Introduction

In December 2010-January 2011 the Archaeological Expedition of the University of Naples “L’Orientale” (UNO), Naples, and the Italian Institute for Africa and Orient (IsIAO), Rome, in collaboration with Boston University (BU), Boston (USA) conducted the tenth field season at the site of Mersa/Wadi Gawasis, Red Sea, under the direction of Prof. Rodolfo Fattovich (UNO/IsIAO), and Prof. Kathryn A. Bard (BU). Cheryl Ward (Coastal Carolina University, Conway, SC, USA) was the co-principal investigator for the nautical archaeological component and the conservation of nautical remains at the site.

The site of Mersa/Wadi Gawasis is located 23 km to the south of the modern port of Safaga, on the top and along the slopes of a fossil coral terrace, to the west of which is the lower Wadi Gawasis. Earlier excavations along the western slope of the terrace provided good evidence of the use of Mersa/Wadi Gawasis as the pharaonic port for voyages to Punt in the Middle Kingdom and the early New Kingdom (see Sayed 1977; Bard & Fattovich 2007a, 2007b, 2008, 2009a, 2009b, 2010a, 2010b, 2010c; Bard, Calcagno, Fattovich, Ward & Zazzaro 2008; Bard, Fattovich, Manzo & Pirelli 2009; Fattovich 2008; Fattovich & Bard 2007, 2009; Fattovich, Bard & Ward 2007; Fattovich, Manzo & Zazzaro 2009; Hein, FitzGerald, Milne, Bard & Fattovich 2011).

In 2010-2011 the team in the field included Italian, American, Egyptian, British, and German personnel with different specializations (archaeology, nautical archaeology, paleoethnobotany, topography, conservation and computer science). Members of the expedition were Prof. Kathryn A. Bard, BU, Boston (USA), archaeologist; Prof. Rodolfo Fattovich, UNO, Naples (Italy), archaeologist; Prof. Cheryl Ward, Coastal Carolina University, Conway, SC (USA), maritime archaeologist; Prof. Ksenija Borojevic, Boston University, Boston (USA), paleoethnobotanist; Prof. Howie Choset, Carnegie Mellon University, Pittsburgh (USA), computer scientist; Dr. Francesco Berna, BU, Boston (USA), geoarchaeologist; Dr. Andrea D’Andrea, UNO, Naples (Italy), archaeologist; Mr. Rainer Gerisch, Free University, Berlin (Germany), paleoethnobotanist; Mr. Giancarlo Iannone, Cyprus Center, Nicosia (Cyprus), technician; Ms. Maria Imbrenda, University of Pisa, Pisa (Italy), assistant archaeologist; Ms. Caroline Jacoby, Wellman Conservation LLC, Halethorpe, MD (USA), assistant conservator; Ms. Rebecca Mountain, Museum of Fine Arts, Boston (USA), assistant paleoethnobotanist; Mr. Easton Selby Talbot, Coastal Carolina University, (USA), photographer; Mr. Matthew Tesch, Carnegie Mellon University, Pittsburgh (USA), assistant computer scientist; Mr. Stefano Tilia, Trerre, Rome (Italy), surveyor; Dr. Sally Wallace-Jones, Norwich (UK), ceramic analyst; Mr. John Wallace-Jones, Norwich (UK), illustrator; Mr. Howard Wellman, Wellman Conservation LLC, Halethorpe, MD (USA), conservator; Mr. Cornell Wright, Carnegie Mellon University, Pittsburgh (USA), assistant computer scientist; Dr. Chiara Zazzaro, University of Exeter (UK), maritime archeologist.

Mr. Ahmend Sadiq Tawfiq represented the Supreme Council of Antiquities in the field, and greatly supported the excavations there.
The 2010-2011 research program consisted of 1) archaeological investigation including paleoethnobotany and mapping, 2) conservation of timbers and ropes discovered in earlier field seasons at the site, and 3) robotic inspection of two man-made galleries (Cave 6 and Cave 7) in the western sector of the site (Wadi Gawasis).

The archaeological component of the research has been funded by grants of the late Mr. Wallace Sellers and Mrs. Naudain Sellers, Lahaska, PA; the University of Naples “L’Orientale,” Naples (Italy); and the Istituto Italiano per l’Africa e l’Oriente, Rome (Italy). Conservation of the ship timbers was supported by a grant of the American Research Center in Egypt, Antiquities Endowment Fund/USAID to Cheryl Ward. The robotic project was supported by a grant of the National Science Foundation, Washington DC.

The members of the expedition are grateful to the SCA staff in Cairo, Quseir and Safaga, and the Italian Embassy, Italian Cultural Institute and Italian Archaeological Center, Cairo, for their kind support, and in particular the family of late Wallace Sellers for their generous donation to the project.

1. Archaeology
Kathryn A. Bard, Francesco Berna, Ksenija Borojevic, Rodolfo Fattovich and Chiara Zazzaro

The 2010-2011 excavations were conducted along the western and southern slopes of the fossil coral terrace. Four areas were excavated under the supervision of K. A. Bard, R. Fattovich, K. Borojevic, F. Berna and C. Zazzaro: 1) along the western slope of the coral terrace (excavation units WG 31, WG 40 and WG 61/65), 2) at the northwestern base of the slope (WG 70/72/73/76 and WG 75), 3) inside Cave 2 (first excavated in 2004-2005) (WG 71), and 4) inside a rock-shelter along the southern slope of the terrace (WG 74).

The excavated areas were mapped with a TLS (Figure 1). Excavation units WG 70/72/73/76 and WG 74 were surveyed with a Laser Scanner in order to generate a 3-D model of these areas.

WG 31

WG 31 was briefly excavated in 2005-2006 (Bard & Fattovich 2007: 72-73). SU1 of these excavations contained a great mixture of materials, including a ram horn and other animal bones; donkey(?) dung; a dom palm nut; mud-bricks; a (papyrus) sandal; plastered and unplastered pieces of cedar; a small, badly eroded limestone stela (round-topped); a large complete late 12th Dynasty storage jar with many sea shells inside; and a cut piece of (modern) sugar cane.

Test excavations in this unit in January, 2010 revealed more ancient artifacts, including 2 Middle Nubian potsherds and a number of clay sealings (Bard & Fattovich 2010c: 15).

In 2010-2011 an 8 m x 4 m excavation unit was placed here, oriented along the face of the coral terrace. As in 2005-2006, SU1 consisted of a deposit of windblown sand (ca. 40-60 cm deep), containing Middle Kingdom potsherds, one of which had a hieratic potmark(?). Sally Wallace-Jones also identified a Canaanite potsherd from this deposit.

Other materials in SU1 included: 1 wooden bottle lid, rope (large and small types, including one with a large knot), linen fragments, linen string, bird nests (partially made with ancient linen threads), many small pieces of wood, pieces of clay (for sealings?), 1 shell, 1 seed(of unknown species), pieces of mud-brick and burnt mud-brick, and much charcoal.

In the northern part of WG 31, SU1 there was a concentration of mud-brick fragments, and to the north of this, some large Middle Kingdom potsherds, large pieces of wood and charcoal.

Below SU1, the workmen excavated a sterile layer of sand, and continued to find more sterile sand in a 5 m extension of the excavation unit to the northwest. The fossil coral terrace

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1 Excavation was conducted by K. A. Bard.
extended outward at this level, and there was no evidence of any openings for a man-made cave here. It is presumed that the sand in this area of the western slope was leveled off for a limited amount of work activity in proximity to hearths, as reflected in the artifacts and other remains found here.

**WG 40**

Excavation Unit WG 40 was opened just to the south of the entrance to Cave 1, which was not excavated in 2004-2005 when Cave 1 was found. This was a 7 m x 3 m excavation unit, located next to the fossil coral terrace wall. The Stratigraphic Units of WG 40, beginning at the coral terrace wall and diminishing in slope outward, are:

- **SU1**: ca. 66 cm of colluvium and windblown sand, beneath which is ca. 36 cm of windblown sand.
- **SU2**: a layer, ca. 20 cm, of sea-grass and mangrove leaves.
- **SU3**: ca. 30-40 cm of sand with cultural material, including hearths.
- **SU4**: ca. 10-20 cm of deposit with layers of mats.
- **SU5**: sterile deposits.

**SU3** contained the following:

1) **Artifacts**: half of a wooden tag with rope still attached to the hole (5.8 cm long), painted with a boat sign, 2 lithic tools, including a blade, 7.2 cm long; small piece of copper; heavy unknown material(?); many potsherds; 2 Middle Nubian potsherds from a bowl rim; many linen fragments; rope fragments; mat fragments, 1 whole mud-brick (30 cm x 15 cm x 8 cm).

2) **Wood**: many small fragments and some large pieces, including a cedar fragment with a mortise cut, and one long piece (40 cm) cut flat on one side and rounded on the other

3) **Bones**: mammal, bird and fish bones, including a sheep/goat scapula(?), and a goat horn.

4) **Molluscs**: shells, including a bivalve (14.5 cm long), pieces of a squid (chitinous) pen.

5) **Charcoal**

6) **2 dom palm nuts** (inner part)

Excavated in the northern end of WG 40, next to (south of) the entrance to Cave 1, was a large stone (83 cm long) found lying at an angle, next to which was a large deposit of burnt mud-bricks. These artifacts probably originally formed the door and sealing of the Cave 1 entrance, which were removed in antiquity. Also next to the large stone was a conglomerate grinding stone (21 cm x 24 cm x 7 cm), both smooth and pitted on one side where the grinding was done, and broken at one end.

In the southern end of WG 40, a concentration of ropes, cut reeds (raw material), and a large fragment of an in situ mat, were found in SU4. Excavations continue here (SU4), which contained a fragmented rope bag and basket fragments, beneath which was a large fragment of a mat. The rope bag fragments and mat fragment were removed with plywood boards underneath. Also in SU4 was a kind of construction with 2 coral rocks and a wooden stake, cut to a point at one end. At the bottom of WG 40, SU4 were 2 burnt mud-bricks associated with charcoal (a hearth?), small pieces of wood and some animal bone fragments.

Aside from the rope bag fragments and the mat fragment, WG 40, SU4 contained: a deposit of large rope fragments, many smaller rope fragments, small pieces of wood, potsherds, 1 piece of linen, bone fragments, grass/reed fragments, charcoal, and a broken wooden peg(?) cut at one end.

Since a large articulated mat was found at the end of WG 40, SU4 extending south, the excavation unit was extended 2 m south and was named WG 40, S extension. SU1 and SU2 were cleared off of WG 40, S extension, and a well articulated hearth was found in SU3, associated with an almost whole marl jar. Beneath the hearth in SU4, more matting was found. At least two

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2 Excavation was conducted by K. A. Bard.
different types of matting were piled here, extending out from the coral terrace wall for up to 260 cm:

1) Mat made of two twisted rope fibers, identified by Ksenija Borojevic as halfa grass.
2) Woven mat made of flat strips of dom palm leaves (K. Borojevic identification).

The mats were thrown here in a pile and large quantities of thick storage jar sherds were also found above and associated with the mats. Some large mammal bones were also found here, along with much wood, mainly of local types with bark and branches.

Also in WG 40, S extension, SU4 was a broken, wooden furniture(?) leg, flat on one side with evidence of red paint (35.5 cm long, 3.0 cm wide at widest point). Ksenija Borojevic suggests that some of the mat fragments here associated with the wooden furniture leg may be from a bed. According to the excavator (K. B.) the piece of furniture was probably a smaller stool/seat, as the wooden furniture leg(?) is not large enough to support a bed.

According to Sally Wallace-Jones, all the pottery from WG 40 and WG 40, S extension is domestic, mainly cooking pots and plates, so this area was associated with domestic activities: cooking and eating.

SU3 and SU4 in WG 40 and WG 40, S extension represent multiple episodes (at least two) of use for domestic activities in this area, and there is no evidence of administrative activities here as farther north outside the entrance to Cave 8.

Since the pile of mats was fragile – and large – they were left in situ and covered with a plastic sheet and then sand. As in WG 31, there is no evidence of any man-made caves in WG 40 and WG 40, S extension, which were excavated down to sterile deposits of sand.

WG 61/65 (C3 SU36 in SU2 Fire-pit 14 (SU 35), formerly (east) 15A and Fire-pit 15 (SU 36), formerly (west) 15B)

A structured combustion feature delineated by mud-brick walls and composed of two fire-pits, Fire-pit 14 (SU 35), formerly 15A, and Fire-pit 15 (SU 36), formerly 15B, containing thousands of charred barley seeds, was unearthed during the 2009–2010 field season. The feature is located in square C3 of Area WG 65, near the entrance of Cave 8 (Figure 2). The aim of the fieldwork during the 2010–2011 field season was to conduct a microstratigraphic excavation of SU35 and SU36, and integrate the botanical and chemical-mineralogical results, including the FT-IR analysis, in order to obtain information about the age and use of the combustion feature (Figure 3).

The whole feature, including both fire-pits, is ca. 2 m long x 1 m wide. Both fire-pits were situated against the coral terrace wall and were covered by SU1, the surface layer consisting of alternating sub-layers of colluvium (large-grain aeolian sand, large pebbles and rock fragments from the coral terrace). SU36 (Fire-pit 15 on the west side) sits on top of a mud-brick feature (a possible platform) that in its turn sits on top of SU2 (aeolian sand with many mud-brick fragments, potsherds and wood fragments). The feature is sloping ca. 25 cm southward. The highest elevation, the preserved central mud-brick walls abutting the coral terrace, was taken as a datum point at 9.960 m ASL (point 0 during the excavations). The two fire-pits were excavated and analyzed separately.

Excavation strategy
The space in WG 65, SU35 and SU36 was subdivided into 1 m squares and excavated by delimiting arbitrary horizontal areas and following the visible stratigraphic units. The mud-brick walls were left in place. The microstratigraphic units were then partially excavated (and sampled) by removing arbitrary spits (thickness) that followed their specific thickness. The excavations of the two fire-pits concentrated on the careful removal and sampling of the southern edges of the fire-pits to reveal the microstratigraphy in section (Figure 4).

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3 Ksenija Borojevic suggests that some of the mat fragments here associated with the wooden furniture leg may be from a bed. According to the excavator (K. B.) the piece of furniture was probably a smaller stool/seat, as the wooden furniture leg(?) is not large enough to support a bed.
4 Excavation was conducted by K. Borojevic, F. Berna and R. Mountain.
In Fire-pit 14 (SU35), two smaller areas were systematically excavated to the bottom layer of sand (Figures 5 and 6). In the southeast corner, a block (ca. 20 × 20 cm) was excavated to a depth of ca. 20 cm below the surface (Figure 5). On the east side, a block (ca. 20 × 30 cm) was excavated to a depth of ca. 35 cm below the surface (Figure 6). In the southern and eastern part of the unit there are three rows of sand/mud-bricks (each brick ca. 23 × 11 × 8 cm). The mud-bricks were placed on the top of the sand layer. Most of the mud-bricks were left in place, but the mud-bricks in the middle of the preserved eastern wall of Fire-pit 14 were removed. The sand layer was reached at 9.61 m ASL, and it was the lowest excavated point in SU35. From Fire-pit 15, 46 cm of deposits were excavated until the sand layer was reached at 9.5 m ASL in the southern part (Figure 7).

**Microstratigraphy**

Field observation revealed significant stratigraphic differences between Fire-pit 14 (SU35) and Fire-pit 15 (SU36). Fire-pit 14 appeared to have been used last. In fact, the ashes comprising the topmost layer of SU35 covered the topmost ashes of SU36 (Figure 5). Moreover, Fire-pit 14 was composed of a single 2- to 5-cm-thick layer of white wood ashes containing charcoal and mud-brick fragments on top of a 1cm-thick sand layer (Figure 6). The topmost portion of the ash layer is transformed into a few-millimeter-thick crust. At the eastern margin of the feature, the ash and sand layer sits on top of 5- to 8-cm-thick layer of uncombusted plant material (Figure 6). Therefore, the stratigraphy of feature Fire-pit 14 (SU35) can be described as follows. From top to bottom (Figure 6):

1a) encrusted 5-mm-thick layer of wood ashes
1b) 2- to 3-cm-thick layer of wood ashes with charcoal and mud-brick fragments
2) 2- to 3-cm-thick sandy layer, slightly grayish
3) 5-cm-thick layer of uncombusted plant material
4) 3 cm layer of sand

In contrast, Fire-pit 15 (SU36) is characterized by the presence of several millimeter- to centimeter-thick layers (Figure 7). From top to bottom:

1) 5-mm-thick layer of charred cereals seeds, wood fragments, and cord material (Figure 7)
2) 2- to 5-cm-thick layer of highly cemented wood ashes, with charcoal. The difference between layer 1 and 2 is that the charred material in layer 1 comprises almost 100% of the sample; in layer 2, 75% of the sample is calcitic ash and 25% is charred material. This difference could indicate a higher firing temperature in layer 2)
3) 1-cm-thick layer of sand and uncombusted plant material with a few charcoal fragments
4) 2- to 3-cm-thick layer of slightly cemented gray fine sand and ash
5) 1- to 2-cm-thick layer of sand and uncombusted plant material with a few charcoal fragments
6) 2-cm-thick layer of grayish discolored sand
7) 1-cm-thick layer of sand and uncombusted plant material with a few charcoal fragments
8) 5-cm-thick sand layer

The alternation of combustion residues and uncombusted material suggests that the feature was used periodically. The cementation of some of the combusted material suggests that the period of disuse was long enough to allow the formation of salt crust.

**Fourier Transform Infrared Spectroscopy (FT-IR)** (F. Berna)

A portable FT-IR spectrometer (Thermo Scientific Nicolet iS5) was brought to Egypt (Figure 3). Sediment samples were powdered and a few tens of micrograms were mixed with about 50 mg of KBr (IR-grade) and processed into 7 mm pellets by using a hand press (Qwik Handi-Press, Spectra-
FT-IR spectra were collected between 4000 and 400 cm⁻¹ at 4 cm⁻¹ resolution.

In Figure 8, representative IR spectra of sediment sampled from the different layers of Fire-pit 14 (US 35) are illustrated and contextualized into a photograph of the southeastern microstratigraphic section. The FT-IR analysis shows the absorption of calcite (from wood ash and limestone), aragonite (from fragments of coral reef), quartz and feldspars (from sand), kaolinite (from airborne clay particles and mud-brick material), gypsum (from natural desert crust), and anhydrite (calcium sulfate generally forming irreversibly by heating gypsum at a temperature above 250° C). It is interesting to note that all the above-mentioned components are present in different relative proportions in all the layers despite the dissimilar appearance of the layers. This suggests that the use of Fire-pit 14 led to the mixing of the ashes deriving from the fuel with the natural components. The presence of anhydrite suggests that the gypsum that formed naturally from the evaporation of the marine aerosol was heated.

In Figure 9, representative FT-IR spectra of sediment sampled from the different layers of Fire-pit 15 (US 36) are illustrated and contextualized in a photograph of the south microstratigraphic section. FT-IR analysis shows that the chemical mineralogical composition of the layers varies distinctively between the different layers. The charred material (seeds and wood) shows high aromatic-carbon absorption, indicating that the combustion condition led to effective charring of the wood. The ashy layers 2, 4, and 6 show strong absorption of calcite (a major component of wood ash) and of anhydrite.

In contrast the sediments composing the layers containing uncombusted plant material show strong absorption of gypsum, suggesting that the material was exposed on the surface for some time. Interestingly, in the uncombusted layers calcite is significantly less abundant while in the combusted layers absorption of anhydrite is associated with gypsum, indicating that the fire occurred after the crust was formed.

In Figure 10, representative FT-IR spectra of mud-brick materials sampled from both Fire-pits 14 and 15 are illustrated and contextualized into a photograph of both features.

The FT-IR analysis shows that fresh mud-bricks contain significant amount of kaolinite (absorptions at 3695 and 3620 cm⁻¹). The structure of kaolinite is generally destroyed at temperatures between 420° and 500° C. It is therefore interesting to note that all the mud-bricks, despite being rubefied, show absorption of kaolinite. This suggests that the temperature reached by the mud-brick material was less than 420°–500° C. It is also interesting to note that the kaolinite absorption of the rubefied mud-bricks delimiting Fire-pit 14 is less intense than in Fire-pit 15, indicating different combustion conditions in the two fire-pits.

The presence of anhydrate and reduced kaolinite suggests that in Fire-pit 14 the temperature and the intensity of pyrotechnological activity was probably slightly more intense than in Fire-pit 15.

WG 70/72/73/76

Excavation units WG 70, WG 72, WG 73 and WG 76 were opened at the base and on the lower western slope of the coral terrace at Wadi Gawasis to the north of Cave 8 (excavated in 2009-2010), between the shore of the paleolagoon and the terrace.

Excavation Unit WG 70, 10 m x 10 m in area, was an extension of the test excavation in WG 70 A1-A2, B1-B2 (2009-2010; see Bard & Fattovich 2010c: 17). Twenty-one squares, each 2 m x 2 m in area, were excavated to the sterile basal sand: A3, A4, A5; B3, B4, B5; C1, C2, C3, C4, C5; D1, D2, D3, D4, D5; E1, E2, E3, E4, E5.

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5 Excavation was conducted under the supervision of R. Fattovich and M. Imbrenda.
Excavation Unit WG 72 was an extension, 2 m x 10 m in area, immediately to the east of WG 70. Five squares, each 2 m x 2 m in area, were opened: A1, A2, A3, A4, A5.

Excavation Unit WG 73 was delimited immediately to the north of WG 70. Ten squares, each 2 m x 2 m in area, were opened: A4, A5; B4, B5; C4, C5; D4, D5; E4, E5.

Excavation Unit WG 76 was delimited immediately to the south of WG 72. Six squares, each 2 m x 2 m in area, were opened: A1, A2, A3; B1, B2, B3.

On the whole, an area of 168 sq. m was investigated in the 2010-2011 field season with about 2 m rise from the west on the side of the paleolagoon to east on the slope.

The following SUs have been distinguished during the excavation:

WG 70, C1, SU1: superficial stratum of very compact windblown sand, practically sterile. One fragment of copper and traces of a fire.

WG 70, C1, SU2: stratum of very compact sand (mud?), about 5 cm thick, over mud-bricks at the top of Feature 1 (mud-brick structure excavated in 2009-2010).

WG 70, D1, SU1: superficial stratum of windblown sand, about 0.3 m thick, with a salt crust covering a possibly rounded mud-brick structure.

WG 70, D1, SU2: windblown sand covering the top of a few coral rocks to the north of F1. The coral rocks are at the same level as the top of F1.

WG 70, E1, SU1: superficial stratum of windblown sand, about 0.4 m thick, with evidence of a fire-pit and possibly mud-bricks. One timber (T98) was close to the western edge of the square, about 0.4 m deep.

WG 70, C2, SU1: superficial stratum of windblown sand with evidence of fire at the base.

WG 70, D2, SU1: superficial stratum of windblown sand with evidence of a mud-brick wall along a NE-SW axis (F3).

WG 70, E2, SU1: superficial stratum of compact windblown sand, about 0.2 m thick, with disturbed evidence of the mud-brick wall (F3). At the base of the SU there was evidence of a very compact stratum of mud.

WG 70, E2, SU2: very compact stratum of mud sloping down to the south-west.

WG 70, A3/B3/C3, SU1: superficial stratum of windblown sand over some coral rocks.

WG 70, B3, SU3: stratum with evidence of occupation and use (fire) associated with the mud-brick feature (F1).

WG 70, C3, SU2: stratum of mud, about 5-7 cm thick, over a thin stratum of sand covering a possible “platform” of coral rocks.

WG 70, C3, SU3: stratum of soft windblown sand with at the top some evidence of use. One fragment of limestone (an anchor?) at the interface SU2/SU3. Evidence of a huge concentration of charcoal covering a possible “platform” of coral rocks and a mud-brick wall (F1)

WG 70, D3/E3, SU1: superficial windblown sand containing 1 copper strip.

WG 70, D3/E3, SU2: thin stratum of mud covering SU3.

WG 70, D3/E3, SU3: occupation level with evidence of fire.

WG 70, A4, SU1: superficial stratum of compact windblown sand.

WG 70, B4, SU1: superficial stratum of windblown sand covering a possible mud-brick feature.

WG 70, D4, SU1: superficial stratum of windblown sand, containing very small fragments of copper, covering a possible mud-brick feature.

WG 70, C4, SU2: stratum of mud.

WG 70, A5/B5, SU1: superficial stratum of compact windblown sand, about 5-7 cm thick, covering coral rocks and a salt crust.
WG 70, A4/A5 – B4/B5, SU3: stratum of fire associated with a mud-brick feature (F4) extending into C3 and C5.
WG 70, C5, SU1: superficial stratum of windblown sand with evidence of a wall with two rows of mud-bricks at the base.
WG 70, D4, SU2: stratum of mud.
WG 70, D3/D4 SU3: stratum with evidence of fire-pits beneath SU2.
WG 70, D3/D4, SU4: stratum of sterile sand beneath SU3.
WG 70, D4/D5 – E4/E5, SU3: huge concentration of charcoal and wood debris beneath SU2, corresponding to a hearth extending into D3; the hearth was in a stratum of sand, about 0.4 m thick, which covered a mud-brick wall to the southwest.
WG 72, A1-A2, SU1: superficial stratum of windblown sand covering some collapsed coral rocks from the terrace wall and a timber (T105), most likely associated with another timber (T100/104) in WG 70, E1.
WG 72, A3, SU1: superficial stratum of windblown soil covering a very badly preserved mud-brick wall (F3) with evidence of fire.
WG 72, A3, SU2: stratum of mud mixed with potsherds and fragments of wood along the mud-brick wall (F3).
WG 72, A4/A5, SU 1: superficial stratum of windblown sand.
WG 72, A4/A5, SU 2: stratum of mud with evidence of fire.
WG 72, A4/A5, SU3: stratum of sand with a concentration of bread molds and mud-bricks. Evidence of a pottery plate with many fragments of bread molds on the top (F5).
WG 73, A5/B5, SU1: superficial stratum of windblown sand with evidence of mud-bricks and fire at the base.
WG 73, A4/A5 – B4/B5, SU2/SU3: evidence of a mud-brick feature which continues into WG 70, A/B/C1: with a stratum of mud (SU2) sloping down to the southwest toward the paleolagoon.
WG 73, C4, SU1: superficial stratum of windblown sand, about 0.1-0.2 m thick, mixed with potsherds.
WG 73, C4, SU2: stratum of compact mud with evidence of fire at the top.
WG 73, C5, SU1: superficial stratum of windblown sand, about 0.1-0.2 m thick, mixed with potsherds.
WG 73, C5, SU2: stratum of mud mixed with some charcoal, laid over a stratum of sand (SU3) directly covering F1 in WG 70, C1.
WG 73, C5, SU3: stratum of sand with charcoal and two possible wood posts, mixed with a small fragment of wood, burnt potsherds and 1 fragment of a bread mold, covering a large burnt area with ash and charcoal stretching into WG 70, C1.
WG 73, C 5, SU4: burnt area at the base of SU3, perhaps a burnt mat, and a thin stratum of burnt vegetal material. A combusted feature, maybe a small hearth, about 0.4 m in diameter, associated with fragments of bread molds overlapping SU4 in the southwestern corner of C5.
WG 73, D 4-E4, SU1: superficial stratum of windblown sand with evidence of a mud-brick wall (F3) and a stratum of mud beneath it. One fragment of a copper strip from the mud stratum.
WG 73, D5, SU 1: superficial stratum of windblown sand.
WG 76, A1/A2/A3, SU1: superficial stratum of windblown sand.
WG 76, A1, SU2: stratum of mud associated with a mud-brick wall (F7) with a northeast – southwest axis and a thin mangrove post.
WG 76, A2, SU 3: stratum with evidence of hearths and ceramics.
WG 76, A3, SU3: stratum with an alignment of two thin posts. 
WG 76, B1/B2/B3, SU1: superficial stratum of windblown sand. 

At WG 70/72/73/76 four mud-brick features (F1, F3, F4, F7) were recorded. These features were associated with a great quantity of wood debris and hearths, suggesting that carpentry activity was practiced in this area (Figure 11).

F1, F3, F4 and F7 had a similar structure that consisted of mud-brick walls, apparently no more than 0.3 m in height, forming a corner at the end. The walls were oriented along a NW-SE axis and were aligned approximately parallel to the edge of the paleolagoon. They were 6 m (F1), 8 m (F3), 4 m (F4) and ~6 m (F7) long. F1 and F3 were built with mud-bricks approximately 15-18 cm wide. F4 and F7 were built with mud-bricks approximately 27 cm wide (Figure 12).

F1, F3 and F7 had evidence of an alignment of thin mangrove poles along the external side of the wall, and delimited areas covered with a stratum of mud, about 5-7 cm thick, sloping down to the shore of the paleolagoon. These areas were associated with copper strips and wood debris, suggesting they might have been slipways to disassemble ships. F1 was located at the base of the slope near the shore of the paleolagoon. F3 and F7 were on the slope of the terrace.

F4 consisted of a possible threshold with perpendicular walls, in WG 70, B5 at the edge of the excavation unit. The evidence suggested part of a mud-brick building close to the shore of the paleolagoon.

The chronological sequence of these features is still uncertain. On the basis of the size of the mud-bricks, F1 might be contemporary to F3 and F4 to F7.

A small “platform” of coral rocks (F2), about 2 m x 2 m in area and 0.4 m high, was built at the base of the slope between F1 and F4. This feature might be earlier than F1 as the mud-brick wall of this structure abutted the rocks of the “platform.”

A great number of hearths (e.g., F6) and a plate with many fragments of bread molds at the top (F5) was found beneath the stratum of mud (SU2). This evidence suggests that the whole area was initially used for specific activities including bread making and carpentry.

The following stratigraphic sequence in the area was outlined:
1) F4 was built directly on the white sand of the ancient shore of the lagoon.
2) F2 cut the stratum of sand that F4 was built on, at the base of SU3 with the hearths.
3) F1 was erected on a higher level of the slope, over some hearths, which were excavated in the 2009-2010 field season and most likely were associated with F4.
4) Hearths were located on the top of the sterile sand forming the slope to the east of F1 and F4 (SU3).
5) The hearths in SU3 were covered with a thin stratum of mud (SU2) associate with F3.
6) F3 was erected at a higher level on the slope on a lower stratum of mud-bricks overlapping the same original stratum of white sand forming the ancient slope, which also occurs beneath F4 and F1.
7) F5 (plate with bread mold fragments) was associated with the hearths in SU3 beneath F3.
8) F7 and F8 are similar in construction as they have a pole at the northern corner.

WG 71 (Cave 2)\(^6\)

WG 71 is located within Cave 2, one of the group of five galleries discovered in 2004-2005 after a deposit of ca. 2 m of aeolian sand along the western edge of the fossil coral terrace was removed (Bard & Fattovich 2007: 61). Cave 2 is 24 m long and ca. 4-5 m wide. Oriented southwest-

\(^6\) Excavation was conducted by C. Zazzaro.
northeast, this gallery consists of a large natural rock shelter that was extended by the ancient Egyptians. It is divided into three sectors: the Entrance Corridor and Room 1, excavated during the 2004-2005 and 2005-2006 field seasons, and Room 2, surveyed in 2005-2006 and partially excavated in 2009-2010 (WG 64).

Previous excavations in the Entrance Corridor and Room 1 revealed two occupation phases consisting of ceramics, wood debitage and ship timbers incorporated as features in the gallery, and food production artifacts (Bard & Fattovich 2007: 65). During the most recent field season, Excavation Unit WG 71 was opened in the area obstructed by rock fall from the ceiling separating Room 1 from Room 2 (much of this deposit was removed during the 2005-2006 field season). The unit includes two transects. Transect 1, 4 m x 1 m, is parallel to the southeast wall; Transect 2, 2 m x 1 m, is perpendicular to Transect 1. Excavations in WG 71 are incomplete, and the unit will be further investigated during the next field season.

WG 71 revealed evidence of work activities related to ropes, timber cleaning and food processing, so WG 71 was laid out to determine whether activities here were linked to those previously identified in Room 2. WG 71 allowed documentation of the relationship between the Entrance Corridor, Room 1 and Room 2, and investigation of the arrangement and use of different spaces within the gallery. Additional excavation is required to fully explore these problems.

The surface in WG 71 was characterized by rock fall from the ceiling (SU1). Within this layer were one or two probable oar loom fragments (W968), ca. 6 cm in diameter, a wood debitage fragment, and jar sherds.

The layer below the rock fall (SU2) included scattered concentrations of organic materials, ship components, rope and debitage. The southwest corner of Transect 2 had a concentration of rope and wood debitage (SU3) lying on a compact stratum of reeds that also included barley seeds, beetles, and other small insects (SU4). This mound, 50 cm x 40 cm and 18 cm thick, is located ca.1 m from the wall and 1.35 cm below the ceiling. The deposit may be the remains of a pallet for sleeping or sitting, or even the remains of rope-making activities.

The condition of the debitage was, in general, good, but most surfaces were moist and soft, lacking detail due to degradation. The wood debitage is likely the result of dismantling, cleaning and modification of ship timbers. The debitage is consistent with the size and types of wood debitage excavated in the Entrance Corridor in 2005-2006 (Ward & Zazzaro 2010: 30-31).

The cordage assemblage from WG 71 includes 24 fragments of different types ranging from 5 to 24 cm in length. The cordage varies in dimension and composition: the two-strand line type is composed of Z-spun yarns and S-twisted strands; the three-strand line is composed of S-spun yarns and Z-twisted strands. According to Ksenija Borovec and Rebecca Mount, the material used for making the rope found at the site is papyrus. The WG 71 cordage assemblage consists of the following:

1 fragment of a two-strand line, zS: composition, 2 cm in diameter
1 fragments of a two-strand line, zS: composition, 1.3 cm in diameter.
4 fragments of a two-strand line, zS: composition, 1.1-0.6 cm in diameter.
1 fragment of a two-strand line, zS: composition, 0.6 cm in diameter.
1 fragment of a two-strand line, zS: composition, 0.5 cm in diameter with a knot at one end
1 fragment of a two-strand line, zS: composition, 0.5 cm in diameter
2 fragments of a two-strand line, zS: composition, 0.2 cm in diameter.
4 fragments of a two-strand line, sZ: composition, 1.5 cm in diameter
1 fragment of a three-strand line, sZ: composition, 3.3 cm in diameter, tied at one end.
1 fragment of a three-strand line, sZ: composition, 3 cm in diameter.
3 fragments of three-strand line, sZ: composition, 1.1 cm in diameter

Discussion
The composition of wood debitage in WG 71 and in the Entrance Corridor of this gallery differs significantly from wood debitage collected in the contiguous gallery, Cave 3. The two galleries were most likely in use at different times. The surface and upper layers of Cave 3 are characterized by fastener fragments larger than those in Cave 2 and of different types, including dovetail tenons. Cave 2 is the source of most our remains (primarily loom fragments), found in the disturbed area in Room 1 of WG 64 as well as throughout WG 71.

The discovery of a thick layer of rope fragments, reeds and seeds suggests that the excavated occupational level in WG 71 was a living area where rope-related activities, food processing and/or food storage occurred. Wood debitage and fragmentary oars attest that woodworking activity also occurred in this area, almost certainly ship dismantling and the subsequent modification of ship components.

The WG 71 Stratigraphic Units were:
- SU1: surface layer including rocks fallen from the ceiling. SU1 covered SU2.
- SU2: spots with concentrations of organic materials including wood debitage, rope, linen rope, round-sectioned wood fragments and other ficus sycamore-type wood fragments. SU2 covered SU3 and was below SU1.
- SU3: concentration of rope fragments of different dimensions and wood debris. The upper layer of this stratigraphic unit was characterized by thicker rope, one of which is made with three strands, 3.3 cm in diameter, and tied at one end. The lower layer included a rope fragment of medium size and ca. 20 cm long. SU3 covered SU4 and was covered by SU2.
- SU4: concentration of aligned reeds, 5 cm thick, in the southwest corner of the trench. This stratigraphic unit included barley seeds, beetles and other small insects. SU4 was above SU5 and below SU3. This stratum has been sampled for palaeobotanical analysis.
- SU5: sandy soil extending all along the trench. It included one fragment of a dovetail tenon with traces of shipworm damage lying exactly beneath two fragments of rope from SU4. SU5 was covered by SU4.
- SU6: very tiny fragments of wood debris associated with the reed concentration in SU4. SU6 was above SU5 and below SU3.

**WG 74**

WG 74 is a 10 m x 5 m excavation unit located on the southern slope of the western coral terrace, where two (unfinished) limestone anchors are visible on the surface along with large fragments of storage jars. In 2003 A. M. Sayed told Rodolfo Fattovich that this was an important area to investigate.

WG 74 is located in a natural rock shelter, which forms an arch, overlooking the southern part of Wadi Gawasis (Figure 13). A mud-brick platform was constructed within this shelter, on the west side of the shelter. But as the excavations proceeded several huge pieces of collapsed coral terrace appeared, aligned in a straight line/fall. This terrace collapse occurred after the construction of the mud-brick platform, and probably destroyed part of this platform. As a result of this collapse, the rock shelter was abandoned in antiquity and there is no evidence of any cave structure being excavated here.

The WG 74 Stratigraphic Units are:
- SU1: windblown sand and very thick deposits of salt that had to be hammered out.
- SU2: mud-brick platform construction. The maximum height from the top of this construction to the top of the rock shelter roof was 132 cm.
- SU3: deposit within the layer of mud-bricks.
- SU4: sterile sand and thick salt deposits beneath the mud-bricks.

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7 Excavation was conducted under the supervision of K. A. Bard.
Ceramics on top of the mud-brick construction or just outside of it included: many sherds of large storage jars, plus sherds of smaller bowls, a beer(?) jar, and a small whole drinking cup with a hole in it (so it was not used, according to Sally Wallace-Jones).

Artifacts within this same context included: a small limestone stela with no trace of an inscription (a blank, 19 cm x 14 cm at widest x 7 cm), and a basalt grinding stone (just within the rock shelter, on the east side).

Other finds on top of the mud-brick construction or just outside it included: a large bivalve shell (22 cm long) and some smaller shells, some animal bones, and charcoal.

In WG 74, SU3 more potsherds were found, including a black incised Middle Nubian potsherd, and a fragment of a copper strip (ca. 2 cm wide).

The maximum height of the rock shelter is ca. 132 cm from on top of the mud-brick platform to the ceiling of the shelter. Thus, the mud-brick platform was for storage and sitting: the area was too low for workers to stand up. This is also evident by the fact that the mud-brick platform does not continue back into the lowest part of the rock shelter, next to the terrace wall. The mud-brick platform extends for ca. 3.4 m E-W, and 1.4 m from the interior of the rock shelter to the area of rock collapse. Dimensions of two complete, whole mud-bricks are: 33 cm x 15 cm x 9 cm, and 36 cm x 16 cm x 9.5 cm.

WG 75

This is a 4 m x 4 m excavation unit/test pit to the north of WG 70/72/73. A number of lithics were collected on the surface of this unit. SU1 consisted of colluvium, sand, potsherds and pieces of wood debris. But beneath this in SU2 there was sterile sand, with no artifacts. There was no evidence of the mud-brick construction continuing this far north of the large structures in WG 70/72/73, and the excavations here were discontinued.

2. Robotic inspection of Caves 6 and 7
Howie Choset

A robotic inspection of Caves 6 and 7, which are too unstable for humans to enter due to fear of collapse and thus are well suited for robotic exploration, was conducted by Howie Choset to test a prototype of snake robot for archaeological investigation.

These robots are highly articulated mechanisms that can thread through tightly packed volumes reaching locations that people and machinery otherwise cannot (Figure 14). Their ability to move through a myriad of terrains suggests that snake robots have the potential to explore tombs, buried aqueducts, and pyramid passageways that are too small for people to enter. Once in a void space, the snake robot can move about with minimal disturbance to surrounding areas, through rugged terrain traversing distances over 150 meters. The snake robots consist of sixteen identical single degree of freedom modules arranged in a serial chain. The robot, approximately 91.5 cm long by 5 cm in diameter, moves by changing its body shape to push off the environment.

Unlike the robot used in the Giza pyramids, the snake robot can look around corners, pass through many holes and cracks, and access regions rigid mechanisms cannot. An on-board camera, with its own lighting, can return images from remote dark void spaces providing views which are otherwise unobtainable. These robots can also be fitted with water protective skin to pass through volumes containing water.

The snake robot was deployed to explore the caves (Caves 6 and 7) by having one person lay in front of the entrance to insert the robot and then manage the tether (Figure 15). The robot entered the first cave (Cave 6) and explored areas mostly in view from the entrance.

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8 Excavation was conducted under the supervision of K. A. Bard.
At some points the robot was able to see parts of the cave not visible from the entrance, but no artifacts were found. It was clear from the view from the snake robot’s camera that the cave went back further, however, the robot had difficulty getting up a slope which prevented it from continuing. The robot also entered Cave 7 with similar results.

From our experience at Wadi Gawasis, we learned what changes we would need to make to the robot in order to progress further in the caves in the future. Examples of this include better slope climbing, situational awareness, and forward movement of the robot.

3. Maritime Archaeology
Cheryl Ward and Chiara Zazzaro

The 2010-2011 excavation season at Mersa/Wadi Gawasis included continued exploration, excavation, documentation and conservation of maritime-oriented archaeological remains. Major funding through the Antiquities Endowment Fund of the American Research Center in Egypt, funded by USAID, permitted us to bring a conservation team to the site to assess, clean, stabilize, and safely store ship timbers and other finds from previous field seasons and to consider the problem posed by the dry and brittle coils of rope in Cave 5. In addition, conservator Howard Wellman was able to successfully stabilize and lift part of a disaggregating rope coil from Cave 5.

Documentation
Since January 2005, approximately 100 identifiable ship and boat components have been excavated and studied on site. Several (steering oar blades T1 and T2, hull plank T34) are now curated by the Supreme Council of Antiquities in a display at the Museum of the Sea in Suez. The others were stored in the inner portions of Caves 2 and 3, on the gallery floors.

The AEF grant allowed us to focus much of our attention on preparing more efficient and secure storage shelves in the gallery for these components and to document them by digital images, video, and with drawings prior to storage in a more controlled environment individually tailored to each piece. Photographer Easton Selby also made publication-quality still images of each ship component to complement scale and full-sized drawings and descriptions of individual features and objects (Figure 17).

Many of the timbers were too long and delicate to remove from the gallery, so they had to be photographed in sections and the resulting images digitally composited together. In addition to documenting the timbers, Selby documented the rope cave/gallery, the pottery assemblage for project ceramicist Sally Wallace-Jones, the timber archiving process used by conservator Howard Wellman, and made site record photographs of trenches under excavation, panoramic photographs of the entire site, and general photographs of the excavation and study process. All images totaled approximately 25GB and will be available in different ways to scholars and the public.

The documentation process was extremely important because during our review of all stored timbers, new information was retrieved from several that had received little attention when excavated. One of these, cedar ship’s hull plank T19 was excavated in 2006-2007 from the entry to Cave 2. It has the most damage from marine mollusks yet recorded (8 cm into the plank thickness) and attests to the condition of lower hull planks at the end of some voyages.

Another, made of Nile acacia according to project botanist Rainer Gerisch, is likely the frame of a Type 4 small craft. T117 has a curved outer surface that ends in a flat. Type 4 refers to the unique and relatively thin planks, of native woods or reworked cedar hull planks, joined to one

9 A separate report by conservator Howard Wellman details the work undertaken as a result of this grant.
another with small mortise-and-tenon fastenings and lashings. This discovery expands the range of Type 4 timbers to include hull planks, sheer planks, and a frame.

**WG 32 ship timber stabilization**

As noted in the 2009-2010 report, considerable attention was given to the ship timbers outside the entrance to Cave 6. These seem to have been used as a ramp by ancient Egyptians, and consist of a pair of steering oar blades about 4 m long, along with a range of auxiliary timbers. Stabilization efforts in 2010-2011 focused on providing a plaster casing for these fragile timbers. The wood is both cedar and the white acacia recognized in the pair of blades (T1 and T2) in the entrance of Cave 2, and it is in extremely poor condition. The blades were heavily infested with shipworm in the submerged portion, and there is a very thin layer of wood fragments amongst the mollusk shells and remains of copper ligatures (see 2009-10 report for details).

**New finds**

In WG 70/72/73/76, a number of thin boards and stakes in poor condition were found in the areas immediately adjacent to the north side of the mud-brick building and to the east (T121, T122, T123 and T101). Two factors are primarily responsible for their fragmentary condition: these are thin and narrow sycomore or acacia boards discovered only in a few centimeters of sand below the surface, thus subject to moisture and temperature cycling in addition to insect activity. There is no identifiable maritime purpose for these fragile boards, but they were surrounded by the remains of a windblown mass of cedar wood chips and debitage, as well as the very decayed remains of larger cedar shavings and debitage, suggesting that this area was downwind of a major woodworking activity area.

Excavation in WG 71, in Room 2 of Cave 2, produced wood debitage, including dovetail and trapezoidal tenon fragments, oar loom fragments ca. 6 cm in diameter and often about 45 cm long, and a section of the first piece to be identified with confidence as a spar fragment.

Twenty-four fragments of rope of different types, ranging from 5 to 24 cm in length, were also collected in this excavation unit. The cordage varies in dimension and composition, the two-strand line type is composed of Z-spun yarns and S-twisted strands; the three-strand line is composed of S-spun yarns and Z-twisted strands. According to Ksenija Borojevic and Rebecca Mountain, the material used for making the ropes is papyrus.

**Summary**

The AEF grant from the American Research Center in Egypt permitted us to establish a long-term solution to the storage of ship components in the innermost part of Cave 3 after intensive photo documentation and cataloging. Additional details retrieved from previously excavated timbers add significantly to our data about the small watercraft represented by Type 4 planks. In addition, the maritime team recorded about 20 new planks or timbers and, once again, thousands of fragments of wood debitage from WG 31, WG 64, WG 71 and WG 70/72/73/76.

**4. Pottery**

Sally Wallace-Jones and Maria Imbrenda

Work continued on sorting and recording the ceramic material. Following the usual methodology, the material was washed then sorted by fabric and surface treatment. All the body sherds were examined and all diagnostic sherds were drawn and catalogued. The most significant ceramic items were photographed by Mr. Easton Selby of Coastal Carolina University. The authors gratefully acknowledge his work and the support of a grant from The Antiquities Endowment Fund of ARCE supported by USAID, which made it possible to produce a very thorough photographic archive of
the ceramic finds from the site. Work done this year work confirms the findings of previous years, in that the material continues to date firmly to the Middle Kingdom with a bias towards the 12th Dynasty. There is, however, evidence of material from the early 13th Dynasty, especially in the forms of jar rims in both Marl C and Nile B2 clays which show a transition from shapes typical of the 13th Dynasty into the kettle mouthed form known from the 13th Dynasty (Aston 2005).

A wide range of clays and vessel types continues to be represented at the site. Whilst large storage jars of Marl C and Marl C1 predominate, representing up to 2/3rd of all material, there is also a significant proportion of large marl A3, Nile C and Nile B2 jars and of Nile B2 and B1 cups represented in every context. A typical context contains a mix of large jar material with smaller quantities of sherds from Nile B2 and Nile C bottles, plates and large platters, and fragments of smaller jars and plates of marl A3 and Nile B2. Also present in most contexts but in smaller quantities are bread mold fragments and pieces of small marl A3 bowls. Less frequently represented are forms and fabrics such as Nile B1 and B2 carinated cups, small cookers of marl C and Nile clays. Occasional decorated vessels occur, exclusively in marl A3. There are also some rare pieces of Nile E cooker, and very occasionally special forms such as a tiny, thin walled, vessel of marl A3 found this season, which could resemble the form of a pomegranate. This vessel has a faded and partly broken away inscription in hieratic and appears to be some kind of special vessel possibly for unguents. Also discovered this season was a finely made and finished vessel of marl A2 (an unusual find on this site), with a burnished surface and wheel made ring foot which had been added to a wheel made but hand finished base. This was clearly a vessel of some status. Such vessels seem to be special and may have been personal possessions brought to the site by individuals. Finally, there are the sherds of foreign material which occur infrequently but regularly. Dominant amongst these is the Nubian and Eritrean material, but there is an increasing body of material which is Canaanite and also a few sherds of Minoan material (Wallace-Jones 2008, 2009). Further Canaanite sherds were identified this year from WG 31, SU1.

Two important questions arise from studying the wide range of material present at the site: one being how the distribution of material can illuminate what activities were taking place, and the second being the question of how much material was brought in and whether there was any material being produced in situ. Answering these questions has been a major focus of study this season. The explanation for the wide range of ceramic material present at Wadi Gawasis must be that the site experienced a wide range of uses relating to and in support of its main function as a base for foreign trade. It was necessary to bring in supplies vital to maintain the operation; it was crucial to feed the personnel, to maintain the sea going vessels, to fulfill cult activities and to be prepared for all eventualities. The ceramic material represents all these functions, especially domestic activity. It is also clear that the huge amounts of raw materials required to fulfill the needs generated by each expedition had to be transported to and from the site, and it is equally clear that this was frequently achieved through the use of large jars. Jars found at the site all have very clear and definite rim types, all of which we can now say are well known and documented in the Nile Valley and Delta in the same period, making it very likely that the jars were produced away from the site itself, probably in state controlled workshops, and were brought in as required containing all manner of vital supplies.

The jars themselves came to the site with a primary function as containers and that function almost certainly continued to be their main role, storing and transporting vital raw materials. Jars were probably used and re-used, sometimes even after being broken as we can see from WG 70, A1-2, SU3, which produced over 30 counters which had been re-cut from sherds of Nile B2 jars. It is also common to find sherds which have been reworked and used as fan-shaped or pointed scrapers and there is some evidence that fire-pits might sometimes have been lined with the broken bases of large jars as there are several occurrences of large, blackened jar bases being found at the
bottom of such pits. The effort of getting so much material to so difficult a location meant that nothing could be wasted.

What is interesting is that we can also say with some certainty that the majority of vessel types, other than jars which were present on the site, were also brought into the site, either being provided by the state or in a few cases as prized personal possessions. The large open forms and smaller jars, plates, platters, cups, bowls, and cookers are all of types well know and documented in the Nile Valley, for example at Lisht and Kahun, and they all appear to be made from clay types in use in the Nile Valley during the Middle Kingdom. It is probable that the vast majority of ceramic material at the site, including that used for food preparation and serving, and small items of personal value, were brought to the site from the Nile Valley. The scale of this operation, given the fragility or in some cases size and weight of some of the vessels involved, is hard to imagine. Nevertheless, it appears that the forms and fabrics of the majority of vessels on the site are forms and fabrics which originated in the Nile Valley. So we can be confident that much of the ceramic material was made off site and brought in, even to the extent of bringing huge, heavy plates and small very breakable hemispherical cups.

There is a growing number of small cooking vessels in marl C and Nile B fabrics which show clear evidence of use and heavy smoke staining and which come from contexts with heavy domestic bias, such as WG 70, WG 74 and WG 40. These vessels are too small to have been used for mass catering and growing evidence for their quite extensive presence suggests that some of the site’s inhabitants may have brought or been provided with their own, personal vessels and that food may in some cases have been prepared by individuals or small groups, perhaps in small official subdivisions or work gangs.

Having established that much of the ceramic material is likely to have been imported into the site, the question now arises whether any ceramic material might actually have been produced at the site. This is a very difficult question to answer despite some scanty evidence for a low level of possible ceramic production at WG 19 (Fattovich & Bard 2005-6). The site itself seems to be a very unpromising area for the large-scale production of pottery, which would have required access to a variety of reliable clay sources and considerable, regular supplies of fuel and fresh water, none of which would seem to be readily available. In fact, the question of where clay might have come from is raised as a problem in the initial report on WG 19 (Fattovich & Bard 2003-4). To have produced on site the quantity of ceramic material found to date would have required workshops of industrial scale and there is no evidence of production on this scale. It also seems unlikely that clay and other raw materials would have been brought to the site in order to produce vessels in situ, and this would have had to be the case for the majority of vessels which are indisputably made from marl clays and Nile alluvium and not from local material.

It would certainly seem, therefore, that a significant proportion of material could not have been produced at the site and that vessels were brought in ready-made, in some cases as valuable personal possessions, but more usually for specific often domestic use or as containers for other materials. Even the tubular bread molds which are present in considerable quantity on the site appear to be made in a technique and from a material very similar to that found in the Nile Valley, and although it seems unlikely they may well also have been brought to the site. Tubular bread molds have been a matter for my concern, however, as the loaves produced in them are not of great size and despite the large number of pieces found on the site and in the industrial area around WG 19, where they were initially identified as tuyères (Fattovich & Bard 2003-4), they seem somewhat inadequate for the production of such an important staple as bread on any kind of sensible scale, especially as the molds often have to be broken to release the bread, making them very labor intensive.

It was felt when WG 19/25/26/27 was excavated that it represented an industrial area where ceramic production may have taken place, and I would like to suggest that this is possible but that
the production could have been linked specifically to bread mold manufacture and possibly to bread production rather than general ceramic manufacture. The tubular molds found at WG 19/25/26/27 are described as having been pre-fired and lined with a thin layer of clay, which is much as one would expect from bread molds excavated in other parts of Egypt. However, there are also many examples of tubular bread molds from the site which are made in a coarse, sandy, low fired clay and which often lack the lining of fine clay slip. It is possible that tubular bread molds were stored in this industrial area ready for use and that if and when it became necessary, more bread molds could have been produced on site from local materials, which could have been resourced as required. It would have been difficult to achieve anything other than relatively low firing temperatures in the dump-type kilns suggested by the evidence, but this would have been sufficient for bread mold material. The lining may also have been omitted if technology or resources were limited by the constraints of the site.

Furthermore, I believe that there is evidence that ovens like the one found in WG 17 (Fattovich & Bard 2003-4), which also resembles the evidence found in WG 19, may have been used for bread production rather than for firing clay. In such ovens platters could have been used bases for domed ovens, taking the form of large, very low fired, thick, clay platters, of which there are a number of examples from the site (including some from this year’s excavations). These are often found in association with burnt organic material and in WG 19 it mentions that “of significant interest was a fire-pit with a fragmentary partially fired platter still in situ.” This could have been used for baking rather than firing, the platter being inside the oven not to be fired but to be used as a platform for bread baking. Platters of this type could well have been produced and fired at the site in a very limited way using local clay and very low firing temperatures to produce oven bases, which could then be used for baking large round loaves similar to the eish shamsi produced in Upper Egypt in modern times. Low firing of the platter in WG 17 goes some way to explaining why the bases appears only partially fired, whilst subsequent reheating during baking could explain why the platter had fragmented as a result of thermal shock. This is known to happen to the bases of clay bread ovens of the type used in Egyptian villages, which periodically need to be replaced. It would make good sense to produce such large, fragile items of pottery as locally as possible. Bases could then be replaced as necessary through local production and the ovens could be used over and over again to produce sufficient bread for daily consumption.

The clay used for the platter bases is very low fired and has a reddish to greyish brown color often with a dark gray core. The material is open in texture, softer and more crumbly than is usual in any Nile material. The matrix contains a considerable amount of coarse straw and straw voids in a higgledy-piggledy arrangement. Straw is not always burnt out and pieces up to 4mm in width have been recorded. The clay also contains a considerable amount of rounded sand grains and other mineral particles, including small stones of up to 5-6mm in diameter. Bases are very thick, usually between 6 and 7 cm, and are handmade. The paste is well prepared and the bases are well shaped, made and finished, but the unusual texture of the clay and the low firing do point to the possibility of a local manufacture, whilst the hand-shaping of these items would also eliminate the need to bring specialist equipment such as a wheel to the site. I therefore think that it is possible that some clay production may have been taking place on the site, but with limited technology and resources and for a very specific need. A project for the future will be to look for any possible sources of clay in the local area as it would seem quite possible that clay could have been found in the surrounding wadis.

The pottery from recent excavation continues to add to the picture of varied domestic activity on the site. WG 40 had very clear evidence of this, being a very mixed assemblage of jars, cups and plates in marl C, marl A3, Nile B1 and B2, and especially noteworthy three large Nile C dishes all of diameter over 40 cm and with typical Middle Kingdom technology of scraped exterior bases with red wash on the interior. These three plates, like much of this deposit, showed smoke
blackening and evidence of cooking. The deposit included a number of small blackened marl C cookers, one with a diameter of 10 cm suitable only for one or two portions rather than catering on a large scale. The deposit also contained a piece of Nile D from a small basin with a rolled rim and red wash on the outside. Nile D is almost never seen at Wadi Gawasis.

WG 74 also showed the usual wide range of domestic material from large marl C jars to small Nile B1 and B2 cups. It also included some pieces of large bread platter, as described above, probably of local manufacture. Many vessels showed definite smoke staining from cooking. There was a complete hemispherical bowl in Nile B1 fabric with a shallow profile, which had clearly been scraped too hard by the potter when finishing the exterior of the base. There are obvious signs of a hole which had been patched with wet clay before firing, leaving the potter’s fingerprint and also a small hole remaining in the vessel wall. That the vessel remains whole and intact may be due to the fact that it leaked from first use and was discarded whilst still complete. The assemblage is dated late 12th to early 13th Dynasties on the basis of the range of marl C jar rims present. This context also contained the marl A2 jar referred to above. This was of extremely good technical manufacture with a wheel-made ring foot applied to a rounded scraped base. The exterior of the vessel had been finely burnished and although the top and rim of the vessel were missing, making it difficult to match it to an exact type, it was obvious that this was a very fine piece of pottery in which the new technology using a ring foot was being employed, again suggesting a later Middle Kingdom date.

Other areas of the site which were excavated in 2010-2011, including WG 64, WG 65, WG 71, WG 75 and WG 70/72/73/76, all date to the Middle Kingdom and their material reflects what is known to be representative of the site. A number of pre- and post-firing pot marks were again recorded and these will be the subject of a separate study. One which is of particular interest was incised post-firing and the signs k3 nb mh can be distinguished. Of particular interest amongst the vessel types identified, is a sandy Nile B2 water jar from WG 70, which has a red outer coating and a flared rim and which is of a very typical 12th Dynasty form, and also two pieces of marl A3 vessels with wavy line decoration, one from WG 75 and one from a carinated bowl in WG 71, which has close parallels at Kahun and which was found in association with the type of corrugated rim defined by Bader (Bader 2002) as type 47 and dated to the early 12th Dynasty. This early material in combination with other evidence from the site helps to confirm that the site was occupied over a considerable period of time beginning in the early 12th Dynasty and extending into the 13th, whilst the wide range of material is beginning to show that the ceramics from the site had a huge range of functions and that activities of many types were taking place, especially in the context of food provision, storage and production.

5. Foreign ceramics
Andrea Manzo

Five fragments of foreign ceramics have been recorded in the 2010-1011 field season at Mersa/Wadi Gawasis. They are:

WG 70, D5, SU3; WG 74, SU3: 2 body-sherds of open or slightly closed bowls with roughly parallel incised lines covering the upper part of the body, dark brown or gray ware with organic and mineral inclusions. The fragment from WG 70, D5, SU3, in particular, is burnt on the outside suggesting that the original vessel was used for cooking food (if the burning is not due to post-depositional factors).

Fragments of vessels with this decoration occur in C-Group, Pan-Grave and Kerma assemblages dating to Middle to the early New Kingdom at several sites in Lower Nubia, Upper Nubia and Egypt, and are always interpreted as cooking pots (Hafsaas 2006-2007: 171; Säve-Söderbergh 1989: 17, 19, 262; Welsby Sjöström 2001: 250-253; see also Gratien 1985: 54-55,
2006-2007: 152, 154, 158-159). These vessels have been already found at Mersa/Wadi Gawasis, as well (Manzo 2010, 441-442, Nubian Type 3, Fig. 2c).

Fragments of similar pots also occur in assemblages of the Eritrean-Sudanese lowlands (see e.g. Sadr 1987: 273, Fig. 5, Fig. 10; Sadr 1990: Fig. 5u), and in surface collections from sites AL, ED16, RD14, and RD15 dated to the 2nd millennium BC, the Research Center on the Eastern Desert (CeRDO), Varese, recorded in the Sudanese Eastern Desert. Therefore, these vessels might also be ascribed to Eastern Desert people and might have arrived with the seafaring expeditions to Wadi Gawasis from the Sudanese coast.

WG 31, SU1: 3 fragments of the one bag-shaped jar or bottle decorated with burnished oblique lines on the outside; red-brown ware with red-brown clay and mineral inclusions, wiped red-brown outside surface, smooth inside surface.

A few fragments of similar bottles were recorded in assemblages of phase 1 B at Ma'ayba in the Yemeni Tihama, dating to ca. 1850-1600 BC (Buffa 2007: 64, 140, 169, pl. 60, 228, 251), but this type of bottle is very frequent in the Oba sites of the Hamasien plateau and in proto-historical assemblages at Adulis on the Eritrean coast, where they are sometimes characterized by wiped to scraped surfaces (A. Manzo, personal observation).

6. Wood anatomical identifications and vegetation studies

Rainer Gerisch

Microscopic work was continued on wood and charcoal remains recovered from Middle Kingdom contexts during a stay from December 27, 2010 to January 13, 2011 to gather information for the newly opened trenches and to work on samples that remained unexamined from previous field seasons. By number of pieces, about two-thirds of the charcoal material derived from the current field season, about one-third from the excavations in 2007-2008 and 2009-2010, by volume, three-quarters and one-quarter, respectively. Finds of timber and wood were studied in collaboration with C. Ward and C. Zazzaro. Also, a year after one of the rarely occurring torrential rainfall had affected the area south of Safaga (16 years after the last one had taken place), the favorable situation was used to carry out further botanical investigations in the near-shore courses of Wadi Gasus and Wadi Gawasis.

Results of charcoal identification by field season, Excavation Unit and Stratigraphical Unit

The material comprises 58 samples containing 2,857 pieces with a volume of about 4,400 ml, thereof the wood charcoal recovered in 2010-2011 was examined almost completely until the date of departure. During the current fieldwork, samples came from trenches WG 31, WG 40, WG 69, WG 71, WG 74, WG 75. Anatomical analysis resulted in the identification of 17 woody taxa among which the species *Acacia nilotica*, *Avicennia marina* and *Cedrus libani* dominate in the sample compositions by number of pieces and volume and also show the highest ubiquity values. Together, they occur with the lesser abundant taxa in similar assemblages. The distribution of the number of taxa over the increasing number of charcoal pieces was obtained by simulation. From the 58 samples, a second taxon was identified on average with the 4th charcoal piece, a third with the 8th, the further taxa with piece numbers 15, 16, 34, 65, 75, 165, 206, 421, 493. The last two values were obtained from a single sample each. This relationship possesses approximately a logarithmic character and forms the basis for the statistical determination of the diversity of woody taxa in the material of the site.

The majority of the charcoal remnants came from excavation units WG 31 and WG 70, in which most of the taxa occurred, 11 and 13 respectively. WG 31 was opened along the western

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10 The systematic study of these materials is in progress.
slope of the coral terrace. In SU1, a deposit of windblown sand, many small pieces of wood, burnt mud-brick, and much charcoal were revealed. WG 70 was a test pit in the NE of WG 69, where a number of hearths were recorded. The results of the identifications are listed below.

Additionally, modern charcoal has been collected on the beach of Mersa Gasus, presumably remnants of prefabricated charcoal delivered from the Nile Valley and those of construction wood (pine), to study the recent use of wood and charcoal fuel. Beside the native Nile acacia, identifications revealed a number of foreign plants: representatives of the genera *Casuarina* native to Australia, Southeast Asia, and islands of the western Pacific Ocean, *Eucalyptus* native to Australia, *Citrus* to East and South Asia, *Ficus* native to India, Pakistan, Southeast Asia, tropical Africa, *Morus* (mulberry) native to East and West Asia, *Prunus* to Middle and Southwest Asia and China, and mango (*Mangifera indica*) from India to Burma, which have become common fruit and street trees in Egypt.

Field season 2007-2008:
WG 54 / SU1 (2 spls) / *Acacia nilotica*: 14 pcs, 13 ml, 8.8 (S), *Avicennia marina*: 1 pc, 0.8 ml, 0.4 g (S), *Cedrus libani*: 29 pcs, 75.3 ml, 21.5 g (S), *Faidherbia albida*: 3 pcs, 2.4 ml, 0.8 g (S), *Tamarix sp.*: 1 pc, 0.3 ml, 0.1 g, total: 48 pcs, 91.8 ml, 31.6 g / uncharred, slightly charred: *C. libani*: 22 pcs, 94 ml, 30.1 g (o)11

Field season 2009-2010:
WG 61 / SU46 (1 spl) / *Acacia nilotica*: 275 pcs, 235 ml, 106.8 g (S), *Acacia sp.*: 55 pcs, 42 ml, 23.7 g (S), *Avicennia marina*: 112 pcs, 111.9 ml, 58.9 g (S), *Cedrus libani*: 3 pcs, 2.9 ml, 0.8 g (1-xxx), *Ficus sycomorus*: 1 pc, 0.3 ml, 0.1 g, *Leptadenia pyrotechnica*: 1 pc, 0.3 ml, 0.1 g (S), *Quercus sp.*, deciduous: 1 pc, 2 ml, 0.7 g (S), *Quercus sp.*, evergreen: 1 pc, 0.3 ml, 0.2 g, *Rhizophora/Bruguiera*: 6 pcs, 4.6 ml, 2.3 g (S), *Salix sp.*: 2 pcs, 1.2 ml, 0.1 g, *Suaeda sp.*: 106 pcs, 70.6 ml, 32.1 g (S) (1-xx, 1-xxx), *Tamarix sp.*: 5 pcs, 4.2 ml, 1.6 g, indet.: 11 pcs, 5.5 ml, 3.8 g (S), bark: 1 pc, 0.2 ml, 0.4 g (S), total: 580 pcs, 481 ml, 231.6 g / uncharred, slightly charred: *Suaeda sp.*: 1 pc, 0.8 ml, 0.3 g (x) / *A. nilotica-lomentum* (one segment without seed, charred): 1 pc, 0.1 ml, 0.1 g

WG 65 / SU36 in SU2 (1 spl) / *Acacia nilotica*: 62 pcs, 229.1 ml, 120.6 g (S), *Avicennia marina*: 1 pc, 2 ml, 0.7 g (S), *Cedrus libani*: 2 pcs, 1.9 ml, 0.6 g (S), indet.: 2 pcs, 3.5 ml, 1.9 g, total: 67 pcs, 236.5 ml, 123.8 g

Field season 2010-2011:
WG 31 / SU1 (6 spls) / *Acacia nilotica*: 383 pcs, 416.4 ml, 224.9 (S), *Avicennia marina*: 41 pcs, 55.6 ml, 29.1 g (S), *Calotropis procera*: 2 pcs, 0.5 ml, 0.2 g (S), *Cedrus libani*: 11 pcs, 10.7 ml, 3 g (S), *Faidherbia albida*: 1 pc, 3.5 ml, 2.1 g (S), *Ficus sycomorus*: 71 pcs, 71.8 ml, 20.3 g (S), *Leptadenia pyrotechnica*: 1 pc, 0.3 ml, 0.1 g, total: 341 pcs, 330.5 ml, 157.2 g

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11 Legend: o-uncharred, x-slightly charred, xx-partly charred, xxx-with uncharred traces, (S) salt encrustations present, (W) sample still wet from the excavation.
Cedrus libani: 1 pc, 1.3 ml, 0.6 g, total: 10 pcs, 9.5 ml, 4.6 g

Acacia nilotica: 1 pc, 1.3 ml, 0.6 g, total: 10 pcs, 9.5 ml, 4.6 g

Avicennia marina: 3 pcs, 21 ml, 6 g (S), Salix sp.: 1 pc, 1.5 ml, 0.3 g (S), Suaeda sp.: 2 pcs, 1.8 ml, 0.8 g, total: 26 pcs, 39.3 ml, 16 g

Acacia nilotica: 3 pcs, 13 ml, 12.3 g (S) (2-xx), Suaeda sp.: 5 pcs, 13 ml, 8.6 g (S), Rhizophora/Bruguiera: 11 pcs, 23 ml, 13.3 g (S), total: 19 pcs, 49 ml, 34.2 g

Acacia nilotica: 4 pcs, 4.6 ml, 2.7 g / copper fragments: 2 pcs, 0.4 g (0.6 cm × 0.8 cm × 0.2 cm, 0.2 g; 0.5 cm × 0.8 cm × 0.1 cm, 0.2 g)

Acacia nilotica: 9 pcs, 6.8 ml, 3.4 g, Avicennia marina: 3 pcs, 4.8 ml, 1.6 g (S), Cedrus libani: 5 pcs, 5 ml, 1.4 g, total: 17 pcs, 16.6 ml, 6.4 g

Acacia nilotica: 21 pcs, 43.1 ml, 24.4 g (S), Avicennia marina: 19 pcs, 18.7 ml, 10.8 g (S), Cedrus libani: 35 pcs, 46.1 ml, 13.5 g (S), Faidherbia albida: 1 pc, 0.4 ml, 0.1 g, Ficus sycomorus: 2 pcs, 2 ml, 0.3 g, Leptadenia pyrotechnica: 2 pcs, 2.8 ml, 0.9 g (S), Rhizophora/Bruguiera: 1 pc, 0.8 ml, 0.4 g, Tamarix sp.: 2 pcs, 2.5 ml, 0.9 g, indet.: 1 pc, 0.3 ml, 0.1 g, total: 84 pcs, 116.7 ml, 51.4 g / uncharred, slightly charred: C. libani: 28 pcs, 65 ml, 10.7 g (o)

Avicennia marina: 78 pcs, 160 ml, 98.1 g (S), Cedrus libani: 17 pcs, 46 ml, 17.2 g (S), Diospyros sp.: 1 pc, 0.8 ml, 0.3 g (2 cm × 1 cm × 0.7 cm), Rhizophora/Bruguiera: 34 pcs, 74 ml, 50 g (S), Suaeda sp.: 5 pcs, 13 ml, 7.6 g (S), Tamarix sp.: 3 pcs, 6 ml, 2.6 g, total: 194 pcs, 407.8 ml, 227.9 g

Acacia nilotica: 5 pcs, 5.8 ml, 2.4 g, Avicennia marina: 17 pcs, 5.1 ml, 3.3 g (S), Cedrus libani: 55 pcs, 81.5 ml, 21 g (S), Rhizophora/Bruguiera: 1 pc, 1.4 ml, 0.7 g, Salix sp.: 1 pc, 1.8 ml, 0.5 g (S), Tamarix sp.: 1 pc, 0.7 ml, 0.2 g, total: 80 pcs, 96.3 ml, 28.1 g

Avicennia marina: 180 pcs, 595 ml, 430.4 g (S), Cedrus libani: 31 pcs, 124 ml, 46.5 g (S), Diospyros sp.: 1 pc, 2.2 ml, 1 g (1.9 cm × 1.5 cm × 1.1 cm), Leptadenia pyrotechnica: 2 pcs, 1.8 ml, 0.7 g, Quercus sp., evergreen: 1 pc, 2 ml, 1.2 g (S), Rhizophora/Bruguiera: 66 pcs, 190 ml, 143.4 g (S), Tamarix sp.: 2 pcs, 6.6 ml, 3.2 g (S), Ziziphus spina-christi: 1 pc, 0.9 ml, 0.5 g, indet.: 1 pc, 1.8 ml, 0.6 g, bark: 1 pc, 1.5 ml, 2.3 g, total: 335 pcs, 1,070.8 ml, 706.8 g

Feature 1 (2 pcs) / Acacia nilotica: 1 pc, 0.1 ml, 0.1 g, Avicennia marina: 17 pcs, 1.3 ml, 0.4 g, Cedrus libani: 9 pcs, 3.3 ml, 0.8 g, total: 27 pcs, 4.7 ml, 1.3 g / uncharred, slightly charred: C. libani: 19 pcs, 16 ml, 3.9 g (o)

Avicennia marina: 3 pcs, 3 ml, 1.8 g, Avicennia marina: 3 pcs, 3.3 ml, 1.8 g (S), Cedrus libani: 2 pcs, 1.5 ml, 0.3 g, Ficus sycomorus: 1 pc, 0.4 ml, 0.1 g, Rhizophora/Bruguiera: 1 pc, 1.3 ml, 0.6 g, total: 10 pcs, 9.5 ml, 4.6 g

Rhizophora/Bruguiera: 66 pcs, 190 ml, 143.4 g (S), Tamarix sp.: 2 pcs, 6.6 ml, 3.2 g (S), Ziziphus spina-christi: 1 pc, 0.9 ml, 0.5 g, indet.: 1 pc, 1.8 ml, 0.6 g, bark: 1 pc, 1.5 ml, 2.3 g, total: 335 pcs, 1,070.8 ml, 706.8 g

Feature 1 (2 pcs) / Acacia nilotica: 1 pc, 0.1 ml, 0.1 g, Avicennia marina: 17 pcs, 1.3 ml, 0.4 g, Cedrus libani: 9 pcs, 3.3 ml, 0.8 g, total: 27 pcs, 4.7 ml, 1.3 g / uncharred, slightly charred: C. libani: 19 pcs, 16 ml, 3.9 g (o)

Acacia nilotica: 3 pcs, 3 ml, 1.8 g, Avicennia marina: 3 pcs, 3.3 ml, 1.8 g (S), Cedrus libani: 2 pcs, 1.5 ml, 0.3 g, Ficus sycomorus: 1 pc, 0.4 ml, 0.1 g, Rhizophora/Bruguiera: 1 pc, 1.3 ml, 0.6 g, total: 10 pcs, 9.5 ml, 4.6 g

Acacia nilotica: 1 pc, 1.8 ml, 0.9 g

Acacia nilotica: 1 pc, 0.9 ml, 0.5 g

Acacia nilotica: 19 pcs, 27.7 ml, 12.6 g (S), Avicennia marina: 8 pcs, 10.2 ml, 5.6 g (S), Cedrus libani: 19 pcs, 18.9 ml, 5.7 g, Pinus sp.: 1 pc, 1.8 ml, 0.7 g, Quercus sp.,
evergreen, 2 pcs, 2.2 ml, 1.3 g, *Rhizophora/Bruguiera*: 5 pcs, 3.6 ml, 2 g, *Suaeda* sp.: 1 pc, 4 ml, 1.7 g, *Tamarix* sp.: 1 pc, 9 ml, 3.7 g, total: 56 pcs, 77.4 ml, 33.3 g

WG 73 / SU1 (2 spls) / *Acacia nilotica*: 6 pcs, 3.2 ml, 1.7 g, *Avicennia marina*: 3 pcs, 2.9 ml, 2 g, *Cedrus libani*: 14 pcs, 12.8 ml, 3.7 g, *Leptadenia pyrotechnica*: 2 pcs, 0.7 ml, 0.3 g, *Rhizophora/Bruguiera*: 3 pcs, 1.4 ml, 0.6 g, total: 28 pcs, 21 ml, 8.3 g

SU2 (1 spl) / *Acacia nilotica*: 10 pcs, 39 ml, 25.6 g

SU3 (2 spls) / *Acacia nilotica*: 7 pcs, 6.5 ml, 2.8 g, *Avicennia marina*: 3 pcs, 10 ml, 4.5 g, *Cedrus libani*: 15 pcs, 38 ml, 10.2 g (S), *Ficus sycomorus*: 1 pc, 1.5 ml, 0.6 g (S), *Leptadenia pyrotechnica*: 1 pc, 1.8 ml, 0.5 g, *Rhizophora/Bruguiera*: 14 pcs, 17 ml, 7.4 g (S), *Tamarix* sp.: 1 pc, 1.2 ml, 0.4 g, total: 42 pcs, 76 ml, 26.4 g

WG 74 / SU1 (3 spls) / *Acacia nilotica*: 17 pcs, 52 ml, 39 g, *Avicennia marina*: 12 pcs, 22 ml, 15.9 g, *Cedrus libani*: 3 pcs, 12.5 ml, 3.8 g, *Faidherbia albida*: 1 pc, 7.5 ml, 1.7 g, *Quercus* sp., deciduous: 5 pcs, 16 ml, 12 g, *Rhizophora/Bruguiera*: 2 pcs, 4 ml, 3.1 g, *Tamarix* sp.: 1 pc, 0.5 ml, 0.2 g, total: 41 pcs, 114.5 ml, 75.7 g (1 sample: W)

WG 75 / SU1 (2 spls) / *Acacia nilotica*: 12 pcs, 23.5 ml, 16.5 g (S), *Avicennia marina*: 10 pcs, 9.5 ml, 6.1 g (S), *Cedrus libani*: 8 pcs, 40 ml, 15.9 g (S), *Leptadenia pyrotechnica*: 5 pcs, 9 ml, 4.4 g, total: 35 pcs, 82 ml, 42.9 g / uncharred, slightly charred: *C. libani*: 1 pc, 0.8 ml, 0.1 g (o)

WG no label (2 spls) / *Acacia nilotica*: 3 pcs, 5.2 ml, 3.1 g (S), *Avicennia marina*: 5 pcs, 1.7 ml, 0.7 g, *Cedrus libani*: 5 pcs, 18.5 ml, 4.5 g, total: 13 pcs, 25.4 ml, 8.3 g / uncharred, slightly charred: *C. libani*: 1 pc, 2.2 ml, 0.4 g (o)

Wood finds

The studied desiccated wood (timber, waste wood, wooden items) again comprises material from different field seasons. Samples taken from timbers T99, T100 and T105 were identified as *Acacia nilotica* and from T107 as *Cedrus libani*. Pieces and samples of W960-W967 were designated as *C. libani*, *A. nilotica*, *Faidherbia albida*, *Ficus sycomorus*, and *Tamarix* sp., W1022 as *F. sycomorus*, 46 pieces of wood debris contained in W1024 were identified as *C. libani*. A post uncovered in WG 61 on top of SU55 (2009-2010) was made of wood from *Avicennia marina*. Two complete and one fragmentary lids found in WG 32 (2006-2007) consisted of *C. libani* (SU25, Inv.Nos. 81 and 82) and *F. sycomorus* (SU10, Inv.No. 97).

Vegetation studies

The area between north of Hurghada and Quseir was subject of several botanical publications, among them Kassas and Zahran (1965, 1967) on the vegetation of the coastal land between El-Galala and Hurghada and on the littoral salt marsh, PERSGA (2004) and Saleh (2007) on the mosaic-like relict stands on mangrove formations near Hurghada, Safaga and Quseir. Early botanical collections were carried out by G. Schweinfurth 1865 in the surroundings of Quseir. He visited Wadi Gasus in January 1885 during a journey through the Eastern Desert to record the architectural remains and hieroglyphic inscriptions (Schweinfurth 1885).

The study area can be divided geomorphologically and ecologically into the wadi beds and slopes, runnels, the western and eastern coral terraces, the disturbed littoral salt marshes, and the shoreline, which offer different possibilities for plant growth. After the floods, the situation in both wadis had revealed an uneven picture. While in Wadi Gasus the surface water had formed almost a lake, the water in Wadi Gawasis had drained away relatively quickly and had left a muddy soil (R. Fattovich, personal communication).

The plant cover was recorded in 76 sample plots, 45 in Wadi Gasus and 31 in Wadi Gawasis, ranging from 8 m × 19 m to 30 m × 30 m, according to the method of Braun-Blanquet.

The vegetation in Wadi Gasus was composed of a large number of plants adapted to the dry and salt-rich environment, annual and perennial herbs, low shrubs and shrubs, often well developed...
and flowering. The plant cover of Wadi Gawasis consisted mainly of shrubs and numerous dried low shrubs and showed no greater differences to that of the years before (Figure 18).

Identified were 9 species of halophytic and xerophytic plants belonging to 7 families: Astragalus vogelii (Mimosaceae), Nitraria retusa (Nitrariaceae), Phragmites australis (Poaceae), Reseda pruinosa (Resedaceae), Tamarix nilotica (Tamaricaceae), Zilla spinosa (Brassicaceae), Zygophyllum album, Z. coccineum (Zygophyllaceae), and a member of the Asteraceae family.

Zygophyllum coccineum and Nitraria retusa were dominating in the mouth of the wadis. A large amount of bright green bushes of Z. coccineum was found in Wadi Gasus, while in Wadi Gawasis numerous dried specimens, except of one plant in full foliage, were present. Z. coccineum represents the most widespread Zygophyllum species in Egypt. The low shrub or perennial herb has 2-foliolate succulent leaves and white flowers and is found within the main channels of wadis. N. retusa is a halophytic many-stemmed shrub with fleshy obovate-cuneate leaves and yellowish green flowers. Zilla spinosa is a xerophytic woody perennial with densely dichotomously branches, terminating in spines and with white or violet flowers and occurred as a common associate species. Identified from Wadi Gasus were also Astragalus vogelii, Reseda pruinosa and a member of the Asteraceae family. One specimen of Tamarix nilotica was found in both wadis.

In the disturbed salt marshes and in two runnels on the eastern coral terrace, which slope to the shore, Tamarix nilotica and Zygophyllum album are the most evident features. T. nilotica is a halophytic bush, which can form thickets in the salt marsh or sand hillocks in the deltaic parts of wadis. Associated species in the salt marsh habitat were Z. album, Z. coccineum and Nitraria retusa. Near water-filled depressions in Wadi Gasus, tamarisk bushes occurred together with Phragmites australis. The common reed is a tall perennial grass which has an extensive rhizome system and spreads rapidly. The runnels showed growth of Z. album, which is a widespread halophytic plant along the whole stretch to the Sudanese border. The many-branched low shrub with mealy-pubescent leaves and white flowers has a high salt tolerance and grows mainly at the shoreline.

For the next field season, it is planned to observe how the vitality of the plants has changed in Wadi Gasus and to extend the studies to further wadis in the vicinity of the excavation site.

7. Paleoethnobotany
Ksenija Borjevic, Rebecca Mountain

More than 40 paleoethnobotanical and micromorphological samples from various features were analyzed in detail at the laboratory facilities at the Coral Sun Beach Resort.

The volume of sediment samples collected for macroplant analysis was measured with graduated beakers. In four large samples, subsamples were taken and the rest of the samples were only scanned and could not be further analyzed because of a lack of time. The samples were dry sieved through four geological sieves (apertures 4.00–0.25 mm). Various categories of the recovered material, including small rocks and ceramics were separated from the plant material that was then sorted into the wood charcoal and other macroplant material that was further identified to the most precise taxon. Plant material from sieves larger than 2 mm was analyzed entirely, while material from sieves smaller than 2 mm was either analyzed entirely or, in the case of four larger samples, a subsample from the fraction smaller than 2 mm was analyzed and the counts and volumes were then extrapolated as if the whole fraction of the sample was analyzed and added to the totals for the particular sample. Wood charcoal pieces were not counted, only the volume of total pieces larger than 2 mm was recorded in milliliters. Counting numerous barley grains and fragments represented a challenge, and often the number of grains had to be extrapolated from a volume of grains based on the count of 100 grains from a particular sieve fraction. In many instances, the grains were stuck together in lumps or to pieces of wood charcoal because of salinization processes. In other cases, barley grains and fragments were stuck together because of
the carbonization process or perhaps because of cooking, e.g., “kasha lumps.” A number of cereal grain fragments seemed to have been charred after being ground (i.e., “bulgur” fragments). In most cases, the fragmentation of grains was due to post-depositional processes. To make the results of the plant analysis among samples and features comparable, the density was computed for each of the fire-pits for plant taxa. The quantity of recovered specimens (count or milliliter for wood charcoal) was divided by the volume (in liters) of sediment from the sample. The identification was based on the morphological characteristics of plant remains identified with a microscope at the site and later from photographs taken during the analysis. The samples were analyzed for each SU unit and feature separately. Botanical material from Fire-pits 14 and 15 was retrieved and analyzed separately and according to the microstratigraphic excavation layers (described above).

Results

N=number of samples taken and analyzed
Vol. (volume of sediment/sand dry screened) ml

WG 65 (SU36) Fire-pit 15
N=15
Vol.=5194 ml

A total of 15 samples was analyzed from this feature. The feature in WG 65, Fire-pit 15 (C3 SU 36 in SU 2) was initially discovered at the end of the excavation season in 2009-2010. The top sand layer was mixed with charred hulled barley seeds, cedar wood charcoal chips, mangrove twigs, small fiber particles, uncharred mangrove leaves, twigs, other blown-in leaf fragments, and desiccated barley chaff.

Layer 1
N=8
Vol.=4530ml
Hand-picked=1

Initially four samples from this top layer were collected in 2010 and analyzed together with the remaining four samples in 2011 (a total of 4530 ml of sediment). Larger pieces of wood charcoal (WG 65, Fire-pit 15, C3 SU 36 in SU 2) consisted of chunks of cedar tree refuse from boat repairs, some of which were clearly infested by pests prior to being used for fuel. Many charcoal pieces were from locally available mangrove twigs (for wood see the report by Rainer Gerisch).

A large sample, #3 (5000 ml of sediment), taken in 2010 from the top layer next to the western brick wall, contained a large quantity of charred barley grains. A subsample of 250 ml (from 5000 ml) was analyzed in which 339 barley grains were recovered in addition to 52 bulgur grain fragments (Figures 19 and 20).

In 2011, four more samples from the same northwest area of Fire-pit 15, where a concentration of charred barley grains was initially noticed in 2010, were collected and analyzed. The highest concentration of charred barley grains was from two samples, ca. 30 cm east of the west wall. Samples were taken from the surface to the depth of 6.5–8 cm (points 1, 2, 10). From Sample #7 (400 ml sediment), ca. 100 ml of wood charcoal was recovered. Most of the wood was cedar. An 8-cm-long piece was partially burnt. The majority of the sample consisted of barley grains (140 ml); most of the grains were fragmented. The total of barley grains, including the whole ones and fragmented ones extrapolated to whole grains based on weight, comes to 2735 whole grains (a density of 6837 barely grains per liter of sediment). Among the fragments, an additional 17 were identified as bulgur. From Sample #8 (1600 ml of sediment), 300 ml of wood charcoal consisted mostly of cedar chips larger than 4 mm. Barley grains were also abundant (650 ml) and were extrapolated to 9860 whole barley grains (a density 6162 grain per liter of sediment). In this
sample, 22 bulgur fragments and a grain of emmer (*Triticum dicoccum*) grain were found. No barley chaff was recovered. The remainder of the samples consisted of rocks and sand.

Layer 2

N=1
Vol.=100 ml

Sample #9 (100 ml) was the only sample taken from this 5-cm-thick layer in the southern part of the feature. Only 25 ml of wood charcoal was recovered; it contained pieces of cedar and mangrove. Barley grains (44) were poorly preserved. The condition of the grains is much worse than those from Layer 1.

Layers 3 and 4

N=1 sample

A sample (#11) was taken from the two layers; Layer 3, which consisted of a 1- to 3-cm-thick layer of very hard, dark gray cemented ashes that contained few if any seeds, and from Layer 4, which consisted of light gray ashes and slightly cemented and charred material mixed with sand. It was impossible to determine a volume or to analyze the cemented samples.

Layer 5

N=1
Vol.=31 ml

Two small samples were taken from the south central part of the feature. The layer consisted of few plant remains, mostly unburnt barley chaff and small charred barley fragments, and sand. Sample #12 (30 ml) contained one piece of burnt mangrove and one piece of unburnt mangrove tree. Of 11 recovered barley grains, two were still in chaff and two were badly burnt. Nine chaff fragments were identified, and seven were unburnt. One of grain of uncharred barley spikelets seemed to have a sprouted root, and one charred barley grain had an impression from a growing sprout (coleoptile) (Figure 20). Sample #13 was a small burnt cluster of melted barley grains.

Layer 6 and 7

N=2
Vol=533 ml

The two samples from these layers consisted of burnt and unburnt plant remains, some rocks, and three potsherds. A single small sample was analyzed from Layer 6 (33 ml), toward the eastern edge of the southern part of the feature that contained six remains of unburnt barley chaff and one bud of a mangrove leaf. Sample #15 is from Layers 6 and 7 from the southeast corner of the feature. A subsample of 500 ml (from 1600 ml) was analyzed entirely and was dominated by unburnt barley chaff (an estimated 347 fragments), 45 charred barley grains, and 20 ml of wood.

In sum, Fire-pit 15 is dominated by a large number of hulled barley grains and fragments (*Hordeum vulgare*) in the upper layers. Extrapolated to whole grains, there were 13,600 grains. Although the total number and the density of 2618 barley grains per liter of sieved sediment is impressive, the total volume of barley grains from Fire-pit 14 is ca. 700 ml (from 5000 ml of sediment). The amount of barley chaff remains from Layer 1 that contained the most of charred grains is very small. Chaff was mostly desiccated (unburnt), and the remains were more numerous in the deeper deposits in the area toward the eastern corner in Layers 6 and 7 where fewer charred barley grains were found. No weed seeds or fruit remains were found. More unburnt barley chaff was found in the adjacent unit WG 61 (reported in 2009–2010). The fire-pit was supported by bricks in the southern part, and only sporadic plant remains were found south of the wall. A hand-picked sample was collected from the surface from WG 65, A4-5, SU46 in 2010, and it contained *Acacia nilotica* pod segments (3), a garlic root (1), and a small fig fruit (1).

WG 65 (SU35), Fire-pit 14

N=9
Vol.=2132 ml
Fire-pit 14 was excavated after Fire-pit 15 and was also partially excavated. The microstratigraphic removal of sediments was carried out in two areas (blocks) of the feature: 1) the southeast corner (ca. 20 x 20 x 20 cm), and 2) the eastern part of the wall (ca. 20 x 30 x 35 cm). There were three rows of sandy-mud bricks (each brick was ca. 23 x 11 x 8 cm). The bricks were on the top of the sand layer, and below this layer there was a dissected vegetation layer. Most bricks were left in place, but the bricks in the middle of the preserved eastern wall of Fire-pit 14 were removed (Figure 5). The sand layer was reached 35 cm below the datum at the eastern part of the wall, and it was the lowest excavated point in SU35. The thickness and the distribution of layers between the two areas of this feature varied to a degree. Nine samples were taken from Fire-pit 14 (initially Fire-pit 15A), a total of 2132 ml of sediment.

Layers 1a and 1b
N=4
Vol.= 957 ml

From these two layers four samples were taken and analyzed. Sample #17 (500 ml) from the eastern section consisted of encrusted ashes and wood (Layer 1a). Wood charcoal (32 ml) was recovered together with a lump of charred barley (5–10 mm in diameter, ca. 17 barley grains) (Figure 20).

Sample #23 (300 ml volume) in the eastern section was from below the desiccated vegetation (Layer 3) that was above the lower bottom layer of bricks. The sample was brownish in color and perhaps represents dispersal of deposits of Layer 1b in this area. It was the most prolific sample from this feature, yielding 88 plant specimens. Some of the barley grains in this sample were badly burnt, while others were unburnt or partially charred, and two barley grains were still in their husks. The sample contained a small but almost equal number of barley chaff remains and grains.

Samples #18 (200 ml) and #19 (225 ml) from the southeast corner contained a few barley grains and bulgar fragments and several charred pieces of a string. Sample #24 (100 ml) from the southeast corner contained a few barley grains and fragments and two pea (cf. *Pisum sativum*) seeds (3–4 mm in diameter).

Layer 3
N=2
Vol.=550 ml

This layer of desiccated, blown-in vegetation was composed mainly of grass-type leaves accumulated toward the eastern part of the wall where it was 5 cm thick. Overall, a very small quantity of charred plant material was recovered compared to the amount of dissected plant material recovered. Two samples were collected: Sample #21 (400 ml) and #22 (150 ml). Of the 150 ml sample, ca. 75 ml was desiccated vegetation in addition to a few barley grains and fragments, including a few bulgar fragments. A total of 20 barley grains, an additional 20 grains stuck together in lumps, and 64 fragments were recovered from the total of nine samples. The barley grains were badly burnt. The remains of barley chaff, including two rachises (total of 30 specimens, both unburnt and burnt) were preserved. A total of 21 bulgur grain fragments were identified.

**Discussion**

Fire-pits 14 and 15, although adjacent and very similar, seem to have different histories of use. The different preservation of remains of the same plants (barley grains are mostly charred and chaff mostly desiccated) demonstrates different episodes and taphonomic process taking place in the features. It is likely that the desiccated plant remains were blown in after the fire cooled down and before they were covered with another layer of sand or the salt crust.

Fire-pit 14 has a fewer layers and significantly less charred material. The botanical material is more mixed, and it contains highly processed (burnt) barley grains, uncharred barely chaff, two
charred pea seeds, dissected blown-in vegetation, and insect remains. Fire-pit 15 has a large concentration of the barley grains that are concentrated on the top and seem to be one of the last episodes of the use of the fire-pit. The amount of barley grains in Fire-pit 14 seems to be a spill from Fire-pit 15 mixed with some kind of a burn refuse. A significant amount of wood charcoal, primarily of cedar and mangrove tree, and other pieces of burnt organic material testify to the use of various fuels.

In Fire-pit 15, a total of 13,600 barley grains have been identified, 98 bulgur fragments, 375 barely chaff remains, and 3 barley rachises. Although the total number and density, 2618 barley of grains per liter of sieved sediment, is impressive, the total volume of barely grains from Fire-pit 15 is ca. 700 ml (from 5000 ml analyzed sediment). This amount of grain is less than 1 kg of barley. There were certainly more grains that were not recovered through sampling, and more that have eroded in the recent and more distant past, but the quantity of barley is still not representative of a type of storage place consumed in a fire, but rather of a smaller quantity of barley, perhaps brought in a bag. Remains of burnt plant fibers were found in the fire-pits. A twined bag (60 × 45 cm large) was found in Cave 2, similar to the ones used for carrying wheat and barley presented in the agricultural scenes in tombs (see Wendrich 2000: 262, Fig. 10.8d). In such a bag a quantity of barley grains larger than the one estimated of the charred barely grains found in the fire-pits could have been carried. The question remains of why the barley was burnt.

The grains of barley (*Hordeum vulgare*) found in Fire-pits 14 and 15 are of the hulled type and are symmetrical, characteristic of 2-row barley. Not many asymmetrical seeds, which are typically present in 6-row barely varieties, were found. The chaff (lemma and palea) of barley is tightly attached to the surface of barley grains. There was proportionally very little charred chaff found and no weed seeds or straw, indicating that the charred barley must have been sieved and then cleaned of contaminants before it was charred. There was a relatively small amount of barley grains that were processed, i.e., bulgur prior to charring, evidenced by characteristic bulging of the surface in the fracture (see Figure 20). Proportionally, the bulgur fragments were not numerous in comparison to the whole seeds or the ones that were fragmented as a consequence of post-depositional processes. The bulgur fragments were not generally small and did not have discernable shiny fracture surfaces, characteristic of bulgur that was well ground and soaked in water prior to charring at low temperatures (Valamoti 2002, Valamoti et al. 2008). The barley grains were not sprouted either, except for perhaps two instances from a sample from Fire-pit 15, Layer 5. The whole barley assemblage from Fire-pit 15 indicates activities associated with the processing of barley grains and perhaps of dehusking hulled grains, when the whole quantity of barley was accidentally burnt. It is possible that several scoops of hulled barley grains, after being cleaned of contaminants, were heated to be dehusked or pounded in a mortar with a little water to shear off the thin barley husks without crushing the grains, thus relatively few bulgur fragments were found. Drying or heating of the hulled barley grains close to the fire could have led to accidental burning of barley in the Fire-pit 15, ca. 3875 years ago. It is impossible to deduce the intentions of the ancient Egyptians regarding the barley, but the dehusking of barley would have been necessary before consumption, e.g., for making porridge. But the ancient Egyptians may have been planning to brew beer (using one part of unsprouted grain); the one part of grain that got accidently charred. Dehusked grain would have been later mixed with sprouted grains (that were not exposed to fire and thus not preserved). The whole process of grinding hulled cereals and beer brewing using two batches of grain was experimentally documented based on archaeological evidence from the New Kingdom by Samuel (see publications of Delwen Samuel12). Beer jars and storage jars have been recovered at the site of Mersa/Wadi Gawasis.

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12 Delwen Samuel’s papers are posted on http://www.ancientgrains.org/html/delwen_s_papers.html
Archaeobotanical analysis from units WG 70/72/73, WG 26, WG 40, WG 61, and T64

WG 26, C5, SU72
N=1
Vol.=500 ml
Sample #26 (500 ml) collected in 2009-2010, contained very little wood charcoal, two barley grain fragments, a fragment of a small bulb, five unidentified fragments, and two fish vertebra, and possibly a fish tooth.

WG 31, SU1
Hand-picked =1
A sample from 2009-2010 containing a type of unidentified “capsule” without internal divisions, identical to the one found in WG 55, C2, SU2 (reported in 2010), was recorded in addition to two small fig fruits.

WG 40, SU1
Hand-picked=1
Two dom palm endocarps were hand-picked (see Figure 2).

WG 61 E4-5 SU 46, DE 2-3 SU 45, SU 46
N=6
Vol.=30
Hand-picked=5
These samples were hand-picked at the end of the 2009-2010 field season. The results of botanical finds from WG 61 have been reported in the 2010 report, when nine samples were analyzed. The entire unit is characterized by the abundance of dissected botanical remains, which include fruits, reeds, grass remains, garlic rootlets, acacia pods, barley chaff, and others remains (see Bard & Fattovich 2010c). From the six additional samples analyzed in 2011, no new plant remains were found except for a small fruit, ca. 1 cm, in diameter, possibly a juniper berry. Desiccated remains of a whole garlic head including cloves and skin were also found in addition to the rootlets. Another unknown whole seed/fruit, identical to ones from WG 55, D1-2, SU3, was found in this unit.

WG 70, C1, B1/C1, Feature 1
N=3
Vol.=1385 ml
From WG 70, C1, B1/C1, and Feature 1, a total of three samples (1385 ml sediment) were analyzed. From WG 70, C1, a dark burnt layer on top of a red concentration, contained visible plant remains. The sample also contained sea shells (some pierced); insect encasings, some of which were burnt; and a small fragment of burnt and of unburned animal bone (Figure 21). Sample #25 (525 ml) from the upper part of the layer consisted of a few wood charcoal pieces (21 ml), several whole charred barley grains (21), a few bulgur fragments and kasha lumps, and a large number of barley fragments (330). The barley fragments from WG 70 were more badly burnt than those from Fire-pit 15, indicating that they were exposed to higher temperatures and perhaps represent a refuse of burning during cooking.

WG 73, A-B4, SU1
Hand-picked=1
One whole, uncharred dom palm fruit was hand picked (see Figure 22).

T64 (under)
N=1
Vol.=680 ml
A relatively large quantity of uncharred hollow barley (*Hordeum vulgare*) spikelets, many with holes, was found in this sample, a testimony of grain infestation by insects (Figure 23).
**Plant fiber material analysis (R. Mountain and K. Borojevic)**

During the Mersa/Wadi Gawasis 2010–2011 field season, in addition to the macrobotanical remains, plant fiber artifacts such as rope, matting, and raw plant leaves and stems were analyzed. Seventeen samples of botanical fiber artifacts from four separate excavation units were identified. Four samples came from the large rope coils in Cave 5; each sample came from a different coil. A large reed fragment was collected from WG 65, Fire-pit 14, and 10 samples from a pile of several mats were collected from WG 40 and its extension. Two samples were also collected from WG 64, A1-B1, SU3, which is located inside Cave 2: a fragment of some frayed plant material and a sample from a large assemblage of raw plant stems and leaves.

The species of fibrous plant was determined by first creating longitudinal thin sections of each sample using a razor blade and then mounting the section on a glass slide and examining it with a compound microscope (100× to 400×). The species were identified by the unique epidermal cell patterns visible in the thin sections. The results of the botanical fiber analysis are given in Table 3 and are discussed below by the excavation units from which the samples were taken.

**Cave 5**

Samples from four distinct rope coils from separate locations within the cave were taken in Cave 5 in order to determine if all of the coils were constructed from the same plant species. All four samples were identified as *Cyperus papyrus* (papyrus), suggesting that all of the coils were constructed from the same material.

**WG 40 and its northern extension**

During the 2010–2011 field season, fragments of matting were discovered in the northern wall of WG 40, and the excavation unit was therefore extended, revealing a large pile of approximately five mats. Samples from different elements of the five mats were analyzed as was a gauze fragment and a small rope fragment recovered within the pile of mats (Figure 24). The gauze was identified as *Linum usitatissimum* (flax/linen) and the rope fragment as *Imperata cylindrica* (halfa grass). For organizational purposes, the mats were labeled A through E, based on their location in the pile in descending order. Most of the mats were constructed with either a weaving or twining method, with the exception of Mat B. Mat A’s interior and border fibers were identified as *Desmostachya bipinnata* (halfa grass). Mat B displayed a plaited construction pattern unlike the other woven and twined mats. It was constructed from *Hyphaeneae thebeica* (dom palm) leaves. Mat C’s interior and border fibers appear to be constructed out of *Desmostachya bipinnata*, although the mat’s binding rope was badly degraded, making identification difficult. Mat D was finer than the others and was identified as *Desmostachya bipinnata*; the lowest mat, Mat E, appeared to have been made from *Desmostachya bipinnata*, but the fibers were very degraded.

**WG 64, A1-B1, SU3 (Cave 2)**

A sample of frayed plant material recovered from this unit was identified as a degraded piece of *Phoenix dactylifera* (date palm) leaf. A few brush-like stems and leaves of raw plant material were recovered in Cave 3 in previous field seasons, and in the 2010–2011 season, a large assemblage of these “brush” stems and sheathes were recovered in WG 64, A1-B1, SU3. They appeared to have been used as some kind of matting or flooring. The plants were identified as *Imperata cylindrica*.

**WG 65, Fire-pit 14**

A large hollow reed fragment with a prominent node was recovered from this unit. The reed was identified as *Arundo donax* (giant reed).

**Conclusion**
Four additional samples taken from different rope coils from Cave 5 (the “Rope Cave”) were all made from papyrus (Cyperus papyrus), confirming the previous identification of the authors that the large ropes were made of papyrus. Cyperus papyrus is native to the Nile Valley and did not grow along the Red Sea or anywhere near the site of Mersa/Wadi Gawasis in antiquity. It is more likely that the expedition members brought the large papyrus ropes found in Cave 5 with them from the Nile Valley rather than bringing raw papyrus stalks to construct the ropes at the site. Rope making on this scale requires some specialized processing and equipment, of which no evidence has been found so far at Mersa/Wadi Gawasis.

Both of the most common reed species, Phragmites australis and Arundo donax, grow near the site of Mersa/Wadi Gawasis and also did so in antiquity. While the intended use of the reed fragment found in WG 65 is unknown, it was likely harvested from nearby.

The majority of the mats and the small rope fragment in WG 40 were made from halfa grasses, Desmostachya bipinnata or Imperata cylindrica, both of which grow in the wadis near the site. It is also possible that Hyphaneae thebeica (dom palm) grew around the Red Sea area in antiquity, and therefore all of the mats could have been made from locally available material. A number of dom palm fruits have already been found at the site. The linen gauze fragment item (made of flax fibers) was brought from the Nile Valley because flax does not grow along the Red Sea and needs water for processing (retting). Many of the same type of linen fragments have been found around the site in previous field seasons. The pile of the mats accumulated in WG 40 adjacent to the coral terrace resembles huts made from mats by present-day nomadic tribes in southern Egypt. The plaited technique has only been reported from New Kingdom sites (Cappers 2006: Fig. 3.3).

Both of the samples from WG 64 come from apparently unprocessed plant material. The frayed date palm leaf material probably came from some other artifact, such as a mat. As mentioned previously, Imperata cylindrica grows locally in the wadis along the Red Sea, and therefore the leaves and stems used as flooring in WG 64 could have been harvested locally.

Summary and Conclusions
Mersa/Wadi Gawasis provides an exceptional opportunity to study ancient Egyptian botanical remains because of the excellent preservation of the organics at the site. Analysis of the plant remains from the 2010–2011 field season has revealed the usual repertoire of charred and desiccated remains previously identified at the site. The new plant species discovered at the site are two legume seeds, most likely of pea (cf. Pisum sativum), and a fruit, possibly a juniper berry (cf. Juniperus sp.). The large concentration of charred barley grains (Hordeum vulgare) discovered in WG 65, Fire-pits 14 and 15 is a result of the accidental burning of barley, perhaps during dehusking of the spikelets and preparing them for a porridge or beer brewing. It is the last episode of burning in Fire-pit 15. Microstratigraphic excavation and geological analysis have revealed that both fire-pits have different life histories and exhibit multiple episodes of uses and abandonment. Cereals, probably in spikelets, together with other supplies must have been brought from the Nile Valley and were further processed at the site.

Artifacts, such as the large rope coils in Cave 5, were made of papyrus and were also brought from the Nile Valley. The set of mats found in WG 40, made from the twining of halfa grasses, and a mat of plaited dom palm leaves, could have been made of locally available resources unless the were brought together with other supplies from the Nile Valley. The pile of mats resembles a collapsed tent-like structure made by modern nomads in Egypt and could have been made as an additional shelter adjacent to the caves. The analysis of the plants provides vital information about different activities and ancient plant uses taking place in the ancient harbor of Mersa/Wadi Gawasis ca. 3850-3875 years ago.
8. Conservation
Howard Wellman

Introduction
Howard Wellman of Wellman Conservation LLC, assisted by Caroline Jacoby, arrived at the Wadi Gawasis site December 27, 2010. Conservation work in this field season was funded by a grant from the American Research Center in Egypt (ARCE). The conservation brief for this excavation season was to assist maritime archaeologist Dr. Cheryl Ward with:

1) The preservation and storage of timbers excavated in previous seasons (Figure 25),
2) An attempt to lift a coil of rope from Cave 5,
3) To continue preservation of the steering oars (T72, etc.) located at the mouth of Cave 6.

Environmental Monitoring
The HOBO-brand (Onset Computer Corp.) environmental data loggers left in Caves 2, 3, and 5 in January 2010 were retrieved and downloaded. They had collected temperature and relative humidity (RH) information at ½ hour intervals for the entire year. The data collected from January to December 2010 confirm observations reported in the 2009-2010 conservation report. Temperatures in the cave follow the exterior temperature closely as the shallow rock strata transmit solar heat to the interior spaces. The bulk of the rock, especially in spaces with minimal air exchange with the exterior, help maintain a steady RH that stays within a range generally acceptable for the maintenance of organic artifacts.

1) At the mouth of Cave 2: temperature annual maximum 37°C, minimum 18°C; Relative Humidity (RH) annual maximum 70%, minimum 15%, daily variation approximately +/- 10% (Figure 26),
2) Rear of Cave 3: temperature annual maximum 31°C, minimum 25°C; RH annual maximum 56%, minimum 26%, daily variation approximately +/- 5% (Figure 27),
3) Cave 5 (“Rope Cave,” sealed): temperature annual maximum 31°C, minimum 27°C; RH annual maximum 50%, minimum 45%, daily variation approximately 1% (Figure 28).

The three data loggers were relaunched and placed in Cave 3 with the stored timbers to monitor the different conditions in the storage area: one left on the open shelf, one sealed in an Escal bag (no oxygen scavenger), and one in a loosely clipped bag (like most of the timbers at present).

Storage of Timbers
Based on research and testing in the 2009-2010 field season, it had been determined that the best storage regime for the WG timbers would be to seal them in impermeable bags with an oxygen scavenger and humidity buffer (Figure 29). The bagged timbers would then be placed on shelving units inside the WG caves, where the relatively stable ambient cave climate would provide an extra level of protection.

The anoxic bagging system chosen was the RP System by Mitsubishi Gas Co. This consists of an Escal bag (polyethylene film with vacuum-deposited ceramic layer) and the proprietary RPS-K oxygen scavenger with humidity buffer. The bag provides physical protection from dust, handling, and insect infestation (silver fish were observed in the cave). The transparent bag allows visual inspection of the enclosed timbers for conservation or research purposes. The oxygen scavenger reduces the rate of organic decay by inhibiting fungal growth and insect activity. The humidity buffer reduces the annual swings in humidity levels. Reducing the humidity swings reduces fungal activity, salt crystal growth and dissolution, and the annual cycle of cellular swelling and shrinkage (Figure 30).

Shelves were constructed in Cave 3 by a local workman with pine lumber (Figure 31).
On-site, a handling protocol was developed in coordination with the archaeologists and photographer:

1) Each timber was gently cleaned with natural bristle brushes and puffer bulbs to remove dust, frass, and other foreign material,

2) Each timber was put on a luan plywood support and tied down with cotton gauze strips,

3) The timber was then put into a custom-fit Escal bag (labels were written on the inside and outside surfaces of each bag to supplement the object labels) and loosely clipped shut,

4) Timbers were given additional examination as needed by the archaeologists,

5) Each timber was photographed and videoed by the photographer,

6) Once all exams and photos were completed, the RP packets were inserted in the bags and they were sealed with a heated tacking iron. Because all of the RP packets did not arrive on site due to shipping problems, only four timbers were sealed and completed. Other timbers were shelved with the bags folded and clipped shut.

7) The bagged timber was placed on a shelf, and the location recorded.

**Future Recommendations**

The unsealed bags should be processed to add the scavenger and properly seal them for long-term preservation. This will take less than one week of labor.

**Treatment of Rope Coil**

Based on field laboratory experiments in the 2009–2010 excavation season, a section of coiled rope was identified for further treatment in Cave 5. Coil 18 (nearest the door and previously suffering damage from people moving inside the cave) was chosen. A scaled sketch and several photographs were taken to document the coil, and then loose surface material was removed by the conservator. Cyclododecane was melted on site with a small electric hot-plate and applied to the rope surface by dropper, spoon, or poured from an adapted coffee-pot. Initial tests showed that significant consolidation could be achieved by applying minimal cyclododecane to the spaces between the rope yarns. Larger volumes of consolidant poured into the coil penetrated more deeply, bonding lengths of rope within the coil together. Using approximately one kilogram of cyclododecane, it was possible to solidify and remove as one unit a “tangle” of rope sitting on top of the greater bulk of coil 18.

The remainder of the cyclododecane on hand was used to consolidate the ends and faces of the rope coils nearest the doorway to Cave 5 that have suffered erosion from visitors.

This test-lift satisfied the archaeologists and conservator that using this technique, a full coil of rope could probably be lifted safely. This, however, begs the further question of what would happen next, and whether a coil should be lifted just because it is possible. We therefore recommend that no further conservation or attempts to remove a rope coil be done until a full conservation plan has been written that considers at a minimum the following criteria:

1) Site access (working space inside the cave) by at least two conservators and protection of adjacent rope coils,

   a. This would involve building a bridge or gantry-way to allow two conservators to climb over adjacent coils and work on the coil selected.

2) Time and materials needed for temporary consolidation,

   a. At least 10 kilograms of cyclododecane and several days of conservation work, not including the construction of protective walk-ways noted above.

3) Location of conservation facility for full conservation of rope post-lifting and planning of treatment options to include at least:

   a. Fumigation to kill silverfish infestation

   b. Cleaning
c. Consolidation
d. Mounting and support,
4) Creation of climate-controlled storage and display setting,
5) Plan for long-term monitoring and assessment.

Future Recommendations
Access to Cave 5 should be tightly controlled to prevent future damage to the extremely fragile coils of rope. The consolidants applied in 2011 should be monitored and re-applied as necessary. If authorities insist that a coil be lifted for research or display reasons, a full conservation plan as outlined above must be developed before any actions are taken.

Protection of timbers in-situ
In the 2009-2010 field season, the steering oar timbers in front of Cave 6 were partially conserved as their salt concretion shells were removed for documentation. The treatment involved consolidation with Butvar B-98 in ethanol, followed by the application of a cotton gauze facing adhered with Acryloid B-72 in acetone. The timbers were then reburied at the end of the field season.

In January 2011, the steering oars were uncovered and reexamined. The facings were still intact, but the consolidated tip of T72 was broken loose from the rest of the timber, which was still covered by its concretion. This fragment was given a hard jacket of gauze bandages impregnated with plaster of Paris with barrier layers of polyethylene film and aluminum foil, then pedestalled on burial sand and a supporting plank was slid underneath it. The fragment was then flipped over and examined. The timber is very badly fragmented due to rot and insect damage. The consolidation in 2009-2010 did not penetrate through the entire timber and the under-surface was very fragile and friable. The surface was cleaned of sand and foreign material, and a plaster of Paris base was prepared in the same fashion as the upper jacket. The timber fragment was then bagged and shelved with the other timbers.

The rest of the oar assemblage was examined. The other timbers were more solid than T72, but still fragile. It is our recommendation that these timbers cannot be lifted intact. Lifting, even with additional conservation and consolidation in situ, will cause the timbers to break into many smaller fragments. In consultation with Dr. Ward, we determined that reburial with a protective shell would be the best option at this time. As described above, a hard jacket of plaster of Paris bandages was applied over barrier layers of plastic film and aluminum foil. The timbers were then reburied under 0.5 meters of sand.

References


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