. There is no visible bed place (Video: R. Harris, Parks Canada; 90M2774EF).



Figure 4.2.16: Two of the three bed places in cabin S2, with fitted drawers on the starboard and forward walls (Video: R. Harris, Parks Canada; 90M2778EF).

Cabin S5 has an unidentified piece of fitted furniture with drawers along its forward wall. However, its sliding door is not fully open and did not allow for the ROV to penetrate. Therefore, its outer and aft portions were not fully documented. A staved container is observed in the middle of the cabin, on deck. If not a bed cabin, it is possibly the Purser's Steward's pantry (or the gunroom Steward's pantry). Cabin S6 holds no obvious bed, but there is possibly one along its forward wall (Figure 4.2.19). This suspected bed would be located on top of drawers. A shelf equipped with multiple small round niches was affixed to the same wall, but has collapsed. The only noticeable object is a glass wine bottle. This space could correspond to the Clerk's bed cabin. The next space going aft, Cabin S7, is fitted with a bed place and some shelving, but no visible desk or table, other than two chairs (Figure 4.2.20). A chamber pot and a tumbler were observed. According to *Terror's* lower deck plan, this space could correspond to the Surgeon's cabin (Betts 2016; NMM 1837b).

The last enclosed space along the starboard side, cabin S8, would logically be the Captain's bed cabin. This space would originally have been

accessible only through the Captain's cabin, but at present the inner partition separating it from the officers' mess has partly or entirely collapsed. A hinged door leading into it from the stern Captain's cabin is open but partly obstructed. Unfortunately, cabin S8 was not accessed in 2019 because it was believed that both access points were obstructed. In future, it should be possible to safely penetrate into the cabin with a micro-ROV.

OFFICERS' MESS

The general location of the officers' mess (or gunroom) accords with the "Plan of the Terrors Lower Deck" (NMM 1837b), except that it seems a bit longer and there are slight variations in cabin door locations (Figure 4.2.21). Access to the room was via a passage on the port side of the vessel, which also provided access to the Captain's cabin and Lieutenants' cabins. The mess partitions are partly collapsed, as there are openings on the walls, and most of the forward partition has collapsed. Also, the suspected Captain's bed cabin (S8) partition appears to have collapsed. What may be a large

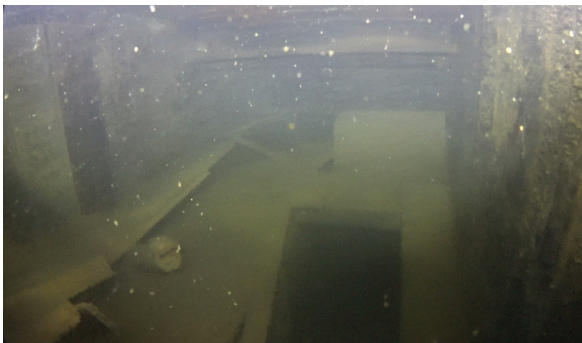


Figure 4.2.17: Cabin S3 is a storage room. An L-shaped counter occupies most of the space (Video: R. Harris, Parks Canada; 90M2780EF).



Figure 4.2.19: Shelving on either side of a deck knee, along the starboard side of cabin S6 (Video: R. Harris, Parks Canada; 90M2786EF).

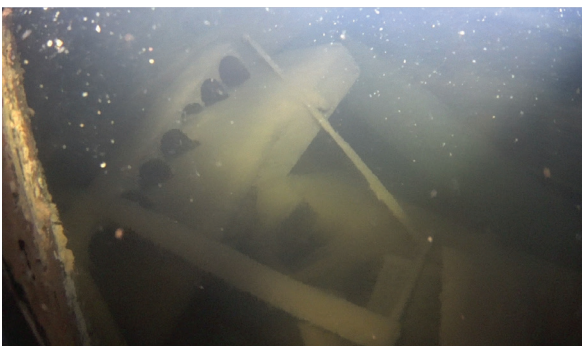


Figure 4.2.18: Shelving with small niches, collapsed from the forward wall of bed cabin S4 (Video: R. Harris, Parks Canada; 90M02782EF).



Figure 4.2.20: Two chairs in bed cabin S7 (Video: R. Harris, Parks Canada; 90M2788EF).



Figure 4.2.21: Cabin S6 and S7 doorways viewed from the center of the Officers' Mess (Video: R. Harris, Parks Canada; 90M2802EF).

table sits in the middle of the room, with possible seats or lockers against the port-side partition. The room was provided with natural light via a skylight—one of the main entry points for the 2019 ROV investigations.

CAPTAIN'S CABIN

The Captain's cabin's organization resembles that of a May 1845 *Illustrated London News* engraving of *Erebus*' Captain's cabin and more closely the "Plan of the Terrors Lower Deck", including the arrangement of tables, shelves, bookcases, cupboards, lockers and chart cabinets (Betts 2016; *Illustrated London News* 1845; NMM 1837b). On account of missing stern gallery window panes and the missing portion of the cabin's skylight above, much of the cabin has been blanketed with sediment, which obscures many of its surfaces.

The most prominent feature of the cabin is a large rectangular writing desk, centered on and up against the propeller trunk (Figure 4.2.22). It is fitted with two drawers on either side of a central chair space. An armchair still upright is next to it on its port side. In the middle of the cabin floor is a large table, resting upside down, with its five turned legs visible. A suspected stove was observed on the starboard side of the desk, with its flue rising through the upper deck. More enigmatic is an estimated 3m-diameter, hoop-like circular wooden object, located on the port side of the cabin (Figure 4.2.23). It is of laminated wood construction and rests partly on the port-side lockers, and partly on deck. It is marked by the letter "D". Similar circular wooden objects of unknown function were found in *Erebus*' hold/bread room in 2016 (Moore et al. 2017:76). It is postulated that this could have been part of a portable observatory. The shelves on the starboard side are mainly empty except for what appear to be degraded book bindings. A heating duct was observed in the back of one of the starboard-side shelves. A hinged door leading to Crozier's bed cabin is open, but the doorway remains partly obstructed by collapsed wooden panels.

The shelves on the port side are filled with what could be scientific instruments and/or instrument boxes. Most notably, a tripod is clearly recognizable and lies prone on one shelf (Figure 4.2.24). The remains of what were probably a thermometer and a barometer are still hanging on the wall next to the Captain's cabin door (Figure 4.2.25).



Figure 4.2.22: Captain Crozier's writing desk in the Captain's cabin (Video: R. Harris, Parks Canada; 90M2797EF).

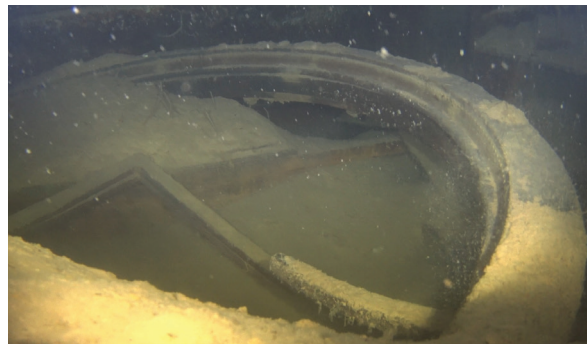


Figure 4.2.23: Large, circular laminated wooden object, located on the port side of the Captain's cabin (Video: R. Harris, Parks Canada; 90M2808EF).

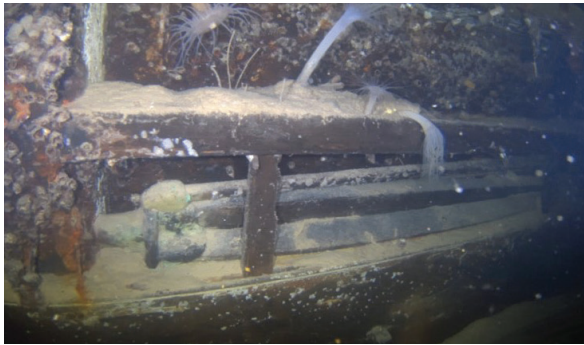


Figure 4.2.24: Tripod on the port side shelving, Captain's cabin (Video: R. Harris, Parks Canada; 90M2815EF).



Figure 4.2.25: Potential thermometer and barometer, hanging on the wall next to the Captain's cabin door (Video: R. Harris, Parks Canada; 90M2816EF).

A wide-mouth, square lobate bottle made of light green glass (similar to 89M38J201-31 from *Erebus*), with a glass tumbler, were observed on a shelf at the base of the stern gallery, in the port-side corner of the room.

4.3 DEBRIS FIELD

The area surrounding the wreck of the *Terror* was surveyed by MBES to gain a better understanding of the site and its debris field. This data is being processed at the time of writing. Still, it appears there are few visible features around the wreck, other than the 23-ft. cutter, and a few previously identified rigging elements. One newly observed feature however is part of a topmast at the starboard bow, lying flat on the bottom, and visible on the MBES image of the site (Figures 4.0.1 and 4.1.1).

4.4 TERROR SITE INTEGRITY

Terror is in an exceptional state of preservation. The wreck's hull appears intact from keel to gunwale on both sides and does not seem to have suffered any major structural damage other than to its rigging (Moore and Dagneau 2017:18–26). Indeed, no significant changes to the site's condition were observed in 2019. Apart from the cutter at the port quarter and part of a topmast at the starboard bow, there is virtually no visible or surface debris field around the hull. The ship's masts and standing rigging have mostly collapsed directly onto the upper deck, and immediately adjacent to the hull on its starboard side (Moore and Dagneau 2017:18–26).

The lower deck seems to contain vast amounts of well-preserved features and groups of artefacts in situ, many of which likely remain unseen within furniture and individual cabins still segregated by bulkheads. Cold water temperatures, annual ice coverage, depth, and minimal currents all likely contribute to the excellent preservation of the wreck. The fact that the upper deck and inner spaces are covered with sediment also certainly contributes to the wreck's excellent preservation conditions. Indeed, unlike *Erebus*, the *Terror* appears not to have been significantly affected by ice action or wind generated waves (Moore and Dagneau 2017:16–17).

5. HMS EREBUS RESULTS

The 2019 fieldwork at HMS *Erebus* focused on the study and excavation of selected areas of the lower deck. Most of the in-water work took place on the port side amidships, in sub-operations 38J/K to 42J/K, within spaces believed to correspond to the Captain's Steward's Pantry and the Third Lieutenant's cabin (see Figures 5.0.1–5.0.3; Dagneau 2020). Only a limited amount of work was conducted in the officers' mess area. Archaeologists also spent some time exploring the orlop deck and the hold of the vessel, including the engine compartment, using a micro-ROV.

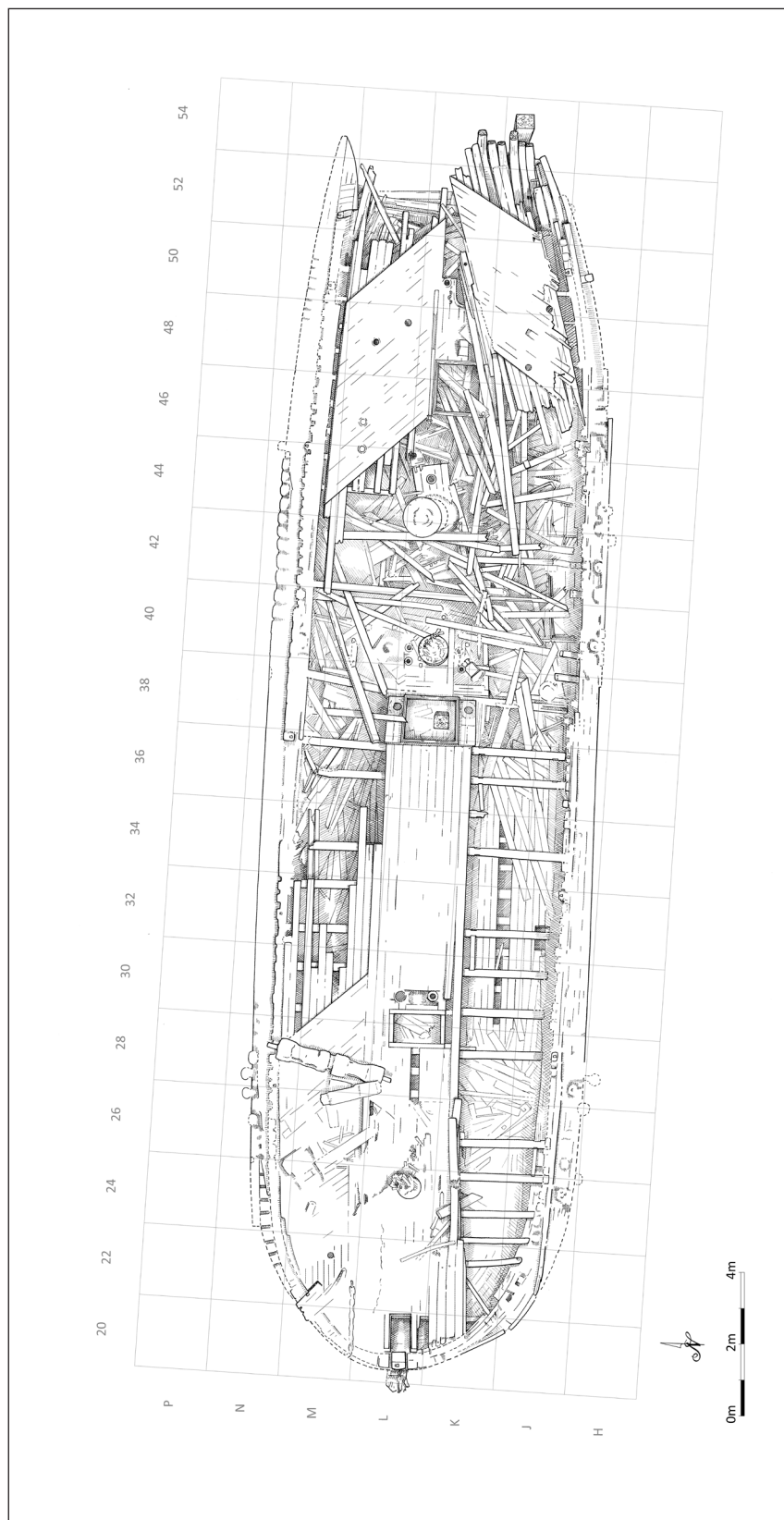


Figure 5.0.1: *Erebus* site plan from 2016 with superimposed provenience grid. This plan does not reflect the most recent damage to the upper deck observed in 2018 and 2019 (Image: B. Lockhart, Parks Canada; Drawing: C. Pillar and C. Dagneau, Parks Canada; 89M-2017-101-1).

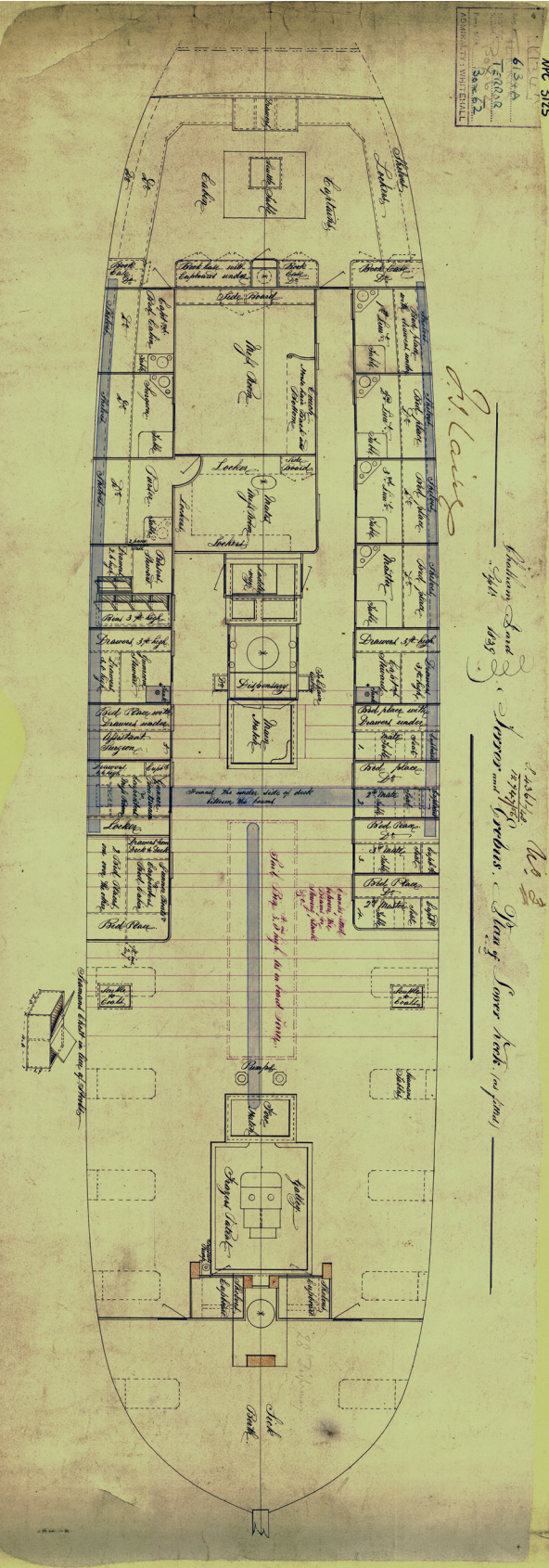


Figure 5.0.2: Terror and Erebus Plan of Lower Deck. (as fitted), dated 1839, depicting Erebus (National Maritime Museum, Greenwich, London; NMM 1839b).

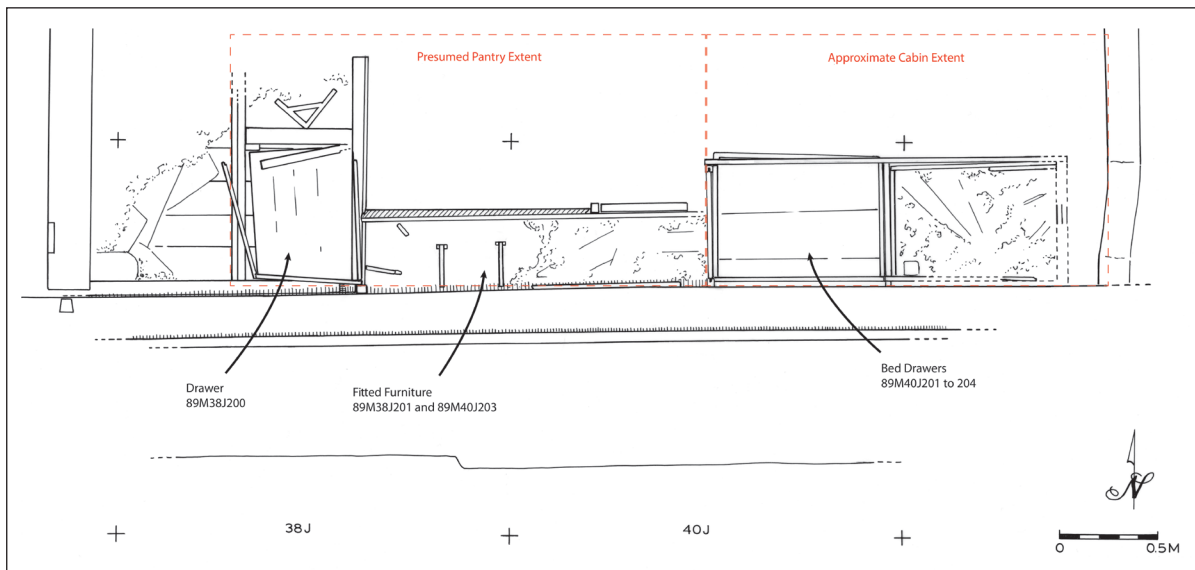


Figure 5.0.3: Sub-operations 38J and 40J showing selected fitted furniture on the port side of the lower deck. The presumed Captain's Steward's pantry is at the middle left and the presumed Third Lieutenant's bed place is at right (Drawing: Carol Pillar, Parks Canada, 89M-2020-101-1).

5.1 LOWER DECK

CAPTAIN'S STEWARD'S PANTRY

One of two cabins excavated in 2019 is believed to be the Captain's Steward's pantry, in sub-operations 38J/K and 40J/K. Although the excavation of this discrete ship space was only partially completed, the artefact assemblage gathered thus far is consistent with this identification, which corresponds with *Terror's* lower deck plan and annotations (Betts 2016; NMM 1837b). The main feature of this cabin is the lower portion of a storage compartment (lots 38J201/40J203) with at least two partitions, located at deck level, along the ship's wall (port side) on the aft side of the cabin. It contained a set of 47 ceramic pieces, as well as an accordion, mitten, numerous buttons, coins, articles of clothing, and many other objects still under study.

The ceramic assemblage consists of 47 whiteware dishes with Whampoa flow blue design, securely stacked together at the bottom of the compartment (Figure 5.1.1). Most of these pieces show a printed floral "Whampoa" crest on their back, as well as an impressed royal arms with the inscription: "Opaque Granite China" and "W R & Co". This maker's mark is associated with William Ridgway & Co, Staffordshire Potteries, in operation from ca. 1834 to 1854 (Godden 1991:538).

Different potters' marks, and multiple batches of variable quality are observed. The assemblage includes 22 dinner plates of two shapes, eight soup plates, four serving bowls, three lids, six platters, and four strainers. As opposed to the Blue Willow ceramics found in the forecabin bearing cut marks and/or graffiti, and likely used by the crew (Moore et al. 2017:89–92), those found in the presumed Captain's Steward's pantry may have been owned by Sir John Franklin (or his officers?) and used for day-to-day meals at his table. The flow blue was also a more fashionable production for the period, popular c. 1840–1860 (Samford 1997:24–25).

A writing kit, including natural and manufactured lead pencils, slate pencils, ink pens and nibs, and an associated case were also discovered in the same storage space (Figure 5.1.2). One of the natural lead pencils bears the inscription "[PURE] CUMBERLAND LEAD BY S. MORDEN & CO LONDON". A quill was also recorded in the same cluster. Given its very fine nib and slit, it might have been used for fine technical drawings rather than writing (Dunning 2019: pers. com.). It is believed that the writing implements may have been used for scientific work or lessons aboard *Erebus*. Other artefacts include a pitcher, a mustard pot with residual contents, a toothbrush, as well as corked bottles of different types. A hairbrush (89M40J203-18) is of particular interest, since human hairs were discovered trapped within its bristles. It is hoped that these hairs will provide valuable insight into



Figure 5.1.1: Storage compartment 38J201/40J203 within the presumed Captain's Steward's pantry containing, amongst many other things, a set of 47 ceramic pieces (Photo: C. Dagneau, Parks Canada; 89M10406EF).

its user's or users' health during the last months of the expedition, and possibly allow DNA sequencing and individual identification (Figure 5.1.3).

A significant artefact from this area, also found in the same storage compartment, is a pewter stamp (89M38J201-43) bearing the inscription "Ed. Hoar" with an anchor motif below. This type of stamp was typically used for marking clothing, cloths and linen (Dunning 2019: pers. com.). Edmund Hoar was Sir John Franklin's steward and this stamp clearly represents a personal possession (Carney 2016; Lloyd-Jones 2005; Muster Book of Her Majesty's Ship 'Erebus' 1845). It is hypothesised that this pantry was mainly used (not occupied) by Hoar and possibly the Subordinate Officers' Steward, John Bridgens, who would have served the combined lieutenants' and mates' mess.

Also of interest is a group of coins including four Chinese cash coins (*Qianlong Tongbao*), a British penny, and a token. While the Chinese coins and the token are manufactured with square holes in their middle, the penny was perforated by hand. The Chinese coins were found stacked together, with the two others within a few centimeters. Therefore, they might have been strung together. Edmund Hoar sailed aboard HMS *Cornwallis* in China (with James Fitzjames and Stephen Stanley) during the First Opium War (1839–1842) (Lloyd-Jones 2005:316–317). It is possible that these coins were acquired by Hoar during his time in China.

More puzzling is a parallel ruler (89M38J201-5) marked "Fred Hornby" that was also found in the compartment. This is an interesting artefact since, according to the muster books, Frederick Hornby was Second Mate of *Terror* (Muster Book of Her Majesty's Ship 'Terror' 1845). This find suggests that Hornby and/or the parallel ruler shifted ships during the expedition, a distinct possibility given the deaths of nine officers by April 1848 (Millar et al. 2013; Millar et al. 2016; Park and Stenton 2019). While we know relatively little about Edmund Hoar at present other than what is in the muster list and description books, there is a great deal more known about Frederick Hornby and his family (Jones 1955). We also know that a double sextant with his name engraved on it was brought back to London by the McClintock search expedition (NMM, record AAA2230; Walpole 2011:49; Walpole 2017).

Finally, a small area was also partly excavated outside and around storage compartment 38J201/40J203, within the limits of the same cabin. A shallow drawer (89M38J200-43) and several furniture parts were recovered, along with many loose artefacts. These include a boot 89M38J200-42 (a pair with boot 89M38J200-8 from 2015), as well as a complete artificial horizon box set, a small book binding, a folding table leg, silver sugar tongs, a fine decorated seal handle and a piece of sealing wax (see Figure 5.1.4). Valuable objects such as the artificial horizon and

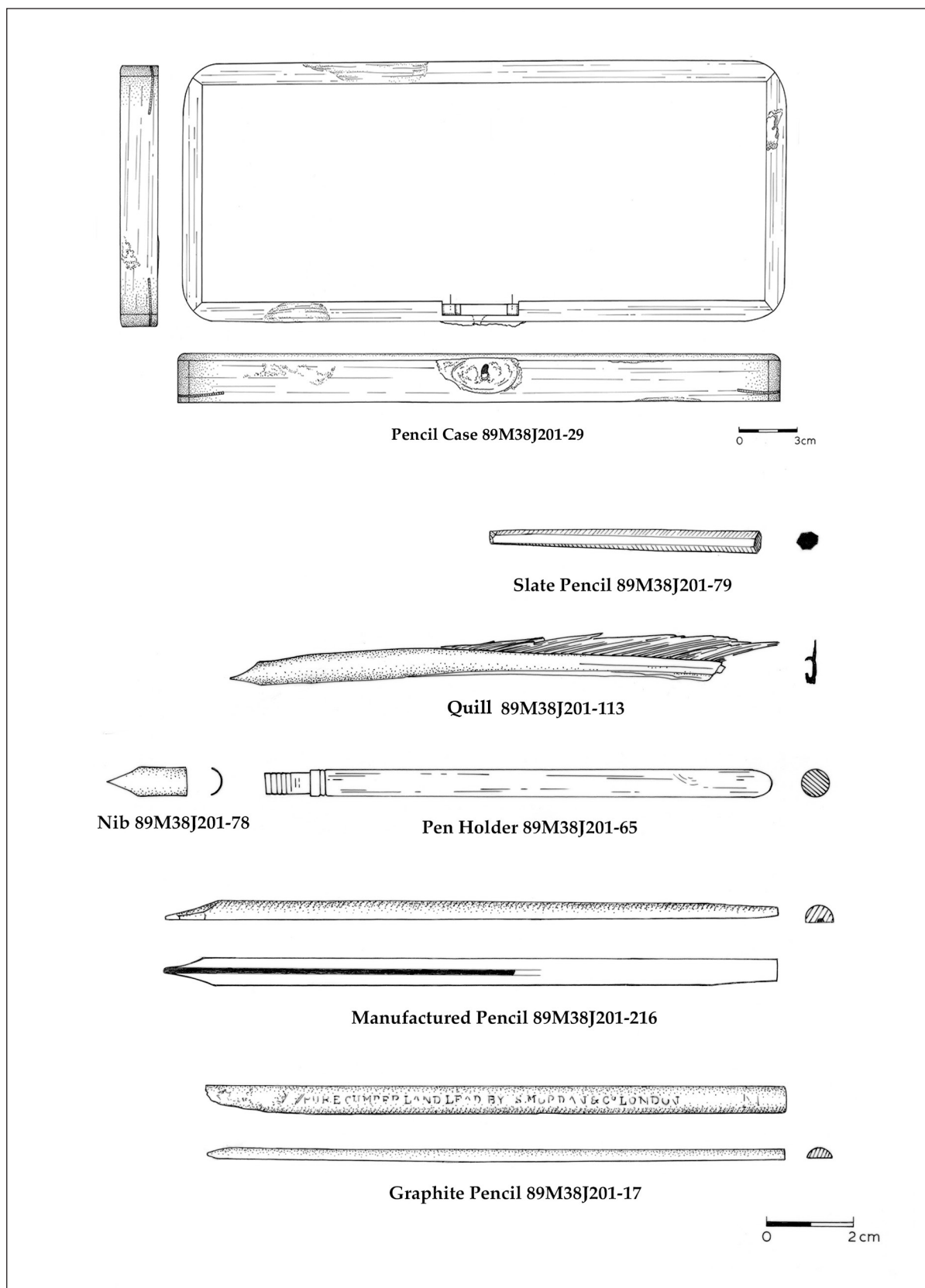


Figure 5.1.2: Writing implements found in storage compartment 38J201/40J203, within the presumed Captain's Steward's pantry (Drawings: C. Pillar, Parks Canada).

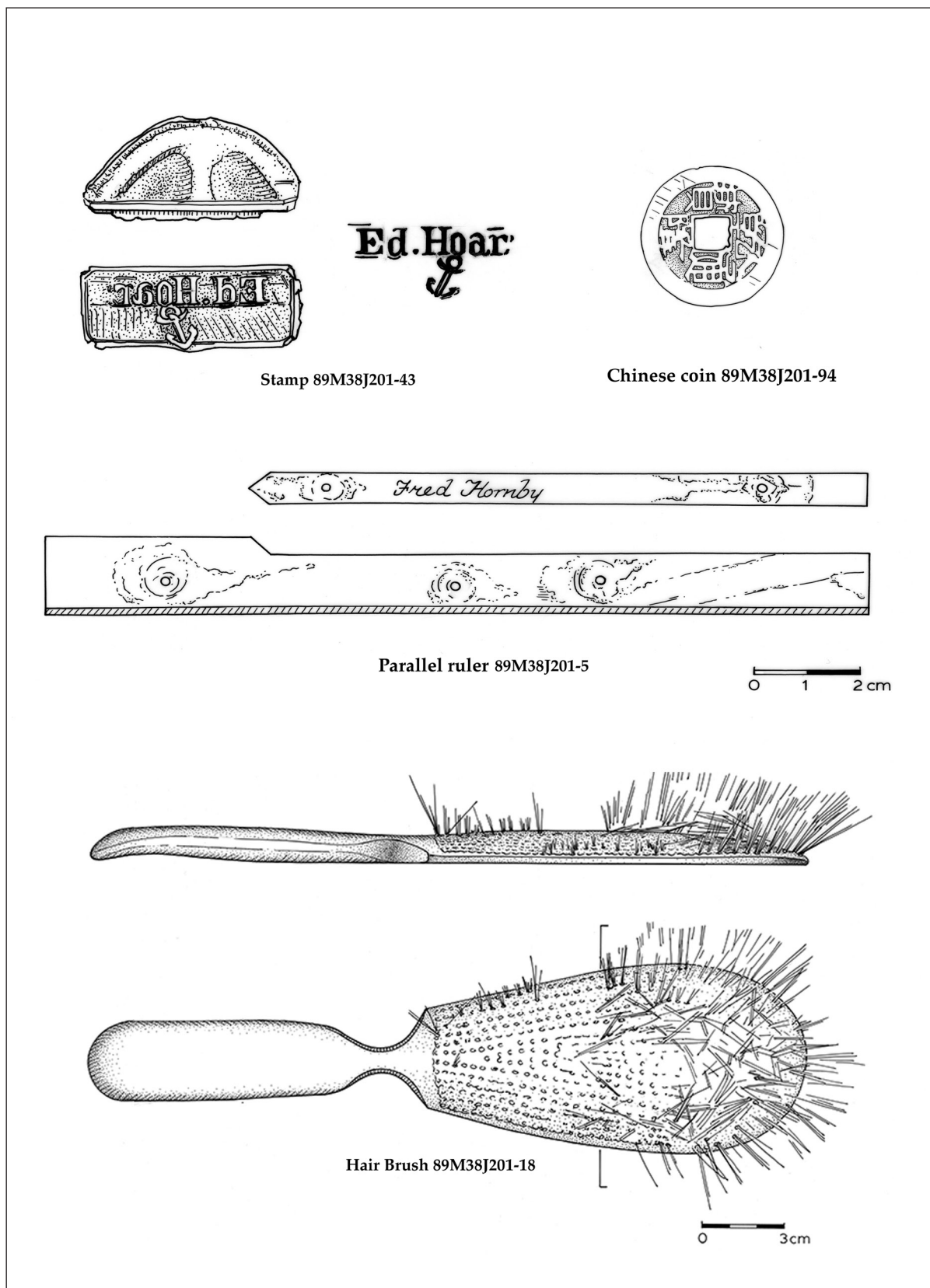


Figure 5.1.3 Some of the noteworthy artefacts found in storage compartment 38J201/40J203, within the presumed Captain's Steward's pantry: hairbrush, pewter stamp marked "Ed. Hoar", and parallel ruler marked "Fred Hornby" (Drawings: C. Pillar, Parks Canada).

silverware would probably bear their owner's name, initials or family crests. This will be confirmed following conservation treatment.

At this early stage of the excavation, preliminary interpretations must be tempered with a degree of caution. While many artefacts such as the set of ceramics were undoubtedly stored in their compartment at the time of wrecking, some objects may have migrated from other shelves or drawers within this cabin space, or from a nearby area during the wrecking process. A detailed study of artefact distribution in relation

to their locations and contexts will be done once this cabin's excavation is completed. However, given their location on the top of lot 38J201, both the stamp marked "Ed. Hoar" and the instrument marked "Fred Hornby" appear to originate from this cabin, although not necessarily from this precise space. That being said, if the Captain's Steward's cabin is representative of the degree of preservation in the other cabins, this excavation could deliver similarly fantastic results, although perhaps at a slower pace than originally anticipated given the sheer quantity of artefacts in situ.

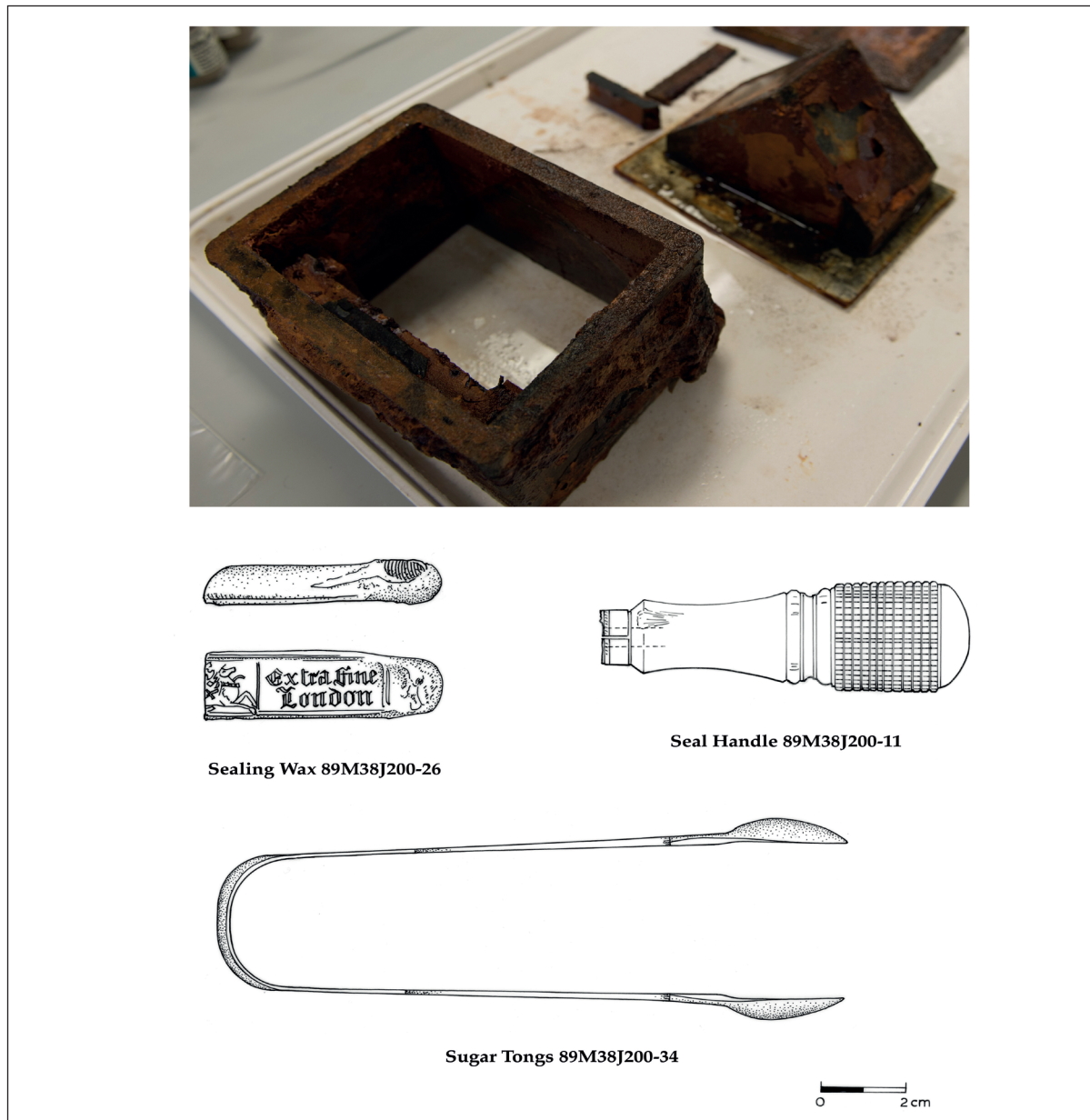


Figure 5.1.4: Other artefacts found within or near the presumed Captain's Steward's pantry: artificial horizon box set, silver sugar tongs, seal handle and sealing wax (Photo: C. Dagneau, Parks Canada; Drawings: C. Pillar, Parks Canada).

THIRD LIEUTENANT'S CABIN

The second cabin partially excavated in 2019 is a port-side officer's bed cabin, located in sub-operations 40J/K and 42J/K, just aft of the Captain's Steward's pantry (Figures 5.0.1 and 5.1.5). This cabin had been targeted as early as 2015 for test excavation, as it showed a fairly well-preserved bed place along the ship's side, thus providing the opportunity to clearly delineate a single cabin and recover artefacts within a specific item of fitted furniture. Based on its location in the wreck next to the aft ladderway, and considering the cabin layout detailed on the "Terror and Erebus, Plan of Lower Deck. (as fitted)" (NMM 1839b), it was believed that this specific cabin might correspond to that of *Erebus*' Third Lieutenant.

Two of the four drawers under the bed were completely excavated. Surprisingly, they contained very few artefacts compared with the Captain's Steward's pantry (Figure 5.1.5). Both drawers, including the closed lower drawer, were found to be

filled with dense sediment that had evidently been deposited over many years. The bed frame and its lee board were missing, exposing the bed place's chest of drawers. The upper excavated drawer (lot 40J200-201) contained a mix of artefacts, including rigging material and cabin fittings that had fallen both from the upper deck and from within the lower deck itself. In contrast the closed, lower drawer (lot 40J204) presented a completely sealed context but was largely empty, with the exception of a well-preserved pair of epaulettes, still in their box (Figure 5.1.6).

The epaulettes (89M40J204-5 and 6) are composed of gold (gilt silver) laces over sheet metal. Their strap and crescent are edged with twisted gold purl, alternating bright and dark, and bordered on either side with small twisted gold wire. Attached to the bonnet are 21 large bullions on the outside, and 20 small bullions on the inside. The Royal Navy button on the strap is made of gilt brass. According to the dress regulations of the day, this model corresponds with the rank of lieutenant (May et al. 1974; Miller 2007:140).



Figure 5.1.5: Presumed Third Lieutenant's cabin during 2019 excavation showing a drawer under the bed place that has just been opened after its excavation, exposing an unexcavated drawer that contained a box of epaulettes encapsulated in sediment (Photo: T. Boyer, Parks Canada; 89M10435EF).



Figure 5.1.6: Pair of lieutenant's epaulettes (89M40J204-5 and 6), found in their box, in a drawer under the suspected Third Lieutenant's bed place (Photo: M. Wilson, Parks Canada; RA9916EF).

It is believed that this cabin was occupied by Third Lieutenant Fairholme and so based on available evidence, the epaulettes belonged to him (O'Byrne 1849). Indeed, in a letter to his father sent from the Whalefish Islands in 1845, Fairholme (1845a) complained about the cool air coming down the aft ladderway opposite his cabin doorway. While we might have expected these very epaulettes to have been depicted in Fairholme's 1845 daguerrotype portrait (NMM 1847), he mentioned in a letter home that out of convenience he actually sat for his portrait wearing Fitzjames' dress coat and not his own (Fairholme 1845b; Ryan 2017; Figure 5.1.7).

The fact that the two bed drawers were mostly empty is interesting and if this proves to be the case for the remaining cabin furniture, it could indicate that the occupant (presumably Fairholme) may have been alive upon desertion of the ships in 1848 and took many or most of his belongings, such as clothing. While we must be prudent when

drawing conclusions at this early stage of excavation, one thing is certain: the epaulettes were left aboard the ship in April 1848, as they would have served no use in the desperate southbound exodus of the crews of *Erebus* and *Terror*.

It is anticipated that full excavation of this cabin will bring new evidence to light that may support or refute these interpretations. Like the other officers on *Erebus*, Fairholme had a distinguished career that is fairly well documented. Three items of his personal silverware originally on *Erebus* and bearing his family crest (a dove with an olive branch and the motto "Spero Meliora") were acquired from Inuit by John Rae and Francis Leopold McClintock's search expeditions in 1854 and 1859, respectively (NMM, records AAA2481, 2386, and 3276). Interestingly, one of the silver spoons (NMM, record AAA2386) also bears the initials "C.H.," presumably those of Cornelius Hickey, Caulker's Mate of HMS *Terror* (Walpole 2011:28).



Figure 5.1.7: Daguerreotype portrait of Lieutenant Fairholme on *Erebus* prior to the expedition's departure in 1845 (NMM 1847).

OFFICERS' MESS

The work in sub-operation 46L was limited to mapping and surface collection of bottles readily accessible without the need to excavate per se. This area is located forward of the officers' mess skylight, where structures and artefacts from the officers' mess are accessible. A decanter (or *eau de toilette* bottle) with its stopper in place, observed in 2017, as well as four wine bottles and a Worcestershire-style condiment bottle, were recovered from this area, most of them corked (Figure 5.1.8). It should be noted that the possible decanter had been seen in different locations in previous years within the area of the Officer's Mess, so its final recovery location is not where it would have originally been stored. It is difficult to infer anything from this space at the moment, given that this excavation unit was barely touched. However, both the bottles and their contents will be subject to detailed chemical analysis as were those recovered from other areas, in order to determine possible contents and/or provenance.



Figure 5.1.8: A decanter, a Worcestershire-style bottle and four wine bottles were recovered from the officers' mess area (46L200). The bottles are not shown to a common scale (Photos: C. Dagneau, Parks Canada).

5.2 ORLOP DECK AND HOLD

Three micro-ROV exploration dives were conducted in 2019 to the orlop deck, in an effort to reach previously undocumented areas inside the hull, yielding a total of 1.4 hours of video (Table 5.2.1). These three dives allowed for more thorough coverage of the main hold (thereby completing initial inspections from 2016), as well as the recording of remarkable new images of the wing coal bunkers, Fraser's patent heating apparatus, the zone around the main mast and pump tubes, and the engine room. ROV footage was also acquired in the bread room on the orlop deck below the forecastle. This video achieved almost identical coverage to that in 2016 (Moore et al. 2017:75–78).

As described in previous reports, the main hold is littered with artefacts and debris of all sorts (Moore et al. 2017:75–78). Two important features were newly observed in the main hold, amongst a great variety of mixed artefacts and debris, largely obscured by a 30–100cm-thick deposit of fine sediment. The first is the presumed Sylvester's heating apparatus, at its expected location at the foot of the (closed) main hatch leading down from the lower deck. The uppermost section of the apparatus is visible and is made from an unidentified gray-coloured sheet metal (tin?) and as a whole it

Date	Entry Point	Video file	Duration (min:sec)
08-09-2019	Forecastle, port side lower deck	89M-2019-R008-HDV	13:17
09-09-2019	Forward companionway	89M-2019-R010-HDV	44:52
09-09-2019	Forecastle, port side lower deck	89M-2019-R011-HDV	27:47

Table 5.2.1: Summary of interior video recorded by ROV in *Erebus* from 2019 used for this report.

is largely obscured by debris and sediment. Second is one of the 22 large, box-shaped fresh water tanks mounted in the main hold. Although its top is missing and the tank is filled with sediment, its distinctive sides with rounded corners are largely intact and thereby recognizable.

WING COAL BUNKERS

Erebus was fitted with coal bunkers on both sides of the ship that extended vertically from the underside of the lower deck down to the hold and longitudinally the length of the main hold, formed by the two wing bulkheads and the hull sides. They were used to store coals used for the heating apparatus to warm the ship and, logically, the patent fuel used for the steam engine when in operation. Both the port and starboard coal bunkers were inspected via an original, open access port at their aft ends, as shown in the plan of *Erebus*' orlop and hold (NMM 1839c). Interestingly, the bunkers were found to be empty down to at least the level of the orlop deck; it is not possible to state whether coal is present in the lower reaches of the bunkers below this deck, nor whether there is coal in the bunkers abreast the bread room farther forward in the ship. The absence of coal in the bunkers is interesting, as it speaks to the state of the ship between the April 1848 of crew desertion and the sinking of the ship relative to the ship's coal supply. That the coal was significantly depleted, as demonstrated by the 2019 interior video, is not entirely surprising given the known expedition chronology, and it is not unreasonable to surmise that the crew experienced a shortage of fuel in the expedition's latter stages. The presence of a collapsed but articulated barrel in the port-side bunker suggests that it might have been placed there by the crew, when the bunker was already partly empty, unless of course it floated there during wrecking. Further exploration of the coal bunkers is warranted to shed further light on the state of the coal supply.

MAIN MAST, PUMP TUBES AND ENGINE ROOM

An unexpected discovery in 2019 was that there is an opening in the transverse watertight bulkhead that defines the aft end of the main hold; this opening, offset to the port side, does not appear in 1839 plans (NMM 1839c) and had been carefully fashioned, with neat cuts through the bulkhead's diagonal planking. It is not possible to state when, or why, such an opening was created that would have compromised the watertight bulkhead. It may have been made, out of necessity, to provide access between the wing coal bunkers and the engine room or to provide ventilation to the engine room. This opening serendipitously permitted ROV access farther aft into a transverse chamber that straddles the main mast and pump tubes, all of which are clearly visible. Only the port side of this space was explored, and is mainly empty, except for wooden debris and a chest on deck.

Furthermore, there is an opening in the aft end of this chamber leading to the engine room, another unexpected finding. Contemporary historical sources and more recent studies, for example Battersby and Carney (2011) and Matthew Betts (2015), demonstrate that the repurposed locomotive engine was fitted transversely across the engine room, offset slightly to starboard to allow space for the engine to be operated on the starboard side, and to align the propeller shaft to the ship's centerline. The 2019 ROV dives confirm this transverse orientation. Sediment accumulation in this room is such that only from one half to one quarter of the engine's total height is visible (Figure 5.2.1). The drive or propulsion features of the engine are mostly if not completely covered in sediment so it was not possible to explore their characteristics. Debris and rope or cable fragments also lie atop the engine. Two sets of shelves were observed on the port side of the engine room, where there is less sediment. These contain with bottles, cans and possible tools. Research on the engine and its features is ongoing.



Figure 5.2.1: *Erebus*' boiler in the engine room (Video: R. Harris, Parks Canada; 89M11230EF)

5.3 EREBUS SITE INTEGRITY

Erebus offers exceptional overall preservation on account of low water temperatures and ice coverage during most of the year. But its shallow depth means it is exposed to wave action from storms during the open water season. *Erebus*' wreck structure has undergone significant changes since 2014. A number of upper deck structural elements and some observed artefacts have moved over the years, mostly during storms. In 2018, a large portion of the upper deck on the starboard bow area was found to have detached and flipped upside down and the windlass was found to have rotated 90 degrees (Dagneau and Moore 2019:4–6). Moreover, since 2018, it appears several upper deck beams on the port side of the wreck have shifted downwards and are closer to the lower deck than in previous years.

Such significant changes to the upper deck's structure illustrate the dynamic nature of the site, and recommend consideration of controlled dismantling and/or shoring of upper deck sections in the short term. These deck sections will eventually block further access to the lower deck, orlop and hold, and, if they fall, could potentially threaten features and artefacts below (Dagneau and Moore 2019:4–6; Moore et al. 2017:125–126). Indeed, it is probably only a matter of time before the remainder of the standing upper deck at the bow collapses. Nevertheless, in 2019, no dramatic structural changes or damage to the upper deck were observed other than the fact that the deck section at the starboard quarter appears to have slumped, thereby further restricting access to the Captain's cabin and Captain's bed cabin below.

On the one hand the broken upper deck of *Erebus* offers some advantages for study and excavation given that it has exposed the lower deck, and in conjunction with the wreck's shallow depth, makes it more archaeologically accessible. On the other hand, the natural site formation processes noted above do pose a real threat. Whereas it appears that large-scale movements and collapse mainly affect the upper deck at present, there are signs of natural dismantling on exposed sections of the lower deck. For example, lower deck planks on the port side of the forecastle have lifted from the deck beams, providing access to the orlop deck below, and collapsed timbers resting on the lower deck along the port side at amidships have been observed to have moved since 2015. As the deck further opens up at the bow, parts of the forecastle and sick berth are further exposed.

A positive sign, however, is that the hull framing appears to be stable for the time being. In 2019 check measurements were taken between the reference points forming the Direct Survey Method network installed in 2015; this demonstrated no significant changes (less than 0.5 cm in all cases). One other important finding from 2019 was that the intact fitted furniture excavated was, in at least the case of the drawers in the Third Lieutenant's cabin, packed with sediment, thereby encapsulating its contents. This had important implications not only for artefact preservation but also the fact that the sediment demonstrably slowed excavation of the drawers.

In 2019 the UAT observed significant changes to the debris field surrounding the hull, in that obvious scouring has taken place since 2018. To give an indication of sediment displacement, there was a tide mark on the starboard side of hull that indicates the drop in sediment level (not measured), and a part of the ship's wheel off the starboard quarter stands noticeably more proud of the seabed. Also, there appears to have been a general flattening out of the timber scatter at the stern. These observations demonstrate that even the deepest sections of the wreck at 11–12 m are still affected by water movement.

CONCLUSION

This interim report described archaeological research undertaken by the UAT at the wrecks of HMS *Erebus* and HMS *Terror* in 2019. This field season continued the evaluation of the *Terror* site through exploration of its lower deck using a micro-ROV as well as further documentation of its upper deck. Work on the *Erebus* site initiated test excavation of the lower deck in parallel with exploration of spaces deeper inside the hull. Most of the 2019 objectives were successfully completed, due in no small part to excellent weather conditions. Initial excavation of *Erebus* has thus far focused on some of its most accessible lower deck areas, including the presumed Captain's Steward's pantry and presumed Third Lieutenant's bed cabin. The finds recovered in 2019 (around 400) only represent a small sample of the total artefacts aboard. The UAT expects to encounter similar dense artefact clusters in sealed contexts in other parts of the lower deck, including the Captain's cabin and bed cabin, should they ultimately prove accessible. Whereas *Terror* may

offer better overall preservation conditions, the advantage of *Erebus* is that it is more accessible to archaeologists, given the opening up of its upper deck and its shallower depth. On the other hand, natural site formation processes at *Erebus* pose a serious threat to the wreck, as described in this report.

Given the levels of preservation of *Erebus* and *Terror*, it is believed that the ongoing archaeological investigation has the potential to rewrite chapters in the history of Franklin's 1845 expedition. It is anticipated that the study and excavation of the wrecks will continue for years to come and will yield further fascinating discoveries. Whereas the COVID-19 pandemic ruled out the continuation of archaeological activities during the summer of 2020, the UAT plans to return to both sites as soon as possible to continue the investigation of *Terror* and the excavation of *Erebus*, weather, ice and pandemic conditions permitting.

REFERENCES CITED

Battersby, William, and Peter Carney

- 2011 Equipping HM Ships Erebus and Terror, 1845. *International Journal for the History of Engineering & Technology* 81(2):192–211.

Betts, Matthew

- 2015 Erebus Station 8 1845 Facing Forward. CAD drawing.
2016 Terror 1845 Lower Deck Plans with Furniture. CAD drawing.

Boyer, Thierry, and Brandy Lockhart

- 2020 Seeing Life in 3D: Digital Recording of HMS *Erebus*. In V. Mastone and C. Mires (Ed.), *ACUA Underwater Archaeology Proceedings 2020*. Advisory Council on Underwater Archaeology, Savannah, p. 135–141.

Carney, Peter

- 2016 Roll Call of the Doomed. *Erebus and Terror Files*. March 18. <https://erebusandterrorfiles.blogspot.com/2016/03/roll-call-of-doomed.html>.

Cyriax, Richard J.

- 1939 *Sir John Franklin's Last Arctic Expedition: A Chapter in the History of the Royal Navy*. Methuen, London.

Dagneau, Charles

- 2018 HMS Erebus Underwater Archaeological Survey 2017. Underwater Archaeology Research Bulletin No. 1. Underwater Archaeology Team, Parks Canada, Ottawa.
2020 HMS Erebus Material Culture: Reaching Out to the Individuals. In V. Mastone and C. Mires (Ed.), *ACUA Underwater Archaeology Proceedings 2020*. Advisory Council on Underwater Archaeology, Savannah, p. 143–152.

Dagneau, Charles, and Jonathan Moore

- 2017 HMS Terror Underwater Archeological Survey April 2017. Wrecks of HMS Erebus and HMS Terror National Historic Site of Canada. Underwater Archaeology Team, Parks Canada, Ottawa.
2019 HMS Erebus Underwater Archaeological Survey 2018. Underwater Archaeology Research Bulletin No. 2. Underwater Archaeology Team, Parks Canada, Ottawa.

Defence and Civil institute of Environmental Medicine

- 1992 *DCIEM Diving Manual: Air Decompression Procedures and Tables*. Department of National Defence, Ottawa.

Dunning, Phil

- 2019 Retired Parks Canada Material Culture Specialist.

Fairholme, James Walker

- 1845a Fairholme to His Father, 1 June 1845. R14108-0-9-E (MG24-H18). Library and Archives Canada, Fairholme Papers fonds.
1845b Fairholme to His Father, 29 May 1845. R14108-0-9-E (MG24-H18). Library and Archives Canada, Fairholme Papers fonds.

Geiger, John, and Alanna Mitchell

2015 *Franklin's Lost Ship: The Historic Discovery of HMS Erebus*. Harper Collins Publishers, Toronto.

Godden, Geoffrey A.

1991 *Encyclopaedia of British Pottery and Porcelain Marks*. Barrie and Jenkins, London.

Government of Canada

1985 *Labour Code. R.S.C., 1985, c. L-2*.

Harris, Ryan, Jonathan Moore, and Marc- André Bernier

2015 Remote Sensing Search 2014 and Discovery of HMS Erebus. Wrecks of HMS Erebus and HMS Terror National Historic Site of Canada. Underwater Archaeology Team, Parks Canada, Ottawa.

Illustrated London News

1845 Captain Sir John Franklin's cabin on board HMS Erebus. *Illustrated London News* May 24.

Jones, A. G. E.

1955 Frederick John Hornby. *The Mariner's Mirror* 41(4):303–307.

Keenleyside, A., M. Bertulli, and H.C. Fricke

1997 The Final Days of the Franklin Expedition: New Skeletal Evidence. *Arctic* 50(1):36–46.

Lloyd-Jones, Ralph

2005 The Men Who Sailed with Franklin. *Polar Record* 41(4):311–318.

May, W. E., W. Y. Carman, and John Tanner

1974 *Badges and Insignia of the British Armed Services*. Adam & Charles Black, London.

Millar, Keith, William Battersby, and Adrian W. Bowman

2013 A Re-Analysis of the Supposed Role of Lead Poisoning in Sir John Franklin's Last Expedition, 1845-1848. *Polar Record* 51(3): 224–238.

Millar, Keith, Adrian W. Bowman, William Battersby, and Richard R. Welbury

2016 The Health of Nine Royal Naval Arctic Crews, 1848 to 1854: Implications for the Lost Franklin Expedition. *Polar Record* 52(4): 423–441.

Miller, Amy

2007 *Dressed to Kill: British Naval Uniform, Masculinity and Contemporary Fashions, 1748-1857*. National Maritime Museum, Greenwich.

Moore, Jonathan

2020 The Wreck of HMS *Erebus*: A Fieldwork and Research Update. In V. Mastone and C. Mires (Ed.), *ACUA Underwater Archaeology Proceedings 2020*. Advisory Council on Underwater Archaeology, Savannah, p. 125–133.

Moore, Jonathan, and Charles Dagneau

2017 HMS Terror Remote Sensing Search and Shipwreck Identification Confirmation 2016. Wrecks of HMS Erebus and HMS Terror National Historic Site of Canada. Underwater Archaeology Team, Parks Canada, Ottawa.

Moore, Jonathan, Charles Dagneau, Marc-André Bernier, Ryan Harris, Thierry Boyer, Filippo Ronca, Brandy Lockhart, and Joe Boucher

2017 HMS Erebus Underwater Archaeological Surveys 2015 and 2016. Wrecks of HMS Erebus and HMS Terror National Historic Site of Canada. Underwater Archaeology Team, Parks Canada, Ottawa.

Muster Book of Her Majesty's Ship 'Erebus'

1845 Muster Book of Her Majesty's Ship 'Erebus', Commencing 3 March, Ending 19 May 1845. ADM 38/672. The National Archives of the United Kingdom, Kew.

Muster Book of Her Majesty's Ship 'Terror'

1845 Muster Book of Her Majesty's Ship 'Terror', Commencing 3 March, Ending 17 May 1845. ADM 38/1962. The National Archives of the United Kingdom, Kew.

National Maritime Museum

1837a *Profile of the Terror. As Fitted for a North-Pole Discovery Ship, at This Port. March 1836.* Admiralty Collection (Ship Plans), ZAZ5672 (J1406). National Maritime Museum, Greenwich.

1837b *Plan of the Terrors Lower Deck.* Admiralty Collection (Ship Plans), ZAZ5676 (J1410). National Maritime Museum, Greenwich.

1839a *Terror and Erebus, Plan of Upper Deck. (as Fitted.).* Admiralty Collection (Ship Plans), ZAZ5675 (1409). National Maritime Museum, Greenwich.

1839b *Terror and Erebus, Plan of Lower Deck. (as Fitted).* Admiralty Collection (Ship Plans), NPC3125 (J8650). National Maritime Museum, Greenwich.

1839c *Terror and Erebus, Plan of Orlop and Hold. (as Fitted).* Admiralty Collection (Ship Plans), ZAZ5677 (J1411). National Maritime Museum, Greenwich.

1845 *Drawings Representing the after Part of the "Erebus" Arctic Ship...* March 17. Admiralty Collection (Ship Plans), ZAZ5683 (J1529). National Maritime Museum, Greenwich.

1847 *Portrait Photographs of the Officers of HMS Erebus (1826) and the Captain of HMS Terror (1812).* National Maritime Museum P4470, Greenwich, London.

1848 *Plan of the Investigator's Upper Deck as Fitted for the Arctic Expedition. At Messrs Greens' Yard Blackwall. April 1848.* July 26. Admiralty Collection (Ship Plans), ZAZ6546 (J2209). National Maritime Museum, Greenwich.

O'Byrne, William R.

1849 James Walter Fairholme. In *A Naval Biographical Dictionary*, Vol. 1: p. 345. John Murray, London.

Park, Robert W., and Douglas R. Stenton

2019 Use Your Best Endeavours to Discover a Sheltered and Safe Harbour. *Polar Record* 55(6): 361–372.

Parks Canada

2005 *Parks Canada Archaeological Recording Manual: Excavations and Surveys.* Parks Canada, Ottawa.

2018 *Parks Canada Dive Directive.* Parks Canada, Ottawa.

2019a Wrecks of HMS Erebus and HMS Terror National Historic Site of Canada Commemorative Integrity Statement. Parks Canada, Gatineau.

2019b *Parks Canada Guided Tour Inside HMS Terror.* Underwater Archaeology Team, Parks Canada, Ottawa. <https://youtu.be/OxyTZ3F7mkA>.

2019c *Parks Canada Explores the Wreck of HMS Erebus.* Underwater Archaeology Team, Parks Canada, Ottawa. <https://youtu.be/OxyTZ3F7mkA>.

Ryan, Karen

- 2017 Remembering the Franklin Expedition — The Lieutenant Fairholme Collection. *Canadian Museum of History Blog*. June 15, 2017. <https://www.historymuseum.ca/blog/remembering-the-franklin-expedition-the-lieutenant-fairholme-collection/>.

Samford, Patricia M.

- 1997 Response to a Market: Dating English Underglaze Transfer-Printed Wares. *Historical Archaeology* 31(2):1–30.

Stanley, Owen

- 1845 *June 4 1845. Parting Company with Erebus*. Catalogue number 2484977. National Library of Australia, Canberra.

Stenton, Douglas R.

- 2014 A Most Inhospitable Coast: The Report of Lieutenant William Hobson's 1859 Search for the Franklin Expedition on King William Island. *Arctic* 67(4):511–22.
- 2018 Finding the Dead: Bodies, Bones and Burials from the 1845 Franklin Northwest Passage Expedition. *Polar Record* 54(3):197–212.

Stenton, Douglas R., and Robert W. Park

- 2020 The “Cast Iron Site”—A Tale of Four Stoves from the 1845 Franklin Northwest Passage Expedition. *Arctic* 73(1):1–14.

Underwater Archaeology Team, and Inuit Heritage Trust

- 2020 Underwater Archaeology Project Research Design: Wrecks of HMS Erebus and HMS Terror National Historic Site of Canada. Parks Canada, Ottawa.

Walpole, Garth

- 2011 The Search for, and an Analysis of, the Relics of the Franklin Expedition 1848-1880. *Undergraduate thesis*, Bangor University, Bangor, United Kingdom.
- 2017 *Relics of the Franklin Expedition : Discovering Artifacts from the Doomed Arctic Voyage of 1845*. Russell Potter (Ed.), McFarland & Co Inc, Jefferson, NC.

Woodman, David C.

- 1991 *Unravelling the Franklin Mystery: Inuit Testimony*. McGill-Queen's University Press, Montréal.

