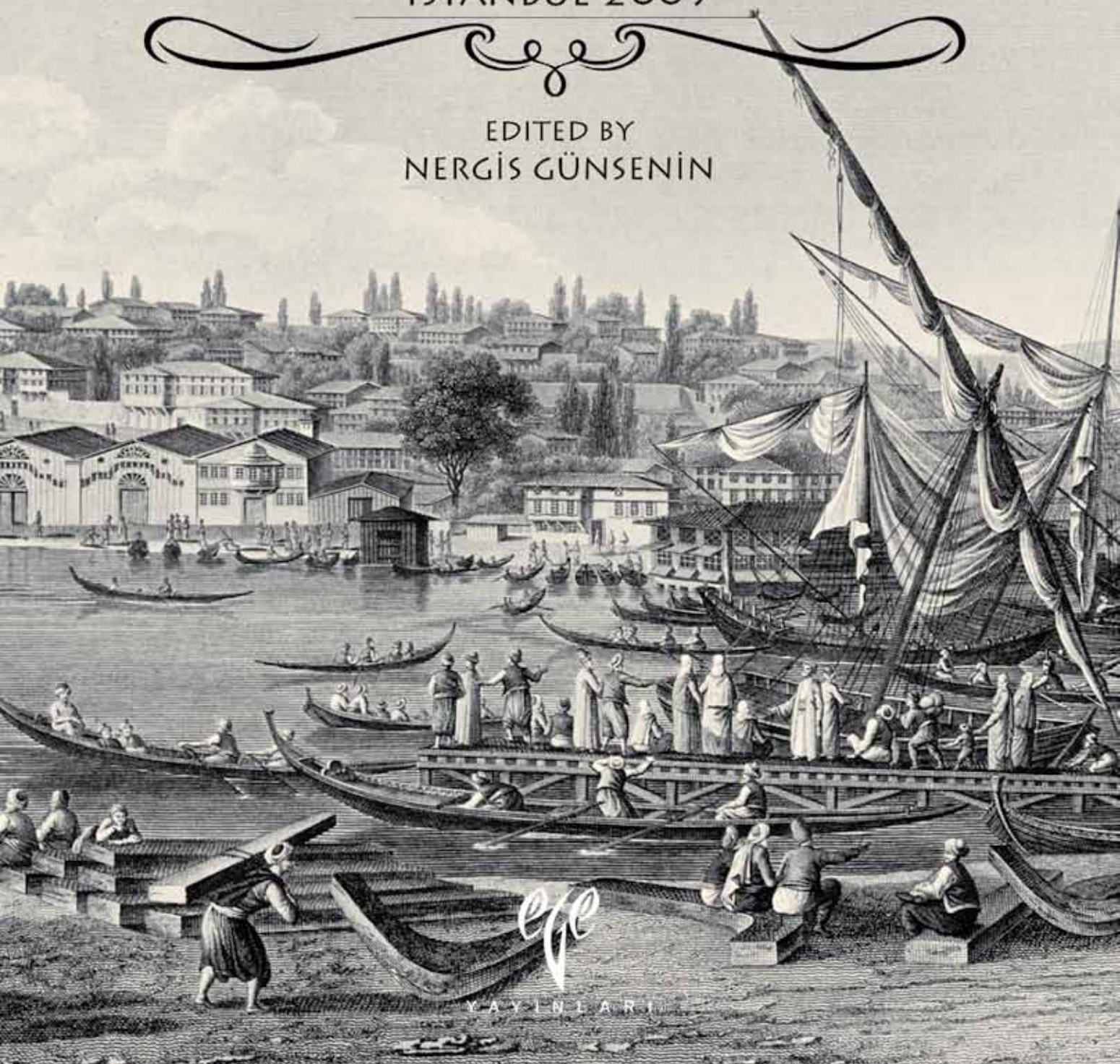
BETWEEN CONTINENTS

Proceedings of the Twelfth Symposium on Boat and Ship Archaeology

Istanbul 2009

Edited by
Nergis Günsenin



YAYINLARI

BETWEEN CONTINENTS

Proceedings of the Twelfth Symposium on Boat and Ship Archaeology
Istanbul 2009

Edited by
Nergis Günsenin

ISBSA 12

Sponsored and Hosted by the
Istanbul Research Institute of the Suna and İnan Kıraç Foundation

Under the auspices of the Underwater Technology Program at Istanbul University's
Vocational School of Technical Sciences in partnership with
the Faculty of Letters, Department of Restoration and Conservation of Artefacts

OFFPRINT

YAYINLARI

BETWEEN CONTINENTS

Proceedings of the Twelfth Symposium on Boat and Ship Archaeology
Istanbul 2009

ISBSA 12

Edited by
Nergis Günsenin

ISBN No: 978-605-4701-02-5

Published by

Ege Yayınları

Publisher Certificate No: 14641

Cover illustration

Antoine Ignace Melling, *A Picturesque Voyage to Constantinople and the Shores of the Bosphorus*,
"View of the Naval Shipyards of Constantinople"

Cover design

Aydın Tibet

With special thanks to

SUNA AND İNAN
KIRAÇ FOUNDATION

Printed by

Paragraf Basım Sanayi A.Ş.
Yüzyıl Mah. Matbaacılar Sit.
2. Cad. No: 202/A Bağcılar İstanbul
Tel: 0212 629 06 07 Fax: 0212 629 03 85
Certificate No: 18469

Production and Distribution

Zero Prodüksiyon
Kitap-Yayın-Dağıtım San. Ltd. Şti.
Abdullah Sokak, No: 17, Taksim, 34433 İstanbul/Türkiye
Tel: +90 (212) 244 7521 Fax: +90 (212) 244 3209
E.mail: info@zerobooksonline.com
www.zerobooksonline.com
www.egeyayinlari.com

To the memory of

Ole Crumlin-Pedersen (1935-2011)
and
Claude Duthuit (1931-2011)

Crumlin-Pedersen founder of the Viking Ship Museum at Roskilde heralded a whole new area of archaeological fieldwork and remained a seminal and inspirational figure in nautical archaeology. Duthuit not only acted as director of the Institute of Nautical Archaeology (INA), but made lifelong contributions to the field. It is thanks to his dedication and his passion that several excavation efforts, including those at Cape Gelidonya, have come to life.

Contents

List of Contributors

Valérie Andreieu-Ponel
Aix-Marseille Université-CNRS, Europôle Méditerranéen de l'Arbois, BP 80, 13 545 Aix-en-Provence Cedex 04, France
valerie.andrieu@univ-cezanne.fr

Staffan von Arbin
Bohusläns museum, Box 403, SE-451 19 Uddevalla, Sweden
staffan.arbin@vgregion.se

Yusuf A. Aydin
Istanbul University, Faculty of Letters, Department of History, Ordu Cad., Laleli 34459, Istanbul, Turkey
yaa@istanbul.edu.tr

Jens Auer
University of Southern Denmark, Maritime Archaeology Programme, Niels Bohrs Vej 9, 6700 Esbjerg, Denmark
auer@hist.sdu.dk

Lucien Basch
Avenue Armand Huysmans 206, bte 9, 1050 Bruxelles, Belgium
sophie.basch@skynet.be

George F. Bass
Distinguished Professor Emeritus at Texas A&M University, and Founder and Chairman Emeritus of the Institute of Nautical Archaeology, USA
gfbass@tamu.edu

Kroum N. Batchvarov
University of Connecticut, Academic Building 116 C, 1084 Shennecossett Road
Groton, Connecticut 06340, USA
kroum.batchvarov@uconn.edu

Tomasz Bednarz
Polish Maritime Museum, Ołowianka 9-13, 80751, Gdańsk, Poland
t.bednarz@cmm.pl

Carlo Beltrame
Dipartimento di Studi Umanistici, Università Ca' Foscari Venezia, Dorsoduro 3484/D 30123, Venezia, Italy
beltrame@unive.it

Vibeke Bischoff
The Viking Ship Museum,Vindeboder 12, 4000 Roskilde, Denmark
vb@vikingeskibsmuseet.dk

Jeng-Horng Chen
Department of Systems and Naval Mechatronic Engineering, National Cheng Kung University, 1 University Rd., Tainan 70101, Taiwan
chenjh@mail.ncku.edu.tw

Furio Ciciliot
via Guidobono 38/3, 17100 Savona, Italy
buranco@libero.it

Deborah Civikel
Department of Maritime Civilizations and Leon Recanati Institute for Maritime Studies, University of Haifa, Haifa 31905, Israel
dcvikel@research.haifa.ac.il

Patrick Couser
Sunnypowers Limited, 1 rue Saint Blaise, Bagneres de Bigorre, 65200, France
patcouser@yahoo.co.uk

Hüseyin Çoban
Bartın 74300, Amasra, Turkey
info@cobandenizcilik.com

Kostas A. Damianidis
Deligiorgi 51-53, 10437Athens, Greece
kostasdamia@gmail.com

Elif Denel
American Research Institute in Turkey, Şehit Ersan cad. 24/9, Çankaya, Ankara 06680, Turkey
elifdenel@gmail.com

Frederick H. van Doorninck, Jr.
Emeritus Professor of Nautical Archaeology,
Texas A&M University and Institute of Nautical Archaeology
6200 Pelham Court, Bryan, 77802-6059, Texas, USA
fredvand@suddenlink.net

Wendy van Duivenvoorde
Department of Maritime Archaeology, Shipwreck Galleries, Western Australian
Museum, 47 Cliff Street, Fremantle, WA 6160, Australia
wendy.vanduivenvoorde@museum.wa.gov.au

Anton Englert
The Viking Ship Museum,Vindeboder 12, 4000 Roskilde, Denmark
ae@vikingshipmuseum.dk

Niklas Eriksson
Södertörn University, SE-141 89 Huddinge, Sweden
niklas.eriksson@sh.se

Sandra Greck
Arkaeos association, 1 boulevard Longchamp, 13001 Marseille, France
sandragreck@arkaeos.fr

Frédéric Guibal
Aix-Marseille Université-CNRS, Europôle Méditerranéen de l'Arbois, BP 80, 13 545 Aix-en-Provence Cedex 4, France
frederic.guibal@univ-cezanne.fr

Jostein Gundersen
The Norwegian Maritime Museum, Bygdøynesveien 37, 0286 Oslo, Norway
jostein.gundersen@marmuseum.no

Marc Guyon
Inrap, 12, rue Louis Maggiorini, 69500 Bron, France
marc.guyon@inrap.fr

Nergis Günsenin
Istanbul University, Vocational School of Technical Sciences, Underwater Technology Program, Avcılar 34320, Istanbul, Turkey
ngunsenin@superonline.com

Patrik Höglund
Swedish National Maritime Museums, BOX 27 131, 10252, Stockholm, Sweden
patrik.hoglund@maritima.se

Eyal Israeli
Leon Recanati Institute for Maritime Studies, University of Haifa, Haifa 31905, Israel
eyal1@zahav.net.il

Toby Jones
Newport Medieval Ship Project, Newport Museum and Heritage Service, Newport Ship Centre, Unit 22, Maesglas Industrial Estate, Newport, Wales, NP20 2NN, United Kingdom
toby.jones@newport.gov.uk

Yaacov Kahanov
Leon Recanati Institute for Maritime Studies, University of Haifa, Haifa 31905, Israel
yak@research.haifa.ac.il

Viktor D. Kobets
Kiev State University of Taras Shevchenko, Ukrania
kobets@univ.kiev.ua

Ufuk Kocabaş
Istanbul University, Faculty of Letters, Department of Conservation of Marine Archaeological
Objects, Ordu Cad., Laleli 34459, Istanbul, Turkey
ufukkocabas@gmail.com

Işıl Özsaİt Kocabaş
Istanbul University, Faculty of Letters, Department of Conservation of Marine Archaeological
Objects, Ordu Cad., Laleli 34459, Istanbul, Turkey
isilkocabas@yahoo.com.tr

John D. Littlefield
Nautical Archaeology Program, Department of Anthropology, Texas A&M University, College Station, Texas 77843-4352, USA
jlittlefield@tamu.edu

Vanessa Loureiro
Rua das Janelas Verdes, nº 4-4º, 1200-691, Lisbon, Portugal
van.loureiro@gmail.com

Mohamed M. Abd-el-Maguid
Supreme Council of Antiquities of Egypt, National Maritime Museum, 270 Tariq El-Gueish, Alexandria, Egypt
momaguid@yahoo.com

Sabrina Marlier
Conseil Général des Bouches-du-Rhône - Direction de la Culture
Musée Départemental Arles Antique, Presqu'île du Cirque Romain
BP 205 - 13635 Arles Cedex, France
sabrina.marlier@cg13.fr

Igor Mihajlović
Department for Underwater Archaeology, Croatian Conservation Institute, Cvijete Zuzorić 43
HR – 10000 Zagreb, Coratia
imihajlovic@h-r-z.hr

Igor Miholjek
Department for Underwater Archaeology, Croatian Conservation Institute, Cvijete Zuzorić 43
HR – 10000 Zagreb, Coratia
imiholjek@h-r-z.hr

Aleydis van de Moortel
Department of Classics, 1101 McClung Tower, University of Tennessee, Knoxville,
TN 37996, USA
avdm@utk.edu

Yannis D. Nakas
Isaia Salonon 13, 11475 Gyzi, Athens, Greece
jnak77@yahoo.com

Nigel Nayling
School of Archaeology, History and Anthropology, University of Wales, Trinity Saint David, Lampeter, Ceredigion, Wales, SA48 7ED, United Kingdom
n.nayling@tsd.ac.uk

Søren Nielsen
The Viking Ship Museum,Vindeboder 12, 4000 Roskilde, Denmark
sn@vikingeskibsmuseet.dk

Waldemar Ossowski
Polish Maritime Museum, Ołowianka 9-13, 80751, Gdańsk, Poland
w.ossowski@cmm.pl

Mladen Pešić
International Centre for Underwater Archaeology in Zadar
Božidara Petranovića 1
HR-23000 Zadar, Coratia
mpesic@icua.hr

Mark E. Polzer
Archaeology M405, The University of Western Australia
35 Stirling Highway, Crawley, WA 6009, Australia
markpolzer@gmail.com

Patrice Pomey
Centre Camille Jullian, CNRS , Université de Provence, 5 rue du Château de l'Horloge,1390 Aix-en-Provence, France
pomey@mmsh.univ-aix.fr

Pierre Poveda
Bureau d'archéologie Navale, B032, MMSH, 5 rue du Château de l'Horloge
BP 647 13094, Aix-en-Provence Cedex 2, France
pierre.poveda@gmail.com

Morten Ravn
The Viking Ship Museum in Roskilde, Vindeboder 12, 4000 Roskilde, Denmark
mr@vikingeskibsmuseet.dk

Eric Rieth
CNRS (LAMOP), Musée National de la Marine, Palais de Chaillot 75116 Paris, France
e.rieth.cnrs@gmail.com

Thomas Schmidts
Römisch-Germanisches Zentralmuseum, Forschungsbereich und Museum für Antike Schiffahrt, Neutorstraße 2b, 55116 Mainz, Germany
schmidts@mufas.de

Holger Schweitzer
Martime Archaeology Programme, University of Southern Denmark, Niels Bohr Vej 9, 6700 Esbjerg, Denmark
holger.schweitzer37@gmail.com

Martin Segschneider
Archaeological State Office Schleswig-Holstein, Schloss Annettenhöh, Brockdorff-Rantzau Str. 70
24837 Schleswig, Germany
martin.segschneider@alsh.landsh.de

Petr Sorokin
Institute of the History Material Culture, Russian Academy of Science, St. Petersburg, Dvorzovaja nab. 18., 191186, Russia
petrsorokin@yandex.ru

Evren Türkmenoğlu
Istanbul University, Faculty of Letters, Department of Conservation of Marine Archaeological Objects
Ordu Cad., Laleli 34459, Istanbul, Turkey
evrentu@istanbul.edu.tr

Metin Ünver
Istanbul University, Faculty of Letters, Department of History, Ordu Cad., 34459 Laleli, Istanbul, Turkey
munver@istanbul.edu.tr

Hilde Vangstad
The Norwegian Maritime Museum, Bygdøynesveien 37, 0286 Oslo, Norway
hilde.vangstad@marmuseum.no

David Vann
University of San Francisco, 33 East Las Palmas Ave., Fremont, CA 94539, USA
david@davidvann.com

Güzden Varinlioğlu
Sualtı Araştırmaları Derneği, Gazi Mustafa Kemal Bulvarı, Akıncılar Sokak, 10/1
Maltepe, Ankara, Turkey
sanalmuze@sad.org.tr

Valeria Vittorio
via G. , Marconi 66/a, 36016 Thiene (VI), Italy
vale.vitt@tiscali.it

Tom Vosmer
Ministry of Foreign Affairs, PO Box 812, Postal Code 100, Muscat, Sultanate of Oman
foxlake@omantel.net.om

Cheryl Ward
Director, Center for Archaeology and Anthropology, Department of History
Coastal Carolina University, P.O. Box 261954, Conway, SC 29528-6054, USA
cward@coastal.edu

Oleg A. Zolotarev
18-35 Lenınsky Village, Leninsky District, Tula Region, Russia
oazis66@list.ru

Preface

The island of Tatihou in France was the site of the first ISBSA meeting I attended in 1994. Encircled by seminal figures in our field, it was the most inspiring event of my academic career. At the time, it became clear that the attendees were eager to hold one of their future meetings in Turkey. Their wish was the driving force that finally led me to this special day.

Positioned between two continents, Istanbul was the perfect place to hold the Symposium. Throughout history, the exchange of goods and cultures between east and west, as well as north and south, was realized in the waters off the Anatolian coast, with the Black Sea to the north, the Sea of Marmara to the northwest, the Aegean Sea to the west, and the Mediterranean Sea to the south. Given the vast area of interest, we invited participants to focus on the four seas and address their pivotal role not only for Turkey but also for the rest of the world.

The Turkish coastline had already been the site of pioneering underwater excavations since the 1960s. Indeed, nautical archaeology was initiated in Turkey under G. F. Bass and further developed under the auspices of the Institute of Nautical Archaeology (INA). Today, the development of nautical archaeology and boat and ship archaeology on an international level far surpasses the initially limited field of underwater archaeology. Moreover, the discovery of the harbour of Theodosius, one of the most outstanding archaeological events of our era, has further enriched our field and added yet another dimension to our symposium.

The excavations in the harbour are still ongoing. Thirty-six shipwrecks dating from the 5th to the 11th centuries have been excavated. Their study will make an enormous contribution to our understanding of ship construction and the transition from shell-first to skeleton-first techniques. It will also allow us to re-examine Byzantine trade and the economy of the period. Furthermore, the remains revealing settlements dating back to 6500 BC, will shed new light on our understanding of the history of the ancient peninsula.

Fig. 1. Group photograph of the participants of ISBSA 12 (Photo: Engin Şengenç).

Fig. 2. Group photograph of the participants of the Amasra excursion.

The ISBSA 12 was held under the auspices of the Underwater Technology Program at Istanbul University's Vocational School of Technical Sciences in partnership with the Faculty of Letters, Department of Restoration and Conservation of Artefacts. It was sponsored and hosted by the Istanbul Research Institute of the Suna and İnan Kıraç Foundation and was held at the Foundation's Pera Museum on 12-16 October, 2009.

More than 200 participants from 24 countries attended the Symposium where 50 papers, 25 posters, and various films were presented (**Fig. 1**). This also allowed numerous young scholars to present their work and contribute to ongoing debates in our field and even launch new areas of research based on recent discoveries. The papers for the symposium were selected by the ISBSA committee from among a multitude of excellent proposals. The mission of the ISBSA is focused on ship construction. While related subjects are welcome, the main thrust has traditionally been a discussion of the ship itself.

It is our hope that the conference theme which has helped bring together numerous scholars from around the world, will also bring together the two sub-fields of archaeology which have until recently remained separate. It is believed that a genuine thematic and methodological dialogue between land and underwater archaeology can only enrich the field and uncover the mysteries of past civilizations. "Between Continents" will thus re-map our field and reset its intellectual boundaries.

Following the Symposium, an excursion to Amasra on 16-18 October offered the opportunity to visit workshops that still continue the traditional art of shipbuilding in *Tekkeönü* and *Kurucaşile* in the Black Sea Region. Participants learned methods of ship construction directly from the local shipbuilders. The Shipbuilding Program at the *Kurucaşile* Technical High School, the Amasra Castle, and the Amasra Archaeological Museum were among the local sites included in the itinerary (**Fig. 2**). Hüseyin Çoban was pivotal to the success of this excursion; his hospitality and his immense knowledge of traditional shipbuilding enriched our trip.

Like many other scholars in our field, I owe my presence here today to George Bass who not only accepted our invitation to attend the symposium but also graciously delivered the keynote address. Frederick van Doorninck, Jr., the late Claude Duthuit, Don Frey and Robin Piercy from the Institute of Nautical Archaeology further enriched

this symposium with their presence. It was a genuine honour to have them in our midst. As in all scholarly disciplines the master - apprentice relationship is central to our field. This was made amply clear during the course of this symposium.

However, our field is based not only on scholarly research. The constant interaction between nature and humans is an inextricable part of it: sailing on a fickle sea, working in the hostile underwater environment, and living in often difficult conditions are among the challenges that make our field so special.

May God save sailors and nautical archaeologists for future research and many more symposia!

Acknowledgments

I would like to express my sincere thanks to Suna, İnan and İpek Kıraç, founders of the Suna and İnan Kıraç Foundation, and Özalp Birol, General Director of the Suna and İnan Kıraç Foundation Culture and Art Enterprises; they made it possible for us to hold the meeting at the Pera Museum. The hospitality of the museum staff was also central to the success of this meeting.

My thanks also go to Gülru Tanman of the Istanbul Research Institute whose help and friendship made it easier to navigate through a complexity of organisational issues. Erkan Bora, also of the Istanbul Research Institute, deserves special thanks for his assistance, not only during the Symposium, but also during the excursion to Amasra. Else Snitker welcomed everyone with her endless energyand friendly, familiar countenance.

I want to express my gratitude to Zeynep Kızıltan, directress of the Istanbul Archaeological Museums, who made it possible for us to visit the Yenikapı excavation site.

Commandant Ali Rıza İşipek generously opened storerooms of the Istanbul Naval Museum, which is presently under construction. Thanks to him, participants had the opportunity to see the sultans' *kayıks* and the famous *kadırga*.

The *Setur* Travel Company team contributed to a remarkable organisation.

My heartfelt thanks also go to Carlo Beltrame, Ronald Bockius, Anton Englert, and Fred Hocker, who shared their invaluable experience as previous ISBSA organisers.

I would also like to acknowledge Ayşın Akyor for providing much needed editorial help with the English text.

Finally, my sincere thanks go to Rezan Benatar for her valuable intellectual and editorial contributions. She not only helped create a seamless text but also attempted to make rather complex material intelligible to the reader.

The success of a symposium is always determined by the contributions of its participants. I would like to sincerely thank each and every one of them for an intellectually stimulating exchange.

This volume is published by Ege Yayınları which has a long-standing commitment to archaeological research. I would like to thank its owner Ahmet Boratav for his interest in our work. My thanks also go to Hülya Tokmak for her patience with the layout of the manuscript.

2. Pharaonic Ship Remains of Ayn Sukhna

Patrice Pomey

The site of Ayn Sukhna is located on the west coast of the gulf of Suez on the nothern part of the Red Sea, at about 70 km south of Suez. The site was identified like a pharaonic settlement thanks to numerous hieroglyphic inscriptions engraved on the rocks. These inscriptions correspond mainly to Middle Kingdom pharaohs and are related to expeditions towards the Sinaï to bring back copper ore and turquoise (Abd El-Raziq, Castel et al. 2002). Since 2001, the site is excavated by a franco-egyptian team under the supervision of Mahmoud Abd el-Raziq (University of Suez), Georges Castel (Institut Français d'Archéologie Orientale, IFAO), Pierre Tallet (University of Paris IV-Sorbonne) and with the assistence of the Centre National de la Recherche Scientifique (CNRS) (Abd El-Raziq, Castel & Tallet 2007; Abd El-Raziq, Castel et al. forthcoming).

The site presents a series of 9 galleries, dug at the foot of the mountain at short distance of the seashore. They are dated by seals and inscriptions of the Old Kingdom (IVth, Vth dynasties). All the galleries were re-used during the Middle Kingdom as warehouse to hold equipment and supplies needed for maritime expeditions to Sinai. Of these galleries, six run parallel to each other and are openned to the north, looking onto the sea

The first two, galleries G2 and G9, held the burnt remains of boats (Fig. 2.1). The first one was excavated from 2006 to 2008 and the second during the campaign of 2009 and 2010. In fact, the galleries held the carefully stored parts of boats that had been dismantled. As the result of a fire, the sandstone ceiling of the gallery collapsed and extinguished the fire. In addition, since the oxygen in the gallery was quickly consumed, a phenomenon of slow combustion, similar to that of a charcoal kiln, occurred, transforming the pieces of boats into charcoal. Because of all this, certain parts have been completely destroyed, yet others are partially preserved, tenons and vegetal stitches, matting and cords, included.

Obviously, given the fragility of wood reduced to carbon, the excavation required a particularly cautious approach. It was necessary to proceed both delicately and slowly. Moreover, the double necessity of shoring up the gallery ceiling for obvious safety reasons with scaffolding and then excavating from a system of movable planks set above the archaeological layers, complicated even further the work in this cramped space.

After clearing the structures, the draft of the ensembles in both plan and section was raised and complemented by photographic coverage (photomosaics). Then, the difficulties engendered by a detailed study *in situ* of the carbonised remains led us, when possible, to remove the vestiges, after consolidation, in order to study them separately[1]. Most of the burnt wooden remains of gallery G2 were removed, whereas in G9 the mass of the wood precluded the idea of lifting and removing the archaeological material.

The Wood Elements of Gallery G2

The gallery measures 20.10 m in length, from 1.80 to 2.90 m in width and 1.60 to 2 m high. The layer of burnt wood covered the surface of the gallery G2's floor over some 12.80 m in length, 2.60 m in width and to a thickness of roughly 30 cm (Fig. 2.1). It was in turn covered by blocks of sandstone, then with layers due to the abandonment of the site and from a late nomadic occupation.

One could make out quite clearly three parallel rows laid out along the length of the gallery. The central row was composed at least of two levels of planks placed flat on top of the other, while the side rows had at least three layers. Additional layers could well

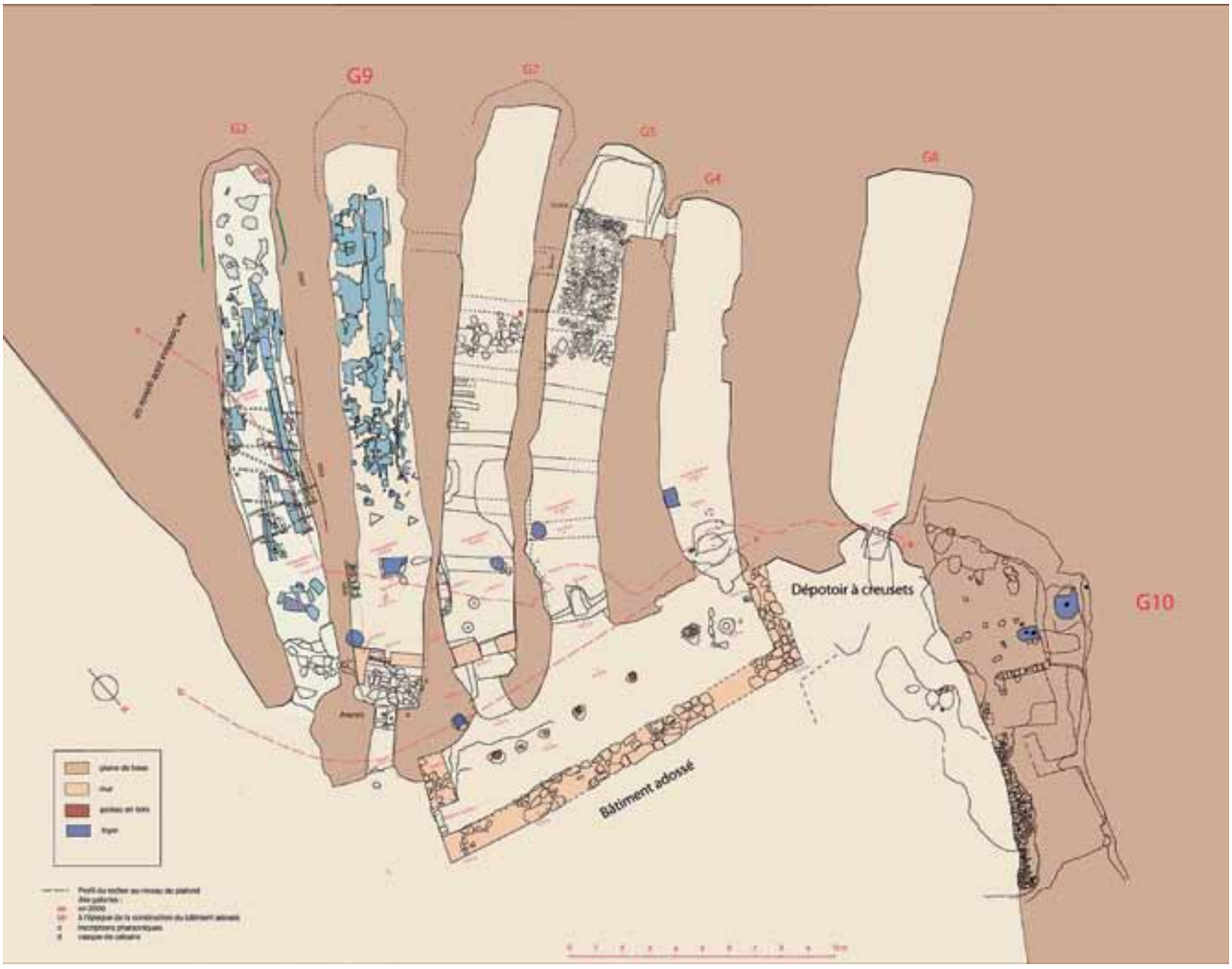


Fig. 2.1. Location plan of the galleries G2 and G9, situated to the east of an ensemble of six more or less parallel galleries opened to the north (Drawing: G. Castel. IFAO).

have originally existed, however, they would have been burned beyond trace.

Other than these three ensembles, one could see, between the west row and the wall of the gallery, fragments of planks standing on their edges, either as they were originally, or as they fell during the fire from the adjacent row. Likewise, fragments lay along the east wall, probably for the same reasons. Lastly, among these ensembles, there were other seemingly isolated pieces that could not easily be associated with any one ensemble.

Some rope was found winding under the rows of wood and other lengths of rope were directly associated with certain pieces. The rope was of two diameters: from 1.7 to 2 cm and 1 cm. These ropes were clearly used to tie up the planks of each row and then to tie these bundles together.

These rows of wood were placed upon cylindrical batons poles to insulate them from the ground. These batons measure on average 5 cm in diameter and some seem to be tapered. They were positioned perpendicular to the wood and were spaced roughly 0.9 m apart. All of this was placed upon mats lying on the ground as can be seen from the fibres that still adhere to the lower surfaces of certain pieces.

The Wood Elements of Gallery G9

The gallery, adjacent and parallel to G2, measures 21.8 m long by 2.5 to 2.9 m wide and is 1.8 to 2 m high. The vestiges of rope and wood are preserved over an area some 13.5 m long, over the entire width available and up to a maximum height of 61 cm (Fig. 2.1). As a result of a fire, the conditions of which were probably different from that of gallery G2, the mass of carbonised wood in G9 is much greater (Fig. 2.2).

Careful observations have led to the distinction of three major ensembles.

The first and most imposing forms a homogeneous mass, 6 m in length, that occupies the end of the gallery. It extends towards the north, though not continuously, for around 5.5 m. In the best preserved part, this ensemble consists of five layers of planks lying flat one on top of the other. At this point it reaches a maximum height of 61 cm and its greatest width, corresponding to that of the lower plank, is 70 cm. The planks are separated from each other by little stone chocks inserted between each one to hold them in place and to support their particular shape. As well as these stone chocks, other stones were placed as supports underneath to insulate the wood from the ground, in the same way as the cylindrical batons were used in gallery G2.

The second large ensemble is situated along the east wall of the gallery. It consists of planks placed on edge, more or less vertically and leaning sideways, the one against the other, as well as several other pieces of complex shape. There are up to 6 planks placed on their edges. The ensemble runs continuously for 5.7 m. Thereafter, the remains, separated by gaps, become sparse and very fragmentary. As with the previous ensemble, chock and support stones were used.

Fig. 2.2. Overview, towards the end (south), of the mass of carbonised wood in gallery G9 corresponding to the dismantled components of a boat (Photo: P. Pomey. CNRS).

The last ensemble, situated towards the entrance, consists of a dense mass of rope that covers the entire width of the gallery over a preserved length of 1.2 m and a maximum thickness of 12 cm. In this mass one can make out a long coil of rope tied off to one end of the coil. Several support stones are placed on top of the rope thus indicating that the pieces of wood extended towards the entrance of the gallery passing over the rope that lay on the floor.

Other wooden remains, often associated with assembly tenons, lie along the west wall of the gallery. They indicate that once there was one or perhaps several wooden planks placed on edge against the wall. Also against this wall are the continuous remains of two poles, 2.10 and 2.20 m in length.

As in gallery G2, the remains of ropes and associated matting are spread almost everywhere and there is even a small fragment of cloth. The ropes were used to bind up the pieces of wood into homogeneous groups that were then protected from the ground by mats and perhaps wrapped in cloth.

General Characteristics of the Wood

In gallery G2, all of the pieces are shaped and worked on the four surfaces. In the majority, they correspond to 'long' pieces, rectangular in section, and their morphology and traces of assembly mark them out to be ships parts of the type 'hull planks'.

Their individual length remains unknown but could vary from 2.35 to 6.4 m. Their width ranges from 28 to 44 cm and their thickness from 9.5 to 13 cm. While most of the fragments show parallel edges, it is not certain that these pieces were parallelepiped along their entire length. On the contrary, certain reconstituted planks display polygonal plans with non-parallel edges. Such pieces, often of a very complex form, are common in Egyptian naval construction as seen in the planking schemes of the boats of Cheops (Lipke 1984: 66, 68), of Dashur (Ward 2000: fig. 36), and the pieces of Lisht (Ward 2000: 109, 117).

One should note that the central row consists of pieces from amongst the biggest in terms of their dimensions (width 39 cm, thickness 13 cm). One might suggest that these elements were the boat's axial planks. The side rows of three layers would then correspond to elements of the planking strakes of each wall of the boat. Always in G2, two 'rhomboidal' pieces (AS G2-P1.07 and AS G2-P9.08) display a particular morphology characterised by an end shaped as a truncated pyramid and parallelepiped body

Fig. 2.3. View of the 'rhomboidal' piece from group AS G2-P1.07 (Photo: P. Pomey. CNRS).

(Fig. 2.3). These pieces are relatively short (1.22 m) but show the same assembly characteristics as the hull planking pieces. From their morphology, they could be the end of two garboard strakes. The presence of these two end pieces, symmetrical in relation to the longitudinal axis of the boat, indicates that towards the far end of the gallery, we have one of the two extremities of the boat. Their proximity confirms the logic of storage by elements of the same type and according to their relative positions in the hull.

In gallery G9, the majority of pieces correspond to hull planking of 30 to 40 cm width and 11 to 13 cm thickness. The first ensemble, however, consist of planks of greater dimensions, reaching 50 cm and even 70 cm for the first of them. These are most probably pieces of a specific nature that has still to be determined. Among the noteworthy pieces, the second ensemble includes a short thick piece with a rounded surface and edges angled inwards (preserved length 45 cm, width 52 cm, thickness 30 cm) and a triangular piece (reconstituted length 87 cm, max. width 40 cm, max. thickness 20 cm) that suggests the so-called 'knife-shaped' pieces often found in Egyptian naval construction and corresponding to end planking (Ward 2000: 117, fig. 36; Ward & Zazzaro 2007: fig. 26, 2009: fig. 5; Ward 2009: fig. 3).

The fragments of rope can be separated into three groups according to their diameter: 1.2 to 1.3 cm, 0.9 to 1.1 cm, 0.6 to 0.7 cm.

The two sections of pole lying along the east wall seem to be different from those cylindrical batons that were placed transversally beneath the planks of gallery G2. Their size (diam. 4.9 to 6 cm), their situation and their proximity to the rope lead to an interpretation of these pieces as some sort of equipment, such as parts of oars.

In all, everything seems to point to the presence of a second ship, probably similar to that of gallery G2 although the elements observed here are more numerous and varied, probably because of different conditions of combustion.

Elements of Assembly

All of the pieces show several types of assembly, often present simultaneously on the same piece :

- Single mortise cut horizontally mid-way into the edge of the pieces to receive a tenon. This latter is never pegged contrary to Mediterranean tradition (Pomey 1998). The mortise measures on average: width 6 to 8.5 cm, thickness 1 to 2 cm, max. depth 15 cm, tenon: length 15 cm, width 5.5 to 8 cm, thickness 0.9 to 1.9 cm.
- Double mortise, one above the other (vertical space: 2 to 2.5 cm) to receive unpegged tenons. Mortise: width 5.5 to 8.3 cm, thickness 1.1 to 2 cm, max. depth 15 cm, tenon: length 15 cm, width 5 to 8 cm, thickness 0.9 to 1.9 cm.
- L-shaped mortise, cut horizontally from the edge and exiting vertically through the upper surface. This type of mortise is used for individual stitching. Mortise: width 6.5 to 8 cm, thickness 1 to 2 cm, depth 11 cm, stitches: 9 to 12 strings of 4 to 5 mm diam.
- Cylindrical mortises for dowels: diam. 2.5 to 4.5 cm.

For example, on a fragment of plank *(AS G2-P2.06;* 94 cm long, 40 cm wide, 30 cm thick) we can note on a lateral surface: two superposed mortises with tenons, an L-shaped mortise for stiching, a single mortise with tenon and just above a dowel. An other fragment with two planks superposed (*AS G2-P3.06*, 93 cm long, 43 cm wide, 20 cm thick) comporte two L-shaped mortises for stiching, a single mortise with tenon, a double superposed mortise and a hole for a treenail (Fig. 2.4).

These assembly elements are characteristic of naval construction in Pharaonic Egypt (Ward 2000, 2004) and can be found on the ships of Cheops, of Dashur, and the pieces of Lisht and of Wadi Gawasis. However, if single mortise-and-tenon joints and

Fig. 2.4. View of lifted group AS G2-P3.06 comprising the remains of two planks, one on top of the other, and their assembly elements. Note the stiches still in place on the upper plank (Photo: P. Pomey. CNRS).

L-shaped mortises for individual stitches are present in every instance, double mortises are only attested on planking from Lisht (Ward 2000: 113-115) and from Wadi Gawasis (Ward & Zazzaro 2007, 2009; Ward 2009). On the other hand, cylindrical dowels have so far only been attested on pieces at Ayn Sukhna. One might think that the double mortise system, whose obvious function is to reinforce the structure, is a peculiarity of seafaring (Wadi Gawasis, Ayn Sukhna) and cargo (Lisht) ships. Likewise for the cylindrical dowels, the function of which would be to help hold the components together during preassembly, to avoid any lateral shake and to reinforce the structure.

Analysis and Dating

Analysis of the different samples of wood taken from the gallery G2 and G9[2] show that the great majority of the planks are of cedar, some others being in oak. On the other hand, all the tenons are of acacia. As for the cylindrical batons, acacia is the majority, with sometimes cedar. It is to be noted that structural elements are made of imported wood (cedar and oak), while assembly elements were cut from a common Egyptian tree, acacia.

In gallery G2, the remains of the boat lie upon ceramics from the Middle Kingdom dating to the 12th dynasty, which implies that the boat was placed here then or thereafter. The results from radiocarbon dating analysis confirm this interpretation[3]. While the oldest plank sample dates back to the 5th dynasty, the most recent and the elements on which the wood lay, matting and ropes, date back to the 12th-13th dynasties. From this, one can deduce that the boat in gallery G2 was dismantled and placed here during that period. In addition, the most recent plank indicates that the boat was still in use during the 12th-13th dynasties, while the presence of a tenon dated to between the 6th and 11th dynasties indicates a state of assembly at some point between the end of the Old Kingdom and the beginning of the Middle Kingdom. Radiocarbon dating of the wood from gallery G9 confirms the above.

Thus, it was towards the end of the Middle Kingdom and the beginning of the 2nd Intermediate Period that the boats would have been dismantled and stored in galleries G2 and G9. The fires that destroyed them can only have happened thereafter.

The wide gap between the dating of the oldest and the most recent planks, which goes far beyond the problem of any approximate dating, raises several questions. Dealing with fine imported species (cedar, oak), it is probable that the felled trees had reached a respectable age and size at the moment of their felling. It is also probable that the constraints of their importation, and the resultant problems of storage, must have greatly increased the delay in use. About the longevity of the boats, which appears to be considerable, it is probable that the conditions of use and maintenance must have followed specific rules when one considers the rarity and price of the imported woods employed. The use of fine species of great durability, the practice of dismantling the boats, so well attested here, the reshaping and re-use of pieces, as witnessed in the Wadi Gawasis excavations (Ward & Zazzaro 2007, 2009; Ward 2009), can all lead to an employment time span of considerable length. These particular conditions of use thus make the notion of longevity appear more relative[4].

A Hypothetical Interpretation

Obviously the burnt pieces of wood of galleries G2 and G9 have been methodically organised in a manner that would correspond with the storage, after dismantling, of the components of two ships. We have here elements that correspond in the most part to hull planks. The parts were carefully stored, probably grouped according to function (bottom planks, port and starboard strakes). The two funerary boats of Cheops, discovered dismantled in pits near to the pyramid, provide examples of the dismantling and placing of elements on several layers in a logical fashion that respects the geometry and architecture of the boat (Jenkins 1980; Lipke 1984; Ward 2000).

However, we have not found any pieces serving as longitudinal or transversal reinforcement (axial girder, floor timber or beam). Similarly, except for the possible fragments of oars in G9, we have no elements of the superstructure (deck, cabin, gallery etc.), or steering gear (rudder), or of the rigging (mast, yards etc.). It is possible that such pieces were lying on top and might have burnt completely, just as it is possible that certain of them never existed, for example the floor timbers.

The carbonised wood preserved in gallery G2 of Ayn Sukhna is generally homogeneous and would seem to correspond to a single boat, though probably quite incomplete. The distribution, dimensions and morphology of the pieces of planking (axial planks and side strakes) correspond on average to those of the Dashur boats (Ward 2000: 85-91), rather than to the pieces of Cheops' boat that are a good deal thicker, or the pieces from Lisht, the complex morphology of which is considerably different (Ward 2000: 116-117). Likewise, the absence of internal framing mirrors the absence of frames in the Dashur boats (Ward 2000: 83-98). So, the boat of Ayn Sukhna appears to resemble the Dashur type.

Now, one might bring all these dimensions together in order to estimate the size of the G2 boat. Accepting that the planking and strakes of the Ayn Sukhna boat were distributed in a similar fashion to the Dashur boats, and according to the surface of the wood in the gallery we can propose a minimum reconstituted length of 13.5 m. Nevertheless, given the numerous incertitudes concerning the layout of the wood and its importance in relation to the original wood, this result can only be an indication.

As for the remains of the boat in gallery G9, of which there seems to be even more vestiges, it is still too early to attempt any such evaluation of the original vessel.

Some Remarks on the Construction System

We have seen that the characteristics of the pieces, as deduced from the analysis of the wooden vestiges of gallery G2, and an initial examination of G9, lead us more readily to see similarities to the boats of Dashur than those of Cheops and of Lisht. Moreover, when looking at assembly by sewing, the system of individual stitching observed at Ayn Sukhna springs from a different concept of assembly than the continuous transversal sewing system of Abydos (Ward 2003) and of Cheops (Lipke 1984: 75). It is by looking at the pieces of the sea-going boat from Wadi Gawasis and the cargo ship of Lisht that we will find more relevant comparisons with the assembly system (Ward 2000: 113-115; Ward & Zazzaro 2007, 2009; Ward 2009): single mortise-and-tenon joints, double mortise-and-tenon joints, L-shaped mortises for individual stitches. On the other hand, the presence of dowels seems for the moment to be attested only at Ayn Sukhna. A reinforced assembly system could thus be the mark of sea-going cargo vessels.

The boats of Ayn Sukhna are morphologically and chronologically close to those of Dashur. Furthermore, one might wonder whether the Ayn Sukhna boats are not vessels close to a Nilotic type, as represented by the Dashur examples, but adapted for maritime navigation, notably by a reinforcement of the assembly system.

The assembly system merits a final remark. One might be surprised that within the assembly system of Egyptian ships the tenons (single or double) slotted into the mortises are never pegged. However, the technique of a pegged tenon in a mortise, that is *a priori* more solid, had been known since the Old Kingdom (Ward 2000: 33). The response to this would seem to be that this assembly technique of unpegged tenon associated with ligatures allowed for the dismantling of the vessel. This practice of dismantling, which seemed until now to have been reserved for funerary boats, would have in fact been a current procedure if one can believe the examples of Ayn Sukhna and Wadi Gawasis (Ward & Zazzaro 2007, 2009; Ward 2009). Thus the systematic use of unpegged tenons. Such a dismantling supposes that the ships were not used in a permanent fashion in the Red Sea. Since they could not be left in the water nor on dry land without some form of shelter, they were dismantled between expeditions to be stored in the galleries (Ayn Sukhna) or transport to the Nile (Wadi Gawasis).

Types of Boats

According to hieroglyphic inscriptions at the site and its geographic position, maritime expeditions from Ayn Sukhna were most probably destined for the Sinai, or more precisely the mining region of Serabit El-Khadin. Inscriptions discovered at this latter would seem to confirm this[5]. These inscriptions, and notably those at Rod el-Air, are often accompanied by wall engravings of shipping, and one can

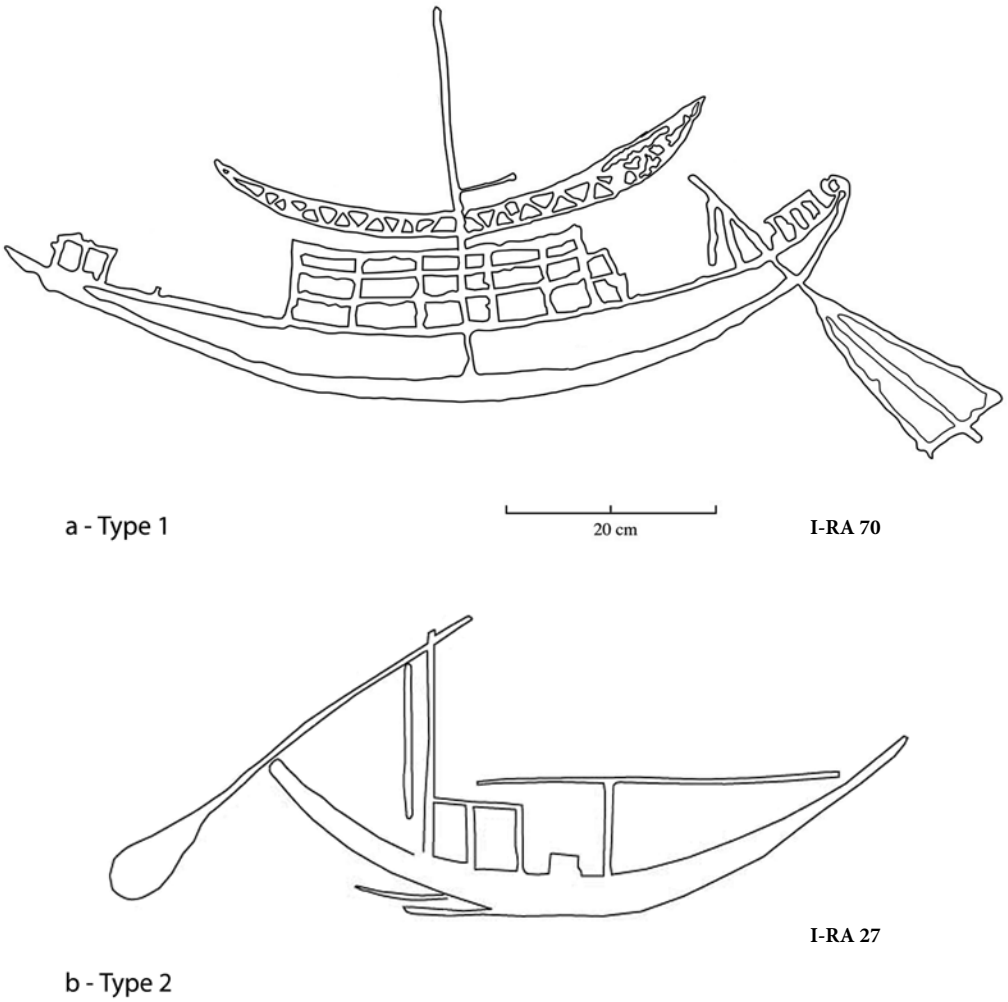


Fig. 2.5. Rod el-Air, drawings of rock carving ships of Type 1 and Type 2 (Drawing: P. Tallet).

reasonably assume that they represent the expedition boats and thus the sort of boat whose vestiges have been found at Ayn Sukhna.

Among these representations, one can, on first analysis, distinguish two types.

The first is characterised by a crescent-shaped hull, a large central cabin, a mast with yards (not always represented), prow and poop galleries and lateral rudders (Fig. 2.5a). The second is characterised by a rather slim crescent-shaped hull, a cabin, a mast (often lowered and not always represented) and a long-loomed axial rudder (Fig. 2.5b). These two boat types are well attested in the Middle Kingdom. The former resembles the Dashur boats and the second, is found in paintings and models from Beni Hassan (12th Dynasty) (Fabre 2005: 116). Are we, once again, faced with an adaptation of a Nilotic type for a marine context, as has already been suggested?

With a length of around 13,5 to 15 m, the boats of Ayn Sukhna are of a respectable size that is easily sufficient to cross the Gulf of Suez to the Sinai peninsula and return with a cargo of ore weighing several tons. They are, in fact, a sort of shuttle boat carrying out a swift turnaround. The engravings at Rod-el-Air show that these vessels were sail-powered, but they were probably also equipped with oars according to Egyptian practice. The distance between Ayn Sukhna and Abu Zenima, the port that served the mines of Serabit El-Khadin, is some 100 km, that is 55 nautical miles. If one allows for a cruising speed of around 3 to 4 knots with a favourable wind, the duration of the crossing would only be from 14 to 18 hours of navigation, and probably slightly more for the return journey[6].

Conclusion

The importance invested in the boats of Ayn Sukhna for the success of maritime expeditions to the Sinai, of which they were the key elements, could perhaps explain their very destruction. The fires that ravaged the galleries G2 and G9, and only they, do not seem to have been accidental. Nonetheless, if the fire and the intention to destroy were probably deliberate, it

remains to be seen who was the culprit and why.

The results of the study of the carbonised wood in galleries G2 and G9 at Ayn Sukhna clearly confirm that one is faced with the remains of dismantled boats. This practice of dismantling can thus be attested not only for funerary purposes as with the two boats of Cheops, but also within the context of maritime expeditions as is proved also by the pieces discovered at Wadi Gawasis.

In sum, the exceptional interest that the Ayn Sukhna boat components represent should be emphasised. In use during the Middle Kingdom, if not before, they provide us with some of the oldest evidence of Egyptian sea-going boats known today and found within a maritime context, unlike the other Egyptian ship remains that have until now been found in a funerary or religious context. Their study is thus of fundamental interest in the overall study of Egyptian maritime naval construction, in the study of nautical practices and in a general way in the study of the Egyptian navy, which still remains to a certain extent little known.

Acknowledgment

I would like to express my warmest thanks to Colin Clement for translating the present article into English.

Notes

1 The consolidation of the elements, their mounting on a support was undertaken by Ebeid Mahmoud, restorer (IFAO).

2 The analysis of the carbonised wood from G2 was undertaken by Claire Newton, (IFAO) and from G9 by Mohammed Mahran (IFAO).

3 ^{14}C dating was undertaken in the IFAO laboratory, Cairo, under the supervision of M. Wuttmann. I would like to thank G. Castel and P. Tallet for their valuable remarks regarding the dating of material and wood from the galleries.

4 For example, we are far from the longevity generally accepted for ancient ships of the Mediterranean which is in the order of twenty to thirty-odd years. On the question of dating shipwrecks cf. Pomey & Rieth 2005: 139-142.

5 I would like to express my thanks to Pierre Tallet, to whom I am indebted for this information as well as that of the rock carvings of Rod el-Air. This previously unreleased data will published by himself as part of survey of the mining region of South Sinai.

6 According to the experimental navigation of *Min of the Desert*, see Ward et al. in this volume. The prevailing north winds would have facilitated the voyage down towards Abu Zenima and made the return up to Ayn Sukhna a little more difficult.

References

Abd El-Raziq, M., Castel G., Tallet P. & V. Ghica, 2002, *Les inscriptions d'Ayn Soukhna*. Mélanges Institut Français d'Archéologie Orientale 122. Cairo.

Abd El-Raziq, M., Castel G. & Tallet P., 2007, L'exploration archéologique du site d'Ayn Soukhna. In J.-Cl. Goyon & Ch. Cardin (eds), *Proceedings of the Ninth International Congress of Egyptologists*. OLA 150: 61-68. Louvain.

Fabre, D., 2005, *Le destin maritime de l'Egypte ancienne*. Periplus. London.

Jenkins, N., 1980, *The Boat Beneath the Pyramid. King Cheops' Royal Ship*. Thames and Hudson. London.

Lipke, P., 1984, *The Royal Ship of Cheops. A retrospective account of the discovery, restoration and reconstruction. Based on interviews with Hag Ahmed Youssef Moustafa.* National Maritime Museum Archaeological series, no. 9. BAR International series 225. Greenwich.

Pomey, P., 1998, Conception et réalisation des navires dans l'Antiquité méditerranéenne. In E. Rieth (ed.), *Concevoir et construire les navires. De la trière au picoteux*. Technologies, Idéologies, Pratiques XIII.1: 49-72. Ramonville Saint-Agne.

Pomey, P. forthcoming, The Ship remains of Ayn Sukhna. In P. Tallet (ed.), *Proceedings of the International Symosium 'The Red Sea in Pharaonic Times. Recent Discoveries along the Red Sea Coast', Cairo - Ayn Sukhna 2009*. BIFAO, 2012.

Pomey, P. & Rieth E., 2005, *L'archéologie navale.* Errance. Collection archéologique. Paris.

Ward, C., 2000, *Sacred and Secular: Ancient Egyptian Ships and Boats.* University Museum, University of Pennsylvania. Philadelphia.

Ward, C., 2003, Sewn Planked Boat from Early Dynastic Abydos, Egypt. In C. Beltrame (ed.), *Boats, Ships and Shipyards. Proceedings of the Ninth International Symposium on Boat and Ship Archaeology, Venice 2000,* 19-23. Oxford.

Ward, C., 2004, Boatbuilding in Ancient Egypt. In F. Hocker & Ch. Ward (eds), *The Philosophy of Shipbuilding, 13-24.* Texas A&M University Press. College Station. Texas.

Ward, C., 2009, Evidence for Ancient Egyptian Seafaring. In R. Bockius (ed.), *Between the Seas. Transfer and Exchange in Nautical Technology. Proceedings of the Eleventh International Symposium on Boat and Ship Archaeology, Mainz 2006,* 9-16. Mainz

Ward, Ch. & Zazzaro, Ch., 2007, Finds: Ship evidence. In K. A. Bard & R. Fattovich (eds), *Harbor of the Pharaohs to the Land of Punt. Archaeological Investigations at Mersa/Wadi Gawasis, Egypt, 2001-2005.* Universita degli Studi di Napoli 'L'Orientale'. Naples.

Ward, Ch. & Zazzaro, Ch., 2009, Evidence for Pharaonic Seagoing Ships at Mersa/Wadi Gawasis, Egypt. *International Journal of Nautical Archaeology* 39.1: 1-17.

Zazzaro, Ch., 2009, Nautical evidence from the pharaonic site of Marsa/Wadi Gawasis. Report on two parts of a teering oar/rudder. In R. Bockius (ed.), *Between the Seas. Transfer and Exchange in Nautical Technology. Proceedings of the Eleventh International Symposium on Boat and Ship Archaeology, Mainz 2006,* 3-8. Mainz.