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Recent Research on the "Carnegie Boat" from Dahshur, Egypt

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While Andrew Carnegie was seeking world-class objects of natural history and material culture to fill his new museum as part of the Carnegie Institute in Pittsburgh, Pennsylvania, Jacques de Morgan made a fantastic discovery in the 1894–95 season at Senwosret III's pyramid complex at Dahshur: funerary boat burials associated with a vaulted boat building.[1] From the time of their discovery, De Morgan's contradictory reporting (during the infancy of modern archaeology) has resulted in confusion over even the most basic information. For instance, one excavation report indicated six boats were found, while only five were represented in its plan, and several other reports document five boats were found.[2] Additionally, De Morgan noted he was not able to excavate all five (or six) boats during his primary season, and until 1985, the whereabouts of only three of the boats were known to the scholarly community: two in the Egyptian Museum in Cairo (CG 4925 and CG 4926) and one in the Field Museum of Natural History in Chicago, Illinois (acc. 1842). Through research carried out for an Egyptian installation at the Carnegie Museum of Natural History (CMNH) in the Walton Hall of Ancient Egypt, the boat in the museum's collection (acc. 1842-1) was identified as a fourth boat coming from Dahshur (Fig. 1).[3] The existence and location of the fifth boat is still a mystery, despite recent geophysical survey and search with ground-penetrating radar at Dahshur.[4] While it remains that much primary and contextual information was lost that would greatly improve our understanding, this research note demonstrates continued research of objects in historic museum collections, such as the Carnegie boat, can yield new and exciting scientific and historic information.

Between 1975 and 1989, the Carnegie boat was dismantled and researched, generating new insights about its acquisition, function, and original shape and decoration. While these insights are important, some remain open to discussion, such as its methods of construction and how the boat was used in antiquity, warranting further research. Additionally, new discoveries at Senwosret III's mortuary complex at Abydos could provide comparative evidence impacting our understanding of the Carnegie boat and its mates. Further, advancements in technology and methodological approaches open new opportunities, specifically including dendrochronological analyses, oxygen and carbon stable isotopic study, and conservation testing for pigments—all of which are presently in progress by the authors.

As for the boat's methods of construction, the timbers are primarily held together with mortise-and-tenon joints, and were likely lashed with rope (a common boat construction method in Egypt), as opposed to the dovetail fastenings that are currently in place (Fig. 2). There is some debate about when

Figure 1: The Carnegie boat on display in the Walton Hall of Ancient Egypt (photograph: E. Peters, 2016) © Carnegie Museum of Natural History, Carnegie Institute, 2017.

Figure 2: Detail of the plank joinings of the Carnegie boat (photograph: E. Peters, 2017) © Carnegie Museum of Natural History, Carnegie Institute, 2017.

the dovetail fastenings were created, but the turn of the 20th century CE seems likely. Research in the 1980s concluded that some of the dovetails are modern, while others may be at least historic, if not ancient. Dovetails, however, are an uncommon boat construction method, and if they are ancient, it is likely that the boat could not withstand long riverine journeys.[5] With new technology, such as high-resolution 3D digital scanning, it may be possible to study fine details in the carving of the dovetails not visible in standard physical examination, leading to a more definitive answer regarding the boat's construction.

Discoveries outside of the Carnegie Museum have great potential to contribute information as well. Current Penn Museum, University of Pennsylvania archaeological excavations at Abydos have revealed new comparanda, and may yield more information on boats in Middle Kingdom mortuary religion in general as well as the historic connection of the funerary sites of Senwosret III.[6] In addition to the pyramid complex at Dahshur, a tomb was built for Senwosret III within a large multi-feature mortuary complex at Abydos. Near this tomb, a full-size boat burial was recently discovered within a mud brick vaulted boat building similar in size, material, and shape to a vaulted structure at Dahshur; but both lacked the intact ship.[7] Future work at Dahshur in comparison with that at Abydos could yield contextual information for the Carnegie boat's

Figure 3: Pearce Paul Creasman and Chris Baisan of the University of Arizona's Laboratory for Tree-Ring Research coring the Carnegie boat for dendrochronological samples in April 2017 (photograph: E. Peters, 2017) © Carnegie Museum of Natural History, Carnegie Institute, 2017.

original use, deposition, construction, etc.

In April 2017, the Carnegie Museum permitted the boat in its collection to be dendrochronologically sampled. While the boat was previously sampled in the 1980s,[8] advances in methodologies and ship timber analyses[9] necessitated additional sampling to recover a more complete representation of the available data. Forty-five additional samples were collected (Fig. 3) and are being processed at the Laboratory of Tree-Ring Research, University of Arizona. The intended work will result in the first comprehensive dendrochronological examination of an ancient Egyptian boat and will address several critical questions related to Egyptology (i.e., where did the wood originate, thus evaluating trade networks), maritime history (i.e., how much wood was required to build a boat, extrapolated for a fleet, etc.), and the environmental sciences (i.e, is there evidence of "4.2kya" environmental decline in the eastern Mediterranean?). Portions of the specimens will be sub-divided for use in chemical analyses, especially carbon and isotopic studies. Of specific interest is the use of these specimens in two major endeavors: 1) refining the strontium isotope provenancing methodology,[10] and 2) the construction of a regional radiocarbon calibration curve for the Mediterranean.

Previous examination of the Carnegie boat has revealed traces of paint from the vessel's original polychrome surface. New information may be derived from these paint remnants with the help of multispectral imaging, or MSI. MSI is a photographic technique that uses visible, ultraviolet, and infrared light to locate and characterize pigments and binding media on artifacts.[11] An example of this technique is visible-induced infrared luminescence, a reaction that can be used to locate even small traces of Egyptian blue pigment on a surface.[12] Imaging and pigment analysis could provide useful information the Carnegie boat's original decoration. These data might then be compared to paint materials found on the other Dahshur boats.

Ultimately, new data and research can help CMNH best care for the boat as it plans an updated display of the Walton Hall, add to its interpretation of the boat for museum audiences, and advance research and scholarship, offering considerable validation to continued resource allocation and support for the care and preservation of historic museum collections.

1 J. De Morgan, *Fouilles à Dâhchour: Mars–Juin 1894* (Vienna: A. Holzhausen, 1895), 81–83; D. Arnold, *The Pyramid Complex of Senwosret III at Dahshur: Architectural Studies* (New York: Metropolitan Museum of Art, 2002), 105. For an overview of boat burials in Egypt, see P. P. Creasman and N. Doyle, "From Pit to Procession: The Diminution of Ritual Boats and the Development of Royal Burial Practices in Pharaonic Egypt." *Studien zur Altägyptischen Kultur* 44 (2015): 83–101. Note that Andrew Carnegie began his Institute with a public library in 1895, and the rest of the complex, including a music hall, museum, and art gallery, opened in 1896. In 1996, the library and music hall had separated from the Institute, and four distinct museums were combined under the aegis of the Carnegie Museums of Pittsburgh: the Carnegie Science Center, the Andy Warhol Museum, the Carnegie Museum of Art, and the Carnegie Museum of Natural History.

2 Detailed in P. P. Creasman, "A Further Investigation of the Cairo Dahshur Boats," *The Journal of Egyptian Archaeology* 96 (2010): 101–102; De Morgan 1895, fig. 105, 81–3, pls. XXIX–XXXI; J. De Morgan, "Note sur les travaux du service des antiquités de l'E'gypte et l'Institut Égyptien pendant les années 1892, 93 et 94," in *Actes du dixième congrès international des orientalistes, session de Geneve 1894* (Leiden: Brill, 1897), 15; J. De Morgan, *Carte de la nécropole Memphite: Dahchour, Sakkarah, Abou-Sir* (Cairo: H. Ravon Bey, 1897), pl. 4; J. De Morgan, *Account of the Work of the Service of Antiquities of Egypt and of the Egyptian Institute During the Years 1892, 1893, and 1894: Annual Report of the Board of Regents of the Smithsonian Institution July 1896* (Washington DC: Smithsonian Institution/Government Printing Office, 1898), 600.

3 C. W. Haldane, "A Fourth Dahshur Boat," *Journal of Egyptian Archaeology* 71 (1985): 174–175; D. C. Patch and C. W. Haldane, *The Pharaoh's Boat at the Carnegie* (Pittsburgh: Carnegie Museum of Natural History, 1990), 9–11.

4 P. P. Creasman, B. Vining, S. Koepnick, and N. Doyle, "An Exploratory Geophysical Survey at the Pyramid Complex of Senwosret III at Dahshur, Egypt, in Search of Boats," *International Journal of Nautical Archaeology* 38.2 (2009): 386–399; P. P. Creasman, D. Sassen, S. Koepnick, and N. Doyle, "Ground-Penetrating Radar Survey at the Pyramid Complex of Senwosret III at Dahshur, Egypt, 2008:

Search for the Lost Boat of a Pharaoh," *Journal of Archaeological Science* 37.3 (2010): 516–524.

5 Patch and Haldane 1990, 41; C. A. Ward, *Sacred and Secular: Ancient Egyptian Ships and Boats* (Boston: Archaeological Institute of America, 2000), 93–94.

6 J. Wegner, "A Royal Boat Burial and Watercraft Tableau of Egypt's 12th Dynasty (c. 1850 BCE) at South Abydos," *International Journal of Nautical Archaeology* 46.1 (2017): 5–30.

7 De Morgan 1895, 81–3, pl. 15; Arnold 2002, 106–7; Creasman et al., 2009, 386–99; Wegner 2017, 20–1.

8 See S. Manning, M. W. Dee, E. M. Wild, C. Bronk Ramsey, K. Bandy, P. P. Creasman, C. B. Griggs, C. L. Pearson, A. J. Shortland, and P. Steier, "High-Precision Dendro-14C Dating of Two Cedar Wood Sequences from First Intermediate Period and Middle Kingdom Egypt and a Small Regional Climate-Related 14C Divergence," *Journal of Archaeological Science* 46 (2014): 401–416.

9 E.g., P. P. Creasman, *Extracting Cultural Information from Ship Timber*, Doctoral dissertation. Texas A&M University, 2010; P. P. Creasman, "Ship Timber and the Reuse of Wood in Ancient Egypt," *Journal of Egyptian History* 6.2 (2013): 152–176.

10 F. Hajj, A. Poszwa, J. Bouchez, and F. Guerold, "Radiogenic and 'Stable' Strontium Isotopes in Provenance Studies: A Review and First Results on Archaeological Wood from Shipwrecks," *Journal of Archaeological Science* 86 (2017): 24–49.

11 A. Cosentino, "Identification of Pigments by Multispectral Imaging; A Flowchart Method," *Conservation Heritage Science* 2.8 (2014): 1–12; J. K. Delaney, E. Walmsley, B. H. Berrie, and C. F. Fletcher, "Multi-Spectral Imaging of Paintings in the Infrared to Detect and Map Blue Pigments," in National Academy of Sciences (ed.), *Scientific Examination of Art: Modern Techniques in Conservation and Analysis* (Washington, DC: National Academies Press, 2005), 120–136; J. K. Delaney, P. Ricciardi, L. D. Glinsman, M. Facini, M. Thoury, M. Palmer, and E. R. de la Rie, "Use of Imaging Spectroscopy, Fiber Optic Reflectance Spectroscopy, and X-Ray Fluorescence to Map and Identify Pigments in Illuminated Manuscripts," *Studies in Conservation* 59.2 (2014): 91–101; A. Pelagotti, L. Pezzati, N. Bevilacqua, V. Vascotto, V. Reillon, and C. Daffara, "A Study of UV Fluorescence Emission of Painting Materials," in C. Parisi, G. Buzzanca, G. and A. Paradisi (eds.), *8th International Conference on "Non-destructive Investigations and Microanalysis for the Diagnostics and Conservation of the Cultural and Environmental Heritage:" Lecce (Italy), 15–19 May 2005* (Brescia, Italy: Associazione Italiana Prove non Distruttive Monitoraggio Diagnostica, 2005).

12 G. Verri, "The Spatially Resolved Characterisation of Egyptian Blue, Han Blue and Han Purple by Photo-induced Luminescence Digital Imaging," *Analytical and Bioanalytical Chemistry* 394.4 (2009): 1011–1021.