13th International Symposium on Boat and Ship Archaeology Dutch Maritime Museum 8-12 Oct.’12 Amsterdam - The Netherlands Preliminary overview of abstracts of papers and posters August 2012 - 3.0

Organising Committee ISBSA13

Benno van Tilburg General Secretary ISBSA13, Netherlands Heritage Agency
Thijs Terhorst Assistant Secretary ISBSA13
Martijn Manders Netherlands Heritage Agency
André van Holk University of Groningen
Joost Schokkenbroek Het Scheepvaartmuseum, Amsterdam
Jerzy Gawronski BMA Office for Monuments & Archaeology
Maritime Space and Identity. The Agency of power, bacteria and the vernacular

It can be argued that the major episodes of technological change in seafaring between the late medieval period and the mid 17th century in Europe are directly related to similarly fundamental changes in society that move Europe from medievalism to modernity. Indeed it is in these correlations that we find explanations for what have often been treated as insoluble technical “mysteries” such as the clinker to carvel transition, as well as the subsequent changes in timber conversion, hull form, construction and rig in the late 16th century. But were other factors also at work? This paper begins by reviewing the clinker to carvel change in the light of contemporary power politics as well considering transformative phenomena over which the dynastic competitors of early Europe had no control. How then did these factors play out in the communities who built, sailed and sometimes lost the ships that developed Europe’s nation states in an increasingly global world?

Amjad Ali,1 Erbprem Vatcharangkul,2 Shabir Ali Aamar,1 Ateeque Rahman Khuharo1 and Pirzada J.A. Siddiqui,1

1 Center of Excellence in marine biology, University of Karachi, Karachi, Pakistan
2 Underwater Archaeology Division, Fine Arts Department of Thailand, Kai Nern Wong, Tha Chalaeb, Thailand

Marine life associated with Ruea Mail wreck near Mannok Island, Thailand

Wrecks of sunken ships not only have great cultural, historical and technological significance but also act as reefs under the sea and serve as biodiversity hot spots. In spite of having a great number of benefits, ship wrecks across the globe face a number of threats including: earth quakes, cyclones, physiochemical weathering, biological deterioration, looting and damage from irresponsible recreational diving, etc. The Ruea Mail wreck site is located near Mannok Island in Rayang province of Thailand. The ship has a steel hull and is lying in 18 to 20 m of water. The coins gathered from the wreck show that it was a French vessel of the colonial period. Basically, it was a commercial cargo carrier in nature and run between Saigon, Viet Nam and Bangkok for trade purposes. The present study was carried out to assess the diversity and abundance of marine life and possible threats to Ruea Mail wreck as a part during second foundation training course on underwater cultural heritage held in Chanthaburi, Thailand (1st March to 9th of April, 2010) organized and supported by UNESCO Bangkok. The results show that Ruea Mail wreck possesses highly diverse fauna compared to its surrounding habitats. Threats to Ruea Mail wreck are discussed. Although there were no major threat but fishing activity appears have considerable impact on the wreck and its biodiversity.
Fabio Esteban Amador  
National Geographic Society, USA  

National Geographic’s Contribution to Nautical, Maritime and Underwater Archaeology

National Geographic is well known for its iconic magazine, but not truly recognized for being a leader in funding research. The fact is that in the past 120 years, NG has provided over 10,000 grants in the natural and social sciences. The development of nautical and maritime and underwater archaeology has been at the forefront of our efforts that have produced hundreds of articles, publications and television specials that have promoted the science to a world wide audience. We are proud to have been the supporter of George Bass’ 1961 Cape Gelidonya excavation project, considered the first underwater archaeology project, Robert Ballard’s research on the Titanic, and most recently, Randal Sasaki’s study of the Mongol Invasion of Vietnam. These are some examples of our commitment to support scientists and explorers in achieving their goals and in changing world views and perspectives of the past. National Geographic has been at the forefront of nautical, maritime and underwater archaeology and we are presently contributing to the development of advanced deep water mapping and imaging technologies which will enhance our understanding of maritime cultures. This presentation hopes to provide a brief look at the history of National Geographic’s support and a perspective of future research, by focusing on recently funded projects around the world that may change the way we explore, study, preserve and understand submerged cultural heritage.

Alessia Amato  
University of Coimbra, Portugal  

The maritime system in the Garb Al-Andalus, Portugal

As part part of an ongoing PhD project at the University of Coimbra, data are compiled and analysed related to the development of the fruition of the maritime system in the Garb Al-Andalus. It covers the chronological period of five centuries of Islamic presence in Portugal, with its geographical borders between the Tagus and Guadiana rivers. The referred territory represents the startingpoint in the identification process of all maritime affinities present in the nautical character of the region. The objective of this research is the reconstruction of a living and dynamic system of integrated maritime trade port in a given circuit, which coincides with the morphological and physical realities defined by Maria Luisa Blot (2003) (estuaries, rivers and lakes) and their possible inclusion in a larger space formed by the interaction between a latin sea (the Mediterranean), albeit in Arabic language, and the technological innovations present in the Atlantic sea. After determining the specific elements of each port or areas under the influence of a given port (the topographic location of aquatic activity, accessibility and the lines of penetration into the territory), the research aims to determine the access level to raw materials used in the shipbuilding process, as well as places of production and logistics related to yards and arsenals. This study will also analyze the iconographic features present in ceramic evidences and graffiti of an allegedly Moorish ship from the 7th to 13th centuries.
Evgenia Anichtchenko  
Anchorage Museum, Anchorage, Alaska, USA

Euro-American Shipwrecks in the Indigenous Landscape of the Arctic

For most indigenous people of the Arctic the first contact with European and American explorers, traders and whalers was a maritime affair. First greetings and trade goods between Native inhabitants and non-native newcomers were often passed between the skin boats and the decks of ships. Although dates of this contact differ from one Arctic nation to another, the results were often the same. Carrying new technology, resources and culture, European and American shipping and ships themselves significantly altered both the social and physical landscapes of the Arctic.

At the same time, once inserted into the indigenous landscapes, the ships also acquired new meanings and uses, especially after their abandonment or wrecking. Ships were seen as both similar and different to the Native boats. Just like skin boats they were perceived as animated objects or beings with their own needs, including deposition of their “remains.” In the holistic indigenous worldview this deposition was both functional and ritualistic, which is reflected in how the ship wreckage was used. Using the site of the 1871 Chukchi Sea maritime whaling disaster as a case study this presentation discusses the impact of a large shipwreck event on an Arctic community and the perception of the Euro-American ship as it is reflected in the use of wreckage remains.

In early September of 1871, a fleet of 32 whaling ships became trapped and abandoned between the icepack and the Chukchi Sea coast near Point Franklin, Alaska. All but one were crushed by the ice, providing local Inupiat communities with a wealth of resources, which in turn affected the settlement distribution, house architecture and even changes in subsistence technology. Shipwreck remains are still present and prominent in the local landscape. The paper draws on the results of three archaeological seasons (2005, 2007 and 2008), as well as interviews with local elders and traditional Arctic boat lore.
Jens Auer  
University of Southern Denmark, Esbjerg, Denmark

The *Skjernøysund 3* Wreck. An example for long distance timber trade in the late 14th century

In 2011, the Maritime Archaeology Programme at the University of Southern Denmark carried out a diving field school in southern Norway. The three week field school was organized in cooperation with the Norwegian Maritime Museum and targeted the remains of a clinker vessel in Skjernøysund, a strait separating the small island of Skjernøy from the mainland. The wreck was found by local divers and had been subject of a short inspection by the Norwegian Maritime Museum. As it was partially exposed and heavily affected by marine borers, the main aim of the field school was to carry out full in-situ recording and limited excavation to extract the maximum amount of information from the site. In addition extensive dendrochronological sampling was undertaken. The wreck of *Skjernøysund 3* consists of a 16.5 m long section of the keel and an 18 m long and almost 4m wide part of the starboard side. The side survives to a level just above the turn of the bilge. The vessel was built of southern Baltic oak and could be dated to 1390. Cargo remains found on the site include slaked lime in wooden barrels and radially split oak planks. This paper focuses on the results of the field school project and reports on construction and analysis of a long distance trader from the end of the 14th century. The presence of a datable timber cargo with known provenance offers new alleys of research into late medieval timber trade.

Paul Baggaley, Stephanie Arnott, Graham Scott  
Wessex Archaeology Ltd

Regional environmental characterization. Multi-disciplinary studies of maritime cultural landscapes in the UK

Increasing reliance in the UK on marine aggregates has led to a need for regional studies of the character of the marine environment in areas that are subject to marine aggregate extraction. These regional environmental characterisation (REC) studies involve archaeology, geology, biological characterisation and integrated assessment of habitats and biotopes. Multidisciplinary working by a range of different specialists and the shared use of geophysical and other data are key aspects of these studies, as is an approach to the shipwreck archaeology that is based upon an understanding of the wider maritime and economic history of the region concerned. The paper will examine a typical project, the South Coast Regional Environmental Characterisation. It will examine the strategy behind the REC approach to maritime cultural heritage, the multi-disciplinary use of data, the methodology adopted for the study of the maritime cultural landscape, significant results and the lessons learnt in terms of how far this approach can inform both the management and study of shipwreck sites in the regions concerned.
Karen Balayan  
“AYAS” Nautical Research Club, Yerevan, Armenia

Armenian merchants in the Indian ocean in the 17th-18th centuries

Armenian merchants had a great influence in India and China from very early times (BC). In the 12th century AD Armenian sea merchants had their own trade settlement in Canton. Up to the 17th century AD Armenians have created a large net of their merchant sea routes in Indian Ocean and the west part of the Pacific. Europeans became to play important role in the region after the discovery of sea route from Europe to India around the Cape of Good Hope. On the initial stage of their activity in India the Europeans looked for partnership with the Armenian merchants. Armenians had such a big influence and position, that the Europeans used these connections to penetrate deeper in the Indian community. In this process Armenians plied the role of mediators between the Europeans and local authorities. Permanent wars between the Europeans created difficulties for cooperation and trade between them. In this situation Armenians have took the role of mediators between Europeans as well.

We have collected information about the usage of the Armenian flag by Europeans in order to avoid difficulties when entering the harbour cities, which were controlled by theirs enemies. They were sometimes even dressed in Armenian traditional clothes. They have introduced their goods as an Armenian belongings and addressed them to Armenian supercargo as used Armenian ships for the same reason. After establishing a stabil trade net the European companies have changed theirs politics toward the Armenian merchants, who become their competitors in the region. Mostly it is concerning Britishers. Competition was present between Europeans as well, but all of them had a governmental support, in contrast to Armenians, who did not have independent state at that time. Sometimes Europeans turned to such methods as piracy, privateers and other dubious methods of competition.

A lot of evidences of their actions have been preserved. Privateers extended theirs rights and captured the ships of the allies and friends very often. In absence of the state support, Armenians’ trade collapsed. By the end of the 19th century Armenian colonies decreased in number. Only a few small companies in the Far East were left.
The Hidden Structure of Vasa. Recording the Frames

As part of the ongoing documentation and research into the Dutch-built Swedish warship Vasa, and on behalf of the Vasa Museum, the author developed and implemented a method of recording the hidden frame structure of the ship. The method involves tracing the individual timbers of the frame and marking points along their edges, which are subsequently recorded with TotalStation. At each point, the sided and moulded dimensions of the frame timbers are also recorded. The data is used to produce a three-dimensional framing plan of the ship. The accuracy of the method was confirmed by the removal of three planks from the exterior of the hull, which exposed the timbers of the frame. The research has proven that Vasa was constructed in accordance with the Northern Dutch method of shipbuilding described by Nicolaes Witsen, rather than the Southern as has sometimes been suggested. The project has also uncovered archaeological evidence that the ship was intended to be a three-decker from the beginning of the building and, contrary to popular legend, no major structural changes were introduced in the process of construction. The project will aid the conservation effort, the design of the new support system for the vessel and the research into 17th-century Dutch shipbuilding.

Tomasz Bednarz
Polish Maritime Museum, Gdańsk, Poland
Menno Leenstra
Centre for International Heritage Activities, Groningen, Netherlands

The 18th-century Dutch vessel De Jonge Seerp, identified as wreck W-27 from Gdańsk Bay, and his skipper Johannes Leenderts

The W-27 wreck was discovered in 1985. From this time research was conducted, with short breaks till 2006. Most of the artefacts and elements of stern construction were scattered within 30-40 m on S-W from the main wreck construction. The wreck was lying in a sandy bottom of Gdańsk Bay, at a depth of 25 m. The W-27 wreck was a flat bottom trade ship, kuff type, over 30 m long. Some of wreck’s artefacts and construction’s elements, for example decoration of a head ruder in a shape of a clover leaf, show that we deal with a ship of a Dutch origin. Another interesting artefact, a brass tobacco-box with engraved a genre scene and words in Flemish. On the basis of analysis of the coins, lead seals and barrels, it is accepted that the ship sank at the end of 18th century, probably in 1791 or a little later. In June 1791 there was a shipwreck noticed which could be associated to the W-27 wreck. John Campion, a skipper from Whitby, testified in front of the Gdańsk mayor that his vessel the Recovery, in a heavy windstorm, had had a collision with the Dutch kuff De Jonge Seerp under Johannes Leenderts, a skipper, command. The Dutch ship sank soon after the accident.
Johannes Leenderts is a name which regularly appears in the Sonttol-registers of this period. Although similar names sometimes are mentioned, he can be rather easy identified, as in most of his voyages he is registerd as coming from the Frisian harbour of Harlingen. A ship under his command passed the Sont eastwards on 8-6-1791. At the wreck-site a name shield "JONGE SEERP" has been found. A musterroll of a ship of this name, commanded by Johannes Leenderts, dated 17-7-1786, has been located in the Amsterdam Municipal Archives.

In different sources concerning the city of Harlingen, the life and carreer of Johannes Leenderts can be followed from his birth in that city on 20-10-1757, to his death on 6-5-1828 in the same place. In periods when the Dutch were at war with the English he possibly changed his “city of origin” a few times to Emden, but from 1788 to his death he did posses the same house in Harlingen, where he settled as harbourmaster from 1814.

Except from the musterroll no documents are found yet with more details on the ship De Jonge Seerp. A possible candidate for its name-giving could be Seerp Gratama, born in Harlingen on 17-10-1757, as a member of a merchant and shipping family, that administered other ships with similar family-related names.

Charles D Beeker
Indiana University Indiana University, Bloomington (IN), USA
Pavel Galoumian
ANAHIT Association, Geneva, Switzerland

Captain Kidd’s Armenian shipwreck the Quedagh Merchant. A unique west India constructed 17th-century pirate shipwreck in the Caribbean

For over 300 years, people have searched for the Quedagh Merchant, the Armenian owned vessel captured by Captain Kidd off the coast of India in 1698, yet the ship’s location remained a mystery. In 2007 the Dominican Republic Government requested Indiana University investigate an unknown shipwreck. Resulting underwater archaeological excavations indicate the teak hull, framing pattern, rabbeted joints, use of iron spikes for fasteners, and use of the concrete-like glue sealant all point to origin of the ship as specifically the west coast of India. During Captain Kidd’s 1701 trial for piracy in London he testified “…the ship was built in Surat…with all seams rabbited.” The archival records together with the underwater archaeological findings on the wreck site provides the proof for Indiana University’s identification of the wreck as that of India Merchantman Quedagh Merchant. More importantly then being the only positively identified pirate ship in the Caribbean as the captured prize of Captain Kidd, the Quedagh Merchant is a unique extant example of 17th-century west coast of India shipwright technology.
Mike Belasus  
Deutsches Schiffahrtsmuseum, Bremerhaven, Germany

**Connecting maritime Landscapes. Early modern news from two former „Baltic Cogs“**

For a long time it was believed that the wrecks of two large clinker vessels from the Baltic coast of Mecklenburg-West Pomerania, *Poel 11* and *Hiddensee 12*, were the remnants of late 14th-century cargo ships of extraordinary size built on the southern Baltic coast. It was also suggested that they represent a special type of ship which was then called “Baltic Cog”. This definition was based on observations of some common technical features with ships of the so-called “cog” – tradition and goes back to a theory of the German scholar Paul Heinsius. However, many aspects such as technical details and the use of conifer wood differed from the known medieval ship finds of the Southwest Baltic Sea. Recent dendrochronological Analysis carried out by Aoife Daly dated the *Poel 11* wreck to 1773 or shortly after. The pine trees for the ship where cut in Southwest Finland. The medieval dating of the *Hiddensee 12* wreck could not be confirmed. A new investigation of the cargo and other finds from the site as well as the technical comparison with other ship finds from the Baltic point to a building date around 1800 in the same area of the Baltic as observed for *Poel 11*. Their former interpretation as a type of the medieval “cog” allows to draw connections between maritime landscapes and the circumstances of the development of shipbuilding traditions.
The hull of a presumed Venetian shipwreck of the end of the 16th century off the Croatian coast

Three short seasons of excavation carried out by a Croatian and Venetian team on a seafloor at a depth between 36 and 43 m have allowed a preliminary documentation and study of the remains of the hull of a shipwreck sunk against the so called S. Paul's cliff, off the island of Mljet. The cargo was composed by various types of Iznik pottery and some vessels of glass while the ship owned to a western merchant. At least one (but probably seven) of the eight swivel bronze guns are in fact of Venetian production, bones of pig have been recovered and at least a part of the pottery which was probably used aboard has been produced in Venice. The sinking had to happen some years after the date 1567 engraved on the ship bell as suggested also from the dating of some coins.

The remains of the ship, which cover a surface of only 6 per 3.7 m, allow to reconstruct a possible 24 m long vessel with quite flat bottom and apparently without keel. Original is the use of a double layer of external planking which is unusual in the Medieval shipbuilding of the Mediterranean. Observations will be presented on the results of the wooden analysis, on the design of the frames and on the elements composing the keelson. We will present also some objects from the nautical equipment. This hull is a very rare evidence of shipconstruction of the Late Middle Age in the Mediterranean.
Alessandra Benini  
Università della Calabria, Associazione Italiana Archeologi Subacquei, Italy

The Greek Archaic sewn boat from Gela, Sicily

The shipwreck *Gela I* has been accidentally discovered in 1988, thanks to a pile of stones protruding from a sandy bottom in a depth of about 5 m, not far from the coastline. Between 1989 and 1993 the site was almost completely excavated and the cargo fully recovered. The excavations of the site re-started during the summer of 2003, with the aim of recovering the wooden hull. The difficult task took something like 5 years and was completed in 2008, when all the wooden preserved parts of the boat were shipped to Portsmouth in the United Kingdom, to be restored. After 4 years the restoration is not finished yet.

The find of about seven tons of stones, probably the ballast, seems to demonstrated that all the goods of the load must have already been discharged when the ship sunk. In fact, according to its topographic position, we can argue that, before sinking, ship was sailing to the *emporium* of Gela, possibly to sell the last items. On the other hand, the data collected during many years of researches do not permit us to exclude that the boat could have even been on its route back from trading goods along the Sicilian coast.

The residual load consisted of different amphoras and decorated pottery: their analysis concur in dating the wreck to the end of the 5th century BC.

Concerning the structural elements of the boat we can say that the preserved part of the hull was about 17 m in length (we found part of the keel and the sternpost), for a maximal width of about 4.30 m (12 planking strakes have been recovered). The excavations allowed us to recover 12 of the 17 original floor timbers as well as the keelson.

According to our analysis, all the planking was sewn, but mortise and tenon joints locked by tapered pegs seems to have been used in the bow and stern assemblies. Moreover, during the preliminary study of the hull, we are still waiting for the return of the timbers from Portsmouth, we have identified some interesting details that make this shipwreck unique and different from others Greek archaic ships, especially concerning the hull assembly.
José Bettencourt  
Centre for Overseas History, Universidade Nova de Lisboa & Universidade dos Açores, Portugal

The 16th-century Iberian ship *Angra B* (Azores, Portugal). A pre-disturbance survey

Discovered in 1960s, *Angra B* wreck was first surveyed in 1996 by an Institute of Nautical Archaeology team and, after 2006, by the Centre for Overseas History (Centro de História de Além-Mar - CHAM) in the scope of PIAS and A ship for the Atlantic projects. The wreck was located at around 5 m deep within the protected area of Angra Bay Archaeological Park, created in 2006 by Azores Government, and is actually affected by a complex combination of environmental processes that exposed and gradually eroded the ship timbers. The site includes an 18 m long and 11m wide ballast tumulus, which protects one side of the hull, from the keel to the beginning of the first deck. The analysis made between 2006 and 2011 of exposed timbers (frames, stringers, ceiling planks and outer planking) reveals features of Iberian ships, probably related to Biscayan shipbuilding, similar to several observed on ships operating in Atlantic exploration in the 16th century. Between them, are a probable T cross section of the keel or the presence, in the ceiling, of a strake notched to receive filler planks, known in Spanish documents as *albaola* and *escoperadas*.

Caesar Bita  
National Museums of Kenya, Mombasa, Kenya

Shipbuilding technologies of the Swahili coast

Kenya has a coastline approximately 600 km long which is part of the Western Indian Ocean; commonly referred as the “Swahili coast”. This coast is characterized by alternating beaches, rocky outcrops, coral reefs, large estuarine areas, wetlands, lagoons and inter-tidal flats. It has an almost continuous fringing of coral reef shelf running parallel to the coastline. Over the years the adjacent continental shelf has been subjected to marine activity thereby leading to creation of new coastlines through fresh deposition of sand dunes and formation of coral rocks. Communities in the region have had a long and continuous history of interaction with the Indian Ocean in terms of subsistence fishing, trans-continental trade, warfare and magico-religious practices. Dotted along this stretch of coastline therefore are maritime practices that continue to depict varied relationships between humanity and the sea. Similarly, the coastal landscape has influenced much of these maritime practices. Although different types of sea crafts are used in the Swahili coast, their construction technology and use has been influenced by the Swahili coastal landscapes. From the large deep sea venturing *jahazi* (large boat) to the smallest *mtumbwi* (dug-outs), the traditional boat building styles that have been practiced for centuries continue to play a role in the lives of coastal people in the Swahili coast. Drawing from ancient literature, previous and current maritime studies; this paper examines ship building technologies and how these have been influenced by the varying landscapes in the Swahili coast.
Emergency recording of the “barque du Léman Neptune”: working conditions, methods, results

The “barque” Neptune, built in 1904 according to Mediterranean design and building methods, is today attached to the port of Geneva and, being the last surviving representative of a formerly numerous fleet of large lateen-rigged stone carriers, classified a cultural heritage monument. Almost entirely rebuilt in 1973-1975, she was to undergo another thorough restoration in 2004-2005. If any original structures had been left in place on the occasion of the restoration of 1973-1975 or the subsequent repairs, they could be expected to come to light again this time, but there was a major risk that the last surviving authentic elements of a shipbuilding tradition several centuries old might disappear almost unnoticed. I was given the opportunity to survey and record the original structures of the ship provided that I would not interfere with the ongoing restoration works. The recording methods had therefore to be simple and efficient. It was possible to establish: 1. the method used in moulding the floors, 2. the process of shaping the floors, and 3. the assembly sequence of the pre-determined frames prior to their erection on the keel. These three issues have strong parallels in medieval and later Mediterranean shipbuilding: 4. The planking of the central part of the bottom followed an unusual pattern with straight seams. 5. Repairs: changing of floors, parts of floors, bottom planks, and futtocks.

Lucy Blue, Julian Whitewright
Centre for Maritime Archaeology, University of Southampton, UK
John P Cooper
MARES Project, University of Exeter, UK

The ubiquitous ḥūrī

This paper will provide a brief overview of a project that has been ongoing for over ten years: the University of Southampton Indian Ocean ḥūrī Project. Until very recently ḥūrī (plural ḥawārī) could be seen in almost all harbours around the shores of the western Indian Ocean and Red Sea littoral. Constructed in western India and transported across the sea on the decks of dhows, this small log boat operated as ship’s lighter, harbour boat and coastal fishing craft in inshore waters from India to the Arabian Gulf, from East Africa to the Red Sea. The ḥūrī project has been studying the remains of this craft, noting its adaptation to context and culture at ports across the region. This paper draws upon fieldwork conducted in Egypt, Eritrea, Sudan, Yemen, Tanzania, Oman and India. It outlines the basic constructional features of the ḥūrī but also explores the variety of changes undertaken, the technological choices, social statements and functional variation that are expressed in these adaptations, and that reflect the society that used them. Viewed through the lens of ethnographic analysis, this continuity and variation provides an opportunity to inform upon and potentially further our understanding of maritime technology in the archaeological record.
Ronald Bockius
Römisch-Germanisches Zentralmuseum (RGZM), Mainz, Germany

The Nydam ship finds and the crystallization of Northern European shipbuilding tradition during the Roman Iron Age

Ship remains found in 1863/4 in the Nydam bog since more than 100 years ago were discussed as being the earliest witnesses of a shipbuilding tradition which developed in Scandinavia and adjacent regions from the Migration through Viking periods well into modern times. Clinker construction with overlapping strakes riveted by iron roves and rivets is one prominent feature which survives throughout the past whereas the principle of frames lashed through fast clamps to the plank shell was replaced by another system during the Viking Age. Even fittings such as the characteristic sickle-shaped oarlocks of the oar driven Nydam vessels continued to be used in northern Norway by the 19th century.

The constructional differences to other shipbuilding practices, particularly such from the contemporary Mediterranean tradition seemed widely clear so that scholars rarely compared shape and technical features of the Nydam boats with sources other than those found in the North. Was the origin of shipshape of the double-pointed vessels interpreted by the occurrence of expanded logboats since the early 1st century AD, the Iron Age Hjortspring boat and British Bronze Age shipbuilding standards indicate technical components which obviously predetermine characteristics found with the Nydam and younger plank built watercraft.

It was the late Ole Crumlin-Pedersen who in his later carrier began to accept certain elements as “Roman influence” on Northern European seafaring and shipbuilding, as iron stock anchors of Mediterranean type, the design of stem and stern posts and the method to join them onto the keel of the Nydam boats, last but not least the introduction of oar propulsion for navigation in the Baltic.

The present paper analyses a selection of ship technical details and processes which should be interpreted as standards of Romano-Celtic shipbuilding, especially in the field of inland vessels. Hints are provided in particular by regional types of Gallo-Roman ship finds from the lower Rhine area, but also from the French river systems of Saône, Rhône and Gironde where luting procedures and lapstrake construction reveal correlation to early clinker built boats of the Western Baltic and southern Scandinavia. Other features are related to specific elements of oared vessels found in the Roman Rhine provinces and further to the concert of Mediterranean ship construction.

As comparisons indicate the earliest remnants of clinker built boats of the North, but also some expanded logboats from a ship technical perspective figure an amalgam of prehistoric Northern European skills and Roman techniques adopted and modified respectively by local boat builders. The geographical scope of that phenomenon seems to be the coastal landscapes along the Southern and Western Baltic, with the core area in the south of Jylland peninsula. Ole Crumlin’s tentative historical explanation of a technological transfer carried by the reflux of “barbarians” retired from the Roman auxiliary troops stationed along the Rhine limes seems to be most convincig.
Giulia Boetto  
Centre Camille Jullian (CNRS), Aix-en-Provence, France  
Paola Germoni, Alessandra Ghelli  

New Roman Shipwrecks from Isola Sacra, Rome, Italy  

In April 2011, the discovery in Isola Sacra (Fiumicino, Rome) right bank of the Tiber of a new ship-find was announced to the press by the Italian Ministry of Heritage and Cultural Activities and by the archaeologists of the Special Superintendence of Archaeology of Rome (SSBAR). This unexpected discovery, about 50 years after the discovery of the well-known shipwrecks of Fiumicino in the port of Claudius, appeared at a depth of 2.5 m during the excavation of a trench within a huge programme of preventive archaeological researches promoted by the City of Rome and the Superintendence for the construction of a new bridge on the Tiber (Ponte della Scafa) and its connected road system.  
Isola Sacra, situated between the colony of Ostia at the mouth of the Tiber and the maritime harbour of Rome (Portus) facing the fossa traiana (today the secondary outlet of the Tiber, the Fiumicino), is well known for its necropolis dated to the 2nd century AD. The excavation of the shipwreck, named Isola Sacra 1, started in June 2011 and has been completed in the beginning of October. This vessel showed a transom bow and particular fittings in its fore part. The transom allow us to include Isola Sacra 1 within the family of the horeia-type vessels, which are working boats well known from contemporary iconography and archaeologically attested by three exceptional shipwrecks discovered within the ancient silted harbour basins of Toulon (France) and Naples (Italy). During the archaeological investigations, a second shipwreck (Isola Sacra 2), laying perpendicularly to Isola Sacra 1 and partially covered by it, came to light. Only the southern side of Isola Sacra 2 has been investigated and documented. The paper will present the main architectural characteristics of these two well-preserved shipfinds, preliminary dated before the 3rd century AD.
Jörn Bohlmann
Norwegian University of Science and Technology (NTNU) and Sør-Trøndelag University College, Trondheim, Norway

Reconstruction of sails and the craftsmanship of sailmaking. The human senses as intangible culture

Almost never are rigs and sails parts of maritime archaeological findings; hence their reconstructions often are hypothetical. Therefor the forms and cuts of sails are based on the iconographic survey of different contemporary artistic depictions - while the craftsmanship is based on today’s knowledge. The correlations between archaeological findings, the survey of their contemporary arts and our modern idea of traditional craftsmanship are today’s fundamentals for sails within scientific nautical archaeology. Also the reconstruction of the two square sails for a 24 feet long, archaeological boat-finding, the so called Barcode-6-boat, which dendrochronological is dated to be built in 1595 and submerged in Oslo in 1624, is based on that methodology.

However, the approach for their reconstruction deliberately is more versatile. As a leading case for the PhD-project of an educated and experienced sailmaker and wooden-boatbuilder, not only the questions of the sails form and areal rises. Focus is set on aerodynamic depth-profile of sails through history, the use of different materials and qualities of sailcloth and the process of sewing. As a guiding research question, the use of the human senses in traditional sailmaking and sailing is object of the PhD-research. With the investigation of fragments of sails such as the Vasa-sails or the woolen cloth of the 14\textsuperscript{th} / 15\textsuperscript{th} century, found in the roofs of Norwegian churches, the craftsmanship of sailmaking itself and the significance of tacit knowledge is in focus. The question rises, if the paradigms of nowadays “traditional” sailmaking in special and craftsmanship in general are valid for scientific archaeological research.
The involvement of Butuan in the maritime trade ca. 10\textsuperscript{th}-13\textsuperscript{th} centuries AD

Involvement in the ancient maritime trade by the Philippines has not been fully understood. This present research investigates the involvement of Butuan, one of the independent polities found in northeastern Mindanao, southern Philippines, in the maritime trade between the 10\textsuperscript{th}-13\textsuperscript{th} centuries AD.

The Philippines, particularly Butuan, has been considered as peripheral to the ancient maritime trade because of its easternmost geographical location vis-à-vis mainland Southeast Asia and Indonesia although evidence suggests otherwise. The discovery of plank-built, edge peg boats and Chinese tradeware ceramics in the area prove of Butuan’s involvement in the trade. Other imported artifacts included rhinoceros teeth, glass beads, an ivory seal with the word *Puduan* and a gold image of Tara, a Buddhist escort.

The landscape of Butuan has undergone many changes due to geologic factors. The use of geomorphological maps helped in identifying the areas that were used by the different groups of people but are no longer easily seen. Faultlines were identified that bisected Butuan that pushed Agusan River, one of two major river systems in Mindanao, from west to east, inundating and drying places in the process.

There were different groups of people that participated in the involvement of Butuan in the maritime trade. There were the *Sama* who are the most probable builders and navigators of the boats that plied the trade, the Muslim traders who were taken-in to represent the Butuanon chieftain while the Manobo collected forest products and built the dug-out canoes that Butuan exchanged for the imported goods.
Sónia Bombico
CIDEHUS (Centro Interdisciplinar de História, Culturas e Sociedades), University of Évora, Portugal

Oakfield 1883-97. The shipwreck of an Atlantic Steamship (Ponta Delgada, São Miguel Island, Azores)

In 2008, during archaeological monitoring of the works of the project New Cruise Maritime Terminal of Ponta Delgada, Azores, were identified the remains of an iron structure of a 19th-century English steamer, sunk inside the Ponta Delgada’s harbour dock. The bay frequented by shipping since the discovery of the island of São Miguel, in the 15th century, became a port with great historic and strategic importance in the triangular trade. But the peak of this commercial port happens in the 19th century. In this context, the British steamship, based in the orange trade and the supply of coal, is the major victim of the storms of the 19th century.

The underwater archaeological work allowed a probable identification of the remains with the steam Oakfield. Built in 1883 for Burrell & Son of Glasgow, by Oswald Mordaunt & Co. Shipbuilders & Engineers in Southampton, and sunk on 22 January 1897, according to information gathered in the contemporary local press. The archaeological site was constituted by the ship's hull structures, located at a distance of 15 m from the current shoreline, at an average depth of 5 m. The main structure was about 11 m wide by 35 m long. Subjected to salvaging activities the ship's structure was only preserved in situ at deck level. Among the material identified were included board tools related to the steam engine’s operations, but also fire-clay bricks. We also identified the remains of the ship's cargo, bags of sugar from Demerara (British Guiana) and casks of rum.
Mauro Bondioli
Independent researcher ancient shipwrecks

The *Libro di navigar*. A new treatise on Venetian shipbuilding from the 14th Century

Most of our knowledge pertaining to late medieval Mediterranean shipbuilding is based on Venetian written sources from the 15th century. Until now, studies regarding these sources show that Venetian shipwrights employed geometric reduction methods to pre-design a substantial portion of the ship’s frames. These methods have been documented on some archaeological sources as well, like the Culip VI shipwreck, in Catalonia, Spain. To these shipbuilding sources it is now possible to add a new one, currently the oldest known, dated to around the second half of the 14th century. Its anonymous author, a man of the sea of Venetian origin, used to travel in the Eastern Mediterranean, provides us with information on dimensions and rules to build round-ships, including their masts, sails, rigging, and anchors, as well as descriptions of geometrical reduction methods whose existence was undocumented until the 17th century. This paper highlights the content of this new codex and proposes some new hypotheses regarding the application of geometric reduction methods in the context of the technological revolution of hull conception and construction of the late middle ages, particularly in what pertains to the period of transition from shell-based to skeleton-based shipbuilding.

Karl Brady
Department of Arts, Heritage and the Gaeltacht, National Monuments Service, Dublin, Ireland

Recent shipwreck discoveries in Ireland with particular reference to a probable 17th-century Dutch East Indiaman

This paper will provide an overview of some of the more important shipwrecks discovered in Irish waters in recent years. The Underwater Archaeology Unit (UAU) is responsible for the quantification, management and protection of Ireland’s underwater cultural heritage. However, a major part of the brief of the UAU is to investigate and survey newly discovered archaeological sites and wrecks. The main focus of the talk will centre on a wreck located in the northwest coast of Ireland which has being surveyed by the UAU over the last three years. To date 13 iron cannon, cannon balls, wooden barrels, pewter bottle reinforcement rings and screw caps and a number of boat-shaped lead ingots have been recorded at the site. Preliminary analysis of the artefacts appear to indicate that the wreck may be that of a previously unrecorded 17th-century Dutch East Indiaman. Evidence from other wrecks in the vicinity indicate that there may also be the remains of a second Dutch East Indiaman located in the same Bay. This wreck will be discussed in detail along with a summary of other wrecks recently discovered, including dugout boats, a possible 17th-century pirate/slave trader from Dunworley Bay and what may be a revenue cutter, excavated and reburied at Inishbofin Island, off the west coast of Ireland.
During the 17th century enormous changes occurred in ship construction practices in Northern and Western Europe. Most knowledge about 17th-century ship construction derives from treatises. If these records are reliable, ship construction techniques of this period often vary in terminology and construction method. Archaeological finds have contradicted, and at times, corrected historical sources. This perhaps reflects the 17th century as a period of technological innovation and change in ship construction practices. Archaeological examples of this time period are sparse, and 17th-century wrecks in North America, even rarer.

In 2010 the remains of a 17th-century wooden ship were removed from the sands of Corolla, North Carolina. Documentation and analysis of what is popularly known as the Corolla Wreck, (North Carolina Underwater Archaeology Branch Site 0022CKB) present an opportunity to study 17th-century wooden ship remains in context of the maritime cultural landscapes of Atlantic North America. Research questions asked of this wreck stem from archaeological and historical observations made over two years of field work and research. Ship construction analysis will seek to answer whether the extant remains of the Corolla Wreck can offer evidence for its use and origins when compared to contemporary archaeological wrecks. Analysis of constraints involved in ship construction may reveal insight into its myriad of influences, most importantly, what ideological factors affected the vessel’s design and construction. Research will seek answers to the possible origin and function of this ship and what part it played in the systems of Atlantic commerce and colonization.
P. Burger¹, R. Stacey¹, M. Hacke¹, N. Nayling², T. Jones³ and K. Smith⁴

¹ Department of Conservation and Scientific Research, The British Museum, London, UK
² School of Archaeology, History and Anthropology, University of Wales, Ceredigion, UK
³ Newport Medieval Ship Project, Newport, UK
⁴ School of Chemistry, Cardiff University, Cardiff, UK

Ancient maritime pitch and tar. A multi-disciplinary study of sources, technology and preservation

Tars and pitches are black sticky substances manufactured by destructive distillation of wood from softwood trees such as pine and spruce. Tar is the initial liquid pyrolysate, while further distillation produces more viscous pitch, which is solid at ambient temperatures and must be re-heated prior to use. These materials have a long history of use as waterproofing agents and timber preservatives, especially in maritime contexts: they have been used by shipbuilders and seafarers to caulk the seams of vessels and to waterproof rope and tarpaulins. In the medieval period, their role in ship building and maintenance led them to acquire crucial strategic and political importance for the developing European seafaring economies and naval fleets.

Material from the recently excavated Newport Ship discovered in 2002 on the right bank of the river Usk in Newport, Wales is central to this study. The wreck constitutes the most complete example of a 15th-century clinker-built vessel ever found in the UK. The dating evidence (from dendrochronological analysis and coinage) indicates that it was constructed after AD 1445 and came to rest in Newport soon after AD 1468, while associated finds suggest contacts with the Iberian Peninsula. The ship predates the carvel-built Mary Rose by some 50 years and represents a late survival of northern European shipbuilding traditions. Results of a systematic study to map the use of tars and pitches over the whole vessel to further the understanding of the construction and later repair of the ship will be reported here.
A Byzantine anchor and a wooden boat from Late Antiquity found at Plaza Nueva, Seville, Spain.

Few Byzantine shipbuilding examples (hull remains from shipwrecks) and Byzantine anchors are known, and the most important cases are located in the eastern Mediterranean. In 1981 during public construction works in Seville, Spain, Spanish archaeologists found a Byzantine anchor and the hull remains of a wooden boat. Later on in 1988, it was believed that the anchor belonged to the boat and, consequently, the boat remains found in Seville were described as belonging to the Byzantine Period. The report of a Byzantine shipwreck found in the western Mediterranean, at the shores of the Guadalquivir River, seemed quite an unusual and important discovery. Briefly in 2007 and more extensively in 2012, the author has inspected and documented the remains of the iron anchor and the wooden boat found in the early 1980s.

The preliminary results of the study, presented in this paper, reveal that the morphological characteristics of the anchor are almost identical to some of the anchors found in the Yassi Ada shipwreck (7th century AD). However, if only the historical period in which Seville was under the rule of Byzantium is taken into consideration, the anchor found in Seville could be dated from the second half of the 6th century AD. The study also reveals that, although the anchor was made during the Byzantine Empire, the boat remains could belong to a later period. It appears the boat remains could date from the period between 711 and 1090 AD when Ishbiliya (Seville) was under Muslim rule as part of Al-Andalus.

The Stella 1 Roman shipwreck. A laced vessel in the upper-Adriatic region

A laced barge dated to the 1st century AD was found in 1981 on the Stella River, near Palazzolo dello Stella in Udine, Italy, loaded with roof tiles, coarse ceramics, and a small number of amphorae. It was surveyed in 1998/99 by Drs. Francesca Bressan and Serena Vitri, and covered with geotextile and sand bags. In summer of 2011 the University of Udine started the recording of the hull remains of this vessel as part of a larger project of study of the Stella River directed by archaeologist Massimo Capulli and titled Anaxum Project (Archaeology and History of a Fluvial Landscape). The 2011 field season was conducted in cooperation with the Nautical Archaeology Program at Texas A&M University, and coordinated by Dr. Luigi Fozzati of the Soprintendenza per i Beni Archeologici del Friuli Venezia Giulia.
After two stages (totally 5 years) of underwater archaeology survey in several hot zones around Taiwan, including Pescadores islands, Taiwan Banks, and nearshore areas near Tainan, many shipwrecks, including battle ships of Ching Dynasty, western and Japanese ships, were identified. Other suspected shipwrecks of Chinese junks, anchors and animal fossils were also founded. The future studies and preservation of these cultural heritages need good plans. Further surveys near Taiwan Banks, Pratas Island, and nearshore areas near Tainan and northern Taiwan are also planned.

On the other hand, recent two replicas of junks and the on-going retrieve project of Free China, a junk crossed the Pacific from Taiwan half century ago, together form a chance of experimental archaeology approach of junk technology study. Among them, Princess Taiping’s successful building and crossing the Pacific provided important clues, but, unfortunately, was sunk in a maritime accident; the replica of 17th-century Taiwanese junk Taiwan Cheng Kung is under preparation and will also need good plan for the study in real sea voyages. The retrieve of a real but modified junk Free China from San Francisco Bay Area is undergoing and hopefully will have a good study plan for its structure and history in the near future.
Eleni Christidou-Stylianou  
University of Leiden, The Netherlands  

Byzantine and Arab Cultural Relations in the Middle Ages  

The Byzantine and the Arab Empire were the two most outstanding powers in the Mediterranean which were in constant conflict. The aim of my paper is to show that in spite of their numerous disputes, they had simultaneously close cultural relations. I will attempt to trace the interrelations of these two grand Empires regarding navigation, literature and art. First of all, I will discuss the trade routes that existed at the time as well as their importance in linking the East with the West. Furthermore, after demonstrating the paramount importance of navigation as means of communication in the Byzantine and Arab world, the types of ships used by both powers are examined and explained. Subsequently, I describe in detail the types of ships of both empires with specific examples known through excavations and documentation, the advantages and difficulties that appeared in navigation, the methods of ship construction focusing on the transaction of shell-first to skeleton-first technique, the technology used, the trade routes that they followed and the mutual influences which took place. Therefore, the common characteristics that are shared by both powers are being examined, by concentrating on the main types of warships such as the Byzantine *dromon* and the Arab *shini*. Once it is established that navigation played an important role in the development of their cultural relations, since it was one of the main ways of communication, I will further discuss how the impact of the cultural exchanges of the two great powers of the time is manifested in their art and the literature.
The Roman *Ouest Giraglia 2* shipwreck (Corsica). Architectural study and some elements of reflection about the ship’s cargo

Discovered in 2008, the *Ouest Giraglia 2* shipwreck, located at Corsica Cape by 34 m depth, was excavated in 2010 and 2011 by a mixed team composed of underwater archaeologists of the Département des Recherches Archéologiques Subaquatiques et Sous-Marines (DRASSM) and Arkaeos association and voluntary divers of the Fédération Françaises d’Etudes et de Sports Sous-Marins (kind of french CMAS). The shipwreck has scientific value because it is a *dolia* ship type; the cargo is composed by *dolia* (big rounded jars) with different sizes, considered as wine containers. An important number of these jars revealed stamps *in planta pedis*, related to five different personages, at least. This is the most important stamp collection documented in a *dolia* type shipwreck. A complementary cargo of Dressel 2-4 amphorae, produced in Hispania Tarraconensis coastal pottery workshops, is associated to these *dolia*. Few stamps on these amphorae made possible to propose its sinking towards 50 AD, but this date doesn’t completely fit with the information given by the *dolia* stamps. All *dolia* were dispersed from the hull, most of them broken, covering a big area. To study their volume it has tested a based photogrammetry method that gives an approximation to the size of some of them. Moreover an important part of the bottom of the hull was preserved. Conserved over a 7.50 m length and a maximum width of 3 m, the fragment of hull probably corresponds to the central part of the boat and includes the keel, the first strakes of the shell and about twenty frames. The study reveals a particular architectural system which thus tends to confirm an architectural specificity of the *dolia* ship type with a flat bottom intended to receive and transport the heavy containers.
Pearce Paul Creasman  
Laboratory of Tree-Ring Research, University of Arizona, USA  

Ship timber as a basis for environmental and cultural interpretations

Basic dendroarchaeological analyses have been applied to ships for decades, largely to address chronological questions (for example, to provide a construction *terminus post quem*). Yet, dendroarchaeological analysis can extend far beyond the scope of a ship’s construction, back to the shipyard where it was built, up the supply-chain and into the forests from which the timbers were harvested. As such, this paper addresses fundamental, but often overlooked, questions regarding wooden ships: what can the timbers reveal about the people that built the vessels, the environment which yielded the natural resources, and their interactions?

While ships are commonly recognized as valuable economic and technological indicators, behavioral and environmental investigations derived from their timbers comprise a miniscule segment of the published record. Maritime prowess is and has always been, in part, dependent on access to the terrestrial products from which ships are made, especially wood. Without suitable timber supplies many societies struggled to build or maintain maritime influence. Given the volume of raw material typically required to construct a wooden ship there is much knowledge to be gained by systematically studying the timbers for insight into human-environment interactions, including: forestry practices, responses to environmental change, timber selection processes, patterns reuse and repair, seasoning, stockpiling, deadwood use, economy of wood use, and timber supply and trade. Ship timbers are a virtually unharvested trove of behavioral and environmental information and this paper presents the case for further investigation of such questions.
Deborah Cvikel  
Leon Recanati Institute for Maritime Studies, University of Haifa, Israel

The Akko 1 shipwreck, Israel. New evidence of the ship and its wrecking

The Akko 1 shipwreck and its finds were presented in the 12th ISBSA. Some questions, which were left open, have since been answered. Building scaled wooden models of the archaeological find and comparison with ships of the period were used in order to determine the original hull lines, and to establish the reconstruction of the original ship. The ship was built of eastern Mediterranean oak species, but the hull was not a protective shell. As scaled-down cannon fire experiments proved, a 12-pdr cannonball, striking perpendicularly, would have easily penetrated the side of the ship, causing much internal damage. Archaeometallurgical analysis, based on chemical composition of the metal, proved that two cannonballs (9-pdr and 24-pdr) retrieved from the shipwreck, were manufactured post-1839. In addition, petrographic analysis of sand found inside the 9-pdr cannonball determined the location of its manufacture to be in Egypt. Supporting the Egyptian connection of the ship are various finds, among them several clay tobacco pipes, and a base of a water vessel, all located in-situ, and found to be of Egyptian origin. In light of the archaeological evidence and the historical background, it is suggested that the Akko 1 shipwreck is the remains of a 26-m-long auxiliary 16-gun brig, built in the first quarter of the 19th century, and sailing under the Egyptian flag. The brig was friendly to Akko, and the wrecking was probably as a result of the 1840 naval bombardment of the town.

Aoife Daly  
School of Archaeology, University College Dublin, Ireland

Timber – regionality and temporality in Northern Europe’s shipbuilding resource

A great wealth of tree-ring data now exists for oak ships found across Northern Europe, due to the exercise of dating these timbers and, not least, determining their region of origin. This has allowed links between diverse regions to be made, and to see, in this material evidence, patterns of communication growing and changing through time. We can also tap into this dendrochronological resource, through analysis of timber size, age and growth rate, to try to attain a picture of the availability of the timber resource for shipbuilding, through time and space. In this paper I will explore oak in Northern Europe, to extract details on timber availability, both regionally and temporally. This will enable a description of the regionality of resource depletion versus abundance, and draw us towards some explanation of the dynamic of the patterns of the maritime timber trade that we see increasing, through time, in Northern Europe. While preliminary work on these questions is in press (Arbin, S & Daly, A., in press, A re-evaluation of the Mollö cog. Accepted in IJNA), I will in this paper explore the matter in greater depth, and incorporate both maritime and terrestrial dendrochronological material.
Kostas A. Damianidis  
architect  
Artemis Valani  

3D survey on the Archaic ship model H90 from Samos

There are several wooden ship-models found at Hireon of the island of Samos. Most of them are on display in the Archaeological Museum of Samos. They are dated in the middle of the 7th century BC or in the period 650-600 BC. Twenty-two of them were discovered during several excavation companies from 1937 until 1977 and another seven of them were discovered during excavations in 1983 and 1984. The majority of the models represent long vessels, possibly warships, and each one of them was made out of a single wooden block. All of them belong to the same context of the archaic Hireon temple and they are considered to be ritual votives or offerings to Hera of Samos, a primary maritime deity. The most remarkable features of the models are the shapes of the hulls, which, in some cases, remind the modern shipbuilding half-models. In order to study thoroughly these hulls, three of them were digitally captured using a structured light 3D scanner. The data of this survey are then processed so as to enable and assist the attempt to reconstruct the lines and analyze their geometrical characteristics. In this paper we focus especially on the results concerning the survey of the model H90.

Ekaterina P. DellaPorta  
Ephorate of Underwater Antiquities, Ministry of Culture, Athens, Greece

Zante shipwreck revisited

The excavation of the wreck of a wooden ship, located 1 nautical mile outside the harbour of Zakynthos, 15 m southwest of the “Dimitris” or “Sinialo” reef in August 2000. Since then the shipwreck has been covered with the water-permeable material Terram 4000 for protection aim. The vessel is preserved to a satisfactory degree, under a relatively thick layer of soft mud. It seems to have been constructed of heavy timbers, which are preserved in excellent condition. For the most part these are of oak, a particularly hard wood widely used in shipbuilding. Excavations gradually revealed a significant intact section of the west side as well as large beams in random arrangement at the northwest end of the wreck, which bear obvious signs of violent breakage. Although excavation uncovered the south end of the wreck, we cannot determine accurately the other end and consequently the overall length of the ship, which from the visible elements is estimated at around 20 m. Towards the middle of the longitudinal axis of the ship, where the destruction is less severe, is the ship’s ballast of polychrome shingle and pebbles. The evidence to date suggests that this was probably a merchant vessel, constructed by the skeleton-first technique, which was transporting hazel nuts in wooden crates as the main cargo in its hold. Silver coins of Philip II of Spain, the majority minted in 1585, which were found in situ between the ribs and the planking, the various pieces of
majolica pottery, the pipe-stems and bowls of Western European type as well as a wooden tool-haft inscribed with the initials P V, and a cross of Maltese - type (cruz potenzada) advocate for a ship of Western provenance, probably of Spanish interests, which sank in the waters of the Venetian -ruled Ionian Islands. The results of the analysis and measurements of the samples of wood and hazel nuts, by the Archaeometry Laboratory of the National Hellenic Research Foundation Nuclear Research Centre, “Demokritos”, coincide in dating the wreck to the 16th century. The paper will attempt to present the new data evidences and results of the underwater interdisciplinary research that will be accomplished between Universities of Peloponnese, the Institute for Technological Education (TEI) and the Hellenic Centre of Marine Research on Zante (Zakynthos) shipwreck.

Wendy van Duivenvoorde
Department of Archaeology, Flinders University, Adelaide, Australia

The Zuiddorp ship and its wreckage (1712–2012)

Three hundred years ago, the Dutch East India Company ship Zuiddorp vanished without a trace while en route to the East Indies. Zuiddorp was the last vessel begun under the supervision of shipwright Henrik Penne on the Zeeland shipyard. Penne laid the keel for what would have been his 38th ship in December 1700. He passed away before the ship’s completion and his successor, Anjaas, completed Zuiddorp’s construction on 22 June 1701. Of the 38 ships commenced by Penne, only four—including Zuiddorp—were 160 feet in length; all others were of a smaller charter. Wreckage from Zuiddorp was first discovered in the early 20th century by Aboriginal and European station hands north of the mouth of the Murchison River and the present-day town of Kalbarri, in Western Australia. The dynamic and fierce surf zone surrounding the shipwreck site provided an adverse environment detrimental to the ship’s preservation. Nevertheless, some material from the ship itself did survive, such as the singular example of a caryatid herm from the ship’s stern, fragments of its masts and spars, and meager remains of the ship’s hull. A recent study of these remnants demonstrates the archaic nature of Zuiddorp’s construction, which make the ship more a late 17th-century than an early 18th-century Dutch Indiaman. This paper highlights how even a seemingly insignificant amount of ship timbers can provide evidence sufficient to broaden our understanding of hull construction and the Dutch shipbuilding tradition.
Joseph Eliav  
Bar Ilan University, Tel Aviv, Israel

The Oar System of the Venetian *Quinquereme*

When Vettore Fausto proposed to build his *Quinquereme* in 1525, he promised that she would be as fast under oar as a regular war galley (*a galera sottil*) in spite of being bigger and heavier. Having examined his design, the *Proti* of the Venetian Arsenal concluded that the proposed galley would indeed be fast, but only if Fausto could build an oar system wherein all five oars would be effective; admitting that they did not know how to do that. In May 1529 the *Quinquereme* won a race with a regular war-galley; so Fausto had evidently built an effective oar system but its design has remained an enigma, which this paper tries to resolve.

The paper presents two feasible design solutions, both compatible with the few direct clues available in primary sources and with contemporary Venetian shipbuilding practices. At this stage, both design solutions are still hypothetical. Then, two separate and independent pieces of eyewitness graphical evidence, by two contemporary architects, validate unequivocally, so I argue, one of the two hypotheses. This resolves the general design of Fausto's oar system; but the devil is in the details. These details are, in this case, some parameters related to the structure and dimensions of the outrigger assembly and to its position relative to the hull, which the existing historical evidence cannot reveal. A 1:15 scale model of the galley's mid-section, fitted with several versions of the outrigger assembly, served as a platform for verifying the feasibility of the design solution and for estimating these parameters by trial and error.

Jeff Emanuel  
Anthropology and Archaeology, Harvard University, Boston, USA

Crown Jewel of the Fleet. Design, Construction, and Use of the Seagoing Balsa of the Pre-Columbian Andean Coast

The seaworthiness of the *balsa* sailing raft, and the seafaring aptitude of those who built and sailed it, has been the subject of critically biased, often conflicting accounts over the nearly five centuries since the Spanish conquest of the Inka empire. This paper objectively marshals historical and archaeological evidence to recover the pre-Columbian design and construction of this “Crown Jewel” of the Peruvian and Ecuadorian fleet, and to demonstrate the role of the landscape – specifically, environmental conditions and available resources – in its development and use. Through this evidentiary reconstruction, it will be shown that, though these rafts appeared primitive to many of the Europeans who saw and wrote about them, the aboriginal balsas of the Andean coast were both well-designed and extraordinarily capable of performing their assigned tasks, which included fishing and coastal trade, and which may also have included lengthy voyages of commerce and exploration.
Gencer Emiroğlu
Independent researcher, Istanbul, Turkey

Istanbul Skiff. Shaping and being shaped by 19th-century Istanbul's urban and cosmopolitan maritime landscape

Focusing on the example of Istanbul skiff, the aim of this paper is to analyze the maritime cultural landscape of Istanbul in the 19th century shaping the small boats and being shaped by the small boats. General purpose- and purpose built-small boats existed in very large numbers and were used for various purposes such as work horse, people transport, fishing and recreational craft and therefore were used at all social levels. The urban and cosmopolitan maritime landscape of the Ottoman capital determined the local boatbuilding and some of the small boats used in this capital city were unique to the city and were different from those build in rural areas. Because of their size and function, small boats are part of daily life and tells the story of the ordinary people as well as of the small boatbuilding industry which were the pioneers of entrepreneurship of their time. In this investigation the aim is also to study the material culture which refers to the relationship between small boats and social relations. The study of Istanbul’s relationship to small boats is a lens through which social and cultural attitudes towards water related activities are seen and to enable to understand how the Ottoman capital’s culture was organized and functioned around this time period. On the other hand, the present study set out to determine the effect of the natural geography of the Levant waters -the Bosporus and the estuary Golden Horn-, the already existing boatbuilding culture and the availability of boat-building material, on the skiff design. The arrival of photography in the middle of 19th century to Istanbul, and the personal interest of the Sultan for this new technique, both enabled a comprehensive and accurate documentation of the shoreline of the capital's waters with small craft activities recorded. Using the analysis of the surviving photographic evidence together with existing literature, the findings suggest that in the example of Istanbul skiff, small boats were integrated in daily life of the cosmopolitan capital and shaped it considerably in the 19th century much more than any small or big water craft today. Further work is suggested to be done to estimate the implications of the elimination of the small boat from urban landscape today.
Transport with class. The large Nordic cargo ship from Karschau near Schleswig

In January 2000, the remains of a large clinker-built cargo vessel were found at extreme low water at the hamlet of Karschau, on the north bank of the Schlei fjord, in the ancient border region between Germany and Denmark. The Karschau ship was excavated in 2001 by the archaeological state service of Schleswig-Holstein under the direction of Hans Joachim Kühn. In a landscape dominated by the archaeological importance of the Viking Age port of Hedeby, the 12th-century ship-find of Karschau made archaeologists and the public aware of the continued use of large Nordic-style cargo ships after the Viking Age and the fall of Hedeby in 1066, highlighting the importance of Schleswig as a medieval port of trade at the southern rim of the Danish kingdom.

This paper presents the dating, dimensions and constructional features of this remarkable ship-find. The size and style of the vessel make it possible to identify the social status and economic expectations of its owners. It will be shown that the Karschau ship belonged to a distinguished class of large cargo ships representing a Danish society and economy that underwent rapid change in the face of foreign influence and competition. At the same time, the Karschau ship and its class also mark the peak of a continuous development in traditional Nordic clinker-boatbuilding with its light hulls, elegant lines and aesthetic standards in Southern Scandinavia. Only few decades after, heavily built bottom-based ships were introduced to transport ever growing amounts of bulk cargo.

The Ghost ship. A 17th-century fluit in the Baltic Sea

In 2003 an exceptionally well-preserved 17th-century shipwreck was found east of the island of Gotska Sandön in the middle of the Baltic Sea. The discovery, dubbed the “Ghost ship”, rests nearly intact on the seabed, at a depth of 130 m. The hull measures 27 m between the posts. Most of the deck is still intact and two of originally thee undermasts are still standing. The wreck reveals the characteristics of a Dutch fluit, the tool in the profitable trade between Sweden and the Netherlands and the most common ship-type on the Baltic Sea during the 17th century.

An international research team was formed around the discovery and two expeditions have been made to the site. Due to the great waterdepth, the surveys were carried out using Remote Operated Vehicles (ROV) equipped with cameras, robot-arms, multi beam echosounders and other high tech devices, replacing the diving archaeologist. The aim of this paper is to present some of the methods used and some of the results from this fieldwork. Is it really possible to record the interior of a fluitship, resting 130 m from the surface?
Experimental archaeology. Uluburun II reanimation project. Ancient navigation and maneuvers

Discovered in 1982 by a local sponge diver, the Uluburun Wreck excavations lasted for 11 years in collaboration with Bodrum Museum of Underwater Archeology and Institute of Nautical Archaeology (INA). Its The Uluburun Shipwreck that made it possible to draw crucial historical connections From 3300 years before. 360 Degree Research Association has worked on Uluburun II Reanimation Project under the light of the mentioned excavations. Uluburun II is also known to be world's oldest seagoing vessel. With this very project, information utilized 3300 years ago, such as ship building, ancient trade routes, ancient ports, ancient navigation and sailing bronze age boats are aimed to be found as well. The information on the excavation conveyed by the leader of the excavation Prof. Dr. Cemal Pulak was put together as a blueprint by ship engineers. Launched into the sea in 2005, Uluburun II had sailed 3000 sea miles. With this project 360 Degree Research Association has been the partner of the exhibition entitled “Uluburun Ship and three thousand year old sea trade” in Bochum Bergbau Museum for 9 months.

Our experimental work to reanimate world's oldest known ship wreck had shown us that the ancient navigation knowledge going back to 14th century BC are very little known to us today, especially navigation. “Ancient mariners were cruising with the help of stars”. This argument remains incomplete and false if necessary information is not supplied. Because within 24 hours, one can see the stars for only 8 hours. The real question lies in the remaining 16 hours. Another misconception is sailing boats going to the preferred direction as soon as the sails are out. Cruising 3000 sea miles with square sail, we had a very hard time on staying on the same route. Sailing a boat without a keel, sidewinds will cause extreme leeways. In addition to this, with its limited capacity of maneuvering, hardest part was going into the harbors.

Methods of pumping the sea water out that leaks in rather from the freeboard, deck or hull, are based on vague estimations. However, it’s obvious that these ship somehow succeeded their journeys anlong the Eastern Mediterarrenan that houses strong winds and shores directly connected to open waters. Today journeys can be done by modern sailing boats and navigation tools. For instance a journey from Crete to Alexandria (300 sea miles) was a sure case back then. While it is still today considered dangerous/risky. These little known subjects encouraged our group to work on experimental archeology. Our work continues on various different projects.
Tori Falck  
Norsk Maritimt Museum, Oslo, Norway

**One boat, several lives. Sørenga 7 in the urban landscape**

*Sørenga 7* is a 9.4 m long clinker-built vessel found in the harbour of Oslo (formerly Christiania) in 2006. The boat’s main structure is made of oak, and strakes have been dated by dendrochronological analysis to approximately AD 1665. The paper will show how documentation of the parts digitally in 3D, followed by a physical model, has assisted the interpretation of both technical features and elements of the lifespan of the boat. It has become clear that the boat had been restructured by extending the height from eight to ten strakes. The cultural and functional motivation for such a solution is so far a question for speculation and debate. Answers can be found through a combination of an understanding of the function of this particular boat, and the cultural and economic relationships in contemporary society. Secondly the paper will focus on the boat in the maritime landscape of Christiania. It is likely that the boat was sunk deliberately, and that it had a purpose in the town planning in connection with the need for new land. Therefore the boat also casts some light on the maritime landscape of late-17\(^{\text{th}}\)- and early-18\(^{\text{th}}\)-century Christiania. There was a shift in activity and a radical change in the town in 1624, when the King decided to move the town center from the east to the west side of Bjørvika, the inner bay. The *Sørenga 7* boat find shows that there was still a need in the town for expanding the east side of the bay, into the Sørenga area.

P. Filin  
Museum "Ice-breaker "Krassin", St. Petersburg, Russia

**New data on sewing technique in 17\(^{\text{th}}\)-century shipbuilding in Europe and Siberia**

This paper presents new data on ships remains made in sewing technique in Russia and Sweden. In North Russian and Siberia the sewn technology was at its height in the 16\(^{\text{th}}\) – 17\(^{\text{th}}\) centuries. Planks of clinker-built ships were tightened together by steamed roots of pine, juniper, fir or withes. All ships of Pomors (Russians who settled on the White Sea and did regular voyages to Novaya Zemlya and Siberia) were sewn. Unique finds were made during excavations in Mangazea (17\(^{\text{th}}\)-century Russian town in Siberia beyond the Arctic Circle). A lot of ship fragments were found in permafrost which kept the items in good condition. Mangazea houses appeared to have been constructed from fragments of former ships, called *kotch, doshanik, lodia, kayuk* and others, because of the lack of wood in the region. Keels, masts, stem and stern posts served as foundation of houses, while ships planking was used for walls and floor. The finds allow a preliminary reconstruction of the length of the ships of about 15 - 20 m. Other parts of sewn ships were found in the center of Stockholm close to Grand Hotel at the end of 2011 (excavations by Jim Hansson, Swedish National Maritime Museums). Typologically these parts are absolutely identical to those found in Siberia. The sewing technique was not typical for Sweden, but the dendro samples showed that the timbers were cut down between the years 1631-1635 in the region around Stockholm. The new finds raise a lot of questions regarding sewing technology development and the way of its spreading in Europe and Asia.
Angra D (Azores, Portugal). Study and reconstruction of an Iberian wreck

In 1998, a team from Centro Nacional de ArqueologiaNáutica e Subaquática (CNANS) did a rescue excavation of Angra D, a probable 17th-century Iberian shipwreck situated in the construction area of a new harbour in Angra Bay, Terceira island (Azores). The study of the site was never completed and the disassembled ship’s timbers ended up kept into two underwater deposits. In 2011, a team from Centre for Overseas History (Centro de História de Além-Mar-CHAM) continued the study of Angra D, based on the archaeological record and artifacts and ship timbers analysis, including the wood species identification. The question was over the possibility to determine the exact typology of Angra D based upon the remaining timbers. CNANS team suggested a reputed galeão, with more than 500 tons. From our data analysis, Angra D is probably a small merchant owned vessel, perhaps one of the many anonymous ships that carried cargo, resupplied colonies and did most of the important and yet to be studied low-level trade. Conclusions are mostly based on a thorough analysis of the available information hence the timbers did not survive in the underwater deposits. Without these, several questions have arisen regarding the size of the vessel, its shape and its provenance. Our hypotheses and preliminary reconstruction proposals are the subject of this communication.

An approximation to the Maritime Cultural Landscape of Cascais, Portugal, in the Early Modern Period

The discussion of the Maritime Cultural landscape concepts is, in Portuguese maritime archaeology, very recent. We present, in this paper, the research impact that this type of approach can lead to, in the heavily diverse and morphologically complex Cascais’ coastline. A shoreline shaped from influences of the Atlantic Ocean and the Tagus River estuary. The seaside town of Cascais, located next to Lisbon, is the epistemological paradigm of this approach. Forts, fortresses, lighthouses, harbors, anchorages and shipwrecks are part of a range displayed in a “longue durée” perspective. This is based upon Braudel’s Mediterranean influences, but with the uniqueness of having been understood and applied to the Portuguese Atlantic culture. These relationships and networks between man’s direct and indirect cultural heritage traces, are presented in this paper in a nautical diachronic approach centered in Early Modern Period, focusing the earlier historical influences and later period constraints. This analysis, based on Chister Westerdahl, Ben Ford and Brad Duncan studies, utilizes the investigation made by the Archaeology research project “Underwater Archaeological chart of Cascais shore” of Centro de História Além-Mar. This research was furthered in the academic field in the scope of the master's degree in archaeology at the Universidade Nova Lisboa.
A.S. Gaur  
CSIR-National Institute of Oceanography, Goa, India

Shipwreck Archaeology of the Indian Subcontinent region

Over 10,000 km long coastline of the Indian subcontinent region, played a vital role in transmitting and adopting social, cultural and religious traditions not only to different other regions in Asia but also other parts of the world. Maritime history of this region dates back to the early Bronze Age when Harappan sailed to the Mesopotamian region. However, maritime activities increased many folds during the early historic and the medieval period. The remains of these activities have been traced from the several coastal sites in the form of ceramics and other antiquities.

The story of shipwreck archaeology in this part of world is rather recent when one compares with the rest of the world and shipwrecks of the Bronze Age are unknown so far. There is also limited information on the shipwrecks of the early historical period. There are however two examples from this region namely Bet Dwarka (in India) and Godawaya (in Sri Lanka). In Bet Dwarka region a large number of antiquities including Roman amphorae, a Roman hand mill, lead ingot and possibly lead anchors have been found close to present a passenger jetty at a water depth of 8 m. The site is located in high energy tidal current thus the chance of survival of any lighter material is low. The quantity of pottery and material indicate the possibility of a shipwreck of foreign origin. Recently a shipwreck of the early historic period has been discovered at Godawaya in Sri Lankan waters and that is lying in 33 m water depth. The important antiquities from this wreck include stone quern, glass ingots, copper nodules and a large number of pottery. The comparative study and a radiocarbon date of this wreck suggest a date to the 1st century AD. The origin of this ship might have been the Indian Subcontinent region.

Besides above there are a number of wooden hulled wrecks in this region dated between 16th century and mid-20th century from Indian waters which include an 18th-century wreck at Poompuhar, 17th-century wreck in Goa waters and several shipwrecks in Sri Lankan waters. There are also several steam engine wrecks found in Goa and Lakshadweep waters. This paper will give an overview of the current knowledge of shipwreck archaeology in the Indian subcontinent region, highlighting the two exemptional finds of the early historical period sites Bet Dwarka and Godawaya.
Cities and oceans. The urban development of 16th and 17th-century Amsterdam and maritime culture

The city of Amsterdam grew in a relatively short period at the end of the 16th century from a regional transit harbour to a maritime hub within a global shipping system. Essentially this process of urban development comprised four subsequent phases of urban layout between 1580 and 1660. The result was a city plan with a radial system of concentric canals within a semicircular fortification of 26 bastions. The traditional discussion on the origins of this characteristic layout concentrated on the question whether it represents a military engineering design based on Renaissance rules and principles or reflects a evolutionary process guided by practical demands. Absent in these reflections is the element of water which is present as a basic and tangible element of the city plan and also symbolically as a carrier of maritime culture. Water carried ships and ships functioned as moving elements within the city’s spatial framework. With ships also people, goods and ideas entered the city which circulated within a global maritime network. In this paper I would like to discuss the maritime urban landscape of Amsterdam by introducing the presence of water in the specific development of the harbour and its facilities as a sofar neglected but basically steering element of this urban process. A historical cartographic overview will illustrate that the creation of space for harbour facilities basically lead to the development of a maritime core as centre of the overall urban plan.
Smiljan Gluscevic
Archaeological Museum Zadar, Croatia

Seriliae from the Roman harbour at Zaton

Excavations undertaken at various times throughout the past thirty years in the Roman harbour at Zaton near Zadar have resulted in the discovery of three maritime vessels made using a technique of sewing (sutiles nave). The first vessel consisted of only a few preserved ribs and part of the corresponding planking, but lacked any other structural elements. The other vessel was preserved in a length of 8.5 m with a double base to the mast and a different arrangement of ribs. The third vessel differs from the second because of a different structural solution to counter keel. A series of finds of more or less bent bronze sheet metal at all the vessels might indicate the necessity of investigating data about the hull sheathing of ancient ships. The current findings suggest that the Liburnians, the people who occupied the broader region in which the vessels were found, had at least two different types of sewn boats that the classical sources called serilia.

Damian M. Goodburn
Museum of London Archaeology, London, UK

Excavations at Three Quays House by the Tower. The heart of medieval London’s shipwright’s quarter

Museum of London Archaeology (MoLA) carried out excavations in 2011-2012 in a quarter in which many of London’s medieval shipwrights are documented as living. The site was thought to be the building site of two large clinker built galleys in the 1290’s. A substantial area of waterlogged waterfront was excavated yielding much well preserved evidence of many aspects of clinker boat and ship building. This included reused ship and boat timbers including; keels, stems, (a stem apprentice piece) framing timbers, stringers, a mast step and a large range of planking from a variety of sizes of boats and ships. Some of the planking material had oarports, hood end details, repairs and merchants marks. Evidence of the boat building in situ was also found such as; distinctive woodworking debris, a “strong back” of an old keel used for building small clinker vessels, and a range of tools such as axes, augers, an early saw and a pair of clinker builder’s clamps. Even two part used tar casks were uncovered. With the detailed recording and tree-ring sampling of the fresh and reused woodwork on the site we should be able to tightly compare the evidence with the extensive historical sources for individual shipwrights families and their properties.
Morten Gøthche, Kristiane Strætkvern
Viking Ship Museum, Roskilde, Denmark

Roskilde 6. Reconstructing the longest warship find of the Viking Age

In 1997, nine ship-finds were discovered during the construction of the new museum island at the Viking Ship Museum in Roskilde. Among the ships was the longest Viking ship ever found, Roskilde 6. With a preserved length of keel of 32 m, the total length is estimated at 37 m. Documentation is now finished and conservation of the nine ships is in progress.

In 2009, the Danish National Museum in Copenhagen, the British Museum in London and the Museum für Vor- und Frühgeschichte in Berlin agreed to join forces in the preparation of a large international Viking-Age exhibition, opening 2013. For this purpose, Roskilde 6 was selected as a key object. This gave a unique opportunity to analyse one of the exceptional long ships of the Viking-Age, since the reconstruction of the ship was a precondition to realising the project.

The current conservation method of the National Museum requires that the original shape of each ship timber is known beforehand. Therefore a physical reconstruction model was made in scale 1:10 in order to establish the exact shape of all the ship parts before the vacuum freeze-drying process could begin. The reconstruction model was measured with the Faro-Arm, a 3D-digitising arm. With the help of the Rhinoceros drawing programme, the outside shape of the hull was generated as a wire frame of ten strakes and 48 frames. This enables the building of a mobile and easily assembled steel frame that serves both as a stable support for the ship timbers, but also gives the audience a full scale impression of the 37 m long ship and its former purpose as an instrument of power and royal rule in the late Viking Age. The new constructional insights gained during the analysis and reconstruction will be presented at the symposium.
Learning from archaeological wood material. The Gallo-Roman barge *Arles-Rhone 3* studies experience

In 2011, with the exhibition project of the wreck in the Arles Museum of Antiquities, led by the General Council of the Bouches-du-Rhone (France), the excavation of the Gallo-Roman barge *Arles Rhone-3* was completed enabling its raising and thus revealing all of its structures that had remained in the river since it sank 2,000 years ago. Free from the confines of underwater working, the opportunity to study in detail every perfectly preserved wooden part of the boat was however counterbalanced by the very short time permitted to complete the project and the impossibility to make samples that would harm its exhibition value. Alongside the architectural study of the barge, methodological data recording from the wood was set up to ensure the collection of maximum information and, beyond the original objectives, to deepen the studies in process.

The unobtrusive and systematic sampling of the structures and the observations on the natural material transformed by man, environment and time, allow us to qualify and quantify the raw material needed for the building and to define the operational sequence of its exploitation, from the trees selected in the forest environment to its implementation and evolution within the barge. Taking advantage of cutting the wreck into ten sections, the photographic survey of the parts cross-sections, equally placed throughout the length of the boat, provides tree-ring data needed to specify the date of the barge construction, estimated now to the decade 50 AD.
Alexandra Grille
Paris I University and LAMOP (CNRS), France

Reconstructing the Aber Wrac’h 1 ship (France)

Large clinker ships of the 15th century are of particular interest in naval architecture as the skeleton-first carvel shipbuilding is going to spread across the Northern and Western Europe. The recent finds in the last decade and the restudy of earlier ship finds allow comparisons of technical data and hull shape, as well as a better understanding of the construction and sailing properties of 15th-century ships. In 1987-1988, the Aber Wrac’h 1 shipwreck was excavated in the North part of Brittany (West of France). It consisted of an 18 m-long and 5 m-wide hull portion of a clinker-built vessel. The ship was characterised by heavy framing and surviving through-beam heads. It is thought that about 20% of the original ship remained, protected by the stone ballast. The starboard side was lost as well as the upper part of the port side above the beams, and both ends are missing, although some V-shaped floor timbers and a part of the stem were found forward of the wreck. Despite the difficulties arising from the lack of original data, it was possible to carry out a reconstruction with the data from the excavation. The process includes the correction of the distortions in the framing and the realisation of a wooden 1:10 scale model in order to reconstruct the missing bow and stern. A three-dimensional digital model completed the process to verify the reconstruction model, allow calculation of hydrostatic properties and offer a better comprehension of the ship within its socio-economic context.
Taner Güler  
Department of Conservation of Marine Archaeological Objects, Istanbul University, Kadikoy-İstanbul, Turkey

Construction Technique of Yenikapi 20 Shipwreck found in the Harbour of Theodosius

Marmaray-Metro railway transfer station excavations which have been started at 2004, revealed the largest Medieval shipwreck collection in Yenikapi-İstanbul/Turkey in the former harbour of Byzantine Emperor Theodosius I or Portus Theodosiacus. The harbour was discovered by chance because of the metro excavations and includes 36 shipwrecks. This shipwreck collection has been studied by Istanbul University, Department of Marine Archaeological Objects experts. The YK20 shipwreck was located at the east side of the metro construction site, at a depth of 0.70-1.00 m below ordnance level and it extended in the east-west direction. It is dated between 9-10th centuries AD based on radiocarbon analysis. The hull survived up to turn of the bilge. The preserved length of the vessel is about 8.76 m. while the width is 2.30 m. Hull remains include 29 frames, a keel, a mast step, fragment of a stringer, and 21 planking strakes. Planks were secured to the frames by both iron and tree nails and joined together by edge dowels up to the first wale level. Moulded dimension of the frames was about 5-7 cm, the sided was 7-8 cm. Like most of the Yenikapi ships that dated to the 9-10th centuries, YK20 has its planking strakes below the waterline leveled off with their edge-joints in the form of small coaks. This coak system possibly represents the last fase in the transition to skeleton-first construction for it was used minimally. As the Yenikapi shipwrecks are better preserved than those uncovered from under the sea we will able to understand clearly the edge-joint systematic and the building technology.
As the original trans-isthmian passage – or the original Panama Canal – the Chagres River has a rich history, including Christopher Columbus’ final voyage and the subsequent Spanish colonization, Henry Morgan and the privateer attack of 1671, the 1849 California Gold Rush, and finally the construction of the modern Panama Canal. The Chagres River Maritime Cultural Landscape Study seeks to answer questions about the historical maritime activity on a river dubbed by one historian as the “richest river in the world”. Since 2008, a team of archaeologists has carried out underwater archaeological investigations off the mouth of the Chagres River, identifying submerged cultural resources from the 17th through 20th centuries. The current focus of the study is the Lost Ships of Henry Morgan Project. One of the most famous pirates of all time, Henry Morgan was one of the few to survive and enjoy his ill-gotten gains. In 1670, he amassed a fleet of 36 vessels and 1,846 men, the largest fleet of pirates in the history of the Caribbean, and set sail for one of the richest cities on the Spanish Main: Panama City. Morgan’s subsequent sack of Panama City not only served as his crowning victory and final raid, but also dealt the blow that loosened Spain’s grip on the New World. The team has been piecing together the evidence of Captain Morgan’s last raid, including the search for his flagship Satisfaction and four other vessels that sank approaching the Chagres River en route to Panama City.
Jim Hansson
Swedish Maritime Museums, Sweden

Five ship wrecks found on the royal shipyard in Stockholm – approaches to early shipbuilding with different techniques connected to the development of the Swedish society

During excavations in 2010 and 2011 five 17th-century wreck has been found in the Stockholm harbour. The location of the wrecks is on one of Stockholm’s oldest royal shipyards close to the castle. All five wrecks are clinker built but with different materials, joints and techniques. The planks on one of the wrecks are sewn together: that technique is not local or traditional for Swedish shipbuilding. The sizes of these ships are also bigger than the average ships from the 17th century. The Swedish maritime museums will survey the wrecks during the spring.

This paper will give an introduction to the discovery and the result of the survey and the research so far. The paper will also discuss what kind of information we are able to extract from wrecks like this that can give us more information to the historical environment and activity on the historical site. Can we record the wrecks, cultural layers and artifacts and see traces of the shipyards approach to the development of shipbuilding? What can these wrecks tell us about the Swedish society’s wish to be a great power? Probably are these wrecks links between the old traditional Swedish shipbuilding and the new approach with foreign techniques involved to get a more effective royal fleet.

Matthew Harpster
Institute of Nautical Archaeology, Texas A&M University, College Station (TX), USA

Maritime Regionalism in the Mediterranean Maritime Landscape

Past maritime archaeological activity in the Mediterranean Sea has focused on associating an assemblage of archaeological material in a maritime context with groups inhabiting the terrestrial landscape of the Mediterranean. This approach creates a Mediterranean maritime space inhabited by merchant ships that are “Byzantine”, “Etruscan” or “Muslim”, for example, and are extensions of the terrestrial group moving across the sea. Perceiving the maritime landscape of the Mediterranean Sea as a domain inhabited by a separate community, in contrast, means that these ships on the seafloor are agglomerations of terrestrial elements, but represent the activities of a community on the sea. The ships’ identities and activities, thus, are not solely “Byzantine” or “Muslim”, but are representative of the needs and habits of the community, a multi-cultural stew of people similar to today. Starting from this alternative view, and using a new methodology, this paper will highlight how particular maritime networks and regions in the Mediterranean maritime landscape may be deciphered, and how they prompt new perspectives of the connections and networks across the sea as well.
Maritime Trade, Politics, and Pottery Industry. The Penteskouphia Pinakes from Archaic Corinth

The Penteskouphia terracotta pinakes constitute an unusual assemblage in terms of their complicated recovery (in 1886 and 1905), their large number (over 1,100 examples) and their unique combination of otherwise rare iconographical themes, such as potters at work, Poseidon, and ships. None of these themes enjoy any popularity in contemporary Corinthian or Greek iconography. The depictions of merchant ships and warships on the pinakes constitute a small percentage of this corpus, are of various size and quality, but they all underline the strong physical and economical reliance of Corinthian potters on maritime trade in the Archaic period. It also offers a glimpse into political competitions among Archaic tyrannies and their control over this trade. This paper will attempt to explore these political and economical connections while examining these relatively unknown images produced in the thriving potters’ community in full.

Eldar Heide
Centre for Medieval Studies (CMS), University of Bergen, Bergen, Norway

Early Viking Age ship types and their terms

Archaeological finds tell us much of Scandinavian ships from the Viking Age: Size, construction, appearance, etc. But if we want to know what the different types were called, we have to turn to the medieval texts. However, not much work has been done to combine these source groups, so generally we do not know what the archaeologically known ship types were called, and what actual ship types the literary terms refer to. In this paper, the speaker presents his attempts to identify the early Viking Age terms for ship types from Old Norse High Medieval manuscripts, early Viking Age runic inscriptions, references in contemporary English and German manuscripts, etc., and to identify these terms with actual depictions and archaeological finds of ships from the Early Viking Age. He argues that *knorr*, *beit*, *skeið*, *kjóll*, *askr*, and *elliði* were the main ship types in Early Viking Age Scandinavia, at least in the west, and that *knorr* in this phase referred to warships like Oseberg, and only later cargo ships like Skuldelev 1. ‘A ship with a backwards curved stem’ seems to have been the original meaning of *knorr*. *Kjólar* were heavy all-round ships like Gokstad, the speaker argues, and *beit* were the very early ships with angular stems known from depictions. *Askar* were also very early, small, light ships with stitched planking known from archaeological finds, whereas *elliðar* were a combined inland / sea type, originally Eastern European, not identified on depictions or in finds.
The Zuiderzee. Highway, fishing ground and power landscape

In this paper the Zuiderzee will be portrayed as three different, though coherent, landscapes. Firstly the Zuiderzee will be looked upon as a highway for transport. In the 17th and 18th century at least 8,000 ships were engaged only in the transport of peat. The importance of this inland sea as an integrating factor and thus for the creation of a modern integrated market, has long been underestimated. Considered in this way the Zuiderzee formed an important element in shaping the economy of the Dutch Republic. The result was the hegemony of Holland and especially the city of Amsterdam. A hegemony not only within the Republic, but also on an unprecedented worldwide scale. The economic growth of Amsterdam had other implications. The fast growing population had to be fed. An enormous rich fishing ground was well within reach: the rich fishing grounds of the Zuiderzee. A fleet of waterships with their trawlnets – of which numerous examples have been wrecked on the former Zuiderzee – poached the Zuiderzee day and night from the 15th century onwards.

It is only logical that this grand transport avenue and rich fishing ground was an attractive and sought after space. The political and military control over this space as a consequence was continuously an item of debate and an item for conflict. Shipwrecks excavated in the former Zuiderzee area which represent and elucidate the function of the Zuiderzee as a highway, fishing ground and power landscape will be presented and understood in their historical-cultural context. In short in the context of the maritime cultural landscape.
Rachel L. Horlings  
Syracuse University, Syracuse (NY), USA

**A Technique for Archaeological Micro-Sampling through Sediment Coring of Shipwrecks**

A recently developed technique for archaeological micro-sampling of submerged sites, including shipwrecks and other archaeological features, has provided archaeologists with insights into numerous aspects of submerged sites that are notoriously difficult to ascertain. Diver-assisted sediment coring through this technique has provided invaluable data on two facets in particular: site stratigraphy, data typically disregarded as too difficult to effectively collect in submerged sites in dynamic environments; and natural and cultural site formation processes. Because traditional underwater archaeological excavation techniques are often more coarse than in terrestrial contexts, this technique provides fine-grained views of both natural and cultural materials related to submerged sites. While the micro-sampling technique has been used throughout the Elmina Bay in coastal Ghana, West Africa, this paper presents a case study of sediment micro-sampling taken from work on the Elmina Shipwreck site, located within the Bay. It highlights comparisons to traditional survey and excavation results, and provides conclusions drawn from cultural material recovered in sediment cores pertaining to both the sinking event itself (including information invisible through both surface investigations and excavations), as well as the formation processes and their subsequent effects on the wrecked vessel. Finally, the paper will briefly touch on the potential for developing this technique for the investigation and monitoring of a range of submerged archaeological sites across a spectrum of environmental and subsurface conditions.

Ab Hoving  
Rijksmuseum, Amsterdam, The Netherlands

**Measuring an “elephant”. Ship building knowledge and the interpretation of the proportional calibration of a shipmodel**

In this paper an authentic 18th-century shipmodel of the *Witte Oliphant* (White Elephant) in the Rijksmuseum Navy collection will be used as a startingpoint to proof that the 18th century Dutch Republic did build ships that were specifically designed to act as transporters in the slave-trade. This is in contrast to what has always been the general assumption. By combining technical knowledge of shipbuilding and the horrible facts about the sinking of the West Indian Company (WIC) slave vessel *Leusden* in the Marowijne River in 1738 this model can be identified as a slave ship. The case shows that knowledge of the basic principles of the shipbuilding craft can attribute to a better understanding of historical events, objects and situations.
Fishing vessels of the Socotra archipelago, Indian Ocean

The Socotra archipelago lies in the Arabian Sea, about 380 kilometres south of Ras Fartaq, Yemen and 250 kilometres northeast of Cape Guardafui, Somalia. The archipelago is made up of the islands Socotra, Abd al Kuri, Samha and Darsa, of which Socotra is the largest and most populated. Socotra by virtue of its position at the entrance to the Red Sea has been a maritime traffic node and cultural crossroads from at least the first century AD. This is reflected in Socotra’s fishing community, who constitute a hybridised mixture of cultural fragments from a multitude of sources. Due to Socotra’s position the fishermen find themselves in an unenviable position, where the seas and currents of the western Indian Ocean are at their most violent and the force of the monsoon winds are virtually unceasing. Notwithstanding the ferocity of the weather the fishermen are extremely successful in fishing the rich waters off the island, using vessels which are reflective of Socotra’s trading and cultural links with India, Africa and Arabia. In this paper I analyse the types of vessels employed by the fishermen of Socotra, from the earliest craft in living memory to those currently in use, and look at how social, economic, cultural and environmental influences have affected the types of vessels in use. The emphasis in this paper will be on two of the fishing vessels in use, namely: a catamaran, known as ramash, and a dugout canoe, known as hūrī.
Toby Jones, Nigel Nayling
Newport Medieval Ship Project, Newport, UK

Physical and Digital Modeling of the Newport Medieval Ship Original Hull Form

The timbers from the mid 15th-century clinker built Newport Ship have been comprehensively documented using contact digitizers and laser scanners. The innovative three dimensional digital recording methods have created an accurate and detailed data set that is being utilized in novel ways to create models of the original hull form. These methods involve converting the digital point cloud data into digital solid models, which can then be manufactured using three dimensional rapid prototyping technology. The Newport Ship Project chose to use laser sintering to produce scaled model pieces, which were fastened together using specially designed micro-fasteners. The resulting model consisted of over 800 pieces, and measured nearly 3 m in length. The level of detail is high, with scarf joints and rebates clearly visible. The model has been documented at various construction phases using a contact digitizer and laser scanner, with changes in the hull form being monitored as additional pieces were attached. The completed model, based entirely on archaeological evidence, has served as a foundation on which to attach battens in order to ghost in missing parts of the ship. When completed, the model and battens will be digitized a final time, with lines from the physical model being used as a starting point to create a faired original hull form in the modeling software Rhinoceros. The physical model will serve as a research tool, a public display, and a three dimensional blueprint to follow when reconstructing the soon-to-be preserved ship timbers in a planned museum.

Carlos de Juan
Universitat de València, Spain

The Ouest Giraglia 2 cross section model. An analysis about its building process

The Ouest Giraglia 2 shipwreck, located at Corsica Cape at 34 m depth, was excavated in 2010 and 2011 by DRASSM, Arkaeos Association and FFESSM. To complete the study of preserved hull, a central cross section was surface recovered. The scientific aim of this action in this particular dolia type shipwreck was: know the keel and garboard strakes form, get all pieces measured, study the particular floor timber shape and analyze how could be the building process done. The wood parts of shipwreck were pretty affected by Teredo navalis so the complete the analysis of keel form, rabbet and how the garboards were jointed, was done in a carpentry an experimental replica of the Ouest Giraglia 2’s central cross section. Moreover the floor timber had a perfect angle shape in its base face and had holes related to pegs to fix hull’s two tenon-mortise joints. After the experimental replica was done, the deduction was that there were some previous erected frames for this medium size ship, fixed to carena before most of the planks, then playing an important ship shape role. In our own view (hypothesis), this fact is not related to any change in longitudinal shellfirst shipbuilding process, but maybe its interpretation resides in a ship armed prototype that was replicated by the shipyard, because had the characteristic wanted by navicularii belonging to the bulk wine system commerce.
Connie Kelleher
Underwater Archaeology Unit, Department of Arts, Heritage & the Gaeltacht, National Monuments Service, Ireland

The Rutland Island Shipwreck, Donegal, Ireland. Ongoing Work by the State Underwater Archaeology Unit

Results from a recently discovered wreck lying in the shallows of Rutland Harbour near Burtonport in Donegal, look to be the remains of a possible 16th-century shipwreck. Work has been ongoing at the site since 2010 when the Underwater Archaeology Unit began to investigate the wreck, the lower wooden hull of which is intact from bow to stern. Lying on its starboard side, the remains of the rudder protrude from the seabed. Excavations inside the stern section have revealed interesting constructional details as well as a variety of artefactual material. Finds range from lead musket shot and cannon balls, a bandolier’s belt and a turned wooden bowl, along with a mixture of pottery types being recovered. This was an armed vessel that was engaged in conflict as evidenced by some of the munitions found but what the true identity of the ship was or how it came to lie in the waters of Rutland Harbour is still awaiting discovery.

Jun Kimura
Asia Research Centre, Murdoch University, Western Australia

East Asian shipbuilding traditions and its historical evolvement

The archaeological study of the excavated ships has potential to contribute to the realm of past seafaring and maritime activities. Such study includes the assessment of the hull structure and construction methods. This paper highlights technological innovations evidenced in the ship remnants in China, Korea, and Japan. One representative hull component to trace the innovations in East Asia is bulkhead. Based on the excavated ships’ data after the tenth century and onwards, this paper addresses the significance of the bulkhead in oceangoing ships in the light of technological innovations, diffusion, and hybridization. This contributes to the understanding of formation of regional shipbuilding traditions identified as a “Yellow Sea”, an “East China Sea,” and a “South China Sea” shipbuilding tradition. The “Yellow Sea shipbuilding tradition” is identified in ships operating in the northern waters of East Asia. They primarily show flat bottoms, yet there is diversity in this tradition represented by the early Tang Dynasty riverine ships and Goryeo Dynasty ships, and in later periods by Ming Dynasty ships excavated in Penglai, China. Recent archaeological inspections conducted on the Quanzhou ship, Shinan shipwreck, and some ship timbers from the Takashima underwater site identify “East China Sea” shipbuilding technologies used for these ships. This shipbuilding tradition is characterised by v-shaped bottoms, keel and bulkheads, and multiple-layered hull planking with iron fastenings. The ships built according to this tradition came to be used in seaborne activities within and beyond the region of East Asia and Southeast Asia. The “South China Sea shipbuilding tradition”, which has been presented as a type of hybrid ship by precursors, is newly interpreted as a cluster of technologies formed by integrating East China Sea shipbuilding traditions into shipbuilding traditions in Southeast Asia.
The Zaan as a maritime landscape (Kleij)

North of the IJ and north of Amsterdam, in the Zaan region, a swampy and wet part of Holland, an extensive maritime landscape emerged during the early modern era. The Zaan maritime landscape consisted of two different elements. First, the objects and constructions related to the shipbuilding industry. Second, the elements connected with the shipping industry.

The basis for the shipbuilding industry were the shipyards. During the seventeenth century there were around 25 large yards. In the 1990s along the Hogendijk in the Voorzaan area a complex of four slipways was excavated. The shipyards were depend on a whole range of suppliers, divided in a specific way over the Zaan district. In the direct vicinity there were the blacksmiths. Timber was transported over water, so the sawmills processing the timber were build further away on the river banks. Sail making and rope making were situated even further, to the north in Krommenie, Assendelft and Wormer. Other supplying industries included compass making and woodcarving were scattered all over the area.

The port at the mouth of the Zaan River, the quays, the beacons and the ships are clearly recognizable elements of the maritime cultural landscape directly linked with the shipping industry, but this can also be found in the houses and churches of the area. Especially the characteristic whaling industry has left its mark with large tarred warehouses and whale oil cookhouses. Connections with the West Indies resulted in new enterprises like paint manufacturing (milling of dyewoods) and the chocolate industry (milling of cacao).

The rise and fall of the Zaan shipbuilding industry (Enthoven)

Along the banks of the Zaan River, nearby the thriving port of Amsterdam, the largest maritime industrial complex of the pre-industrial era developed. Initially the ships were build on yards along the Binnenzaan. The Dam in the river, however, prevented larger ships to get to Amsterdam and open sea. Around 1600 new shipyards were created on newly developed lands in the Voorzaan area. Here predominantly large flyboats were build. During its heydays, some 150 large hulls were build along the Zaan River annually.

The Zaan shipbuilding industry had two remarkable characteristics. First, the Zaan entrepreneurs were active in three different, but closely connected industries: the timber trade, shipbuilding and operating the ships as ship owners. Families like Rogge, Brouwer, Cardinaal, Groot, and Van der Stad had stakes these different links in the maritime chain. Second, around the Zaan area arose all sorts of maritime suppliers like sail makers, bakeries, mills, instrument makers, rope makers and raising cattle for feeding the sailors. During the eighteenth century, when in markets such as Friesland, England and France new shipbuilding industries emerged, the Zaan shipbuilding declined rapidly.
Abhirada Komoot  
Faculty of Archaeology, University of Leiden, The Netherlands

From function to inspiration. The Royal Barge once helped Siam to maintain its independence

The Royal Barge can be dated back to the 13th century. From the Sukhothai to the Rattanakosin period the Royal Barge procession has continuously been used for many (Royal) occasions. The first barge has not survived until now but they had been rebuilt and reconstructed ever since. Royal Barge is a long and narrow riverboat. It is made from wood, painted mainly in red, gold and black colours. And sometimes it is decorated with finest wood carving and gilt. Distinctively, there are various kinds of figurehead, animals in the myth, containing auspicious meanings. Normally it would be on duty for processions accompanied by as many as 50-100 boats cruising along together. It is and was used especially for formal journeys of the King.

One spectacular duty of the Royal Barge a century ago was when receiving the Prince of Russia, Nicholas II, during his travel to the East in 1890-1891. At that time, Siam was encountering a serious issue with England and France. To survive and maintain the independence of the Kingdom, it needed to find a backup to scare off the Brits and French. One of the best way was to establish a firm relationship with Russia. When coming to Bangkok, the Russian Prince was picked up by the Royal Barge that transferred him over the river Chao Phraya into the capital. He appreciated this so much that in return good relations were established.

Although travel by water is not the only practical way nowadays, the Royal Barge still remains important as the pride of nation. This paper will discuss the past and present use of the royal Barge and the way it has been constructed to meet the special requirements of the landscape and its use.
Lars Kröger  
Medieval and post-medieval archaeology, Otto-Friedrich-University of Bamberg, Germany  

Crossing the river. Ferries as part of the maritime landscape of the Main river, Germany  

In the last few years, a huge number of new logboatfinds were made or announced to the field of archaeology in the area of the river Main in central Germany. Adding these to the already well-known, but not yet well published finds, we have currently 94 logboats in all. This provides an opportunity to carry out detailed analyses for a whole river system. Systematic dating of the finds has shown that approximately 90% of the logboats were parts of medieval and early-modern ferry constructions. The construction technique of several linked logboats is common to many regions in Europe, but has never been part of a detailed cross-border research.  
A project at the Chair of medieval and post-medieval archaeology of the Otto-Friedrich-University of Bamberg is studying the development of the logboat/ferry-boat design of the Main River. Currently three different types of construction can be identified, differing in regions and periods. The written sources in the region were analyzed and show the evolution of approximately 150 ferry stations on the Main River from the 11th to the 19th century. Additionally the medieval and post-medieval infrastructure like roads and towns are also part of the research.  
The intent of the project (and presentation) is an inspection of the maritime landscape in the area of the Main River, focused on the river crossings. Their construction, social connection and the use of ferries as a part in the development from ford to bridge will be discussed.
Vasiliki Kyprouli
Maritime Archaeology, University of Southern Denmark (SDU), Esbjerg, Denmark

Barca F of Pisa, a small Roman riverboat

In 1998, during works for the expansion of a railway station in San Rossore, Pisa, archeologists came across the ancient port of Pisa, used mainly during the Imperial Ages, when due to repeated environmental events (floods) the port was destructed- but remains from Etruscan and Hellenistic period have also been found, the river Arno and its tributaries had been extensively used for transportation. Innumerable artefacts related to the maritime and harbour life were discovered, as well as 16 river-going vessels, some whole and others in part. Several boats interpreted as Roman lintres -boats for inshore traffic, both rivers and lagoons- have been uncovered in the layers connected with the Middle Empire floods. A small boat (Barca F) falls within this category of minor boats; it has a flat bottom, with low, straight broadsides, which has moved with a perch or oars. Its research sheds more light on Portus Pisanus’ system, as well as on knowledge about fluvial transportation in Roman Ages. Besides, the design of the Barca F directs our attention on the small boats still used in the marshy areas of Tuscan plain (such as in Fucecchio and San Miniato), which maybe proves a continuity of tradition and its influence by the local environment. The Barca F will soon be part of the permanent exhibition of the new “Museum of Ships” in the Arsenali Medicei on the Arno embankments in Pisa.

Ligaya S.P. Lacsina
Archaeology Division, National Museum of the Philippines

Lashed-lug watercraft of island Southeast Asian

This paper outlines the ongoing research of traditional watercraft of island Southeast Asia, particularly the examples of lash-lugged and edge-pegged constructed boats, as well as the re-examination of their remains in Philippine archaeological sites. The study aims to utilize the available archaeological resources, from which very little comprehensive research has been done, in investigating these types of traditional Southeast Asian boats in the Philippines. At least three examples of such watercraft have been identified in Philippine archaeological sites, all of which predate Spanish colonization which began in the middle to late 16th century. The research explores other sources of information including similar such sites in Southeast Asia, existing regional ethnographic studies and available historical accounts. The paper will discuss the potential of future studies on the topic of traditional boatbuilding in the region and how this can be used in the pursuit of revealing more of the Philippines’ maritime past. A future goal is to form a cohesive study on the ancient maritime culture in the Philippines and interactions with its Southeast Asian neighbours as already evidenced by other shared cultural traits.
Connecting shipwreck sites to their wider cultural environment. Innovative approaches in the UK

Archaeological studies of maritime cultural landscapes have traditionally tended to arise as stages in the investigation of individual shipwreck sites. However, Wessex Archaeology and its clients have been pioneering regional and thematic studies that approach the investigation of these sites from the other direction. These studies seek to place cultural context as one of the main drivers in the management of maritime cultural landscapes and in the selection of individual sites for investigation. The paper will discuss three different examples of this approach, all of which have produced a new and sometimes very different understanding of the shipwreck sites concerned.

Wessex Archaeology has investigated the maritime archaeology of the Welsh coal trade for CADW. The study sought to understand the significance of individual shipwreck sites through a study of the maritime transport system of an industry that transformed the society and economy of Wales in the 19th and early 20th centuries. A new approach was also adopted to help Historic Scotland and others manage and study the shipwreck archaeology of Shetland. By assessing the region’s complex maritime history, key themes of local, national and international significance were identified. Each known shipwreck site was then assessed for relevance to these themes. In addition, a national-level study of shipwreck sites in Scottish waters has been undertaken to assess the level of existing knowledge of the resource and its potential significance in terms of key themes in Scottish maritime history such as fishing, shipbuilding and migration.
Sloops to ships. Vessels in the 19th-century Honolulu-based whaling fleet

The Honolulu-based fleet uniquely only pursued whales in the Pacific, conducted seasonal rather than multi-year cruises, and sailed under the colors of several nations. Entrepreneurs purchased and/or refitted vessels for about 250 seasonal cruises in the 19th century. The nearly 80 identified fleet vessels included sloops, yacht schooners, brigs, barques, and ships with American, Oldenburg, or Hawaiian registry. Early cruises involved the barque Denmark Hill in 1831, the brig Waverly in 1835, and the barque Honolulu in 1841 and 1842. In 1851, the refitted American ship Chariot departed for the Ochotsk Sea. Three years later, six vessels sailed on cruises. The fleet fluctuated yearly from eight to eighteen vessels between 1856 and 1871. Four of the eight vessels in the 1871 fleet were lost in the Arctic. Only three to five vessels comprised the fleet each year from 1872 through 1875. The schooner Julia A. Long completed the last Honolulu-based whaling cruise in 1880.

This historical study of vessels in the fleet uses data extracted from government records and Honolulu newspapers. The vessels were owned and/or fitted out by foreign residents and agents. Some vessels departed on a single cruise each year while others sailed twice. The brig Victoria undertook sixteen cruises before being lost in the Arctic. Twenty-seven vessels conducted between four and fifteen cruises. Most completed only one or two cruises. Smaller vessels mainly cruised within Hawaiian waters or served as tenders. A few vessels took sharks, seals, and/or turtles in addition to whales while a larger number engaged both in whaling and trading.
Christian Lemée
Køge Museum, Køge, Denmark

The Hummeren-project. Reconstructing an early-17th-century Danish man-of-war based on original documents and archaeological finds

During the first decades of the 17th century, Denmark was a European super power and had the largest war fleet of the continent, in order to protect its vast maritime territory, stretching far into the Northern Atlantic Ocean & the Baltic Sea. Many of the Danish king Christian 4th’s ships were designed and built by foreign master shipbuilders. The most renown of these was David Balfour, of scot origins. David Balfour was very active as master shipbuilder and had an important influence on the introduction of new designs in Danish naval shipbuilding. In the design process he produced drawings, which was a rather new method for this period. A handful of these unique drawings have survived time and are now preserved in the Royal Archives in Copenhagen.

Køge Museum in Denmark is planning to build a full-scale reconstruction of a man-of-war after one of the Balfour drawings. The drawing E9 is assumed to represent a small size warship named Hummeren, which was commissioned in 1623 and launched in 1624. It was the first of a series of seven warships built according to the same drawing and contract, which is also preserved, mentioning the main dimensions of the planned vessel and parts of its equipment.

This paper will present and discuss how it is possible to interpret the preserved documents combined with the archaeological finds in order to reconstruct the Hummeren. The original Hummeren was built near the spot were eight ships and boats (the so-called B&W ships) were excavated in 1996 and 1997 by the National Museum of Denmark; six of the wrecks were dated to the late 16th and early 17th century. The land plot was situated where David Balfour established a private shipyard in 1624. Though rebuilding ships of the past has become a common method of investigating the past, the Hummeren-project is unique, as it will be the first time that a ship of the early 17th century will be reconstructed using original documents combined with the latest archaeological knowledge.
Final Analysis of the First Century BC Stone Carrier Hull from Kızılburun, Turkey

How does ancient stone-carrier construction fit with contemporaneous shipbuilding? Were stone-carriers more heavily constructed ships than normal in order to transport a concentrated weight of stone cargo? As large questions such as these certainly loom over the understanding of the construction of ancient stone-carriers, particularly pre-Imperial and Imperial Roman period vessels, even the scant remains of such a vessel can offer significant data on a ship type whose constructional data corpus is severely lacking archaeological support.

From 2005 to 2011, the Institute of Nautical Archaeology (INA) at Texas A&M University excavated a 1st-century BC stone-carrier at Kızılburun, Turkey under the archaeological direction of Dr. Deborah N. Carlson. The ship was in transit from the Sea of Marmara with a primary cargo of approximately 60 tons of rough cut Proconnesian marble and wrecked along Turkey’s western coast near Çesme en route to the temple of Apollo at Claros. Although the ship’s hull remains are meager, they provided enough information to undertake an in-depth analysis of the wooden remains, which is now complete. This presentation updates, amends, and augments information previously offered and demonstrates that the vessel was of relatively light construction, but of common dimensions and construction for its time, and provides data for comparison to other stone-carriers.
Kristian Løseth
Norwegian Maritime Museum, Oslo, Norway

Post-medieval sea-routes – a GIS model

The subject of this paper is the creation of a model of post-medieval (c 1550-1800) sea-routes of southern and eastern Norway. A geographical information system (GIS) is used to analyze large amounts of data, creating a model which is based on a combination of historical and archeological sources. This will serve as a useful tool for understanding the relationship between landscape, technology and society. The GIS-model is based on old maps, pilot guides, archaeological data, historical data and geographical information. Crucial for the construction of such a model is translating all this information into relevant geographical data. In this paper I present the different sources of information and discuss their relevance for sea-routes. Also the relationship between the data and the resolution of the model is discussed.

A model of post-medieval sea-routes is useful both for cultural heritage management and research of Norway’s maritime past. In cultural heritage management such a model could serve as a basis for predictive modeling. Understanding the sea-routes is also important for understanding several of the historical processes taking place in this period. Examples are the transition from clinker to carvel built ships, the decline of the Hanseatic League and the rise of Dutch timber trade and also the origins of several of the towns and harbors along the coast of southern and eastern Norway.

Thijs Maarleveld
Maritime Archaeology, University of Southern Denmark (SDU), Esbjerg, Denmark

Aanloop Molengat. A maritime archaeological milestone

In the development of maritime archaeology in the Netherlands, the site of Aanloop Molengat in the North Sea, west of Texel has a special place. Discovered in 1984, its rich cargo of metals and ingots was the occasion to extend heritage protection to include underwater shipwreck sites and to let research prevail over quick and dirty salvage. Building on a small group of professionals and large numbers of volunteers, methods for fieldwork at depth under exposed North Sea conditions were developed and tested. A wide range of interim and specialized reports was published, but it was only in 2011, that the balance could be drawn up, thanks to an Odysseegrant of the Netherlands Organisation for Scientific Research and a team that was coordinated by Alice Overmeer and Wilma Gijsbers in Lelystad with assistance of the project’s original director, Thijs Maarleveld in Denmark. The cargo’s composition informs us in detail on aspects of industrial production and the structure of intermediate trade. The ship’s demise occurred in 1635 or shortly after, a very muddled period in the Thirty Years war. The sheer size and carrying capacity of the ship makes it stand out for the period. Some of the most intriguing conclusions on mining and trade in metals, including lead extraction and handling in Poland, tin quality assaying in Bohemia, the production and trade of rough iron and Leiden cloth will be presented, but the presentation will focus on the parameters that helped determine ship size, origin and function.
Rivers are most important to human beings and other living creatures because:
i. It is a source of food, especially fish
ii. The continuation and permanent supply of water for everyday use especially for drinking, cleaning, bathing and others. The sufficient supply of water also can be used for agriculture activities.
iii. Land near the rivers is usually fertile and very suitable for growing crops, and
iv. Waterways can be used for communication.

The importance of rivers to humans is the main factor of the emergence of early civilizations. The examples of early civilization based on the river such as the Egyptian Civilization on the Nile River, Chinese Civilization on the Yangtze and Yellow River, Indian Civilization on the Indus River, Sumerian, Babylon and Mesopotamian Civilization on the Tigris-Euphrates River, and Khmer and Funan Civilization on the Mekong River. In all these civilizations human settlements at the beginning were only small villages and then developed into urbanized centres.

Brunei is no exception: rivers are the most important in the establishment of early settlements in Brunei. Due to archaeological researches conducted in Brunei in the last 47 years, so far 68 archaeological sites have been recorded. The majority of these archaeological sites are settlement areas of which 50 were built on or near the river. Because most of the people of Brunei relied heavily on the river as a mode of communication, boats were the most important type of transportation. From historical records and archaeological evidences, the manufacturing of boats can be traced back a thousand years ago. Various types of boatwatercrafts made for economic, social, transportation and others purposes. This paper will touch about the early settlement pattern and the uses of boat in Brunei.

Case study on ancient boat remains from Sungai Limau Manis Site (Yahya)

In tropical countries like Brunei, wood normally decays rapidly. Because of this, we have to rely on written accounts to give us a picture of what ancient Bruneian boats looked like. In addition to written accounts, several boats remains found at Sungai Limau Manis site can be use in reconstructing the maritime history of Brunei.

As a result of research carried out at Sungai Limau Manis site, tens of thousands of Chinese ceramic shards dating from Sung to Yuan Dynasty (10th to 14th century AD) have been collected. Apart from ceramics, other artifacts include beads, iron objects, bronze objects, glass, gold, skulls and wooden objects. This makes the remains of the boats found at Sungai Limau Manis site, which must have been built at the same time, among the oldest known plank-built vessels. The findings lead the writer to believe that the site was an important river port for at least 400 years, from the 10th to the 14th centuries AD.
The boat remains were found in separate pieces. The boat materials that were uncovered are the hulls, planks, paddles, wooden pegs, wedges, etc. Some of the boats were built by raising planks on each side of a keel-piece. Various components were held together with a variety of stitches and lashings. Apart from stitched-plank techniques, holes were drilled at the edges of planks which gave way to the system of dowelling. Most dowels were of wood.

Martijn Manders
Maritime Archaeology Department, Dutch Cultural Heritage Agency (RCE), Amersfoort, The Netherlands

Herre Wynia
Municipal Archaeology Department of Utrecht, Utrecht, The Netherlands

A logical find: two early medieval shipwrecks (8th and 10th century) found while digging the Viking Rhine in New Town Planning Area Leidsche Rijn, Utrecht (The Netherlands)

In 2010 - while digging a river in a new town planning area loosely based on a former medieval riverbed traced in the area – two early medieval shipwrecks were found. The oldest one is possibly one of the Utrecht type: a hollowed out tree trunk with expanded boards. It was found in an extremely rich early medieval river setting with a quay and prefab shipbuilding material. The younger is that of a typical river barge (accidentally?) sunk in the middle of the river. Although its outer appearance from a distance seems to be typical, closer look reveals details that are astonishing. The building techniques used may be a combination of local and important craftsmanship.

These Vleuten 1 and 2 ships accidentally connect the past with the future. They sank in a medieval river in two different periods when the area had two different faces. In the 8th century it was crowded, while in the 10th century it was desolated. Nature and politics had changed the area dramatically. Now it has been found during the creation of a river that needs to give some historical sense and pleasure to the new area. These ships may not only be the topping on the icing for archaeologists, but also for the people in the neighbourhood.
Sabrina Marlier  
Arles Museum of Antiquity, Arles, France  
Pierre Poveda, Nicolas Ranchin  
Ipso Facto, Marseille, France  

The Arles-Rhône 3 project. From the excavation and raising of a Gallo-Roman barge, in the southern coastal French city of Arles, to its documentation and modelling in 3D (2011-2012)

In 2011, the conclusion of the excavation and raising of the Gallo-Roman barge Arles Rhône 3 took place on the right bank of the Rhône river, in Arles. Initiated by the General Council of the Bouches-du-Rhône as part of the project to expand the Arles Museum of Antiquity (Musée départemental Arles Antique), this operation mobilized important means (€1.9M) and was created within the framework of a government contract; a tender won by the operators Ipso Facto, specialized in underwater archaeology, and O’Can, specialized in underwater public works. It is therefore a mixed team, composed of archaeologists, underwater archaeologists (Arles Museum of Antiquity, DRASSM and Ipso Facto), commercial divers (O’Can) and conservator-restorers (Ipso Facto, Arles Museum of Antiquity, Arc-Nucléart and A-Corros), that worked hard for seven months to ensure the end of the excavation and raising of this barge, 31 m in length, in ten sections. The difficulties of this operation were linked to the deadlines, very short; to the location of the wreck embedded in the Roman period harbour garbage dump of the city of Arles, thus being covered by extremely important archaeological material (in both quantity and quality) that needed to be properly excavated to reach the barge; and by the positioning of the wreck, situated between depths of four and eight meters, and following the 35° slope of the bank, which made its documentation and extrication very difficult.

After presenting the Arles-Rhône 3 project and the means employed to successfully complete its excavation and raising, the presentation will shift its focus towards the innovative documentation of the wreck in 3D accomplished by archaeologists from Ipso Facto and the Arles Museum of Antiquity. The use of a new type of digitizer that had never been used in archaeology before, coupled with the logistical and critical time constraints of the project, was a daring gamble and required a particular recording methodology to be devised. Consequently, the 3D recording phase of the project will be presented, along with the advantages and disadvantages of the new digitizer as they pertain to recording in maritime archaeology. Finally, after describing the steps involved in generating an end product, a finalized digital model of the Arles-Rhône 3 Gallo-Roman barge will be presented, along with the main features of the ship structure.
José Manuel Matés Luque  
Maritime archaeologist, Spain

**Flat bottomed boats in Spain. The forgotten fleet**

Spanish shipbuilding is widely and mainly known due to the Ibero-Atlantic ships. These are based on the Medieval ones, similar to European models for the same period like cogs and carracks. It is clear that the post-medieval “Conquering of the Oceans” was a big input into developing other seafaring ships.

At the same time, as those big seagoing vessels evolved, it is clear that the small local shipbuilding should have been in use. Little is known about the evolution of such traditional boats.

However, some have disappeared recently while others are still in use, all of them linked to some regions and their environmental features: Galicia and the Rías (estuaries) with *chalanas* and *gamelas*, Valencia and the Albufera (inland sea lake) with flat bottomed boats, Ciudad Real and the Tablas de Daimiel (inland lake) with flat bottomed boats and the Basque Country and the Rías with *txanelas*, *gabarras* and *big and small alas*. This paper will outline some features of such watercraft and will try to assess their environment to understand this forgotten fleet.
Alexandre Monteiro  
Instituto de Arqueologia e Paleociências, Universities Nova of Lisboa and Algarve, Portugal

The Archaeological Survey of the coast of Grândola. Preliminary results

The Instituto de Arqueologia e Paleociências has obtained from the Portuguese Ministry of Culture permission for the Grandola Subaquatica project to survey 65 km of coast line of Grandola, Portugal - from the inter-tidal zone to 40msw. The area in general includes several Mesolithic shell middens, with more than 100 human burials reported in them, as well as later habitat sites, such as the ones at Comporta, dated between the 4th and 3rd millennia BP. From that period onwards, human occupation of this area was continuous, with sites and artifacts from all Ages and Periods being found - the most notable one being a Phoenician enclave that disseminated oriental goods to the hinterland. For later times, this area includes not only the remains of Troia, the largest fish-processing Roman plant of all Iberia, active for 300 years, but also, upriver, the largest Islamic naval base of the Iberian Peninsula. As for Modern age shipwrecks, our archival research has identified at least 14 of them. Due to their historical relevance, initial efforts will be focused on locating the VOC jacht Schoonhoven (1626), as well as the Spanish galleon Nuestra Señora del Rosario (1589). In this last case, once the wreck is located and positioned, our aim is to scientifically excavate the site, on what will be the first excavation of a treasure galleon using the utmost academic standards and following the recommendations of the UNESCO Convention for the Protection of Underwater Cultural Heritage – of which both Portugal and Spain are State parties. Further objectives are to understand the region’s maritime landscape and its evolution through time; to determine the number and nature of underwater archaeological sites in the area; to establish priority research lines and to enforce protective measures in order to ensure the integrity of the located sites - so that they can be used to improve scientific knowledge of local and global history, lead community outreach programs and create a two-way communication highway between academia and the general public.
Aleydis Van de Moortel  
Department of Classics, University of Tennessee, Knoxville (TN), USA  

Blending Boatbuilding Traditions in the Cultural Landscape of Europe’s Early Medieval Migration Period  

While the natural environment and availability of resources no doubt influenced ship design, I argue that the Utrecht ship type and the medieval barge were created through a conscious decision by early medieval shipwrights who combined concepts of two existing boatbuilding traditions: a “light” tradition of expanded logboats using the tensile strength of thin, bent wood and a “heavy” tradition relying on the rigid strength of heavy oak timbers. Archaeological and historical evidence shows that in Roman times, the “heavy” boatbuilding tradition existed along the Rhine and areas further west, whereas the “light” tradition occurred in the region of Weser and Elbe as well as in southern Scandinavia. Ole Crumlin-Pedersen proposed that during the Migration period Angles, Saxons, and Jutes brought the expanded logboat tradition to the Netherlands and England. The notion of Anglo-Saxon immigration in the Netherlands has been widely rejected for a long time, but a new study provides convincing evidence for settlers from Schleswig-Holstein who arguably came by boat. Moreover, the earliest evidence for expanded logboats in the Netherlands dates to the Migration period, and recently found 7th-century boat fragments from North-Drenthe have features matching those of Utrecht-type craft. All this supports the thesis that the Utrecht ship type indeed originated in the Netherlands from a merger between “Romano-Celtic” boatbuilding and the newly arrived expanded logboat tradition. This mingling of traditions produced a variety of ship types suitable for the varied coastal and inland waterways of the southern North Sea region as well as for crossing the sea to England.
Lauren Morgens  
Kalmar Nyckel Foundation of Delaware, USA

**Sailing the *Kalmar Nyckel*. Early-17**th**-Century Maritime Technology in Modern Practice**

A replica of a 1620s Dutch *pinas*, the sailing ship *Kalmar Nyckel* has been providing educational programs, passenger day sails, and sail training from a variety of ports in the Eastern US since her launch in 1997. Her rigorous schedule requires working under sail on a daily basis, often in relatively small harbor or river systems. Devices and methods that have largely been the purview of historians for hundreds of years are fundamental to her daily operations, and as such, she provides a unique laboratory for experimental archaeology of 17**th**-century maritime technology. Here, I address research questions in three related areas: the dynamics of a 17**th**-century rig and steering system, the requirements of skill and manpower necessary to operate such a vessel, and the technological limitations of this design that spurred later innovation. Some early methods, including the whipstaff steering system and the lateen mizzen sail, have proven surprisingly effective and reliable in modern practice. Others, such as the sprit topsail and large fore and main topsails without reef points, are serviceable but place significant demands upon the crew in terms of manpower and expertise. The practical experience gained from extensively sailing an early-17**th**-century rig, combined with data from more traditional historical and archaeological approaches, can advance our understanding of seamanship in this era of rapid technological change.
Dor 2006 shipwreck. Construction details and tradition

The Dor 2006 shipwreck was discovered in 2006, about 800 m south of Dor (Tantura) lagoon, 100 m from the shore line. The site is challenging and difficult, in the shallow (3.5–4 m) water of the surf zone of the open sea. The shipwreck was dated to between the second half of the 5th and the first half of the 6th centuries AD (the local Byzantine period), based on 14C and ceramic analysis and coins. The shipwreck remains comprised frames, hull planks, ceiling planks and stringers, a round through-beam, and wood and metal fasteners. The wooden components of the hull included a few rare components. Planks were aligned with unpegged mortise-and-tenon joints, unlike most of the shipwrecks excavated in Dor lagoon, which were built based on frames without planking edge fasteners. The implications of the construction details will be presented. Among the finds were wooden objects, ceramic ware, a woven mat, coins, ropes and food remains. Dor 2006 was larger than other shipwrecks of the period, and the largest so far excavated in the area of Dor lagoon. The archaeological finds of shipwrecks from the Dor/Tantura area are evidence of the co-existence of two different construction traditions in the eastern Mediterranean at the beginning of the second half of the 1st millennium AD.
Increasingly, dendrochronological dating of wooden ship and boat finds has become the norm in nautical archaeology although such studies are often limited to sampling of a relatively small proportion of the recovered hull’s timbers. Inevitably, such dating studies focus on those timbers of species most suitable for dendrochronological dating, with most annual rings and or the presence of the parent tree’s bark edge to increase the potential for precise dating. Such sampling strategies, unless complemented by additional dendrological investigation of timbers not selected for dating, a comprehensive programme of species identification, and sustained recording of morphological features such as grain, knots, and side-branches can lead to a biased impression of the nature of parent trees and woodland exploited in the production of the ship’s timbers. Conversely, an extensive program of dendrological documentation of wooden hull assemblages offers the potential for reconstruction of managed wooded landscapes, “treescapes”, essential for timber supply to shipbuilding industries.

This study examines the potential for reconstruction of such treescapes, and contemporary woodland management practices using the Newport Ship as a case study. Almost 900 timbers were recovered during the excavation of this 15th-century ship with tree-ring dating providing crucial dating of the site soon after its discovery. Digital recording of tree morphological features on the timbers was complemented by selective photography, collection of dendrological data (such as ring counts and average ring widths), and an extensive but selective program of dendrochronological dating. What can such a sustained study tell us about the wooded landscapes which supplied the key resource required by shipbuilding industries?
Mariangela Nicolardi
Sorbonne University, Paris, France
Filipe Castro
Institute of Nautical Archaeology, Texas A&M University, College Station (TX), USA

Molds and architectural signs in the skeleton first construction. A methodology to reconstruct the original hull’s shape of the Cais do Sodré shipwreck

One of the most important features in the Mediterranean shipbuilding is the use of wooden molds and geometric methods of reduction, which allowed shipwrights to pre-design a large part of a ship’s frames. The existence of these instruments is documented at least since the second half of the 13th century. Their use implies a number of manual steps, which leave conspicuous marks on the frames during the tracing process, as straight ruts. These signs, along with engravings of Roman numerals, which indicate the corresponding position of the pre-designed frame on the ship’s keel, have been documented in several shipwrecks, such as the late-15th- or early-16th-century shipwreck found in 1995 on the northern bank of the Tagus River, in Lisbon, Portugal. It was exposed during the excavation works for the construction of a subway station at Cais do Sodré Square. The wooden hull was extensively preserved although its ends had been cut on both extremities by the concrete walls of the building. Nevertheless, the amount of timber preserved in place makes this shipwreck a very important find. By considering the current knowledge of the tracing methods, based mainly on Italian and Iberian manuscripts (15th-16th c.), this paper presents an interpretation of the shipbuilding process based on the traces found on the Cais do Sodré frames. This study presents also a good opportunity to discuss hull reconstruction methodologies applied to Mediterranean shipbuilding traditions.

Alexandr Okorokov
Underwater Cultural Heritage Center of Russia (Ministry of Culture), Moscow, Russia

Log canoes

Log canoes are one of the oldest means of transportation on water. They were manufactured everywhere where forests existed. Technology of their construction and design differs depending on the time, availability of construction materials as well as the area of production. Known are log canoes made of a single log, canoes with boards moved apart, twin log canoes etc. From 1900 onwards more than 40 archaeological log canoes (or fragments thereof) were found in Russia. Unfortunately only some of them were studied in detail. Nevertheless the archaeological data supplemented by ethnographic materials supply insight in different aspects of this type of watercraft in Russia, like log canoes design features, the range of their distribution and local production technology.
Just a few hundred meters south of the port of Rotterdam lies an area that is part a natural reserve and a location for recreational purposes. The same spot was from the 16th century the outlet of the Brielse Maas and as such an important economic vein to the inland region. This river outlet was littered with shifting sand banks and shipping incidents were not uncommon. To counter these unfavorable situations a new canal was built north of the estuary and the old outlet was dammed. Within the framework of the water management and the protection of hinterland the old channel was closed and a new lake was formed which gradually became a sweet water lake. Sand extraction for the construction and expansion of the port of Rotterdam in the seventies of the 20th century revealed the presence of archeological objects including shipwrecks. At present we have knowledge of a dozen shipwrecks from the 16th century to modern times. The Dutch Cultural Heritage Agency (RCE) in collaboration with local amateur archaeologists and sport divers are trying to assess the archaeological importance of these shipwrecks which are sometimes still in a remarkable state of preservation. Next step will be the development of an underwater heritage trail, connecting a few of the most important shipwrecks that will illustrate the story of the area from the 16th century up until now. This paper will deal with the discovered shipwrecks in the Oostvoornse Meer and their significance for telling the maritime story of the area.
Artefacts from the late medieval Copperwreck

This paper will discuss the Copperwreck (wreck W-5) - one of the most interesting wrecks excavated so far by the Polish Maritime Museum in Gdansk. The ship was built around 1399, and it sunk on the bottom of the Gulf of Gdansk (Gdansk roadstead region) circa 1408 as a result of the fire shortly after it sailed out from the harbour of Gdansk. The remains of the W-5 ship construction and cargo were raised mainly in 1975/76. This paper will review also progress in the study of the Copper wreck resulting from new discoveries during underwater re-excavations of the site carried out in 2011 and 2012. Goods included in the cargo of the ship were copper slabs, iron bars in bundles, osmund, tar, ash, wooden timbers and wax. The destination for the cargo was probably the ports of Western Europe – perhaps Bruges, London or Antwerp. The diversity of goods in this cargo and their excellent state of preservation makes this one of the most exciting discoveries of this kind to have been made in Europe.

The aim of the paper is to present the recent results of the three years research project conducted on the cargo, personal belongings and armament remains. This paper will combine the results of the archaeological studies on the artefacts with preserved records in the archives concerning shipbuilding and shipping of the Hanseatic towns at that time. The questions concerning the cargo’s structure, origin, ownership, maritime shipping routes and also ship’s ownership, crew and armament will be presented. The artifacts recovered provide a good basis for studies into the history of seafaring, material culture and the everyday life of 15th-century seafarers. The consequences of political and economic situations for ordinary people participating in Baltic trade and shipping in that period are also made more apparent.
A clinker-built giant in the middle of the 16th century. Shipwreck U 34 in Flevoland, the Netherlands

In the reclaimed area of the Netherlands, more than 450 shipwrecks have been found, which contribute to our knowledge of the (Dutch) maritime past. Strikingly, from the period AD 1400-1600 little is known. In this period of explorations and colonizations, important changes in ship design took place, such as the enlargement of ships and the extension of the rigging, the introduction of cannons aboard and the change from clinker-built to carvel-built hull construction. Unfortunately, shipwrecks from this period are rare.

A PhD project started in 2005 may alter this lack of information. Between 1955 and 1999, in the Dutch IJsselmeerpolders (formerly the Zuiderzee), seven shipwrecks were found which all date from this period. They share some striking construction features: completely clinker-built, riveted, straight sternposts and curved stems, flat-bottomed amidships and flaring ends.

One of these wrecks is undeniably a clinker-built giant. The ship, named U 34, was about 33 m long, 9 m wide and had a maximum depth of 6 m. It was clinker-built from keel to gunwales. The overlapping strakes were connected by a combination of rivets and very small treenails. The ship was built around AD 1530, when carvel building already was widely adopted. Moreover, proof for at least four gun ports was found. These are very unusual for a clinker-built hull and such relatively heavy armament is uncommon in this period.

What information do these clinker-built ships conceal? Are they remnants of a particular clinker-built shipbuilding tradition? What was their role within in the economic and political developments in the Zuiderzee area, the cultural environment in which they were built, operated, wrecked and came to a final rest?
Mathilde Pilon  
Master TPTI (Techniques, Patrimoine, Territoires de l’Industrie) of the University Paris 1 Panthéon-Sorbonne (France), the University of Padova (Italy) and the University of Evora (Portugal)

The *moliceiros* of the Ria of Aveiro (Portugal). A case study of nautical ethnography

The *moliceiros* are boats which were used in the Ria of Aveiro, a lagoon located in the North of Portugal, for the harvest of seaweeds (called *moliço*) and which are still existing. They were built and used as work boats in this particular environment during the 19th and the 20th centuries. By an interdisciplinary research we can understand the links between these boats and their environmental and human context. 

In first, the *moliceiros*, as technical objects, are related to a maritime landscape and the people who lives in this landscape. They are flat bottomed boats, used in shallow waters. They are built by shipbuilders of the Ria of Aveiro, using local woods. They are painted of four figurative panels, which can be understood as symbolic representations of values, practices and structures of thought of the community in which they were born. The paintings also reflect the value of the *moliceiros* for the people of the Ria of Aveiro. 

Then, the historical sources show how much these boats are related to their human and geographical context. The analyse of the formation and the evolution of the Ria of Aveiro allows us to understand that the formation and the development of the *moliço*, and so the activity of the *moliceiros*, is linked to the evolution of the Ria. The *moliço* had an impact on the landscape of the Ria as we can see it today. The decline of this activity, from the middle until the end of the 20th century, has been mainly caused by environmental and human reasons. Today the *moliceiros* are not used anymore for the harvest of *moliço* but some always exist, used of tourism and for their heritage value.
Patrice Pomey  
Centre Camille Jullian, Aix-en-Provence, France

The PROTIS Project. The construction of sailing replicas of Archaic Greek ships

The PROTIS project aims to construct sailing replicas of two Archaic Greek vessels of the 6th-century BC that were found in Marseilles. This experimental programme was conceived by the Centre Camille Jullian for Mediterranean and African archaeology (Aix-Marseille University, CNRS) that was responsible for the excavation and study of these wrecks. The shipwrecks Jules-Verne 7 & 9 were discovered and excavated in 1993 in the Place Jules-Verne of Marseilles and were the object of a complete reconstitution. The boats, constructed towards the middle of the 6th century BC by the direct descendants of the founding Phocaean colonists of Marseilles, reflect the construction techniques then in use in the Aegean Sea. The principal features lie in the assembly techniques employed: entirely by stitching for Jules-Verne 9; by stitching and mortise-and-tenon for Jules-Verne 7.

Protis, the sailing replica of Jules-Verne 7 wreck, will be a merchant sailing ship (15 m long; 3.80 m wide) which was the principal carrier in the expansion of Massalian maritime trade in the second half of the 6th century BC. Gyptis, the sailing replica of Jules-Verne 9 wreck, will be a large coastal boat with mixed propulsion of sail and oar. The original craft (10 m long; 1.88 m wide) was clearly used for fishing red coral. The PROTIS project envisages the reconstruction of the boats according to the techniques of the era and would involve experimental voyages allowing for an evaluation of the crafts’ sailing qualities. The project will start with the construction of Gyptis in order to sail at the occasion of Marseille-Provence, capitale européenne de la Culture 2013. The PROTIS project is supported by the Aix-Marseille University, the CNRS, The Région Provence-Alpes-Côtes d’Azur and the urban community Marseille-Provence-Métropole and the association Arkaeos.
Yftinus van Popta  
University of Groningen, Gorningen, The Netherlands  

Shipwreck distribution: a spatial analysis of shipwrecks in Flevoland  

This research focuses on spatial analyses of shipwrecks in the province of Flevoland; the largest ship graveyard on land in the world. Shipwrecks in Flevoland have often been subject of maritime studies. However, the shipwrecks have never been subjected to a spatial analysis as a group. Therefore a reliable database had to be created, containing the data of 430 shipwrecks including their exact locations. By using the geographical information system ArcGis spatial analyses were carried out, revealing certain differences in the densities of shipwrecks. The areas with the highest and lowest densities were selected for further research. The most interesting part of the research is the interpretation of the selected areas. How can large areas in Flevoland in which no ships were found be understood? On the contrary, why are there certain areas that are packed with shipwrecks? In an interdisciplinary approach, by using historical, geographical, geophysical and archaeological sources the answer to this question shows a very distinctive link with the cultural (contemporary and historical) and natural environment. By using historical, geographical and geophysical sources and archaeological sources, the research has been carried out as interdisciplinary as possible. The conclusions of this research contribute to a better understanding of the most important “highway” and fishing ground of the Low Countries for centuries: the Zuiderzee.
In 2008 archaeological work carried out in Barcelona’s medieval harbour gave us the opportunity to study a deck, built in 1477, and a shell-first and clinker built wreck: the Barceloneta I. This ship was probably from the Basque-Cantabrian coast and it is dated as being from the first half of the 15th century. According to the principle of construction (shell-first) and the joined strakes (clinker), the wreck can be dated between 1280 – the beginning of the Mediterranean trading sea route with Flanders- and 1430 – when the last Atlantic-clinker ships arrived in the Mediterranean as documented in the Catalan archives. From 1430, ships from the Atlantic kept arriving, but then, and only in big ships, the principle of construction changed to a frame-first construction with edge-to-edge strakes. Knowing that the first deck was built in 1430, that the wreck was covered with the sediment built up from that year and having taken into consideration the archaeological context, we can date its wreckage to around 1430. From the C14 test carried out on the moss found between the lapstrake planks we know that the ship was built in 1410-1411.

The origin of this ship is, without any doubt, the area comprising the Cantabrian coast and the Southwest French coast. The archives, the palinological and dendrological analyses, the use of moss between the strakes, and its building features, indicate late medieval Basque-Cantabrian tradition.

In conclusion, we have discovered the most ancient clinker-built wreck found in the Mediterranean. It is this archaeological finding that provides evidence of that which is recorded in the archives. In other words, the presence of Biscayan and Cantabrian clinker-built ships in Barcelona during the 14th and 15th centuries.
Irena Radić Rossi
Department of Archaeology, University of Zadar, Zadar (HR), Croatia
Luka Boršić
Institute of Philosophy, Zagreb (HR), Croatia

Illyrian lembos and Liburnian liburnica reconsidered

The Pre-Roman inhabitants of the eastern Adriatic coast developed vessels known as lembos and liburnica (liburnida, liburna). Although in scholarly literature these vessels have often been treated as similar, recently the attention was drawn to the need for their clear distinction.

The very general term lembos was assigned to the vessels developed by the Illyrian tribes that populated the southern part of the eastern Adriatic coast. It seems that they owed their agility and speed to the extension of the water line realized by the elongation of the keel in both directions. Such elements are often erroneously interpreted as rams.

The other type of vessel used by the local inhabitants bore the name of liburnica, liburnida or liburna. Its obvious etymology links it to the Liburnians, the non Illyrian population that played an important role in the maritime history of the Adriatic. It was suggested that the Romans, besides the Liburnian type of ship, adopted the entire Liburnian shipbuilding logistics developed over the centuries of supremacy at sea. A detailed analysis of the written and iconographic sources aims to reconsider their context and point out the basic characteristics of the two different groups of vessels, developed in the areas of different geographic and geomorphologic features. The careful examination of the geographical context of the sewn boats from Roman period, discovered in Dalmatia, do not support the idea of the sewn construction of the late Liburnian liburna.

Morten Ravn
Saxo Institute, Department of Archaeology, University of Copenhagen, Denmark

Maritime communities of Practice

Maritime communities face and interact daily with the sea. This interaction both forms a community of practice and an identity among the community members. The process of becoming an experienced member of a community of practice is socially constructed. The traditions and tricks of the trade are transferred from one generation to another in a dialectic interaction between the individuals and the structure of the community.

In historic maritime communities of practice, many basic skills were learned and adopted during childhood. By watching able seamen and fishermen work, hearing maritime tales, and re-enacting situations related to the life at sea, the children became involved, and thus acculturated.

Viking-Age ship models, interpreted as toy boats, are here used as an archaeological example of how toys might be understood as tools, allowing children – through games – to experience first contact with seamanship and perceptions of life at sea.
Reinder Reinders
Department of Archaeology, University of Groningen, The Netherlands

Trekvaart Landscape. Canals, towpaths and barges in 17th-century Groningen

In the 17th century the City and the Province of Groningen established a dense network of canals (trekvaarten) and towpaths (trekpaden, jaagpaden) which connected the inland port of Groningen with many villages in the hinterland. Horse-drawn barges provided a reliable passenger transportation system that was in use until the end of the 19th century. The City of Groningen invested considerable capital in establishing the trekvaart route to Oldambt, the eastern part of the province, and to the extensive peat-cutting districts which were exploited by the City. The Province established a westward route to the Westerkwartier district and on to Friesland, as well as a four-pronged route into Hunsingo and a route to Fivelingo, both fertile agricultural districts in the northern part of the province.

The network was used not only by trekschuiten, the passenger barges, but also by regular freight services (beurtschepen), by barges carrying bulk cargo, and by market boats from small villages heading to Groningen with passengers and goods on market days.

Along each trekvaart route, tolls were collected to cover maintenance expenditures. The Province of Groningen levied tolls from the extensive network of trekvaarten in the districts of Westerkwartier, Hunsingo and Fivelingo; Groningen City along the trekvaart to Oldambt, the eastern part of the province.

The barges were operated by crews of three: the skipper at the helm and his mate at the mast to hook and unhook the line running from the mast to the horse on the towpath. A jager (jockey) would ride the horse. The mast was moveable, to enable the barge to pass under a fixed bridge (til); lowering and raising the mast was another task for the mate.

The Groningen network was linked via Friesland and across the Zuiderzee to that of Holland, i.e. the western Netherlands. The trekvaart networks in Holland and Groningen differed in that in Holland the network interconnected cities, while in Groningen it linked the port of Groningen with numerous villages in its hinterland.

In this paper the focus will be on the component parts of the trekvaart network. The network comprised not only canals, towpaths and stabling facilities, but also tollbooths, tollgates, bridges to cross side-channels, quays, revetments, locks, ferry houses and quayside taverns. Along the route, signposts indicated distances and posts with rollers facilitated passing canal bends without the barge running into the convex bank. A 19th century design of a barge will be used to analyze the type of boat used for passenger transportation.

Many component parts of the trekvaart heritage are preserved in the waterway landscape of Groningen and deserve to be protected in relation to each other, rather than as separate monuments. The trekvaart landscape offers good possibilities for development in a historically meaningful context.
Michaela Reinfeld  
German Archaeological Institute (DAI), Central Office, Berlin, Germany  

Searching for new markets. Late Antique Seafaring in the Eastern Roman Empire  
The 4th century AD was an important turning point in politics, economy and society of the Roman Empire. Not only that the capital of the empire was moved to Constantinople. At the end of the century, the empire was divided into the Western and Eastern Roman Empire. By relocating the new capital, new markets in the East were opened as well, markets such as the Black Sea and the Syro-Palestinian coast. Moreover, the fundamental changes had a direct impact on shipping, ports, the negotiated goods, shipping routes and the ships itself. Since the 4th century AD, both the government-subsidized shipping and the trade of private ship owners were concentrated to the west, to Constantinople. By means of selected underwater archaeological finds, the paper investigates the economic relations with the new capital. Basis of the investigation are the recent underwater archaeological discoveries off the coast of Antiphellos, the modern Kaş. Due to its favourable location on the southwest coast of modern Turkey the harbor city Antiphellos was an important crossroad for the local trade and the inter-regional exchange of goods with the Syro-Palestinian coast, Egypt and Constantinople.

Edoardo Riccardi  
Associazione Italiana Archeologi Subacquei, Italy  

Rubens D’Oriano, Virgilio Gavini  
Soprintendenza per i Beni Archeologici di Sassari e Nuoro, Sardinia, Italy  

Rudders and Masts from Olbia, Sardinia  
The discovery of many tools and structural elements among the wrecks found in the Olbia Harbour, during the works for the creation of the new terminal, allow us to suppose that archaeological evidence show us the presence of an ancient shipyard which has been in use at least from the 2nd century BC to the 1950s. In this presentation, the author would like to discuss some of the main technical elements of the hull dating to the 1st to the 5th century AD, trying to put in evidence some of the aspects of the ship construction he recognized in the 5th century AD boats in order to underline what can be considered as “innovation” in boat construction. Moreover, starting from the elements linked to the presence of the ancient shipyard, first of all a part of a roman wooden crane, the author would like to present the discovery of 2 roman masts and the rests of at least 5 rudders, putting in evidence the main characteristics of the two classes of objects.
The marine archaeological survey along the West Sumatra’s West Coast conducted by the Research and Development Center for Marine and Coastal Resources has found the Dutch shipwreck sites in Mandeh, Nibung, and Ampyang Parak and some other maritime sites such as harbors, structures, buildings, and tunnels in the gold mines in Salido Village, Bayang, and Cingkuak Island from Dutch Colonial period. Based on interviews with local community, the existence of some shipwrecks along the Sumatra’s West Coast that is located directly opposite the Indian Ocean is caused by accidents due to weather condition and sea condition that could suddenly become dangerous, especially during the eastern wind season. This paper summarizes the importance of those sites which prove that in the Dutch colonial period, the Sumatra’s West Coast has an important role in international shipping and trading before the emergence of Malacca Strait. Sumatra’s West Coast is a producer of gold, silver, coal, and pepper which attracted the Dutch. Historical data obtained from the sources of colonial archives prove a hectic maritime activity along the Sumatra’s West Coast since the Portuguese, VOC, and the Dutch colonial government period in 17th-19th centuries AD. This paper also highlights the existence of Mandeh Shipwreck Site which is located at Pesisir Selatan Regency at coordinates 01° 12’ 03.7” S and 100° 25’ 30.3” E, and lies at 17-31 m depth. Through diving activities we found metal and wooden part of the ship, bottle glasses, and wood fragments. It can be preserved as In-Situ Preservation Site and also can be developed as a dive tourism destination which is expected to improve the local community’s welfare.
Iron Age ships from the Nydam bog, Southern Denmark

In the period 200-350 AD, three large clinker-built ships were sacrificed in a shallow fresh water lake in Southern Denmark together with many other objects, which originated from different war booties. Between 1859 and 1863 the very first ship parts of the Nydam-ships were excavated. 2013 will mark the 150th anniversary of the discovery of the best preserved of the vessels, the so-called Nydam Boat, which is exhibited at Gottorp castle in Schleswig, Germany.

From 1989 to 1999, extensive new archaeological excavations were carried out in the Nydam bog, leading to the discovery and excavation of more than 1600 new parts belonging to the three ships; ranging from complete oars, a well preserved side rudder and ornamental pieces to minor fragments of planks as well as different artifacts belonging to the ship’s equipment.

All these new archaeological finds have now been recorded and studied in detail and been the subject of analyses. The publication of these outstanding archaeological finds is well under way. However, recent investigations of the Nydam site have led to the discovery of even more ship parts, indicating that the Nydam bog has not unveiled all of its secrets. This paper will present the results of more than 10 years research into the ship material from the Nydam bog, and reveal new information concerning the oldest genuine clinker-built ships of North Europe, which can now be set in a new perspective.
Eric Rieth
Nautical Archaeology Department, National Maritime Museum, Paris, France

The shipwreck (EP1-Canche) of the fluvial-maritime coaster of the first half of the 15th century from Beutin (Pas-de-Calais, France), its nautical environment and functional context

The EP1 shipwreck, situated in the inshore river Canche (Pas-de-Calais, France), was dated to the first half of the 15th century. The underwater excavations (2005–2010) were conducted in a historic perspective where the ship, as a technical system, was envisioned through her structure, form, dimensions and proportions, as an indicator of the defined nautical environment and of the determined functional context. The analysis of the shipwreck remains enabled reconstructing the dimensions, proportions and hull lines of this sailing transport constructed “bottom based” to 14 m long, 2.80 m beam and 1.55 m high. Considering the archaeological typologies, the ship could be related to the architectural family of “Cogs”, of which it constituted a regional sub-class which according to the historical documents, could correspond to the Picardian architectural family of gribanes. The geo-archaeological and geo-morphological analyses of the fluvial site of Canche, confronted with the historical evidence, have lead to the reconstruction of the nautical environment as a medieval estuary. The fluvial architectural tradition of the Canche ship presented several structural characteristics and hull lines indicating the adaptation of this architecture to a mixed fluvial-maritime nautical environment. Following the theoretical analysis model developed by Christer Westerdahl for this type of ships, it would correspond to a “micro traditional zone of transport geography”, restricted at the end of the Middle Ages by the Canche estuary to the north and by the Somme estuary to the south, with the two fluvial-maritime port towns of Montreuil-sur-Mer on the Canche and Abbeville on the Somme as economic poles.
Dominique Rissolo  
Waitt Institute, La Jolla (CA), USA

Jeffrey B. Glover  
Georgia State University, USA

**Lost Maritime Landscapes of the Ancient Maya. Recent Research along the North Coast of Quintana Roo, Mexico**

The largely unexplored coastline of the Laguna Holbox bore witness to one of the greatest seafaring traditions of the ancient New World. Maya traders once plied these shores in massive dugout canoes filled with goods from across Mesoamerica. The Costa Escondida Project is a long-term, interdisciplinary research effort focusing on the dynamic relationships between coastal peoples and the diverse landscapes of northern Quintana Roo. Recent canoe-based survey and reconnaissance efforts along the coast have revealed a range of ancient and historical sites and cultural features. More detailed archaeological investigations at the ancient Maya port of Vista Alegre have enabled us to begin to reconstruct the economic and social systems in which these maritime specialists were engaged. Current paleoecological studies will provide a better understanding of coastal adaptive strategies over time at the port site and its surroundings, and will inform future prospecting for preserved ancient canoes beneath the organic harbor sediments. The maritime cultural landscape approach has allowed for a more holistic program of study concerning human-coastal interaction in the Maya world.

Emilio Rodríguez-Álvarez  
University of Arizona, USA

**Structural design, stress of materials and repair costs. Some reflections about the repairs of the trieries**

The aim of this research is to define a hypothetical model for the repair of *triereis* damaged in combat or by its use, as well as to analyse the economic implications of these repairs for the *trierarchos*. In order to achieve this I will pay special attention to the structural design of the hull, since it was the most affected section by the ramming strategies of naval warfare, as well as the nature of the materials with which the ships were constructed. A hypothesis for their repair will be defined, a theory based on the structural capabilities and the limits of the construction of hulls using the pegged mortise-and-tenon technique. Also, some estimations of the costs in resources and money for the repair of the hulls based on the Naval Records recovered in Athens will be estimated, based on different costs of raw materials and daily wages recorded. Finally, special attention will be given to the effect of this hypothesis to the construction and maintenance of the Athenian Fleet in the 4th century BC, from the economic collapse after the Athenian defeat in the Peloponnesian War to the establishment of the Second Athenian Empire.
In the summer of 2011 two new spectacular finds of shipwrecks was done in the central Baltic Sea. After years of searching the well-preserved remains of both Mars (1564) and Svärdet (1676) was found. Both were large royal naval ships which after tough and lengthy battles went down.

The new findings, together with previously known wrecks in the Baltic Sea, such as Kraveln (1525), Vasa (1628) and Kronan (1676) gives an opportunity for new insight into the formative period of Sweden’s history as a nation state. They also sheds further light on the way this process played out and in doing so, reveal not only the ship as a principal tool of European state building, but more generally as both manifestation and agent of social change.

The ongoing documentation of the two wrecks also emphasizes the violent course and the chaotic environment on board during the battles. The sites with all their guns and the ships themselves are well preserved “maritime battlefield”. This opens up potential issues related to practical solutions in naval battles, but also symbolic, mental and psychological aspects associated with warfare in general and human behavior in such situations and environments.

The two wreck of Mars and Svärdet were found by survey teams from Ocean Discovery and Deep Sea Production. The founders of the wrecks cooperate close with maritime archaeologist from MARIS and other institutions in the ongoing research project “Ships at War -Early-Modern Maritime Battlefields in the Baltic”.
Visualising the Viking Sea

The “Viking Sea from A to B” project uses a Viking Age nautical focus to examine how humans perceive, interact with, and continuously adapt to their environments, and the methodology by which this may be modelled using GIS software, employing climatological, hydrographical, and technological data. Viking raids along British coasts and isles have been recorded and discussed since medieval times and the image of the marauding Viking has fascinated scholars and the public alike. However, the bridge between this violent invading force and the Scandinavian settlers who followed (and eventually became British themselves) is often unclear and the subject of much controversy. Why did the people we know as “Vikings” cross dangerous open water to reach uncertain shorelines and, equally importantly, how did these sailors successfully reach the British Isles repeatedly without a map? This poster will present preliminary results of wind, current, and ancient coastline models used to examine how eighth and ninth century Scandinavian, British, and Irish sailors transformed the sea from a barrier into a highway. This project seeks to shed light on the influences of natural phenomena, technological developments, and cultural connections on large scale movement of people from one landmass to another and the forces that drove them to do so.

The Reverse Naval Architecture of Vasa

The Swedish warship Vasa sank in 1628, less than one nautical mile into its maiden voyage. Since its raising in 1961, it has been the focus of much scholarly and popular attention and stands as the only intact 17th-century vessel ever recovered. One aspect of Vasa that has gone largely unexamined until now is the method used by the shipwrights to design the shape of Vasa’s hull. The nationality of the shipwrights in charge of Vasa (Dutch-born Henrik Hybertsson and Henrik Jacobsson) and other construction features seem to situate Vasa within the Northern-Dutch shipbuilding tradition of the early 17th century. Within this tradition, the methods of ship “construction” are reasonably well understood; the methods of ship “design” are not.

This paper presents the initial results of a pioneering exercise in reverse naval architecture to recover the design method used to construct Vasa. Detailed hull data, obtained during two seasons of data collection at the Vasa Museum, forms the basis for this study. Analysis focuses on the proportional system of design of Vasa’s principal dimensions and arrangement, as well as the possibility for geometrical control of curvature and form apparent in the Dutch designed-and-built ship.
Laura Sanna  
Associazione Italiana Archeologi Subacquei, Italy

**Roman Wreck from Terracina. A Roman tiles Cargo**

In 1997, two sport divers reported for the first time the presence of several hundreds of Roman tiles concentrated on a surface of a few meters along the coast of Terracina (LT), at short distance from the harbor, at a depth of about 27 m. After a preliminary survey conducted in 1997, the Superintendence for Archaeological Heritage of Lazio realized in 1998 a small excavation, in order to determine the stratigraphy of the site as well as to verify the presence of wooden elements related to the hull. After this first operation, the site has not been investigated since 2010, when, during the Archeomar Project, it has been surveyed using ROV. After that, the Superintendence for Archaeological Heritage of Lazio, Dr. A. Zarattini, entrusted the writer to study the remains of the wreck. According to the data collected during 2010 and 2011 operations, we can now say that the load of is composed of some hundreds of *tegulae*, many of them still in the original position and arranged in regular rows on at least two superimposed levels. The upper part of the load still has 5 rows visible in the stowage position, inclined towards the west of 60°, probably due to the dynamics of sinking. The first two rows at the two northern and southern ends of the central block are divided by a row of tiles in pairs, placed on the short cut and perpendicular to the main rows. Around the main body of the load, some tiles are placed individually and scattered without apparent order, while others seem to be just upturned at the two sides of the load, perhaps following the breakup of the broadsides of the hull.

From a typological point of view the load can be considered “omogeneus”, consisting exclusively of *tegulae* and of some *imbrices*. The tiles have a size of about 60 x 40 cm. Over the tiles has been discovered a stamp with the word “MARRI” embossed in capital letters and in rectangular cartouche with rounded corners. Following the study of this stamp, we can now propose a relationship between the tiles found on the wreck of Terracina and the production of bricks of Campania, so that we can place them chronologically between the late 1st century BC and 1st half of the 1st century AD.
Sea journeys and ships of the Roman emperors

The size of the Roman Empire with its provinces from Britain to North Africa and Syria required travel activities of the emperors for military campaigns or local inspections. Most of these trips were done via land but also as sea passages. This is conveyed for e.g. Nero, Traianus, Hadrianus or Caracalla. Apart from the literary sources the sea journeys of the emperors were a topic which was depicted on the reverse sides of coins. In most cases they show the ship which was used by the emperor. Usually they were military galleys, while merchant vessels are an exception. The coin legends underline the cause of the issues, which could be the arrival of the emperor or the salvation from dangerous nautical situations. Beside the imperial coinage we know of several relevant reverse motives from coins which were issued by the cities of the eastern provinces of the Roman Empire. These are e.g. Corinthus, Patras or Alexandria. In addition to these examples, which can be classified by the coin legends, some dies show motives of ships that might also be interpreted as a record for the ruler’s sea journeys. The paper discusses especially evidence of the relevant coin reverses. The numismatic evidence delivers well dated depictions of war ships for the Roman Imperial era. It is for some ship types the only source. Because of their small scale illustrations, a critical examination is necessary. The possibilities and limits of coin depictions as a source for the reconstruction of ancient vessels will be discussed. Additionally the paper would like to investigate itineraries and organisation of the emperor’s sea trips.
The devil is in the detail. The dilemma with classification and typology

As more archaeological finds of wrecks and parts of vessels are discovered we are still struggling with interpreting the archaeological facts. The discussions on ship building traditions, classifications and typology have accompanied the field of ship archaeology from its beginning with many issues either still unresolved or new predicaments arising. The various strands of grouping, classifying and interpreting ships and boats from archaeological contexts mostly reflect the assumption that ships were built according to diagnostic conceptual approaches, which are expressions of geographic and cultural backgrounds. Following on from this, a combination of features and characteristics that can be gathered from the archaeological evidence, from diameter of plank fastening to hull form and shape, are seen as distinctive elements for the identification of certain ship building traditions or historically known vessel types.

Archaeological data, which can be obtained from shipwrecks often includes technical and structural aspects. Due to the complex nature of ships and boats, this however means that by using established and commonly accepted models for interpretation may impose preconditioned outcomes, which may not be satisfactory or appropriate. The paper aims to assess whether there is a place for interpreting the growing body of hard archaeological evidence on its own right with a view to let it speak for itself. Without too easily replacing current approaches with a simple “form follows function” principle, the paper will explore whether an expansion to e.g. “form and construction follow function, tradition and environment” as a starting point or component of the research process could prove beneficial before moving to wider geographically and contextually oriented interpretations.
Antonia Sciancalepore, Egidio Severi
Research Centre Bolsena Lake Scuba School, Italy

The wreck of Martana island (Bolsena lake, Italy)

The wreck was found in 2009, very close to the Martana Island, in the Lake of Bolsena, at a depth of about 17 m. It lies on a muddy layer and is well preserved. The hull is triangular and about 6 m long and 1.70 m wide. The wreck can be considered as an example of one of the most ancient traditional boat types which were in use on the lake, constructed according to a local technique which has completely disappeared.

According to historical documents, there were two types of fishing boats in use on the lake of Bolsena. The germagnola which had a width of 1.20 m and a maximum length of 6.40 m was used for fishing with a special conic fish trap called artavello. The retara had the same length but was slightly wider, 1.60 m, because it served to fish with trawl nets.

The boat recovered near Martana Island seems imputably to belong to the retara type.

In July 2010 an excavation was executed to document the wreck. It appeared that the vessel was entirely loaded with bricks, some still in place where they were originally stowed. The bricks have varying dimensions with the maximum length of 27.2 cm; the width of 13.8 cm and the height of 4.5 cm. During the July 2010 operations a graphic relief of the hull and the cargo was created, as well as photographic documentation.

Subsequently 3D reconstructions were made with a virtual simulation of the constructive sequence of the hull and of the disposition of the load, on the basis of which the deadweight of the boat could be calculated. All the operations have been performed in collaboration with the Southern Etruria Archaeological Department of Heritage Ministry (Soprintendenza per I Beni Archeologici dell’Etruria Meridionale), Dr. Patrizia Petitti.

According to additional archival information, this boat possibly belonged to a keeper of the island, and could have been lost while in use around 1930 to do repairs to some of the buildings on the Martana Island.
London Gateway. Commercially sustainable archaeological evaluation of an important maritime cultural landscape

London Gateway is a major new port being developed in the Thames Estuary, historically one of the busiest waterways in the world. The project has enabled archaeologists to develop a practical method for undertaking a commercially sustainable multi-phased archaeological evaluation both in advance of and during major capital dredging projects. The London Gateway project has required archaeologists to develop ways of identifying and rapidly evaluating the significance of large numbers of sites lying in the path of the dredge. It has required archaeologists to develop methods of identifying key impacts upon this archaeology and suitable but also commercially sustainable mitigation. It has also required them to develop cost-effective methods of monitoring the effect of dredging on nearby sites and of monitoring and reacting to the finds made during the dredge itself. Understanding the sites and finds concerned within the context of the cultural and economic history of the Port of London and the estuary has been a key component of this work, as has the ability to work with and use the data produced by other marine specialists. Understanding the cultural context of the work and the resulting significance of its results has also been a key component in communicating the maritime archaeology discovered to a wider and very varied audience. The paper will discuss the methodologies adopted and the lessons learnt for future projects, as well as describing some of the most significant results.
Petr Sorokin  
Institut of the History Material Culture, Russian Academy of Science (RAS), St. Petersburg, Russia  
Ayvar Stepanov

A Dutch 18th-century cargo ship in the eastern part of the Gulf of Finland

At 4.7 km northeast of the island of Hohland in the eastern part of the Gulf of Finland a three-mast wooden vessel has been found on a depth of 48 m. The discovery was followed by a survey to gather preliminary measurements and to plot structural elements. The hull of the vessel was about 26 m long, in the width about 7 m. The structure was preserved to approximately 70 %. The stern and bow of the ship were damaged, but the central part of the hull had remained in good condition. On the deck were two cargo hatches and a brick stove. There are wood ornaments on the ships hull with a carved pattern and panels. Two iron anchors with wooden stocks were located on the seabed in front of the bow. In the hold of vessel wheat and fat were tracked, which represents a traditional Russian cargo for European trade. 

From the vessel 70 individual finds were recovered: metal, ceramic and glass wares, navigating tools, Dutch pipes, 9 silver coins: 4 Dutch stivers 1670-1699 and 5 Russian roubles 1720 – 1769. The vessel is dated in the last quarter of the 18th century. Judging by its shape, design and construction and also because of features of ship architecture and a spar, the vessel reminds of the galiot type. Design features of the ship and the artifacts give evidence for a Dutch origin and trading function. 

The vessel named according the place Hohland 11 was recommended for inclusion in the list of identified cultural heritage sites. At this stage of the study, precise identification of the wreck on the base of written documents is difficult, given the large number of shipwrecks in this area and insufficient knowledge on the vessels themselves, as well as the full range of archival information on the ships lost in that area. At the same time, it is clear that most wrecks belong to medium-sized commercial vessels from several North European states. This is consistent with historical data, according to which the main cargo transportation along the Baltic Sea between Western Europe and Russia was carried out in the 18-19th centuries by West European, mostly British and Dutch vessels.
Katrin Thier
lexicographer, Oxford, UK

Linguistic origins and regional technology of the “cog”

Following the discovery of the Bremen Cog in 1962, Siegfried Fliedner went on to investigate not only the remains of this ship, but also the prehistory of its name (in his definitive 1969 publication). Half a century on, while our knowledge of the archaeology and history of the cog-type has expanded significantly (for instance through the study of the early finds from Denmark), work has also been done in the field of philology (collected in some recently-published etymological dictionaries), and many relevant resources (texts as well as images) have become more easily available. It may therefore be time to go back to look at the word “cog” itself, to investigate its linguistic origins by reviewing the earliest evidence, and to trace its later spread across Europe. The results can then be related to the physical remains and images of the ship type in an attempt to answer questions about the geographical origin of the word, in how far the movement of the word relates to the movement of the corresponding technology, and what regional distinctions may have arisen. This paper aims to give an overview over the available evidence and the problems involved in this research, and will present some preliminary findings.

Mikkel Haugstrup Thomsen
Viking Ship Museum, Roskilde, Denmark

Numerous shipwrecks found in the Danish sector of the Nord Stream offshore gas pipeline across the Baltic Sea

Since 2008, the Viking Ship Museum in Roskilde (DK) has carried out the archaeological assessment and survey required prior to the installation of the trans-Baltic Nord Stream gas pipeline through Danish waters. The project has involved desk-based screening of the data collected as well as archaeological activities in the field. Coast to coast, the 1220 km long twin pipeline crosses Russian, Finnish, Swedish, Danish and German waters. 137.6 km of this is though Danish territorial waters and EEZ. Including an alternative route design approximately 250 km of pipeline corridor has been surveyed in the Danish sector at a width of up to 2 km. Though only a small fraction of the vast seabed, the result is an overwhelming collection of hitherto unknown shipwrecks and other objects dating from the 17th century to the present day: 25 wrecks, seven possible wrecks, and five single objects - to which should be added seven presumed dump sites, the identification and dating of which are inherently problematic. This paper briefly presents the huge research potential of the wrecks and objects discovered; the methodology employed and patterns in the chronological and spatial distribution of the finds will be discussed. Are all these wrecks, of these particular dates, really representative of the entire surrounding seabed? Or are there circumstances in space and time that explain the apparent abundance of wrecks right along the pipeline and the apparent absence of wrecks of Medieval and earlier date?
Francesco Tiboni  
Centre Camille Jullian, Aix-en-Provence, France  
Associazione Italiana Archeologi Subacquei, Italy

The sewn boat from Cavanella d’Adige (VE). A 2nd-century BC boat

The wreck of a sewn boat has been discovered by archaeologists during the summer of 2008, while working on the channels placed near the structure of the so called Idrovora delle Motte in the territory of Cavanella d’Adige – Venezia, in an operation directed by the Superintendence of Veneto. The wreck, almost a complete broadside of a laced hull, was found lying on a layer of grey clay with many wooden broken piles in, possibly testifying a sort of refurbishment of a bank on a riverside in one of the channels that, during the roman era, connected the Adige mouth to the inland of Veneto. The wreck has been completely excavated during the summer of 2008 and has now been reburied in order to be preserved while waiting for a possible recovery and restoration project. From a technical point of view the excavation has allowed the archaeologists to put in light the right broadside of a flat-bottomed sewn plank boat, totally composed by planks sewn together with vegetal fibers following the usual scheme known for this kind of boats in the northern part of the Adriatic Sea. During the operation, many repairs have been discovered on the hull, testifying that this boat must have been used for a long time before being abandoned and reused as a sort of bulkhead or footbridge on the river-side. The archaeological analysis permit us to classify this boat as one of the eldest examples among the riverine flat bottomed boats of the roman era, possibly used to transport part of the loads, goods as well as people, that reached the Adige mouth aboard great maritime ships to the inland of this region. The paper will present a first interpretation of the the data collected during the excavation in order to reconstruct the original structure of the hull seen in the light of recent studies about similar boats discovered in northern Mediterranean area.
I. Triantafillidis  
Zea Harbour Project (Danish Institute at Athens), Piraeus, Greece,  
D. Koutsoumba  

The Harbour Landscape of Aegina  

Aegina formed a society that developed seamanship to the extent of creating a major naval power that reached its pick in the Archaic period. Its maritime aspect led to the extensive building of harbour installations in front of the city and the subsequent transformation of the coastal landscape. In the course of time the natural landscape had been more than ones been adjusted to the naval and trading needs of Aegina. The rise of the sea-level in this area (2-3m) has transformed the ancient lanscape and coastline. Thus substantial surviving parts of this landscape and its construction lie underwater. A part of the area had been surveyed almost 50 years ago including a good deal of harbour sturctures.

A reference by Pausanias, local information and various charts & maps suggested the existence of manmade reefs extending almost parallel to the coast in frond of the whole length of the ancient harbour front. The area of the harbourlandscape extended over 1600 metres including a trading harbour, a naval harbour with shipsheds, long quays, the Acropoliss of Aegina and an important part of the city.

This paper is using a 19th-century Admiralty chart (UKHO), presenting one of the oldest detailed depictions of the harbour, to discuss the Aegina harbour landscape and the structures underwater.
Darina Tully
Maritime Archaeology Studies at Saor-Ollscoil Na hÉireann, Ireland

The Use and Tradition of the Curraoch in the 21st Century

The curraoch, a form of skin boat, is still found in use along the west coast of Ireland. For over a decade an ethnographic study has been ongoing into the use and tradition of the curraoch in the 21st century. Developments of vernacular boats have in many cases been responses to demands of function, environment and tradition. The construction features and associated traditions of the curraoch are rooted in the local environment and maritime landscape. Not only did the curraoch study set out to do an audit of the curraochs in use, but also to try to explain the persistent use of this technologically ancient craft into the 21st century.

In 2010 a physical survey was undertaken; observations of types, size and use were recorded along with a photographic record. Select interviews were undertaken. Conventional lines plans were drawn, and experimental 3D laser scanning was employed to evaluate the performance of the different styles of curraochs. Data was also collected on voyages, not only on speed and distance covered, but also on how the coastline is navigated.

Anthropologists have long considered the west coast of Ireland as a repository of cultural survivals. For the ethnographer, the curraochs are a focus for the continuity of a great range of traditions within communities. They act as a catalyst for the transmission of knowledge, oral traditions, fishing techniques and associated crafts. For the archaeologist, the study of the curraoch as a boat with a long lineage could give us an insight into regional mobility, exploitation of resources and early navigation. This paper will present the findings from the study.
Evren Türkmenoğlu
Faculty of Letters, Istanbul University, Turkey

Construction Features of *Yenikapi 27 Shipwreck* found in the Harbour of Theodosius

The Byzantine harbour of Theodosius (*Portus Theodosiaca*) was discovered on 2004 during the construction of a railway transportation project in İstanbul, Turkey. The ongoing salvage excavations at İstanbul’s Yenikapi district have yielded the largest medieval shipwreck collection ever found in a single site. Yenikapi (YK) 27 is one of those 36 shipwrecks uncovered at site. A team from the Department of Conservation of Marine Archaeological Objects at Istanbul University carried out *in situ* documentation of the *YK 27* shipwreck and then disassembled its hull. According to the preliminary results of research, ship is dated to the 8-9th centuries AD. She was likely a merchantman, however, found without cargo items on board apart from some fragmentary ceramic finds. The bottom of the ship was in fair condition. The hull is preserved over a length of 12 m and a maximum width of 4.30 m. 3 stringers, 49 frames, 21 planking strakes and a keel have been identified so far. Some construction features of *YK 27* differ remarkably from most of the Yenikapi vessels. Lack of edge fasteners between planks, the placement of planking joints only under frames, planks fastened to frames with only metal nails driven from outside the hull are distinctive features of *YK 27*. On the basis of her structural characteristics, suggested construction sequence and design will be presented in this paper.
Zambratija boat, campaign 2011

In the bay of Zambratija, south of Cape Savudrija (Croatia) an important underwater site was explored during September 2011. A wooden hull build by mean of sawing was lying at the depth of 2.20 m. At the explored area of 12 m², eight planks and a frame were found. Over the juncture of the planks on the interior side, a thin lath was placed before sewing. The sewing itself was done with an uninterrupted cord that went diagonally through the holes that left a clearly visible trace on the lath. The use of a sewn up lath is a detail that resembles the technique used on ships that were discovered on the territory of Egypt, as well as on Bronze Age vessels from England. Construction details point discretely to the probable origin of the ship that was, possibly, a forerunner of a larger group of heretofore known sewed ships from the region of the Adriatic and its immediate hinterland. Analysis of one of the ship planks using technique 14C revealed the absolute age of 2535±60. A subsequent analysis of a sample from another plank, using the AMS technique, gave an absolute age of 2860 +/- 30. Considering preliminary results of a scientific surveys and radiocarbon dating, we can ascertain the importance of this site for further research of prehistoric shipbuilding technique.

Susana Vallejos
National Maritime Museums of Sweden, Stockholm, Sweden

Recording the original hull fasteners of the Charles W. Morgan

The Charles W. Morgan is the oldest American commercial wooden square rigged vessel and the last surviving wooden whaleship still afloat. This intact historical vessel was launched in 1841 in New Bedford, Massachusetts, and is now preserved at Mystic Seaport Museum in Mystic, CT, USA. The Morgan is (as of 1973) a floating, living, moving, and sailable wooden ship. To this end, the Morgan, requires a constant and well executed maintenance program. And at times when this is not enough, replacement of timbers that have fallen to decay or worn out is the next step. Since arriving at Mystic Seaport in 1941, the Morgan has undergone two major rebuildings - from the waterline up initially, as she was placed in a sand bed shortly after her arrival. Since refloating the Morgan in 1973, and completing the Museum's Henry B. DuPont Shipyard, the Morgan could be maintained as a living vessel. This third restoration will renew areas of the vessel from the waterline down to below the turn of the bilge, including parts that have not been changed since construction. With the removal of the remaining original hull timbers the original hull fasteners had to be recorded. In november 2011 the fasteners were recorded using a methodology initially developed by Dr. Frederick Hocker, Director of Research at the Vasa Museum in Sweden. A totalstation was used to record the exterior position of the fasteners and the collected data was then used to create a 3D model of their position. This paper discusses the applied methodology and its findings.
Lotika Varadarajan  
New Delhi, India

Traditional Gujarat Boat Carpentry. Intriguing Departures

The traditional mode of hull plank joinery along coastal South Asia and the adjoining littoral of the Arabian Sea is that of coir sewing. The crafts are shell built and there is a complete absence of use of templates and complex tools of measurement. Innovations can be grafted onto an existing technology without any drastic change in approach or procedure. In Bengal the British launch which operated on the Hugli stimulated the building of its analogue, the kakdwip trawler. However, while the shape of the hull was duplicated the building procedures remained traditional and skeleton did not outpace or replace shell.

The case of customary carpentry in Gujarat boat building technology presents a very curious amalgam. There is a complete absence of sewing. Indeed boat builders of Ponsri, South Gujarat state that while they can sew boats to order for Maharashtra nailing is the order of the day in relation to Gujarat. Methods of boat carpentry have been documented in South Gujarat (Ponsri, Taluk Gamdevi, District Navsari), Kutch (Mandvi) and Saurashtra (Salaya Bandar, District Jamnagar). Current practices and procedures duplicate those documented and recorded in Surat by the Dutch traveler, John Splinter Stavorinus, circa eighth decade of the 18th century, as well as by James Hornell who recorded the techniques of plank joinery in circa 1946 in Bulsar and Bilimora.

At the initial stage the two stem and stern posts are joined to the keel after which the two garboard planks are rabbet jointed to the keel. The frames are raised on this base thus providing a skeleton structure on which the remaining portion of the hull is to be raised. The floor timber is joined with nut and bolt to the ribs by the joint known as the phasri wad without any luting procedure. As there is a minimal support base, the series of floor timbers and ribs are supported and held in place by temporary horizontal wooden planks. While the method of the support system approximates that of skeleton first in boat construction the cognitive approach to boat building particularly as relating to points of curvature are based in practices associated with shell first techniques as have been documented in other parts of coastal India.

The basic question remains – why does Gujarat plank joinery take recourse to iron nails along with nuts and bolts and why is the shaping of the hull based on the system of the prior elevation of ribs? The author will base her presentation on field generated ethnological data tracing the elevation of the hull from the stage of laying of the keel to the finishing of the hull. Perhaps the presentation of this material to an international audience will elicit some answers.

In this context two facts may prove to be of some relevance. Circa 1732 a Kutchi seaman, Ram Singh Malam (Malam meaning navigator), encountered difficulties at sea. He was rescued by a Dutch ship and is said to have spent eighteen years in Holland where he learnt many skills which he brought back to Kutch. In this context it is also relevant to place on record that there is a Kutchi pothi, log book, in manuscript form in the collection of the National Museum, New Delhi. The first folio has the hand written words “malammi pothi” on the left while on the right the accession number 82.263 has been inscribed. On the third folio from the end are to be found the words (line one) “Kutch Sea
Navigation (line 2) Malam Samji Pradhan (line 3) Mandvi-Kutch”. It is curious that this is the only pothi among those found in Gujarat and Lakshadweep in which coastal outlines can be found. Perhaps some clue may be provided as to whether the deviation noticed in Gujarat practices of boat building and the presence of this map, completely different in contour from the more familiar Indian cosmological and pilgrim maps, owe their orientation to influences which can be ascribed to Portuguese, Dutch or French presence and interaction generated thereby.

**Erbprem Vatcharangkul**  
Underwater Archaeology Division, Thailand

**Bang Kachai II, a well-preserved Junk in Thai waters**

Today, over 60 sites have been found in Thai waters. The *Bang Kachai II* wreck is one of the most outstanding and most important sites of all. The wreck site lies not far from the coastline at 9 metres of depth and covers a large area of nearly 900 square metres. Research has been done on the site for many years from 1989 to 2002. The ship is built in Chinese style and can be dated around 16-17th c. BC, according to the interpretation of the Chinese porcelain. Based on the excavated artefacts, it is believed to be a cargo ship, sailing between city ports of Thailand and neighbouring countries. There are many kinds of goods found, such as, betel nuts, pepper, timbers as well as copper bars. The site has been excavated and although much is known about the wreck, still some mysteries need to be solved. For example: How did the ship sink? Where did the mysterious pieces of human bone that were found in the wreck come from? And from where were the copper bars shipped? In this paper the result of the research until so far will be presented and some ideas and hypotheses on the present mysteries discussed.
Cogs in context. The research on the cogs from Doel, Belgium

During the construction of the new Deurganckdock in the harbour of Antwerp in 2000 and 2002 two medieval shipwrecks were found. The Doel 1 wreck is a nearly complete vessel, whilst of the Doel 2 wreck only the lower parts are preserved. Both wrecks were situated upside-down and have cog-like characteristics. They were disassembled and stored in 33 water-filled containers. It was until 2010 that an interdisciplinary research project started. Synchronous with the archaeological research, where two Faro-arms are being used, the project also focuses on dendrochronology, palynology, tar-research, analysis of the caulking material, conservation and public outreach. In 2013, an academic publication, a book for the general public and a 1:10 scale model of Doel 1 and 2 made of laser-sintered parts will be presented. The 3D-model will be used for the later scientific reconstruction and hydraulic research. Parallel to the research, the conservation phase is starting up with a final goal of presenting the cogs in context to the public in a purpose-built museum in Antwerp.

Both ships represent an important, and for Flanders a unique, type of vessel which had a large influence on the economic activities and development of the region of Antwerp and Flanders in general in Late Medieval times. In correlation with its maritime cultural landscape the finds can be of importance to understand the ship type and its usage in this period.

The presentation will show the different studies applied on the wrecks, a preliminary insight into the local maritime cultural context and some comparisons of these two ships.
Joep Verweij
ADC ArcheoProjecten, Amersfoort, The Netherlands

Continuity and change in Dutch shipbuilding in the Early Modern period. The case of the watership

The 16th and 17th centuries are characterised as a period of rapid growth in Dutch shipbuilding in which Holland has a central role. Holland is one of the seven provinces at the time in the newly founded Dutch Republic. Ships in Holland grow bigger with multi-mast rigging to carry more cargo over larger distances across the world. In the case of the locally operated watership this is not so apparent. In fact, the general opinion is that there was continuity in the remarkably robust medieval design of the watership up to the point that the last ships were built at the dawn of the 19th century. This presentation discusses the manner in which the available archaeological data of this ship type reveal evidence for change. The data from thirteen documented watership wrecks have been closely examined for that purpose. At least two major design changes have been identified involving increased dimensions and better manoeuvrability. Also a transition from a lap-strake hull to a flush hull is made in the case of the watership, which is contextualized in a discussion on prevailing shipbuilding traditions in Holland. An effort is made to find drivers for change in the context of a rapidly developing maritime infrastructure in Holland. It is appreciated that changing functional requirements and shipbuilding economics at a local level drive design change. The case of the watership shows that dynamics in society are reflected in the design and subsequent construction of ships.

Elisabeth Veyrat, Michel L’Hour
Département des Recherches Archéologiques Subaquatiques et Sous-Marines (DRASSM), French Ministry of Culture, Marseille, France

The two shipwrecks of La Natière, Saint-Malo (France). An archaeological contribution to the Atlantic maritime landscape of the the first half of the 18th century

The two shipwrecks of La Natière, Saint-Malo (France) have been identified as French privateer frigates, respectively, the Dauphine (le Havre, Normandy, built 1703) and the Aimable Grenot (Granville, Normandy, 1747). Both sunk on La Natière rock barrier, off Saint-Malo (France): one in 1704 and the other in 1749. The study of these shipwrecks highlights the importance held by Saint-Malo, Le Havre and Granville in the first half of the 18th century, the links between those cities and the close relationships between these harbours and their supplying hinterlands. Moreover, the shipwrecks of La Natière constitute an amazing evidence of exchanges and contacts with Europe, America and Africa. In that perspective, they are to be considered as key witnesses for the perception of maritime landscape of the era, and represent a good glance at the approach of Atlantic world-economy. This paper aims at pointing out these aspects, through the shipbuilding data and a vast collection of artefacts from the daily life aboard.
Anchor parts discovered during the Liman Tepe Harbor excavations, and the function of the wooden superstructure

This paper will discuss the various parts of anchors exposed during the Liman Tepe Harbor excavations in Urla, Izmir, which have taken place in the last decade under the directorship of Professors Hayat Erkanal and Michal Artzy. The parts have been found in two excavation areas located within the now submerged Archaic through Classical Greek dated harbor basin. The anchor parts include an in situ Archaic wooden anchor arm with iron “tooth”, as well as a number of other teeth of Classical date. A fractured half of a stone stock was also exposed. Discussion will include the implications of these finds to our understanding of ancient anchor development, as well as inferences into the behavior and sizes of ships mooring in the harbor.

Finally, an important observation will be presented resulting from the author's reconstruction and experimentation with wooden anchor designs. It is well recognized that the weight and length of stocks of wooden anchors (be they of stone, lead, or a composite of lead and wood) play an essential role in the anchor’s ability to cant on the sea floor. What has not been discussed is the effect of the wood's positive buoyancy, and that the wood superstructure's interaction with the negatively buoyant stock results in a pseudo self-canting form of anchor; i.e. the pointed arm is naturally oriented towards the sea-floor with the slightest tug on the hawser, resulting in a more immediate hold. This property helps explain the relative longevity of the wooden anchor in the Ancient World.

A shipwreck of a cog-like cargo ship in the IJssel at Kampen, The Netherlands

In April 2011 a 20 by 8 m shipwreck was discovered in the river IJssel at Kampen, The Netherlands. The find was done during an archaeological prospection project carried out by ADC Maritiem and Periplus Archeomare. The research was funded by government as a standard procedure within plans to dredge the riverbed. The lowering of the riverbed of the IJssel is part of a national project to improve water drainage of the entire river system. The size of the wreck was determined by geophysics and construction details were identified by underwaterarchaeologists. These results gave a solid basis for an interpretation as a cog-like vessel. Up to now, no accurate date of the wreck has been determined. Some finds of pottery point towards a date in the 14th-15th century and this is supported by the geological context. The first diving inspections have led to the conclusion that the wreck is extremely well preserved due to favourable conservation conditions in fresh water. A stunning aspect of the find is the maritime context: a wreck of a seaworthy cargo ship at a distance of less than 300 m from the historic harbour of the Hanseatic city of Kampen. Without knowing too much details on the cargo, inventory and personal belongings that presumably are present in the wreck, a vast amount of research questions raise at this stage of research. In tis paper the latest updates of the project will be discussed.
The complexity of extended sea voyages to areas without familiar facilities requires significant advance planning, flexibility, and innovative approaches to utilizing space and resources efficiently. One practical requirement for all sea journeys is the ship’s boat, or boats, small craft capable of tending to the needs of the expedition and individuals, especially in moving between vessels in a fleet or to and from shore. Archaeologists have studied a number of small craft, from northern European burials to Red Bay, and we propose that an assemblage of timbers from the pharaonic port site of Gawasis on the Red Sea is another example. Used intensively over about 300 years from the late third millennium BC, the site was a state-operated frontier camp for staging voyages to the land of Punt in the southern Red Sea. The remains of seagoing ships built of cedar using traditional Egyptian shipbuilding methods have been discussed at earlier ISBSA conferences, but we have new information about the small craft that accompanied the more massive vessels. Descriptions of the individual components and a tentative reconstruction based on physical evidence and representations of small boats from contemporary sources offer a significant contrast to previously published materials.

Per Werenskiold
Norwegian Marine Technology Research Institute, Trondheim (MARINTEK), Norway

Viking ships. The most sophisticated and successful high-speed ships of their time

The paper documents major findings from MARINTEK model tests with Viking ships, and discuss the historic development of the Viking ship types, hull designs and structural strength, steering balance and steering board effectiveness, importance of hull flexibility, and rig, sail and reef systems.

Though dendroarchaeological studies of shipwrecks are increasingly common practice, the more ephemeral, non-wooden components of hulls such as surface treatments and caulking are often overlooked in scholarly study. Basic literature assumes a degree of uniformity in these materials, even while specific case studies indicate that they actually vary widely, having many possible botanical and geographical sources, and often include many different purposeful and non-purposeful additions. As such, the non-wood components associated with archaeological hulls should be carefully examined, recorded, and analyzed as they may potentially provide a wealth of information concerning the ship’s construction environment, availability of material, and the choices made during its construction and maintenance.

This interdisciplinary analysis presents a procedure used to analyze these often-overlooked elements of ship construction using robust, intensive methods of multi-proxy chemical and biological analysis that may be transferrable to other archaeological ship remains. For three Scandinavian boats ranging in origin from the 13th to the 17th centuries, analysis by gas chromatography-mass spectrometry and scanning electron microscope (SEM) indicate that their tars and caulks consists primarily of substantially heat-altered pine tar, with additions of birch bark tar. Birch products have not previously been reported in Scandinavian boatbuilding tars, nor have previous boatbuilding tars shown such high percentages of highly-altered resin products. The presence of elemental inclusions was tested for using SEM. Several elemental substances were indicated, and two were deemed of archaeological interest: sulfur and iron, possibly representing corrosion products, purposeful additions or taphonomic artifacts.

Palynological analysis of plant inclusions of the tars, though preliminary, differentiates the location of manufacture for two of the vessels. Further comparison to reference collections may help determine their regions of origin.
The 18th-century Russian battleship the *St. Alexander*. Expeditions 2011-2012

*St. Alexander* was one of the first 66-cannon battleships, which for the nearest years built up the nucleus of Russian Black Sea Fleet. Laid down on the 28th of July 1781 on the Herson shipyard. The *St. Alexander* was put afloat on April 11 1786. On September 23rd 1786 the ship put to sea and took a ply towards Sevastopol. On the first night of the cruise the ship crashed near the most western point of the Crimea – cape Tarkhankoot.

In the 1990s we found the investigation files on the shipwreck of the *St. Alexander* in the State Russian Marine Archives of St. Petersburg. In August 2005 during divers’ training camp a group of divers found a wreck site of a sailing ship.

In next years divers managed to find a lot of different objects: cast-iron ballast bars, cast-iron cannonballs and bombs, caliber of which was 36, 18, 8, and 6 pounds, caseshot supply in canvas, knipels, flintlock pistol and a bottom of a candlestick, with an engraving that had the letters S and A.

According to the documentary witnesses, only one Black Sea fleet ship crashed at the cape of Tarkhankoot in the 18th century. It was a 66-cannon battleship *St. Alexander*. So, all the information, gathered at the site of underwater research allows to state definitely, that the wreck site of the ship *St. Alexander* was found.

Overview of recently discovered and revisited medieval shipwrecks from Bremen, Germany

- the *Beluga* ship (the wreck of an early 15th-century seagoing clinker ship with Scandinavian features, planked with Baltic wainscot, investigated in 2007.
- the *Becks* ship (a mid-15th-century punt, investigated in 1989,
- the *Schlachte* ship (a late 12th -century log-based, extended vessel with evidence of one of the earliest stern-rudders, a unique find in many ways, investigated in 1991.