Introduction: Underwater Archaeology as Historical Science

Underwater archaeology has evolved rapidly in recent years with the advent of new technologies in marine science and exploration – innovations that have enhanced diving capabilities and enabled researchers to dive and work underwater without the need for heavy suits and surface-supplied air, improved technologies for exploring the underwater environment, including magnetometry, underwater photography, depth-finding equipment, and the sophisticated application of acoustics and computers, and new small submersibles, remotely operated vehicles, and autonomous underwater vehicles for deepwater exploration and survey.

All of these technologies provide opportunities for improved scientific research in the underwater world, and sciences like oceanography, marine biology, and geology have clearly benefited from them. But what about archaeology? What kind of science is underwater archaeology, and what have these new technologies enabled it to accomplish? Problems still remain for underwater archaeology, however, in achieving the credibility accorded to land archaeology. Although as the pioneer underwater archaeologist George Bass argued thirty years ago, it is easier to train an archaeologist to record and excavate sites underwater than it is to train a diver to become a good underwater archaeologist (Bass, 1966: 19), underwater archaeology is still viewed by some land archaeologists as a less scholarly or scientific discipline than their own.

Archaeologists and others have tended to consider the underwater world a chaotic mix of disassociated and dissolved features lost to human view for all time. Wave action, currents, silting, deterioration due to the action of marine organisms, and other little-understood factors have been
assumed to make the study of shipwrecks impossible or impractical. Until
the appearance of sophisticated diving apparatus and electronic devices for
locating and identifying submerged remains after World War II, approaches
to recovering shipwrecks and other submerged cultural remains were char-
acterized by relatively crude methods such as bucket dredging, grappling
with hooks, claws, or nets, blasting, and pumping, all of which only created
a chaos of their own by jumbling, fragmenting, and homogenizing site
materials. Treasure hunters, who have a vested interest in persuading the
public to let them salvage valuables from submerged shipwrecks and other
sites, have fostered this “chaos theory” for their own purposes and often
contributed to or created underwater chaos themselves by planting materials
from other sources or by blasting shipwreck sites in search of marketable items.

Thanks, however, to work by competent maritime and underwater
archaeologists and practitioners of several branches of marine science, the
view of the underwater world as chaotic is no longer tenable. The chal-
lenge to underwater archaeology today is the application of scientific
methods to the archaeological record in an effort to construct a picture of
the human past that is not distorted by intervening natural processes and
human activities. Underwater environments afford us unique opportuni-
ties for studying past human behavior, sometimes preserving complex
associations of cultural remains better than they can be preserved on land.
Many important issues in human prehistory may ultimately be resolved by
archaeology conducted underwater.

The archaeological study of shipwrecks requires approaches common to
the natural, social, and historical sciences. Most shipwreck and maritime
archaeological research so far has employed scientific techniques but not
social-scientific hypotheses. Historical archaeologists in both land and
underwater contexts have tended to prefer descriptive, particularistic
approaches that focus upon the singular characteristics of the period
and place they study. This historical-particularist perspective, though legit-
imate, is inadequate to the task of interpreting archaeological results.
Underwater archaeology must become a historical science in which
hypothesis testing and historical particularism are complementary.

This complementarity of social-scientific generalization and historical
particularism has the potential to move underwater archaeology toward
more credible reconstructions of the human past. Controlled use of
archaeological evidence according to scientifically acceptable standards
has always been the hallmark of good archaeological science. The time has come for underwater archaeologists to make greater use of archaeological science to build more believable ideas about past human behavior in relation to a maritime environment. Hypotheses drawn from in-depth studies of shipping today can be tested against the evidence of ancient wrecks to produce a picture that goes beyond their immediate circumstances to include the social conditions that surrounded them. For example, accounts such as that of the wreck of the Marine Electric can provide insight into the contexts of wrecks of earlier times.

The Marine Electric was lost in a storm thirty miles off the Virginia coast on 12 February 1983, and had it not been for some unusual investigative reporting (Frump and Dwyer, 1983), its loss might have gone unnoticed. The Marine Electric was built in 1945 as a tanker for use in World War II and had been in commercial service ever since. It was an example of a standardized type known as the T-2, and, like the Liberty ships and other standardized types constructed in large numbers for wartime use, it had become increasingly hard to maintain as it aged. It was one of six such ships, all more than thirty-five years old, operated by Marine Transport Lines (MTL), a respected bulk-carrier operator with large fleets of more modern and better-maintained ships.

Like the other T-2s in MTL’s fleet, the Marine Electric had been “jumboized” – that is, modified and enlarged for bulk cargoes (Fig. 1a–b).
Thirty-eight years old in the bow and stern, it was younger in the middle, where an extra section had been inserted. Although corrosion and wear had been noted repeatedly, especially in the hatches and parts of the outer hull, little had been done to correct them. Various temporary fixes employing epoxy, coffee-can lids, and duct tape were recorded within the two years preceding the ship’s loss, but no definitive repairs were made.

On its final voyage, the ship was transporting coal from Norfolk, Virginia, to Somerset, Massachusetts, when it was overtaken by a severe winter storm. It deviated from its normal route to assist a fishing boat and then turned back toward its original course in 6-meter waves. Although the wind had subsided and the Marine Electric had seen worse conditions, it began to settle by the bow, with waves coming over the deck onto the hatches and up to the foot of the bridge. In less than two hours the ship sank, with the loss of thirty-one of its thirty-four crew members. Although the shipowners claimed that the Marine Electric struck the seabed in shallow water, causing the hull to split, the survivors insisted that the ship was in at least 33.5 meters of water – a view later supported by the findings of the U.S. Coast Guard. Divers who examined the wreck later found a gap in the hull 11 meters long and 2.1 meters wide extending from port to starboard at a point about 12.2 meters behind the bow. The ship’s operational and maintenance history indicated that this gap probably resulted from a small hole in the hull that had widened during the storm.

Whatever the proximate causes of the ship’s loss, the question remains why a thirty-eight-year-old ship with a poor maintenance record was allowed to continue operating at sea, especially by a large shipping firm that sailed other, more modern vessels. Similar questions were raised by the author, Noël Mostert (1974), in his account of supertankers built for use during the Arab oil embargo.

Ship losses like this can often be linked to the employment of flags of convenience, whereby ships are registered outside their countries of origin to avoid the strict rules of manning, safety, and maintenance that those countries apply. Countries like Liberia and Panama, whose own merchant marine fleets are insignificant, offer safe havens for marginal shipping operators who wish to continue to use overage ships. But this was not the case for the Marine Electric. This ship was U.S.-registered and was expected to conform to U.S. standards. Then, as now, the United States requires that cargoes transported between U.S. ports be moved on ships built and reg-
istered in the United States and manned by Americans. The old, convert-
ed T-2 ships were retained to meet these requirements. Thus they became part of what is known as the “cargo-preference” trade. MTL’s aging T-2s were a second-class fleet retained specifically to garner profits in a protected trade reserved for U.S. vessels. Some of these old ships were also used for other cargo-preference trading, such as the U.S. Food for Peace shipments of grain to Haifa. Survivors of the Marine Electric reported how they dreaded such oceanic voyages in the ship and tried to take their vacations when such voyages were scheduled.

Most of the press reports about the loss of the Marine Electric focused on the proximate causes of the sinking and the ordeals of the survivors. A historical-scientific perspective requires a broader view of such a loss. By viewing it as the result of a cultural process – that is, as the product of the social institutions that produced it – the investigative reporters called attention to the socioeconomic and legal factors that ultimately caused the disaster – social institutions of long-standing that motivated shipowners to push their ships beyond their intended use-lives. One of the goals of underwater archaeology in the study of shipwrecks is to identify convincing linkages between the physical associations represented by the wreck and social institutions such as those converging in the wreck of the Marine Electric. Risk-taking and loss are not merely events in the chronicle of maritime history but the products of sociocultural processes that need to be identified and explained.

Processes comparable to those affecting the Marine Electric certainly operated in the past, and underwater archaeology affords us direct access to materials that can be evaluated in relation to historical documents to provide explanations that extend beyond the proximate causes of the wreck. The archaeology of the wreck of the sixteenth-century Spanish Armada transport La Trinidad Valencera is a particularly good example of how large-scale socioeconomic factors can be linked to the physical remains of a ship. La Trinidad Valencera was not a warship but an armed transport of Venetian origin. Along with numerous portable artifacts, portions of the ship’s structure, including oak planks held together with iron fasteners, were recovered and documented by an archaeological team led by the maritime archaeologist Colin Martin. Iron fasteners were quicker and easier to attach than wooden ones, making it possible for unskilled workers to construct the ship’s hull. Because of corrosion, however, the
The working life of iron fasteners was not long—generally ten years or less. Martin (1979: 34) linked the use of iron fasteners to mass production of merchant ships by the sixteenth-century Venetians at a time when their commerce was under competitive pressure and in decline.

Venetian merchant ships then were designed for relatively intensive but short use-lives, and the reliance upon iron fasteners is comparable to the modern practice of welding instead of riveting on supertankers (Mostert, 1974: 75–77) in the interest of rapid and cheap production for short-term but intensive use. Further study of La Trinidad Valencera’s structure revealed that the iron fasteners were arranged in straight lines along the wood planks instead of staggered in the manner favored by builders of most wooden ships. Again, it was probably easier and faster for untrained workers to attach fasteners in straight rows, but the effect was to weaken the ship’s hull by making it easier for cracks in the wood planks to travel in a straight line. Such cracks can be expected to appear in wooden-hulled ships after a few years of service at sea because of the flexing of the ship’s structure, and therefore Martin and his associates suggested that this shortcut was another indicator of expediency in the ship’s construction. La Trinidad Valencera was requisitioned for service in the campaign of 1588 and was subsequently exposed to the hazards of English gunfire and heavy seas and weather in the North Atlantic off the coast of Ireland, where it was ill-equipped to survive. Thus its loss seems to have been probably the result of decisions made during construction in the socioeconomic context of sixteenth-century Venetian commerce combined with battle, wind, weather, and geography.

The lesson of these two cases for our purposes is that past social institutions and cultural processes can be compared with those of the present and therefore even extinct sociocultural systems can be identified and studied. This book is about underwater archaeology’s contribution to this effort.
For experienced divers, the underwater world is a familiar neighborhood, and its rewards and hazards are as open to human experience as any on land. Although strikingly different from the land environment, it is knowable in the same way. Underwater archaeology is just as amenable to scientific methods and its results are measurable by the same standards as archaeology on land. The issues with regard to acquiring knowledge of the human past through archaeology are equally relevant underwater and on land. Just as land archaeology has had to distance itself from its early connections with tomb-robbers and pothunters, underwater archaeology is progressively disengaging itself from its unfortunate association with treasure hunting. Increasingly, it is characterized by the use of controlled methods of data recovery and by analytical approaches to inferences about past human behavior based on those data.

**History and Archaeological Science**

Underwater archaeology encompasses a broad range of submerged cultural remains. As a historical science, it is structured by many of the same sorts of assumptions and general principles that guide paleontology, evolutionary biology, and geology. Underwater archaeologists, like their land counterparts, rely heavily upon scientific methods of dating as well as upon controlled laboratory methods for studying ancient diet, technology, and ecology. One of the major questions confronting underwater archaeologists today, however, is the extent to which archaeology should also be viewed as a social science. To what extent should underwater
archaeologists apply and test ideas about the human past based on concepts of culture and society more commonly associated with social sciences than with history? This question is especially significant in the case of shipwrecks that are the products of historically documented situations in the past.

Not everyone agrees on the value of archaeology in studying the human past when documentary evidence is available, and there is even greater disagreement about the relevance of anthropologically based attempts at historical analysis. Some maritime historians and archaeologists argue that it is not worthwhile to engage in the archaeology of shipwrecks or related materials later than the eighteenth century, when ships’ plans, drawings, and other documents and general written accounts become plentiful for the first time (D. Lyon, personal communication; Muckelroy, 1980a: 10; see also Ballard, 1987: 138). This view categorically rejects the archaeological record as a primary and legitimate source of information about past human behavior whenever written documents are available. Archaeologists often counter that the historical record is inherently biased and incomplete – that it commonly concentrates on the activities of cultural elites and major events at the expense of the everyday behavior of ordinary people, (Glassie, 1966; Deetz, 1977). The rationale that archaeology serves to overcome elitist bias is fine as far as it goes, but it provides a timid and inadequate basis for archaeological scholarship because it assigns primacy to the historical record in setting the archaeological agenda.

A more extreme version of this argument points to the self-serving uses of written histories by various elites to justify their behavior and presents archaeology as a similar form of revisionism (Shanks and Tilley, 1988: 186–208; Trigger, 1990: 370–411). Some archaeologists have proposed that archaeological science has achieved dominance by suppressing or ignoring alternative views of the past. The victims of such dominance include women, various ethnic minorities, and other groups defined by religious beliefs, low economic or social status, and generally marginal relations to mainstream Western-oriented culture. Advocates of this view argue that every cultural, ethnic, or other special-interest group has a unique view of the past that must be understood and appreciated on its own terms and accepted as valid to the same degree as archaeological science. Seen from this point of view, archaeological science is hegemonic – an extension of Western cultural imperialism and should be relegated to
the status of an ethnoscience – no better for understanding the human past than, say, Australian Aboriginal concepts of the “Dreamtime” or modern creationism.

A view that is more widely accepted is rooted in assumptions about the scientifically controlled study of the archaeological record as a valid and compelling source of information about the human past. The archaeological record is an assemblage of material associations that provides circumstantial evidence about past human activities. Like the written record, it is subject to bias, but this bias is mainly of a different order from the biases that affect historical or political interpretations in that it is physical rather than ideological. Archaeologists must first identify and control for the postdepositional factors that can alter the physical associations of archaeological materials. Focusing on those aspects of past human behavior that can be reliably inferred from the archaeological record once relevant postdepositional factors have been identified and controlled means that the results of archaeology and documentary history should be compared as alternative accounts based on different kinds of evidence and assumptions. Employed in this fashion, archaeology serves as a reality check on historically received information and ideas about the past.

Much of contemporary archaeological theory is aimed at recognizing postdepositional processes and measuring their relative effects on the archaeological record. In the case of shipwrecks and submerged terrestrial sites, postdepositional factors such as sedimentation, currents, corrosion, marine growth, and mechanical disturbances due to wave action, ice, earthquakes, and volcanic activity, among others, operate to alter the condition of the deposits. About the only factor of this kind that has been mentioned consistently by maritime archaeologists is the shipworm (or “gribble”) *Teredo navalis* (Robinson, 1981: 12–14), which accounts for the rapid loss of wooden structures and artifacts exposed above the siltline in most saltwater environments. The study of these processes has not always been rigorous, and therefore there is often uncertainty about which material associations were products of human behavior and which due to processes of nature.

The archaeologist Michael Schiffer (1987), for example, distinguishes between the cultural system as it existed while the inhabitants were alive and functioning as a society and the archaeological record, which contains material remains of an extinct cultural system but exists in a domain
governed by the laws of physics, chemistry, geology, and biology even when human activities were present. A comparable approach to underwater site formation processes can be found in the work of the maritime archaeologist Keith Muckelroy (1978), who distinguished between “extracting filters”, which lead to the loss of materials, and “scrambling devices,” which rearrange, mix, or alter them. Among his extracting filters were wrecking, salvage operations, and disintegration of perishable materials; He noted, for example, how elements of wood structure at a shipwreck site may simply float away after wrecking thus removing or “extracting” these items from the archaeological record. Scrambling devices were the disorganizing effects of wrecking and the subsequent rearrangement of materials resulting from seabed movement, currents, marine organisms, storms, and other factors. Interpreting the distribution of shipwreck remains requires attention to the differential effects of these filters and scramblers.

**Discovery-Mode Archaeology**

Underwater archaeologists, no less than their land counterparts, have a long history of using archaeology to confirm the historicity of documentary accounts and oral traditions. On land such efforts have been identified with archaeological research aimed at demonstrating the historical reality of the Homeric epics (Schliemann’s studies of Troy), the historical validity of the Bible (the Garstang expeditions search in the 1930s for the walls of Old Testament Jericho and Glueck’s search for King Solomon’s mines), the discovery of the “lost city” of the Incas at Macchu Picchu (described by the explorer-archaeologist Hiram Bingham); and the tracing of ancient sea routes of human migration by the ancestors of the Polynesians as represented in oral traditions (especially the studies by the New Zealand anthropologist Peter Buck and the archaeologist Kenneth Emory). Strong elements of this orientation are present in underwater archaeology as well. This tradition of seeking to confirm past events contributes to one of archaeology’s most common pitfalls – the fallacy of affirming the consequent assuming the very thing one is trying to find out. The difficulty here is that discoveries made without the benefit of an organized sampling approach tell us nothing about those parts of the region where nothing was discovered. The absence of finds elsewhere may simply mean that potential dis-