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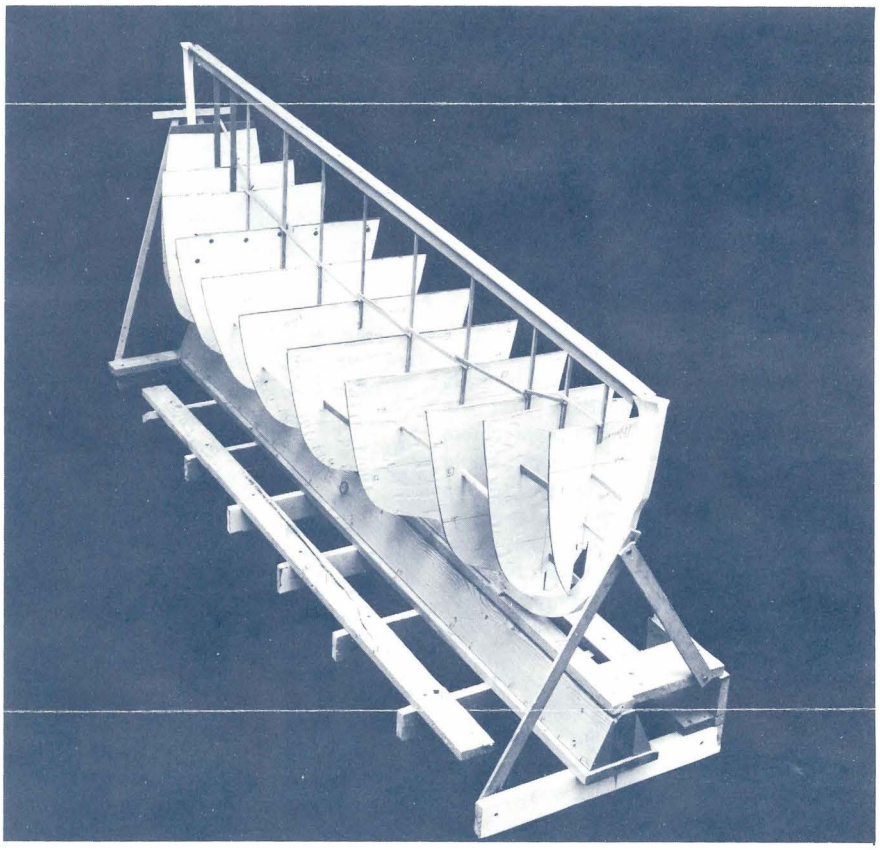
AINA NEWSLETTER

Spring 1976

THE INSTITUTE'S MODEL SHOP

The techniques of underwater archaeology have been well documented and publicized, and most AINA members have at least a rudimentary knowledge of what transpires during the excavation of a shipwreck. Less familiar are the processes of reconstructing vessels whose remains have been sufficiently preserved. It is our intention to include articles or notes of interest on reconstruction in this Newsletter from time to time.

One vital step in the reconstruction of wooden ships is the building of models, for models provide a three-dimensional perspective which is unrivaled by graphic or literary research. While not so colorful nor elaborate as underwater work, the Institute's model-building program is scientific, varied, and extremely important to the research and publication of any project.



The University Museum

An early mould model used to determine hull lines of the Yassi Ada Byzantine ship.

MODELS IN HISTORY

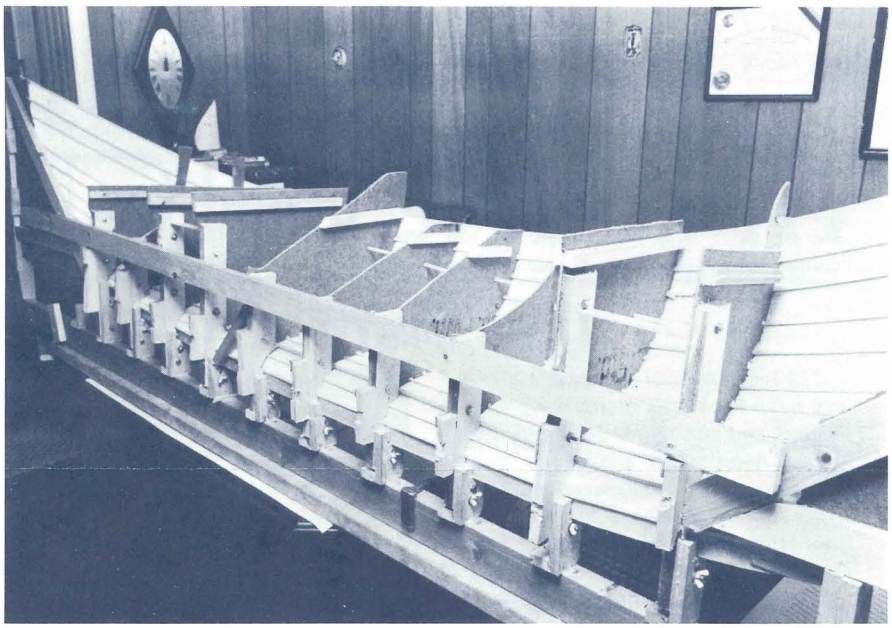
Most laymen consider ship models to be mantle decorations or museum pieces. But models have served in numerous other capacities throughout history. Nearly everyone is familiar with little Egyptian tomb models which reflected the deceased's activities in his life-time and were supposed to help him in the afterlife. For millennia, ship models were used in many cultures as votive offerings. Church ships of western Europe were merely adaptations of earlier votive ships. As silver or glass nefs, they graced the banquet tables of kings and queens.

The most productive uses for ship models have been within the shipbuilding industry. Early naval architects had models built from their latest plans in order to permit admiralty boards to better visualize and, hopefully, to purchase the new designs. Such models were of the finest craftsmanship and often built with a flair intended to win the favor of board members. Perhaps the finest collection of admiralty models in the world is the Rogers Collection at the Naval Academy Museum in Annapolis, Maryland. Ship designers have used carved models, called "half" or "lift" models, to develop hull shapes. "Tank" models are used to test hydrostatic properties in specially designed and activated water tanks.

MODELS AID RESEARCH

Models and replicas produced in the course of AINA research are unlike any of the above. They range from super-detailed miniature ships, with every nail custom-made and put in its proper place, to crude cardboard assemblies. They may duplicate something as simple as a bolt or as elaborate as an entire hull. All serve a common purpose — enlightenment.

Ships cannot be reconstructed in the manner of pottery or stone buildings. When a ship disperses on the seabed, broken edges may rot or erode so that they can no longer be fitted together. Wood grains relax after years in the sea, and planks distort to a point where they no longer represent original hull contours. Shipworms riddle the wood with holes, causing it to collapse and change dimension or the angle of its edges. Much wood may disappear completely. Even where two pieces of wood seem to fit, the match must be regarded as suspect. Reassembling a ship, whether it is done graphically or physically, cannot be considered a giant jig-saw puzzle, since many puzzle pieces will never fit together. For these reasons, we early recognized a need for a reconstruction method which was both scientific and practical.



David A. Steffy

A third-generation mould model locates planking seams and determines hull shapes inside...

We first developed an archaeological research model in the 1950's. At this time, underwater archaeology was in its infancy,. but it was evident that the science would develop to a point where shipwrecks, satisfactorily preserved, could be excavated, studied, and perhaps reassembled. At the time, this writer combined three pastimes — the study of wooden ship construction, structural ship modelling, and pure mathematics — to develop a research method. By 1962 a method had been developed which appeared successful: a hull was carved from a large block of wood to the shape of an Egyptian ship of the Punt Expedition. When this hull had been hollowed out to the thickness of planking, it was cut into hundreds of small pieces which were allowed to disperse as it was believed a sunken ship would do on the seabed. The pieces, each of which had distinguishing marks or shapes, were then "reconstructed" into their original form, using our newly-developed methods of three-dimensional geometry.

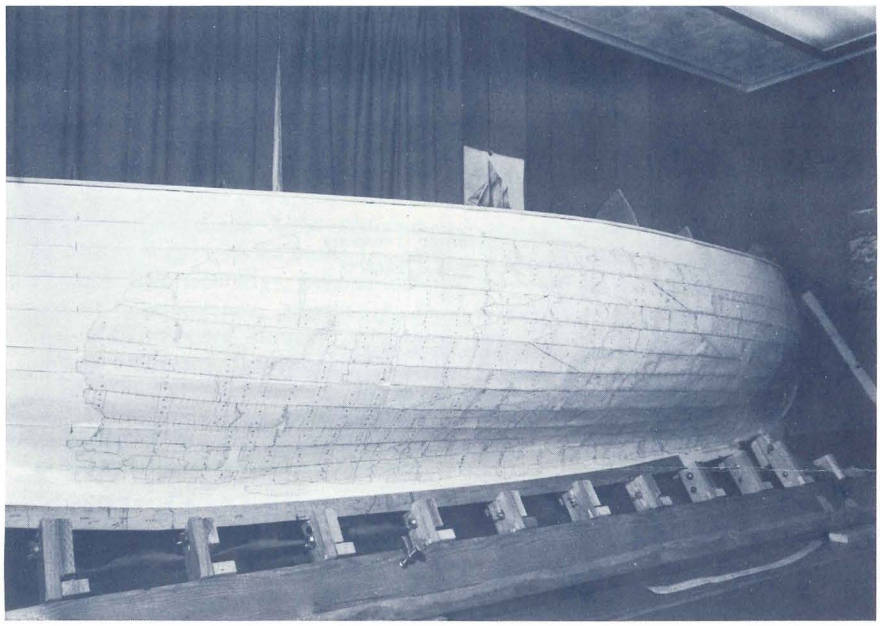
While the method seemed successful, we had no shipwreck on which to test it. Of the various people working on old or ancient wrecks with whom we corresponded, most did not answer and those who did indicated they were primarily interested in artifacts. Several more years passed until we met George F. Bass. This time we were not ignored. Anxious to develop new tools for archaeology and always ready to accomodate fresh ideas, Dr. Bass suggested we try the method to reconstruct the Yassi Ada Byzantine ship. For the next few years we worked closely with Frederick H. vanDoorninck, who had just completed his original graphic reconstruction of the Byzantine ship. Although remains of that vessel were sparse and our models were still primitive, it was quite evident that ship models were destined to play an important role in future ship research.

We have come a long way since the Byzantine project. Michael L. Katzev, director of the Kyrenia ship expedition, was particularly receptive to three-dimensional research, and models were instrumental in the reconstruction of the Kyrenia ship. They will again be used to aid Dr. van Doorninck, this time in his research of the Yassi Ada Roman hull. They are being used in lesser capacities in consultation work and will continue to be employed, in ever-increasing forms of development, for future projects.

OBJECT MODELS

Dozens of types of models and assemblies are made in the AINA model shop and each has a different function. One example of the manner in which models of a single object can be of assistance is found in the models of the Byzantine anchors. Not only did these slender iron "hooks" defy all good principles of anchoring techniques, but their design suggested they may have originally had wooden stocks which disappeared. 1:10 scale models solved the problem of how all eleven anchors were stowed on deck and even suggested a workable arrangement for the stocks. However, we had to weld a full-size working model together from old iron pipes loaded with concrete to determine why they were so designed. The owner of a Chesapeake Bay boat livery was nonplussed when we loaded a six-foot anchor into one of his twelve-foot boats and headed for open water. Absurd as it may have looked, such experiments with these models answered many of Dr. van Doorninck's questions and established a set of standards for all future anchor research.

Almost every excavation yields a piece of timber or an assembly of pieces whose shape and purpose are a complete mystery to us. A model of such an object is always a help, since its function is more easily visualized in three dimensions than in photographs or drawings. It is also



David A. Steffy

...while the outside of the same model precisely locates hundreds of nails and mortise and tenon joints.

much safer to handle a replica than the original object. Quite often, the very process of fabricating a piece brings the solution about and, in several cases, a mysterious piece was identified before its model was half completed.

HULL MODELS

There are "mould" models to determine hull sectional shapes, "batten" models to define hull contours, "sprung plank" models to indicate the method of planking and fastening the hull, and structural mock-ups to calculate stress factors and reveal the extent of the ancient shipwright's technological ability. All of the above model types were developed by us for our own research. Although their functions and derivation are far too involved to explain in this article, their uses will be published as part of the Kyrenia expedition report. It should be mentioned that such models save many hours of drafting time, afford solutions to problems that would otherwise go unsolved, and sometimes provide mathematical proof of their reliability. All are quickly built and require little, if any, cash outlay for materials.

Not so with exhibition models. These miniature ships are built at the end of a reconstruction project and precisely duplicate every nail, joint, and piece of timber in the original vessel as far as our research can determine. The Byzantine model, now half completed in 1:10 scale, will have a removable galley with every piece of pottery and even the hearth duplicated in the original materials. More than a thousand hours of work will be spent on this model.

Exhibition models have many advantages. Because the original shipbuilding process is being duplicated, modelmaking can bring about further revelations in our research. Since all the pieces are exact duplicates of the original, they can be studied by scholars for years to come. Their three-dimensional scope allows the layman to comprehend what he could not derive from paintings and plans. They will be used, in step-by-step photographic recording, to illustrate our expedition reports and are also valuable in the instruction of students.

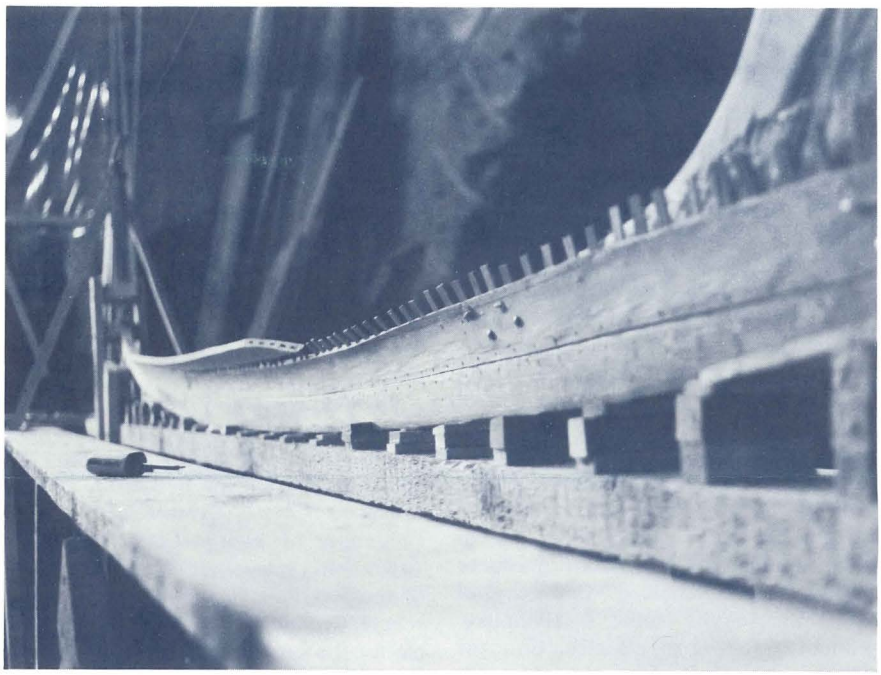
AINA'S MODEL SHOP

Those familiar with our operations do not regard our facilities as a proper model shop. Like the proverbial floating crap game, it can quickly move to a new location. Usually, the shop is located where the reconstructor happens to be. For several years, it occupied a 13th-century barrack room in the Crusader Castle of Kyrenia, Cyprus. But for all practical purposes, the shop is permanently housed in Denver, Pennsylvania. This is an even more unlikely spot than a castle, since ships are definitely not a part of the Pennsylvania Dutch culture. Largely, the reason for the location is a matter of economics. AINA has no budget for a shop, and rented space and elaborate equipment are out of the question. Perhaps some day we will own a proper shop, but for the present most modelling is done in the author's basement and often overflows into the rest of the house. Since our models are seldom less than five feet in length, one house is hardly sufficient, and we have recently established an annex by borrowing a three-car garage from a relative. We have also, on occasion, used local industrial testing and research facilities, and we are grateful for these courtesies.

It is unfortunate that we do not have space to conduct our larger experiments indoors, for they must seem very strange to the public. Our neighbors try not to notice when we dig up divots as we drag an ancient anchor replica across the lawn or even when we hoist a brailed Greek sail on a mast stuck into the ground. Recently we hurriedly built an entire ship's stern of scrap lumber in our "annex", which is situated directly against a narrow street leading to a drive-in bank. The purpose was to re-enact the ship's dispersal on the seabed, thereby providing information needed to determine both the interior stern construction and the method of stacking cargo. It eventually did supply these answers, but on the first attempt the whole rig fell out of the shop and into the street, stopping traffic. The first car in line was Denver's one and only police cruiser whose uniformed occupant could only stare in disbelief. After all, how does one fill out a report stating an ancient ship's stern fell into a street a hundred miles from the sea? Though our antics seem to be politely accepted in this conservative community, we nevertheless keep looking over our shoulders for the men in white coats.

TOOLS AND MATERIALS

Hand tools are preferred to powered equipment for many operations, since our work is most fruitful when done as closely to the ancient methods as possible. Materials for exhibition models duplicate the original ones as nearly as possible. Wood species can generally be duplicated as can pottery, lead, copper, and bronze. Iron castings are too elaborate for our modest facilities, and we generally cast iron replicas in white metal. Fortunately, steel nails are available in almost any size imaginable, and these are substituted for iron nails. The sizes of nail heads do not usually match the ancient ones, but this is quickly corrected with an abrasive wheel. The battens we use for projecting hull lines are split to shape, never machine cut, since the straightness of wood grain is important. Otherwise, the materials used for research models are the cheapest available. Wood is generally scrap and is used many times over. Research models have no use beyond the experiment for which they are created; so appearance and craftsmanship are not important. For this reason, large experimental models often can be built in a few hours. Space requires that each research model be torn down after use and the materials reused for another project.



Susan Womer Katzev

Oak tenons less than 1 mm. thick hold adjacent strakes of planking together. This 1:5 research model duplicates exactly in an effort to determine the ancient shipwright's techniques.

LOOKING AHEAD

Do the results of three-dimensional reconstruction justify the time and expenditure? Do the models contribute more information than conventional research and graphic reconstruction methods? Is there a future for ship models in archaeological research? The answer to all three questions is a resounding "yes". Three-dimensional reconstruction is used "in place of" rather than "in addition to". It constitutes a considerable saving in time and money, at least in this reconstructor's office. An example is the stern section which fell into the street. Such a mock-up can be nailed together well enough to satisfy experimental requirements in about ten hours, hardly more time than it takes to make a set of sketches of the section. When it is completed, we can stand in it, load it with simulated cargo, and acquire a sense of orientation we could never achieve with a drawing. In less than three days that crude stern replica yielded pages of information, including half a dozen major discoveries. Graphically, the same results may have taken weeks if, indeed, many of them would have been noticed at all. The use of ship models in combination with graphic reconstruction and research can be compared with the purchase of a new automobile. It is important to read catalogs and absorb the statistical data, but one should really get into an automobile, look it over, and test-drive it before making the purchase.

As for the future of ship models in archaeology, we predict they will play an increasingly important role in ship reconstruction. Fortunately, AINA is in a position to develop further and encourage three-dimensional research. Two expedition reports now being prepared for publication will emphasize the role of models in that work. A series of color transparencies illustrating the construction of early and ancient vessels is being prepared by photographing various steps in the construction of our exhibition models. Our most exciting contribution, however, lies in the perfection of a series of models now being developed. These models are expected to simplify the recording of hull remains, cut reconstruction time drastically, and reveal information on excavated ships which might not be evident by present methods. Although they have yet to be tested for a complete excavation, we have been encouraged by the results thus far.

We dream of the day when AINA ship reconstruction can enjoy departmental status. Hopefully, that status will include a formal center equipped with drafting rooms, library, and, above all, a properly equipped model shop. Until that time we will keep on building our odd-looking assemblies in basements, garages, or anywhere else we can get the job done. Regardless of the locale, our models continue to contribute to the work of the Institute.

J. Richard Steffy

Current Field Projects

Penobscot Bay, Maine

The second season of excavation of the Revolutionary War privateer, *Defence,* in Stockton Harbor, Maine, will begin on June 20. In conjunction with the excavation, a joint project of AINA and the Maine Maritime Academy and sponsored by the Maine State Museum, AINA will conduct its fourth field school. Student include David F. Bell, technician, Scripps Institution of Oceanography; Jonathan A. Blumenfeld, graduate student of anthropology, University of Colorado; Elizabeth L. Brandt, undergraduate student of classics and history, University of California at San Diego; Paul F. Burke, assistant professor of classics, Boston University; Carolyn Carter, graduate student of anthropology, University of Arizona; Richard L. Green, graduate student of anthropology, University of Texas at Austin; Helen F. Hillhouse, graduate student of classics, Goucher College; Daniel Koski-Karell, graduate student of anthropology, Catholic University of America; Carol A. Olsen, undergraduate student of art history, University of California at Berkeley; Glenn S. Penoyer, graduate student of anthropology, University of Toronto; Richard Preston, undergraduate student of English, Pomona College; and Joseph Schwarzer, graduate student of art and art history, SUNY at Binghamton.

Students and staff will be housed at Maine Maritime Academy in Castine. Transportation to and from the *Defence* site will be provided by the expedition vessel *Dirigo,* a tugboat owned by the Academy and chartered for the excavation.

In addition to the directors, David C. Switzer from AINA, and David B. Wyman, Maine Maritime Academy, expedition and field school staff will include J. Richard Steffy from AINA, Cynthia Orr from the University of Pennsylvania, and Rhys Townsend, University of North Carolina at Chapel Hill. Participants in the 1975 field school, Cynthia and Rhys will be responsible for the on-site conservation and preservation of artifacts and will assist the State Museum conservator, Stephen Brooke. Peter Hentschel of Branford, Connecticut, will continue his role as expedition artist. The expedition photographers will be a father and son team, Carroll and Phil Voss, of Gettysburg, Pa. Part-time assistance will be provided by Steven Ross, of North Adams, Mass., a member of the 1975 expedition, and Warren Reiss of the Ira C. Darling Marine Laboratory at Walpole, Maine.

Using information gained through last summer's examination of the remains of the *Defence,* the 1976 expedition will concentrate on a complete excavation of the bow area. An effort will also be made to determine the configuration of the buried hull structure. Concurrent with the activity at the *Defence* site, Klein Associates of Salem, N.H., will conduct a remote sensing survey in the Penobscot River. This survey, to locate wrecks of other vessels of the Penobscot Fleet, will concentrate on targets noted during last summer's preliminary survey and will extend the sonar and magnetometer search to Bangor, where a number of fleet wrecks have been generally located in historical accounts of the aftermath of the Penobscot Expedition.

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The American Institute of Nautical Archaeology is a nonprofit scientific/educational organization whose purpose is to gather knowledge of man's past as left in the physical remains of his maritime activities and to disseminate this knowledge through scientific and popular publications, seminars, and lectures. The AINA Newsletter is published periodically by AINA and is distributed to its members and Supporting Institutions to inform them of AINA's current activities.

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