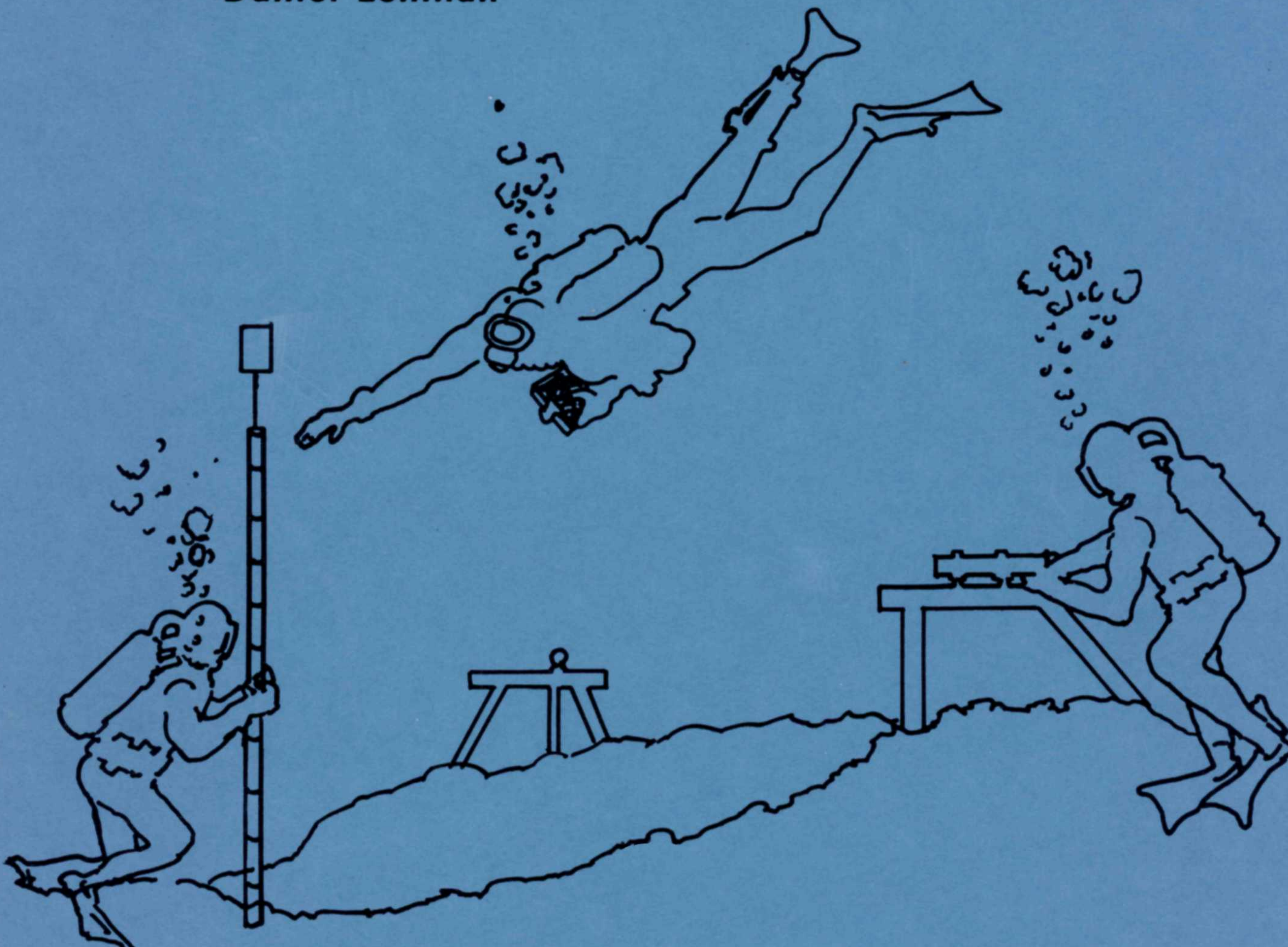
UNDERWATER ARCHEOLOGY IN THE NATIONAL PARK SERVICE

Edited by
Daniel Lenihan



A MODEL FOR THE MANAGEMENT OF SUBMERGED CULTURAL RESOURCES

DIVISION OF ARCHEOLOGY
SOUTHWEST REGION
NATIONAL PARK SERVICE

UNDERWATER ARCHEOLOGY
IN THE
NATIONAL PARK SERVICE

A Model For The Management
Of Submerged Cultural Resources

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Daniel J. Lenihan

DEPARTMENT OF THE INTERIOR

NATIONAL PARK SERVICE

July 1974

ACKNOWLEDGEMENTS

This manuscript would not have been possible without the active support and encouragement rendered by Calvin Cummings, Chief, Division of Archeology, Southwest Region.

My wife, Kaye, proofread the manuscript and made many helpful suggestions in regard to organization of the text. Ron Ice, Bruce Anderson, and Don Fiero, my co-workers at the Division of Archeology, also reviewed and commented on the work. Marta Cole, Orlinda Griffin, and Priscilla Fields, stalwart secretaries of our section, wrestled bravely with my scrawl, the interpretation of which would have tried the patience of Job. Helen Wolfe of the Southwest Regional Office also proofread this work and made valuable comments regarding style and grammar.

Pierre Gonzales from the Southwest Regional Office, Division of Planning and Design, executed the cover motif and created all of the illustrations which serve as section dividers in this work.

Special thanks is owed to George Fischer who besides being a major contributor to this work also played a major role in developing underwater archeological capabilities and consciousness in the National Park Service.

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INTRODUCTION

The National Park Service is mandated to manage and protect resources, both natural and cultural, in lands under its jurisdiction. These cultural elements consist primarily of archeological and historical sites which are resources of a finite non-renewable nature. Within the past few years there has been a growing awareness among National Park Service archeologists that managerial responsibilities towards one aspect of these resources, i.e., submerged cultural remains, have been largely neglected in the New World.

An archeological or historical site can occur anywhere on the face of the earth--on a mountain, in a desert, in a jungle, or under water. The fact that a given site exists in some specific environment does not detract from the cultural significance of the material contained therein. All of the legal mandates pertaining to historic preservation (including archeological resources) apply to any given site, without regard to its location. Archeological theory and philosophy encompass all cultural remains wherever they may be found, including material now covered by water. The only difference between an underwater site and a site in any other environment is the techniques and methods required to investigate that site.

It should be emphasized from the beginning, therefore, that underwater archeology for our purpose is simply archeology done under water and should not be confused with the treasure hunting and marine salvage enterprises which often erroneously adopt that title.

The content of this publication has been gathered from the body of reports and papers that have been generated by Park Service involvement in underwater archeology. Most of the contributions are from Park Service personnel. They include George Fischer, Archeologist, Southeast Archeological Center; Cal Cummings, Chief of the Division of Archeology, Southwest Region; and Dan Lenihan, Archeologist, Southwest Region. Contributors from outside the Park Service include Curtiss Peterson, Underwater Preservation Specialist from Florida Bureau of Archives and History; Roland Wood, Remote Sensing Expert from Florida State University; and Frank Stapor, geologist with the South Carolina Wildlife and Marine Resources Department.

The publication has several purposes; they include:

1. Providing a vehicle for communicating the scope and importance of the legal mandates under which the Service operates in regard to submerged cultural remains.

2. Presenting the history and nature of underwater archeological activities in the Park Service.

3. Making available to the rest of the archeological profession the data accumulated from underwater research in the Park Service thus far.

4. Discussing the theoretical and methodological directions which must be considered in regard to the development and intensification of this aspect of archeology in the future.

Many members of the archeology profession have stated that they felt the logical place for the burgeoning field of underwater archeology in the New World to receive guidance and direction in its growth would be in the National Park Service. The National Park Service, in both Southeast and Southwest Regions, has worked in coordination with various university and state archeologists on standards for developing a systematic problem-oriented approach to shipwreck studies, submerged prehistoric sites surveys and general inundation studies. This program of systematizing and refining approaches to underwater archeological research is still, however, in a nascent stage. It is hoped that this publication will help increase awareness of the great potential of underwater sites in the United States, and underline the leadership role that the Park Service could and should take in developing this resource.

D.J.L.

THE HISTORY AND NATURE OF UNDERWATER ARCHEOLOGY IN THE NATIONAL PARK SERVICE

The first underwater archeology undertaken on this continent was conducted in the 1930's under the auspices of the National Park Service. The site was Colonial National Historical Park and the diving was performed by United States Navy personnel (Ferguson 1939).

The Service continued with many involvements quite early in the history of this developing field. Included among these were a search for the remains of the Colonial Period Fort Caroline in Florida in 1952 (Fairbanks 1952), an involvement with the raising of the Civil War ironclad Cairo in 1956 (Peterson 1971, Bearss 1971), and a magnetometer survey of Point Reyes National Seashore in 1964 (Breiner 1965). Since the mid-1960's, the Service's activities in this field have been becoming increasingly extensive, and the involvement of Service personnel has become more direct and formal. An actual comprehensive in-park underwater archeological program was formulated and authorized in 1969 (Fischer and Riggs). An internal capability for conduct of underwater research was then developed and funding was obtained for projects. Extensive underwater archeological research by Service archeologists is now under proposal for both the Southeast and Southwest regions, and underwater surveys have already been conducted at Gulf Islands and Fort Jefferson, Florida, and at Montezuma's Well, a prehistoric site in the Western Region.

The initial emphasis of the Service's underwater archeology on shipwreck studies is starting to give way to increased concern with prehistoric sites, inundation studies, and the development of general underwater remote sensing techniques to deal with the large areas needing archeological clearances for oil wells on the Outer Continental Shelf.

It may be of general interest and benefit to discuss the needs of the Service which have affected the evolution of our approach to handling submerged antiquities. The Service administers more than 30 million acres of land in nearly 300 areas throughout the United States. Although the majority of this is dry land, a number of parks, particularly the National Recreation areas, contain extensive holdings of submerged land. Within the state of Florida, which contains more National Park Service land under water than any other, well over a third of the jurisdiction covers submerged land. Four areas in Florida--Gulf Islands National Seashore, Biscayne National Monument, Fort Jefferson National Monument, and Everglades National Park--have a total of some 600,000 acres under water. Everglades contains an abundance of submerged prehistoric and historic sites, and the other three are among the major ship graveyards of the New World. The Southwest

Region also has many thousands of acres of submerged lands under its jurisdiction. This is a constantly increasing figure due to the many Federal lands in the Southwest being flooded for reservoir purposes.

A recent historical study yielded evidence of nearly 200 shipwrecks in the 50,000 acres of water around Fort Jefferson in the Dry Tortugas (Bearss 1971). Whereas most researchers in underwater archeology have been concerned with extensive excavation of sites on a highly selective basis, the Service's problem is one of quantification and evaluation of the large number of wreck sites for which we are responsible. Pure research motives are therefore integrated with management concerns in Service underwater projects. Conducting thorough and accurate surveys of an area the size of the Tortugas is a staggering proposition. For comparative purposes, the submerged lands of Fort Jefferson are nearly equal in size to the area of Mesa Verde National Park in Colorado, which has been the scene of extensive archeological activity since the late 19th century, and for which a thorough archeological base map is still far from complete. Recognizing that even a land base map can never be definitive, Service archeologists began accumulating what data they could, both through on-site survey work and by acquiring what information was available on previously known or located wreck sites for the areas in which we were interested. As an adjunct to the surveys, Service historians have conducted archival research to provide what information was available from that source.

In actual survey operations, after locating sites, attempts are then made to provide an evaluation for two purposes: potential for research and needs for protection. Our primary concern at this stage is protection from unauthorized exploitation and destruction, either by sport divers or illicit organized salvage activities. By identifying and evaluating sites, we can provide rangers with information necessary for protection. This site evaluation, however, goes far beyond compiling a list of known sites and their locations so that Service personnel may prevent visitors from diving on them. A continuum of age and historical value exists running from the earliest shipwrecks to recent fishing trawlers, and the sites must therefore be categorized. Visitors to underwater parks are often attracted to historically insignificant wrecks. Knowing which sites are of little or no value, and require no protection, is as necessary for the park managers as knowing which are most significant.

Throughout our underwater parks are many historic wrecks of late periods which are of limited scientific importance but of considerable public interest. For example, in the Dry Tortugas several wrecks of the period of construction of Fort Jefferson (the mid-nineteenth century) have been located. For the most part, these are steel-hulled steam sailers carrying construction materials for the Fort. Much is known of ships of this type and period, and attempts to excavate would probably yield little data. As they were well salvaged at the time of sinking, a minimum of artifactual material is potentially available. The wrecks, however, are spectacular in appearance and of considerable interest to park visitors. It is our intention to map and test selected wrecks in order to acquire sufficient information so that they may be developed as exhibits-in-place for those who would like to see a shipwreck _in situ_. Opening these wrecks to visitors will invite a certain amount of depredation, but just as underwater nature trails bring about destruction of marine flora and fauna which is to some extent irreplaceable, these shipwrecks can be regarded in a sense as a resource which can be expended.

The Service policies toward use or disposition of underwater archeological remains adjudged to be historically significant permits little flexibility, a fact which has caused some misunderstanding among those interested in underwater sites in Service areas, and therefore deserves explanation. The Federal Act for the Preservation of Antiquities of June 8, 1906, comprises a Congressional mandate on which there can be no question: antiquities occurring on Federally owned or controlled land are the property of the American people. The Act, and subsequent legislation, establishes a definite intent of Congress for preservation of antiquities. The Uniform Rules and Regulations under which the Antiquities Act is administered is specific in permitting disturbance or excavation only by qualified archeologists operating under strict controls and adhering to recognized professional standards. The National Park Service Establishment Act of August 25, 1916, directs the Service to preserve the resources we are to administer, and at the same time provide for their utilization in such a manner as to leave them unimpaired in the future--goals which are often to some extent incompatible, particularly in the case of archeological remains. In brief, we are to preserve our shipwrecks and other submerged archeological resources and provide for public and scientific utilization of them without unduly jeopardizing the sites.

Following the announcement by the Southeast Archeological Center that the wreck of the 1622 Spanish Treasure Fleet Galleon _Nuestra Senora del Rosario_ had tentatively been identified in the Dry Tortugas, considerable interest was generated in excavation of the site. Some disappointment was voiced when we let it be known that there was no present intention to excavate and probably will not be within our lifetime, if ever. Even if the Park Service could afford the luxury of concentrating on one site and excavating it completely, it is doubtful that the Service would consider that to be a judicious use of its resources. Complete excavation of individual sites is neither necessary nor desirable from the agency's point of view.

Selective testing is expected to provide what information we need on the site and would also provide a representative collection of materials for study and exhibit. Obtaining the complete collection would not only provide an undesirable burden of preservation but would be uneconomical for Park Service purposes. Perhaps at some time in the future this site and others on Service land will be completely excavated. In the meantime they are protected for the best current utilization and may be available at some future time when, with more sophisticated techniques and a greatly diminished wreck population elsewhere, they will be of far greater value.

At the present time there are a number of underwater studies in progress, and others programmed or proposed, including broad surveys at Fort Jefferson, Biscayne National Monument, and Gulf Islands National Seashore; a more limited shipwreck study at Buck Island Reef National Monument; investigations of what may be a slave cemetery and slave quarters at Cinnamon Bay in Virgin Islands National Park; an intensive survey of Montezuma's Well in the Western Region, and comprehensive inundation studies in the Southwest Region.

To conduct this research the Park Service has developed an underwater archeology capability, which is presently centered in Santa Fe, New Mexico, and Tallahassee, Florida. In the course of this project work, the Service has been providing training and experience in underwater archeology and diving for archeologists from several other offices in the Service who are assigned to projects. The Service has also been able to provide experience for archeologists from outside institutions who have participated as volunteers. Diving safety procedures for archeological projects developed by Dan Lenihan in the Southeast Archeological Center have been used as a model for other Service underwater activities and are being adopted by non-Service archeological groups.

The physical capability has now reached the point where agency personnel are self-sufficient and able to function with their own resources. Because of the short-term and fairly large-scale nature of most of the projects which have been undertaken to date, Park Service archeologists have had to rely heavily on outside volunteers or personnel borrowed from other activities within the agency. The Service is now moving toward an approach whereby work can be conducted on a scale which would provide greater self-sufficiency in regard to the composition of project staff.

The result of these activities to date has been development of partial shipwreck base maps for Fort Jefferson, Biscayne, and Gulf Islands and several others that are in preparation. This research has been reported to the scientific community in Nautical Archeology published by the Council for Nautical Archeology in London, and New World Underwater Archeology, published by the Service. To further these research activities, Service archeologists have developed complete archives of all notes, manuscripts, maps, charts, remote sensing imagery and photographs relating to underwater work, which also comprises a useful resource for those outside the Service interested in underwater archeology.

by George R. Fischer

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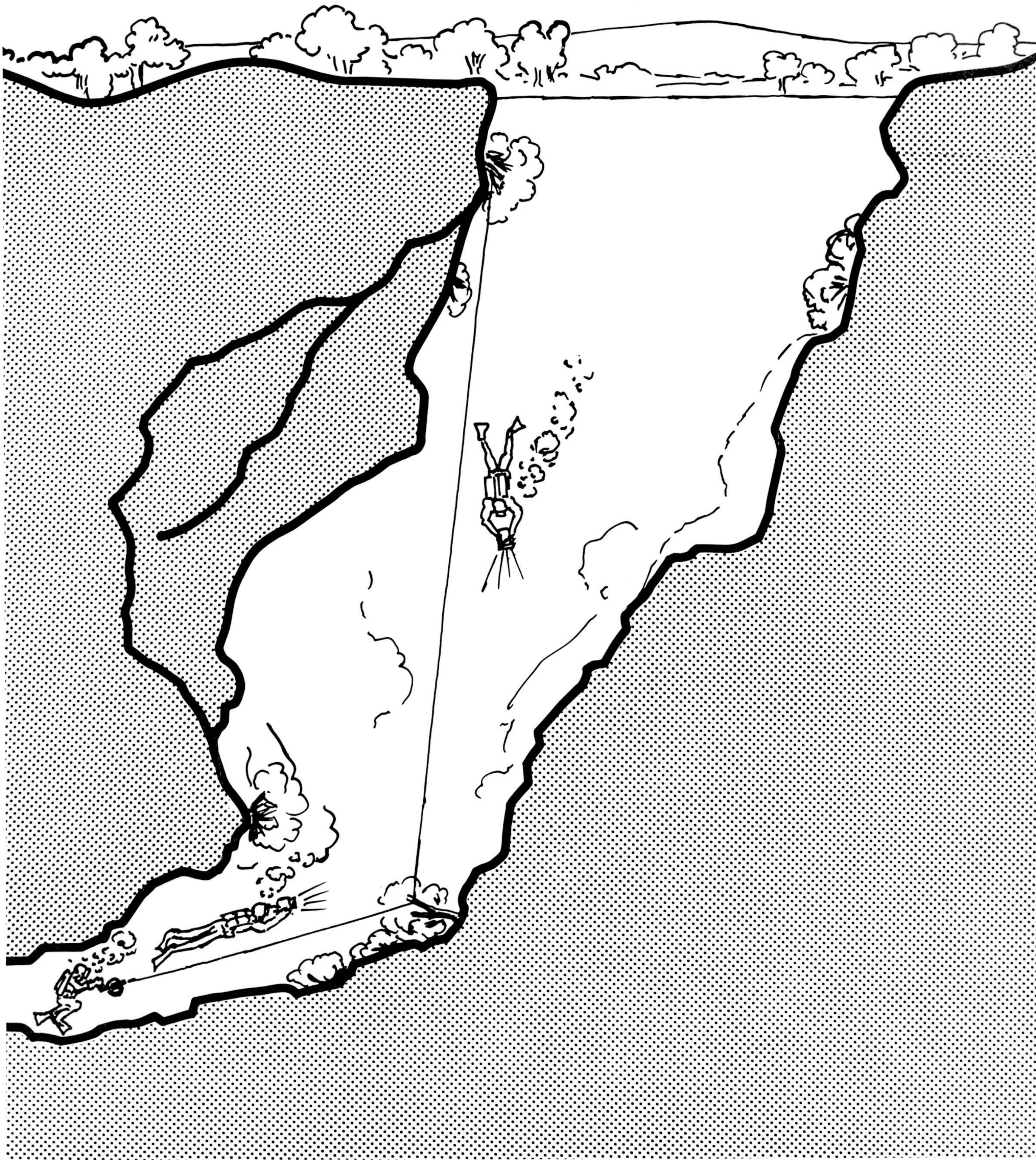
LIMNOARCHEOLOGY



LIMNOARCHEOLOGY

Underwater archeological activities have often been traditionally subsumed under the label of marine archeology. The term limnoarcheology was coined by Donald Jewell (1964: 27) several years ago to delineate those aspects of underwater research that are centered in a freshwater as opposed to a marine environment.

Jewell was thinking mainly in terms of inundation studies or, in other words, the impact on archeological sites of flooding as a result of dam construction. Inundation studies, however, are only one type of fresh water archeological activity. Additional fresh water environments besides man-made lakes or reservoirs include rivers, natural lakes, swamps, and spring-fed limestone sinkholes.

The first of the two reports in this section deals with the last type of fresh water manifestation, the limestone sinkhole. In the past few years sinkholes have been playing an increasingly important role in New World underwater archeology. Two sites in the State of Florida, Little Salt Springs and Warm Mineral Springs, have been the source of what appear to be some of the earliest man finds on the continent. The famed cenotes in Central America which produced many startlingly well preserved vestiges of early Mayan culture are of the same geological genre as the "sinkholes" found in various parts of the United States.

A team of National Park Service archeologists, including George Fischer of the Southeast Archeological Center and Cal Cummings of the Southwest Regional Office, conducted one of the first archeological projects in North American sinkholes at Montezuma's Well, Arizona in 1968. Previous sink archeology, however, had been conducted in the State of Florida in the late 1950's and early 1960's at Wakulla Springs (Olsen 1958), Jug Hole or "Blue Hole" Spring (Gluckman 1967), Warm Mineral Springs (Royal and Clark 1960), and Devil's Den (Gluckman 1967). Carl Clausen, former underwater archeologist for the State of Florida, intensified work done at Warm Mineral and Little Salt Springs, and his successor, W. A. Cockrell, has developed this phase of underwater research in Florida into a full scale, long range project at Warm Mineral Springs.

There are often submerged cave systems in spring-fed sinkholes which are large enough to be easily entered by divers. These conduits may figure importantly into the investigation of a sink site especially if the area has been subject to a lowered water table during the time of human occupation. It is important to note in this regard that diving in caves is an extremely dangerous activity if not undertaken by specially trained divers. This author highly recommends that any archeologist anticipating work in such an environment contact representatives of the National Association for Cave Diving for advice and training.

Inundation studies are the subject of the second of the two items in this section. That paper discusses inundation investigations as they pertain to future Park Service archeological activities, primarily in the Southwest Region. There is a widespread notion that an archeological site, one flooded through dam construction or some other means, is indefinitely preserved. This belief is often reflected in the Environmental Impact Statements that are prepared by land modifying agencies and concerns. It is becoming more and more apparent that this assumption is in many, if not most, cases an erroneous one. Donald Jewell's work on inundated sites in California (1961, 1964) and Elton Prewitt's work at Lake Texoma (1972) both indicate that the flooding process can often ensure the destruction rather than the preservation of a site. Solid incontrovertible proof that inundation is in most cases harmful to sites is still, however, unavailable.

The short prospectus for inundation studies in this section outlines the direction that the Division of Archeology in the Southwest Region is pursuing to obtain conclusive data pertaining to this question.

Park Service archeologists have also taken part in fresh water research in riverine and swamp environments, but these have been amply reported on in other publications (e.g., Bearss 1965) and are beyond the scope of this work.

D.J.L.

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UNDERWATER ARCHEOLOGICAL SURVEY OF MONTEZUMA WELL

ACKNOWLEDGMENTS

Considerable credit for this report goes to the other participants in the project. Roberto A. Costales spent a significant amount of time, much his own, researching park files to find needed material and to answer many questions. In addition to the analysis of materials (appended) which took hundreds of hours to complete, also much on his own time, Calvin R. Cummings is responsible for the sketches on which all but one of the figures are based. Marion J. Riggs assisted with the initial draft of the report and was co-author of a paper presented at the meeting of the Southwest Anthropological Association in 1969, portions of which have been incorporated herein.

Additionally, the faunal analysis by Thomas W. Mathews and Charmion R. McKusick is probably as much as has ever been said about such a sample in terms of the total number of specimens. J. Fred Mang of the Southwest Regional Office provided superlative photographic documentation. Daniel J. Lenihan of the Southeast Archeological Center edited and revised portions of the report in draft form. Finals on most of the drawings were rendered by John A. Sanderson of the Service's Florida Planning Office.

Credit must also go to John M. Corbett, retired Chief Archeologist of the Service, who conceived and inspired this survey, and without whose conception and inspiration of other work in other places, this report might have been completed years ago.

INTRODUCTION

In October of 1968 the National Park Service ventured into the developing field of underwater archeology when the initial internally-conducted project involving underwater archeological research took place at Montezuma Well, Arizona.

This paper deals primarily with the problems of underwater archeology in a sink environment and is a narrative of the method of approach, problems encountered and solutions. General conclusions are made on this type of archeological research, and on what was learned regarding conduct of an underwater archeological project in this set of circumstances. The technical aspects are dealt with only in summary form.

THE AREA

Montezuma Well is located in the Verde Valley of Central Arizona approximately 12 miles northeast of the town of Camp Verde. It is a large, water-filled limestone sink, circular in shape, and more than 400 feet in diameter. The lake within the Well is 300 feet in diameter and reportedly 55 feet in depth, with its water level 70 feet below the top of the steep limestone cliffs surrounding it. Springs in the bottom of the small lake provide a constant source of water. An underground outlet discharges a million and a half gallons of water daily from the lake.

Prehistoric Indians lived near the Well from about A.D. 700 to 1450. They were attracted by the reliable water supply, which was used to irrigate crops. The remains of masonry dwellings built between A.D. 1100 and 1450 are located on the Well rim and in natural rock shelters in the cliffs (Schroeder and Hastings 1958).

It has always been assumed that the Indians lost or discarded objects in the Well's waters, providing potentially rich primary archeological deposits. After abandonment of Montezuma Well the aboriginal dwellings fell into ruins, with building stone and other materials falling and sliding down the cliff sides. In addition to the debris and discarded material which found its way into the water, it is possible the Well could contain prehistoric ceremonial deposits. Similar geologic features in Central America had religious significance to aboriginal inhabitants, and ceremonial materials are often found in them.

PROCEDURES AND TECHNIQUES

A group of four National Park Service archeologists conducted this survey, which was one week in duration: the writer and Marion J. Riggs of the Washington Office; Calvin R. Cummings, Park Archeologist at Sanford Recreation Area in Texas and a member of that park's underwater search and recovery team; and Roberto A. Costales, Park Archeologist at Montezuma Castle National Monument. Mr. Costales was utilized in a support capacity and as a surface swimmer, but did not participate as a diver.

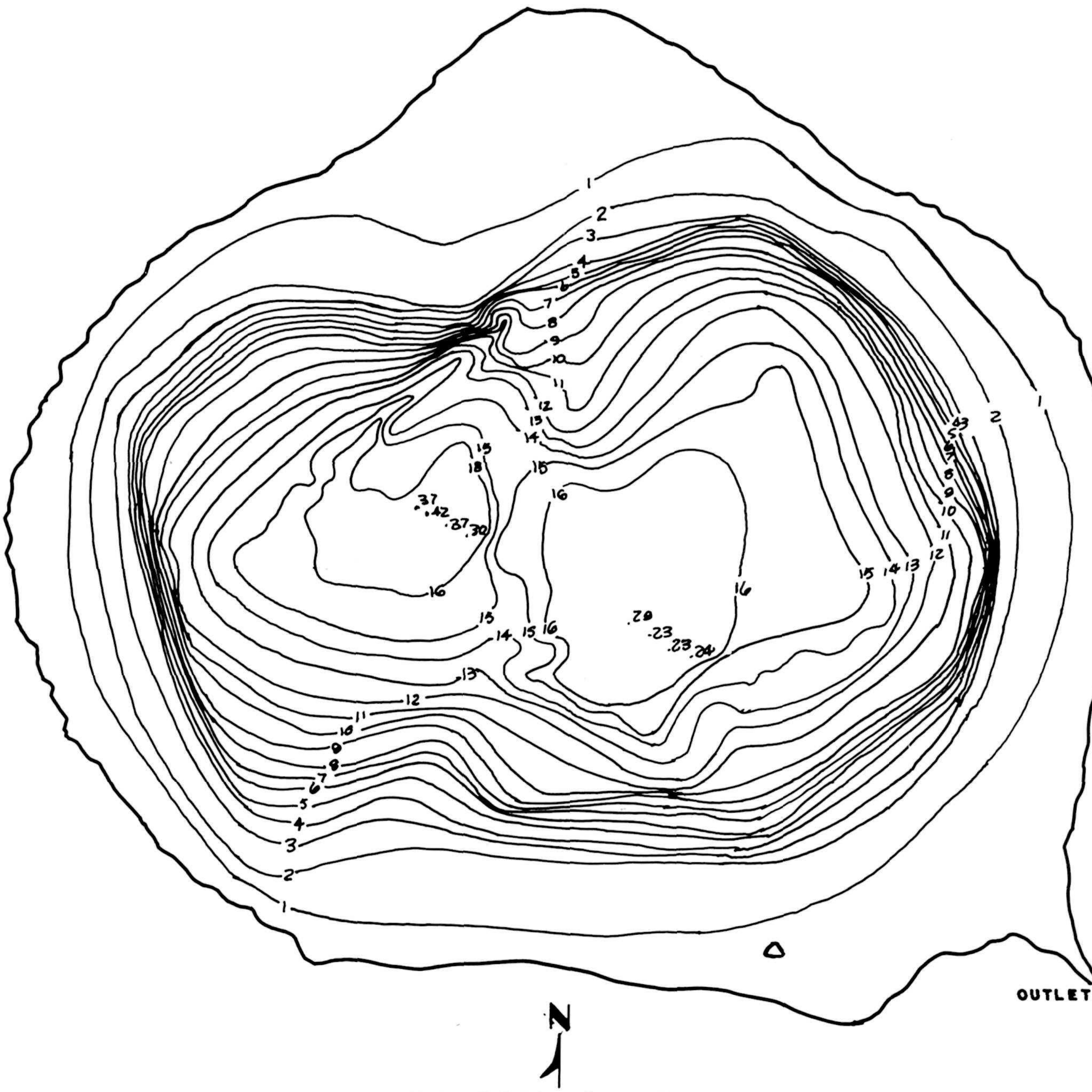
As the primary research purpose was to determine the concentration of cultural material within the Well and its archeological context and feasibility of recovery, sampling methods were designed to provide the broadest coverage within the limited time available. It was decided to conduct the survey at three levels of intensity: a general swimmer reconnaissance of the Well; more intensive and selective investigation of areas directly beneath the Pueblo ruins; and extensive investigation of a gridded section maintaining horizontal and vertical controls beneath three ruins (NA 4630 and NA 1273A and B) in an area which appeared to offer the most promise of yielding archeological materials.

Logistics were a major problem from the outset. The necessary diving and support equipment was not easily obtainable in Arizona. Much had to be imported from as far away as Washington, carried up a steep trail from the nearest road, and then carried down an even steeper trail into the Well or lowered over the cliff.

The experience of other institutions in conducting this type of research, and more recent Service experiences in underwater archeology, indicate the work inevitably requires preparation and support activities dramatically greater than those of terrestrial archeology. While the conventional archeologist can operate alone on a land survey, the requirements of safety in underwater work necessitate a minimum of a "buddy" pair in the water at any given time, with a third diver for support and safety on the surface. Whereas in a conventional excavation, setting up a camp and equipment can be done on the day of arrival at a site, and work perhaps started the following day, the complexity of underwater operations requires infinitely greater preparation. Needless to say, considerable time was spent gathering together all the bits and pieces of equipment necessary for the project, wrestling equipment up and down cliffs, and repairing and coaxing into operation a stubborn compressor and other perverse inanimate objects.

DIVING OPERATIONS

All dives were made using conventional compressed air SCUBA with standard 72 cf single tanks. High pressure air was supplied from a Cornelius Compressor on loan from the Naval Oceanographic Office in Washington. The divers operated from a 12' aluminum boat, diving in pairs with 1/4" safety lines on each diver. One person in the boat kept the craft in position over the divers. A second assisted the divers on entry and exit and handled the safety lines. The second individual also served as safety diver, being rigged and prepared to enter the water on short notice if a need for assistance arose. All diving was conducted in conformance with the National Park Service Free-Diving Policy and SCUBA Guidelines then current.



MONTEZUMA WELL

MONTEZUMA CASTLE NATIONAL MONUMENT
YAVAPAI COUNTY, ARIZONA

AUGUST 1960

FEET
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0 8 16 24 32
METERS

DEPTHS IN METERS

INVESTIGATIONS IN THE WELL CENTER

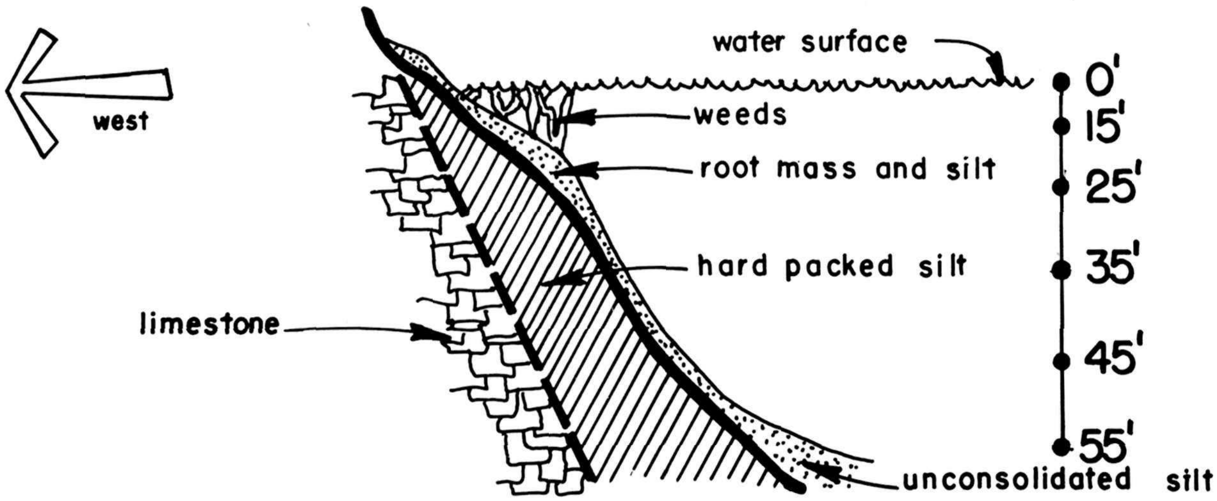
The initial diving was exploratory in nature and took place near the center of the lake over what was known to be the deepest section.

The first significant observation of the divers was that they had been confused by information from an earlier limnological study (Cole n.d. and 1965) which stated water turbidity, when compared to a bank of distilled water, was zero. Apparently clear distilled water is as difficult to find in Central Arizona as diving equipment, since the visibility was extremely limited near the surface and nearly zero at maximum depth. Additionally, bottom sediments in that area were so soft and unstable that recovery of any archeological material there was highly unlikely. The inflow of water from the underground springs apparently keeps the fine silt of the bottom semi-suspended, giving it a consistency similar to minestrone. In fact, at first as we descended in an upright position we were unaware we had reached bottom until, at a depth of 50 feet, it began to cover our face masks. Upon observing this, we began to proceed upward. Our movements produced a rate of ascent of the bottom material greater than ours and we were soon enveloped in a black cloud of extremely fine silt. After reaching clearer water, we became aware of the presence of the Well's largest form of animal life. The water by then was filled with an abundance of leeches, which may have been in the silt and were disturbed by us. Although they were curious, they did not seem hungry. The leeches were with us in varying numbers throughout the project, but none of the divers were bitten. It was disconcerting, however, to occasionally discover one trying to mate with its reflection in your face plate.

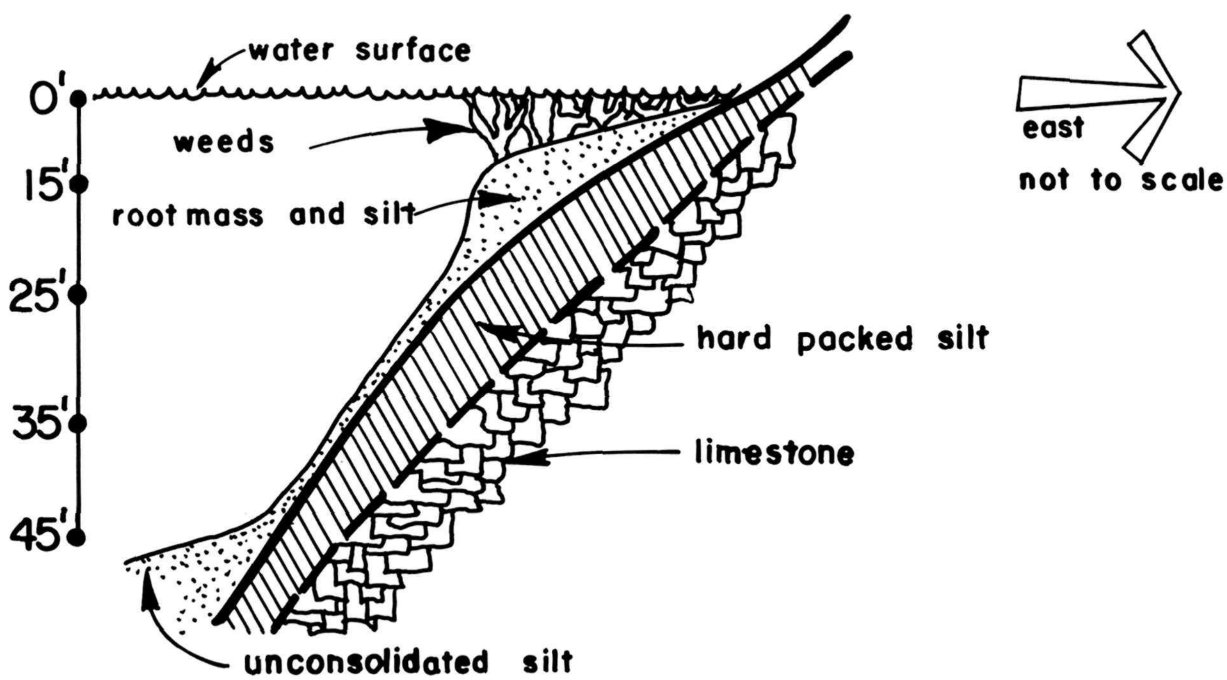
INVESTIGATIONS OF TEST AREA: EAST SIDE OF WELL

After diving in the center section, operations were shifted to the east side of the Well, where a grid system was laid out in the area selected for intensive investigation, beneath a large rim-top Pueblo of approximately 55 rooms (NA 1273A and B) and near a smaller cavate side called the Swallet Cave Ruin (NA 4630). The grid was established below the talus slope from the rim Pueblo where building stone and cultural debris eroding from the ruin reached to the edge of the water. The grid was referenced from the northeast corner (at water's edge), a point 78° north magnetic from the northeast corner of the visitor overlook located on the west side of the Well.

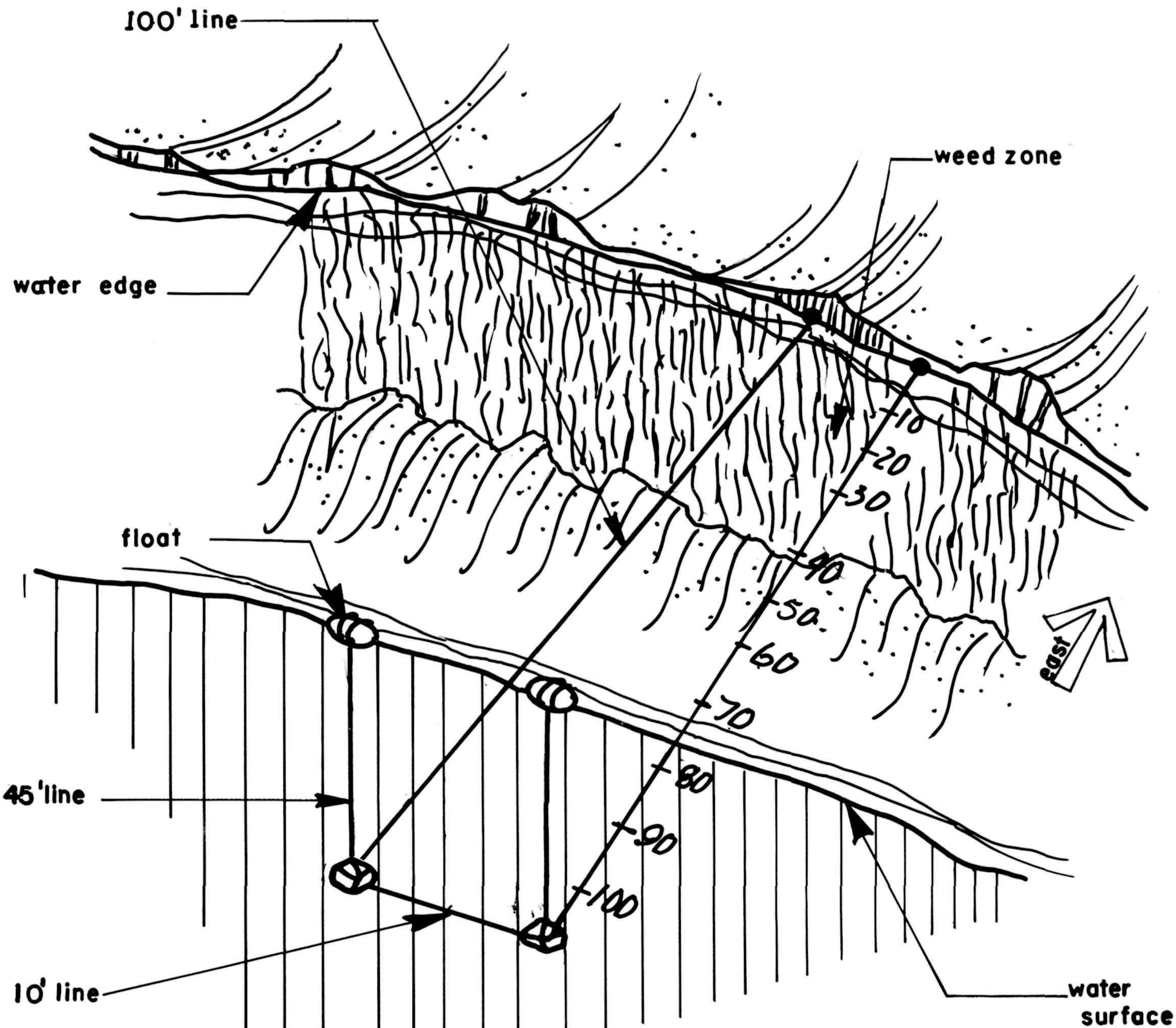
To provide horizontal control in the test area, two buoyant white plastic lines 100 feet in length were laid out running due west from the bank. The lines were parallel and 10 feet apart, staked at the edge of the shore on their east end, and marked by floats anchored to cinder blocks at their west end. The lines were marked at 10 foot



Sketch profile of West side of Wall



Sketch profile of East side of Wall



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Sketch of Test Area

intervals, enabling individual testing of sections 10 feet square running from the water's edge toward the Well center.

A heavy growth of aquatic plants (Potamogeton illinoensis) circles the Well in its shallower depths. In the test area the growth extended from the shore 40 feet toward the center. This vegetation is quite dense from water surface to bottom, necessitating removal of the plants before it was possible to examine the bottom sediments for cultural remains. To avoid the possibility of plugging the Well outlet, floating vegetation was gathered and rolled onto the bank. In the first two test squares the water was shallow enough (ca. 0 to 3 feet and 3 to 6 feet, repectively) to permit clearing and working the area by wading. It was possible to work the third area, 20 to 30 feet, by snorkling. Beyond 30 horizontal feet, the depth exceeded 10 feet and removal of weeds and sampling was accomplished with SCUBA. SCUBA was utilized in the sections 3 to 6 feet and 6 to 10 feet deep where relative absence of building stone enabled a diver to burrow downward into the silt and root mass while held by the ankles from above by another diver. This technique did produce some material, but is not recommended for reasons of safety and comfort.

TEST AREA RESULTS

Following is a brief description of the results of testing in each square:

0' - 10' (Depth 0'-3'). The water was shallow enough to permit fairly thorough screening of the silt. A great deal of limestone, including identifiable building stone which had eroded from the ruin above wasencountered. There was also an abundance of wood: twigs, limbs, and small logs, from the thick vegetation on the bank. Potsherds were recovered throughout the deposit, with greater concentrations in pockets of limestone sand under the blocks. Charcoal, charred wood and bone, and flakes of chert and obsidian were also recovered.

10' - 20' (Depth 3'-6'). The same types of material were recovered in this zone as in the first. Additionally, two small pieces of argillite and a fish vertebrae were found. Less material was located in this second zone, partially because it was not possible to be as thorough without excavation equipment as the water became deeper. The concentration of limestone blocks and pockets of sand and gravel became less further from shore, and as the fine silt is less likely to support artifactual material, except where it is held by the pondweed root system, there is apparently less material.

20' - 30' (Depth 6'-10'). At this distance from shore the bottom was almost entirely silt, with very little limestone. The Potamogeton root system is extensive and reaches as far into the soft silt as we were able to burrow, (ca. 4 to 5 feet). Sherds, chipped stone and burned bone were recovered, although the concentration of material was even lower than in the 10' - 20' section.

30' - 40' (Depth 10'-15'). The conditions encountered in this section were essentially the same as in the previous section, without much cultural material present and recovery made difficult by the plant root systems and silt. At approximately 40' horizontally from shore, the bottom drops quite sharply, and in fact becomes nearly vertical, although still thickly overgrown with aquatic plants.

40' Plus. The great increase in depth beyond the 40-foot point made providing horizontal control difficult. That, coupled with the fact that the significant observations related here to depth rather than distance from shore, led us to no longer concern ourselves with horizontal position. By diving at a distance of 50 feet from shore we descended to a bottom depth of 35'. During descent it was noted that pondweeds grew on the upper portions of the steeply sloping bottom, although they did not reach to the surface. At 25' the growth of vegetation ceased. After reaching what one might call solid bottom at 35', the slope was such that we slid down (and to the west) until the angle decreased at 45' vertical.

It is interesting to note that the Well in profile would appear much like a rimmed soup plate. From the shoreline to a depth of 15 to 20 feet the thick growth of aquatic plants holds silt in its root system. Over a period of years this growth has apparently been gradually building an accumulation of silt, and no doubt causing development of a shallow shelf extending from the shore to the maximum depth at which they can grow. At the point where this depth is reached, and the root system is no longer present to hold silt in place, the bottom grades off veryrapidly until reaching maximum depth. The bottom composition is soft silt in the plant growth area. From the edge of the vegetation to the bottom there is a thin layer of unconsolidated silt (some three inches in thickness in the test area) underlain by much harder consolidated silt. At the toe of this steep bank, reached at a depth of about 45', the angle rapidly grades toward the horizontal, and the accumulation of soft silt rapidly increases to a depth of several feet.

After reaching the bottom of the slope the divers began gradually working upward, toward the east, fanning the silt away from the harder layer beneath. This thin and easily removed silt layer made thorough examination of the area relatively simple. Sherds, calcined bone, and some wood fragments were recovered, although the concentration was very light.

INVESTIGATIONS OF THE WEST SIDE OF WELL

Work on the east side of the Well seemed to indicate time and resources could be most efficiently utilized on the west side by limiting examinations to the slope between the edge of the vegetation and the bottom. Dives were made in two areas beneath the small masonry structure within a rock shelter in the cliff (NA 1272A and B) immediately north of the west Well overlook. The dives were made approximately 100 feet offshore.

The slope of the bottom was much greater at this location than in the other area of investigation. Bottom composition was similar to that which was encountered on the east side, with a hard-packed layer of consolidated silt covered by a layer of loose silt. The packed silt, however, seemed much denser, having a rubbery consistency similar to caliche. The loose silt layer was considerably thinner, being only an inch or two thick in most places, and nonexistent in some. Apparently the steep slope permitted less unconsolidated silt to accumulate. Only one sherd and a metal interpretive trail label stake which a visitor had thrown into the Well, were located. This is no doubt largely because the slope allowed cultural material which may have been present to slide to the deep silt toward the center of the Well where it could not be removed.

OBSERVATIONS ON PHYSICAL CHARACTERISTICS

There are three discrete physical zones within the Well. The first, extending from shoreline to the point where a depth of approximately 25 feet is reached supports the thick growth of *Potamogeton illinoensis* which reaches from the bottom to water surface, except toward the maximum depth where it is able to grow, at which point the plants terminate as much as three feet below the surface. The stems and leaves of these plants form a dense, nearly impenetrable aquatic forest. The plant root systems extend to a considerable depth, with a labyrinth of roots and rootlets which serve to stabilize the silt, and permit its accumulation.

Beyond the depth at which these plants can grow, where the stabilizing root system does not exist, the sediments drop off very rapidly, forming a steep bank of highly compacted silt over which lies a layer of loose unconsolidated silt. This upper layer is in all probability gradually migrating down slope toward the bottom, with some compacting into the denser silt layer.

The third zone, at a depth of approximately 45 feet, begins where the profile rapidly approaches the horizontal. Here, at the base of the slope of the second zone, is a thick accumulation of loose silt. Near the point of transition between zones two and three, the bottom was observed to be firm, with an accumulation of silt from several inches to a few feet in thickness. As this zone extends further toward the Well center, the extent of loose sediment is such that it was not always possible to determine its depth, although it probably is several feet thick in places.

ARTIFACT ANALYSIS

The cultural material collected totalled nearly 700 items, predominantly pottery, but included worked obsidian and chert flakes (many exhibiting fire fracturing), ground basalitic stone, argillite, fired clay, animal bone (all charred), and a single fragment of human bone.

The collection was typical of a late Sinagua site in the Verde Valley, with the exception of an unusually low proportion of decorated trade pottery which could be either a function of sample size or a suggestion of contamination of other analyzed sherd samples from these sites. No material identifiable as relating to the earlier Hohokam or the later Yavipai-Apache occupation of the Verde Valley was in the sample.

Food bone specimens recovered included rabbit, hare, deer, canvasback duck and turtles. Although the several genera represented are naturally occurring in the benthic or littoral areas of the Well, the fact that all bone fragments showed definite evidence of exposure to extreme heat or direct contact with fire indicates they are not naturally occurring.

The 31 worked obsidian samples recovered were submitted to Kenneth L. Decroo of the University of California, Riverside in 1971 for obsidian hydration analysis. The results have not been received to date.

An interesting and unanticipated result of this study was the set of observations made in regard to the geology of Montezuma's Well. Previous researchers had not offered an explanation for the bottom profile. Evidence of this survey indicates the Well is gradually filling from the banks toward the center. The heavy growth of pondweeds near the shore causes an accumulation of fine sediment, creating a shelf extending as much as 40 feet from the lake's banks. At the terminal edge of the growth area, the bottom drops sharply to a maximum depth. There may be potential for determining the rate of accumulation to provide geological or archeological dating.

Although this project was essentially experimental in nature, it is felt the results indicate a worthwhile potential for further investigation using techniques and equipment developed for recovery of archeological data from this unique environment.

OBSERVATIONS ON TECHNIQUES OF UNDERWATER INVESTIGATIONS

Without doubt, the greatest benefit of this survey was the opportunity provided to approach a unique problem in archeological investigation, one which demanded improvisation, development of new techniques, and equipment, and some new ways of thinking.

A second benefit with important implications for future Service projects in underwater archeology lies in the opportunity which was provided to develop a team of underwater archeologists. We began as four individuals with some experience in diving (under much different and more favorable circumstances) and a little experience in underwater archeology. We had collectively read all we could find which had been published on the subject. We had talked with some of the few experts in the field, only to find they knew little more than we did about a project of this nature. We were forced, then, to experiment and invent. Some of our ideas did not work, some did; some were impractical, but a few did work out favorably. At times it was glamorous and quite exciting. There were other times when we were frightened, frustrated, and wondered why, as seemingly intelligent adults, we had ever become involved in such a thing. However, we faced a complex problem which we were forced to work together to solve. We engaged in a potentially dangerous attempt to work in an alien and hostile environment, where dozens of types of minor accidents, malfunctions, or lapses of caution on the part of divers or tenders could be disastrous. Perhaps because of the adversity encountered, and, in the opinion of the writer, certainly because of the personalities of the other participants, we emerged from the project with mutual trust and respect, and a group cohesiveness which in projects involving work of this type is indispensable. It is obvious small projects such as this can be expected to require about 50% support activity, while on larger efforts this can be reduced to a third or less, depending primarily on the duration of the effort. The fact that this type of investigation most often provides samples of specific information otherwise unobtainable is ample justification for the greater expense per unit of data.

RECOMMENDATIONS FOR FURTHER RESEARCH

Considering the difficulty of recovery of cultural material and the disturbance to the natural growth of aquatic plants which would be necessary, it does not presently seem desirable to attempt further work in the area of plant growth near the edge of the lake. Tests into the mass of roots and silt indicated the presence of building rubble from the adjacent Pueblo ruin to a depth of four or five feet, which would tend to indicate significant stratigraphy would not be encountered. The heavier stone could be expected to migrate downward in this matrix, while less dense objects, bone and ceramics, would be more likely to remain nearer the surface. The root growth, of course, could also be expected to cause considerable disturbance of natural stratigraphy if any was present. Additionally, excavation of anything remotely resembling a systematic trench in this situation would be all but impossible under any reasonable circumstances, with equipment and techniques now available.

Investigations in the center section would also seem impractical. Systematic excavation in soft silt such as this would be impossible, and even gross removal would be highly impractical because of the tendency the silt would have to flow into any excavated area. It also goes without saying that disturbance of this deposit would result in complete loss of visibility.

The results of this survey do indicate, however, considerable promise for investigation of the steeply sloping area between the *Potamageton* growth and the bottom of the Well. In this section artifacts rest on the hard-packed clay and are covered only by an easily removed layer of silt. By utilizing a small hydraulic dredge system, or an air lift, this light layer of sediment could be easily removed to expose any material present, and then exhausted some distance away (preferably near the outlet, to preserve water clarity).

In this situation it would probably not even be necessary to screen the outflow of the excavation system, as it could be operated in such a way as to leave artifacts undisturbed. In the event this was not possible, as might be the case if the light sediment was several inches thick, the silt could easily be directed through a screen at the exhaust end of the system. Provenience, while possibly not of any great importance in this situation, could be obtained by any number of practical referencing methods. The suggested technique would be to abandon attempts at establishing a rigid grid system and instead utilize one which would adapt to bottom contour and conditions. Arbitrary excavation areas could be established by floating light buoys over four points on the bottom, two of which would be at the outer edge of the area of plant grown (minimum depth), and two at the toe of the slope (maximum depth). The precise horizontal location of these points could be obtained from a transit on the rim. Precise depths at these points, or any points within an arbitrary excavation area, could be obtained more easily than elevations on a land site by utilizing a permanently established air bubble level system. By leapfrogging two of these bottom points each time the excavation area was to be changed to one adjacent, complete coverage around the perimeter of the Well could be rapidly attained. An additional advantage of this approach would be physical observations and bathymetric measurements which would be obtained, since the horizontal accuracy of the reference points would be within whatever accuracy is obtainable with a transit, and the depth measurements would be accurate to less than a millimeter. Many of the life-support problems encountered during the project could be considerably reduced. Instead of utilizing SCUBA, which necessitates, in addition to bulky tanks, a highly complex and often tempermental high pressure air compressor, diving should be done with light-weight surface supply equipment (hookah). The simplicity of this breathing system would enable divers to stay down approximately 80% of the time during operations. With such an approach a much greater area could be covered in considerably less time. By employing a small platform on which a light surface-supply air compressor and small pump for a dredge could be temporarily secured, a team of four should be able to completely cover the productive area of the Well in approximately a week of working time.

by George R. Fischer

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INUNDATION STUDIES

THE PROBLEM

Controversy surrounds the question of what impact inundation has on cultural resources, particularly archeological sites. Many such sites in areas controlled by the National Park Service have been and will be submerged due to dam and other construction projects. This presents a serious management problem in that proper protection and administration of these resources is contingent on understanding what will happen to them if flooding occurs. Solid systematic data on inundation effects is unavailable at this time and park managers are often forced to make decisions without the benefit of a body of facts to base them on. The situation is further aggravated because evidence is mounting that in many cases archeological sites are being completely destroyed with no effort at mitigation being made!

THE SOLUTION

The Park Service in its developing underwater program is striving to meet this challenge. By utilizing its in-house capacity for underwater archeology in certain regions, Service archeologists are developing sets of guidelines for monitoring and testing inundation effects. Besides setting up tests to determine the effects of flooding, various methods of mitigating resource loss will also be tried and observed over periods of time.

In the Southwest Region alone, the following are among several areas needing inundation studies, and proposals are being generated to carry them out:

1. Amistad National Recreation Area. Known archeological sites have been inundated at Amistad and attempts will be made by the Division of Archeology to have these sites examined on a periodic basis by Service underwater archeologists.

2. Bandelier National Monument. The backwaters of Cochiti Dam, a Corps of Engineers project, will submerge known archeological sites. The Southwest Region, Division of Archeology, is planning to use the area as a test case to determine, over a long period of time, what method would be best to protect cultural resources subjected to inundation.

3. Navajo Reservoir. Underwater archeological field teams will test recorded sites now flooded due to reservoir construction.

4. Arkansas Post and Chalmette National Historical Area. These two areas have been suggested for investigation by archeologists from the Division's underwater section to determine the effects of inundation on archeological sites resulting from river beds shifting. It is hoped that the studies themselves and any material remains recovered will help in interpretive efforts in these parks.

The proposal mentioned above for setting up test situations at sites about to be inundated are geared towards presenting precise comprehensive data on the effects of flooding on archeological remains. This will be accomplished by strictly following a number of steps.

BEFORE FLOODING

1. The site to be studied will be carefully tested and partially excavated. In some areas, surface collections will be recorded without artifactual material being removed. Core samples will be taken over the entire site, and all observable features (both those on the surface and those revealed through excavation) will be noted as will the pH factor of the soil.

2. Various portions of the site will be subjected to different attempts at stabilization, e.g., sandbagging, plastic covers, and reinforcement bar grids with aluminum covers.

3. Arbitrary markers, easily distinguishable by a diver knowing the code, will be placed to mark key points of the site before flooding takes place. These will only be apparent to someone diving directly on the site and will work as guidepoints only to the archeologist who has the coded key to the meaning of the submerged marker. For example, marker A-7 might be 100 feet due west of a lithic scatter.

4. All sites will be simultaneously plotted through several different methods and facility of relocation by all of these techniques will be independently tested. These methods will include sonic pingers, Ilon (horizontal sextant) bearings, positioning through use of triangulation from two active transit stations, and the placement of buoys marking the sites set to fluctuate freely with the rising water levels. The buoys must not be directly on the sites, but set in numbered patterns so that only the archeologist possessing a preset key to the pattern will know where the cultural remains are in relation to the numbered buoys. Some buoys will also be set entirely away from any cultural remains to further confound potential vandals.

DURING FLOODING

Periodic diving will be undertaken on the site to monitor any noticeable changes during the actual process of inundation. Also the buoys and other locational devices will be periodically checked to assure that they are operational and not causing boating hazards.

AFTER FLOODING

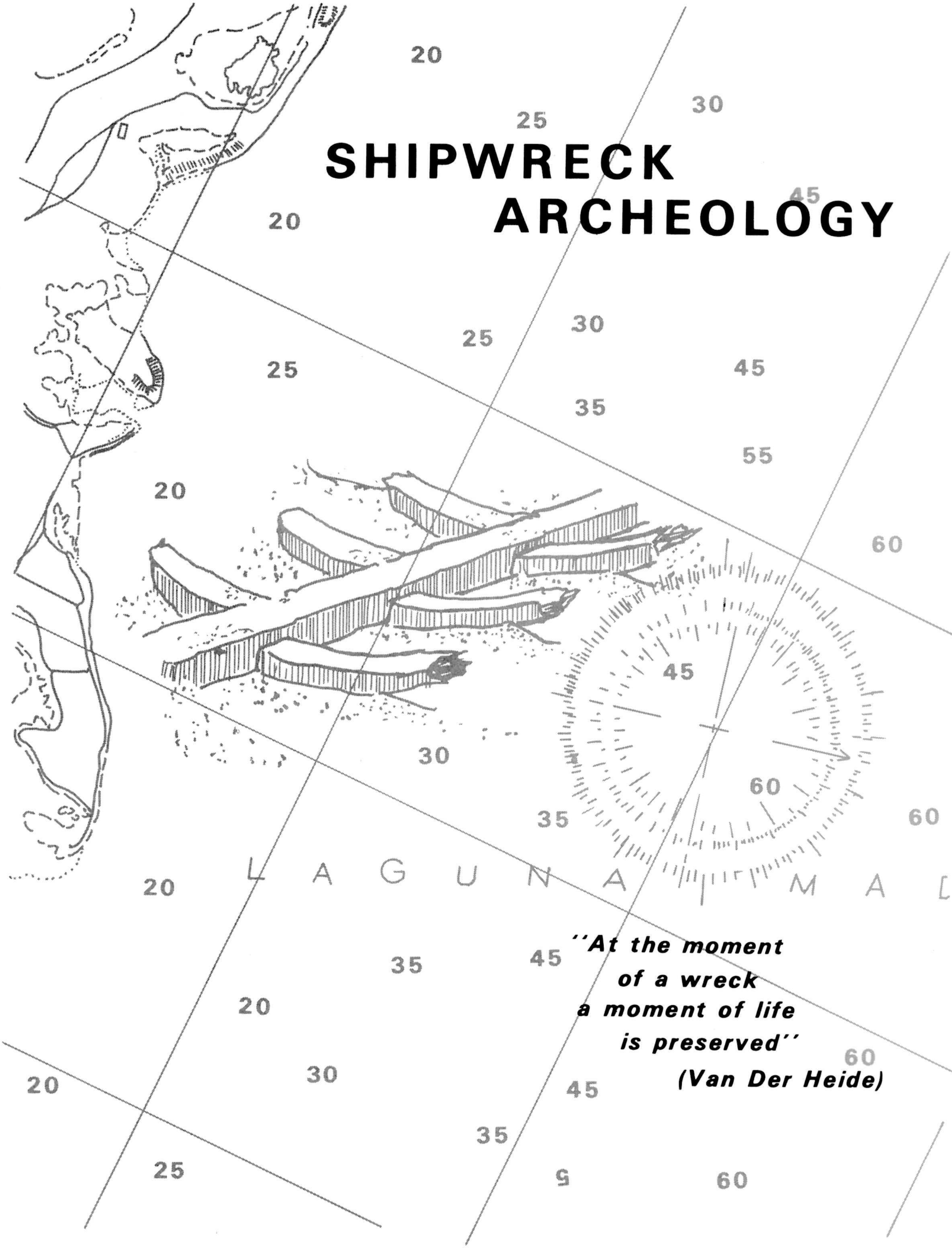
The sites will be relocated and dived on over an indefinite period of time to determine the long term effects of inundation. Some of the coverings will be removed after a year and others left for five and ten year spans.

This project will bring into existence what is in effect a natural laboratory for the on-going controlled study of the effect of inundation in both an immediate sense and in terms of long range effects.

Such a study will also provide a system for comparing the efficacy of methods for underwater data retrieval to terrestial techniques on the same sites. These results will help determine the answer to another question relating to inundation effects; that is, even if some sites are indefinitely perserved, does it mean that their utility is lost to archeologists because methods for adequate data retrieval are unavailable?

by Daniel J. Lenihan

SHIPWRECK ARCHEOLOGY



***''At the moment
of a wreck
a moment of life
is preserved''***
(Van Der Heide)

SHIPWRECKS AS ARCHEOLOGICAL PHENOMENON

A shipwreck can be seen as a snapshot of a particular facet of a culture at a particular time. Due to its peculiar nature as an independent, self-sufficient cultural unit, however, it has also the potential of being seen as a microcosm of the culture at large. The settlement pattern of a village so often studied in land archeology gives evidence of the way a people conceived of and structured their world about them at a given point in time. The priorities they gave certain aspects of their life--religion, social structure, and methods of dealing with daily life needs--are reflected in these material remains. A ship, which is a unit of a culture that operates for long periods of time isolated from its home port, still carries indelibly imprinted in its wooden hulk a reflection of the culture from which it sprang. The way the crew's quarters are arranged, the placement of cargo, the order of priority in which the cargo was jettisoned (quite often an obtainable piece of data) are not the results of chance happenings, but are the end product of culturally influenced, goal-oriented behavior.

It is widely felt that due to the time-capsule nature of a shipwreck it does not have the value of serving as a base for drawing conclusions about processual developments in the history of a people. Rather, it is usually seen as simply a repository of period artifacts which a shipwreck might or might not offer in a more superior state of preservation than those found in land digs. There is no doubt that a shipwreck is valuable in this respect and also in the respect that it serves to document well a unique historical event, i.e., a battle, a convoy racked by storm, or at the very least, the sinking of a ship. What is not as well accepted is that it can also be the basis of a set of theoretical propositions that can feed into a general systematic body of knowledge related to culture change.

Claude Levi-Strauss, the French structural anthropologist, talks of the archeology of history or the role of structuralism in understanding historical process. The notion of true historical insight involving the monitoring of classes of things as opposed to individual components has interesting application here. Binford and others have adopted similar approaches in land-based archeology, but most have been reticent, thus far, in seeing its application to underwater work.

It could be stated, given this basically structuralist orientation, that ships as cultural entities cannot change in themselves, but instead are dependent on the changes that the entire cultural construct undergoes. If this is true, monitoring the development of ship types, construction, layout, and the unique act of destruction itself is a valid if not necessary part of archeological enterprise. On the other hand, the ship, besides being a specific manifestation of cultural processes at a point in time, is also, as mentioned above, a microcosm of the culture as a whole and can reflect in its own internal make-up, the structure of its own parent culture. It should be noted that the shipwreck is here seen in the light of two different conceptual models, which are not conflicting but complementary in nature.

What then is the approach that should be utilized in gaining the most valuable archeological data from shipwrecks, both from a scientific and a resource management point of view? This is the two-headed question with which Park Service underwater archeologists are always faced. The process begins as it does in all other genre of archeological endeavors with the preliminary survey. This is the stage that National Park Service archeologists have been concentrating on thus far in their shipwreck surveys. Following are reports on one such survey and one excavation, the latter conducted on submerged lands adjacent to Padre Island National Seashore by the Texas Antiquities Commission.

D.J.L.

PRELIMINARY ARCHEOLOGICAL SURVEY
OF THE OFFSHORE LANDS OF GULF ISLANDS NATIONAL SEASHORE

At the Gulf Islands National Seashore the park manages the land areas that comprise both lips to the entrance of Santa Rosa Sound of Pensacola Bay. To gain a truly complete picture, therefore, of the historical resources which the Service has a mandate to conserve and interpret, it became necessary to take into consideration the presence of possible cultural remains in the adjacent submerged areas. Following is a report on the survey:

RESEARCH DESIGN

The aim of the research activities conducted during a four-week span in July and August 1973 by the Southeast Archeological Center of the National Park Service was to determine the extent and nature of submerged cultural remains in the waters surrounding Gulf Islands National Seashore. This was not intended as a saturation coverage but rather as a preliminary survey of the area to determine as much as possible about the richness of the area in shipwrecks and other material of historical interest given the limited time and funds at the archeologist's disposal. Besides aiding park officials in managing the resources at hand, the survey would result in information that would help archeologists determine whether it would be most advisable to conduct saturation coverage or actual excavations in the future. Any shipwrecks or remains of submerged fortifications were to be evaluated as to present condition and susceptibility to future vandalism so that park authorities could better protect the sites.

As an adjunct to more conventional underwater archeological techniques, an analysis of aerial photography was concurrently conducted. This project, undertaken by the Earth Satellite Corporation of Washington, D.C. with funds made available to the Service by the U.S. Geological Survey's Earth Resource Observational Program, involved detailed analysis of existing aerial imagery, including both black and white prints and color transparencies scaled at 1:24,000. This phase of the investigation involved preliminary analysis to predict site locations, secondary analysis to further elaborate on locations made through diver observation or magnetometry, and finally, precise location of the sites by combining ground truth and triangulation on existing maps and charts which could then be double-checked by the unquestionable reliability of the aerial camera.

The survey method was based around the use of a Varian Model 4937A Marine Proton Precession Magnetometer which was felt to be by far the most efficient remote sensing system for this type of operation. The instrument works on the principle of detecting changes in the earth's magnetic field caused by the presence of ferrous metals. These variations in the magnetic field, when detected by the machine, are then referred to as anomalies.

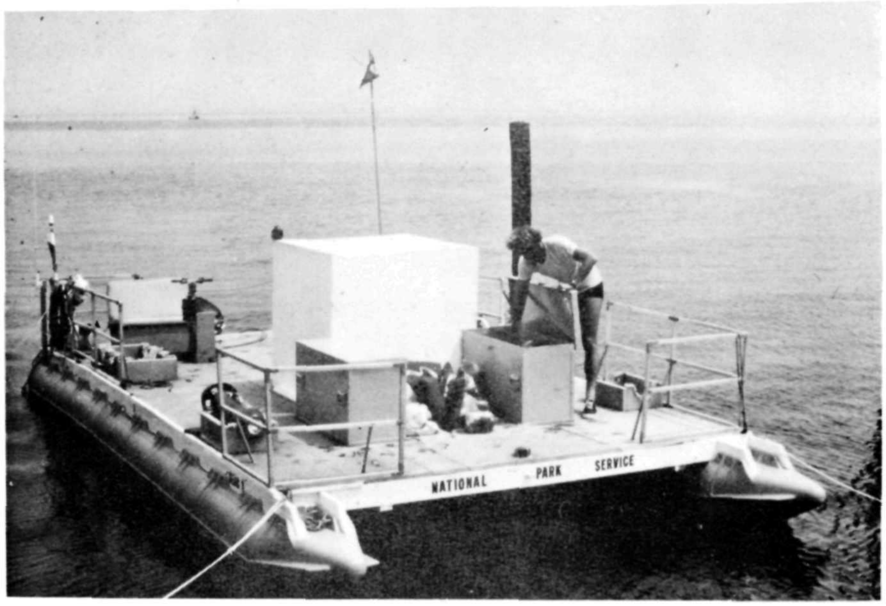
Courses were run along the coastline in the thin band of water which surrounds the western end of Santa Rosa Island and the eastern tip of Perdido Key. The courses were run on visuals and not a grid system which is a reflection of the priority given to covering as much of the large body of water to be surveyed as possible. Researchers felt that although greater precision could be gained by employing a grid in the sense that it would be less likely to miss a spot in the surveyed area, this method would so drastically cut the amount of bottom covered that it was entirely unfeasible. It was also felt by project leaders that the configuration of the area to be studied, which was quite long and narrow, would permit satisfactory results from the use of visual reference points. Considering the preliminary nature of these investigations and the obviously much greater areal coverage possible without the stringent requirements of establishing and orienting a grid system, it was felt infinitely more feasible to conduct magnetometer work by carefully running lines at 70 foot intervals from the beach to the offshore bar.

Once an anomaly was recorded by the magnetometer operator a cement block with an attached numbered float was thrown overboard to mark the spot. A dive crew was then dispatched to check the area both visually and with two-foot probes. If any artifactual material was present, the nature and amount was recorded and a sample was taken for later analysis if it were thought to be of diagnostic value. Whether divers confirmed the presence of shipwreck remains or not, the locations of all areas that had indicated anomalies were precisely located and recorded through the use of a horizontal sextant and magnetics. This was done because it was quite likely that the remains were simply covered by sand and beyond the divers' reach, and future researchers, if so inclined, could excavate to determine the exact nature of the site.

The diving operations performed during this project were closely supervised and regulated. All diving was carried out in strict compliance with the guidelines and safety rules developed by the National Park Service SCUBA policy. Additional guidelines and procedures were also developed for this specific project and for future use in Service underwater archeological research.

RESEARCH RESULTS

The surveyed area was found to be quite rich in cultural material, primarily shipwrecks, although a small number of bricks were also



Above Research Barge "John Corbett" is prepared for the day's work.
Below A team of Service archeologists head out to check anomalies registered on the previous day's magnetometer run.

found at one location which was felt by the archeologists to be the site of the mid-19th Century Fort McRae. A base map was constructed on which all verified wrecks and unconfirmed anomalies were listed and precisely located.

Certain sites were noted as being more significant historically and more amenable to excavation. In one instance a very strong magnetometer recording showing a very definite wreck profile was found to correspond exactly with the designation on a 1858 navigational chart of a shipwreck termed "the Spanish Wreck." The site conditions where the anomaly was found are some of the best in the area in terms of ease of excavation. The bottom is sandy and visibility is in excess of 50 feet at high tide. Water depth is less than 20 feet.

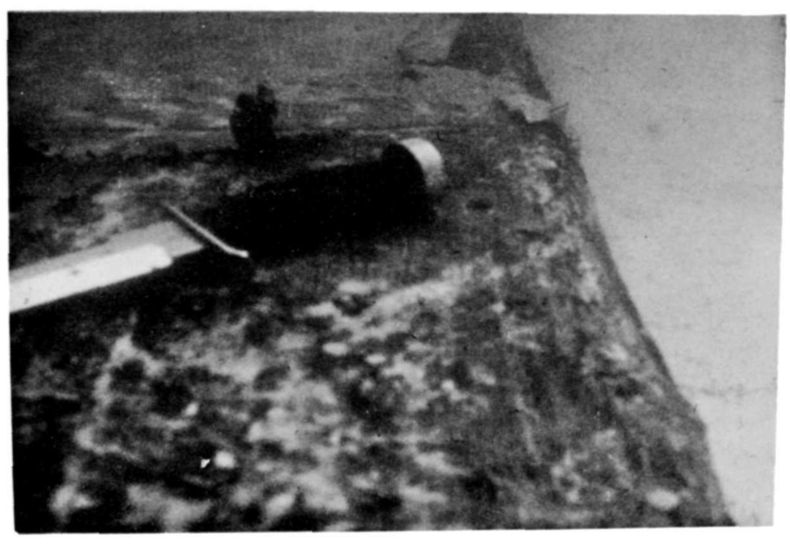
Another area which would be well worth investigating in more detail is off the east tip of Perdido Key. When the dive teams examined this area they found the remains of at least two shipwrecks which had met their demise within yards of each other. The wreck material found here indicated that the two ships were probably of two different eras, some planking being covered by copper sheeting with brass and copper nails and other pieces nearby being secured entirely with iron fastenings. This would provide another instance, if our preliminary analysis is correct, of the "clustering effect" noted by George Bass as occurring frequently in the Mediterranean. Excavation would be feasible in the shallow water (4-10 feet) covering this site despite the swift current, and the operation could pay extra dividends if the methodology used was oriented towards increasing our understanding of the effects of migrating sands (a dynamic constant) on beached shipwrecks which are in a surf zone (a variable).

Divers in the course of their investigation noted that all visible sites showed signs of being disturbed by vandals including a number of wrecks which lay exposed on the beach. What was more surprising was the fact that a whole string of anomalies which were registered by the magnetometer off Perdido Key corresponded exactly with marker stakes set up along the shoreline. There was absolutely no cultural material apparent to the divers on visual investigation, which suggests that a group or groups of treasure hunters was organized and systematic enough to locate every "possible wreck" site along several miles of coastline even though they were completely covered with sand. It is possible that this was accomplished through beachcombing after storms. Even sand-inundated wrecks near shore often release debris and coins, etc. at these times which are then scattered along the beach in characteristic pattern by the wave action. Some professional treasure-hunters claim that they can precisely locate most off-shore wrecks in an area using this method

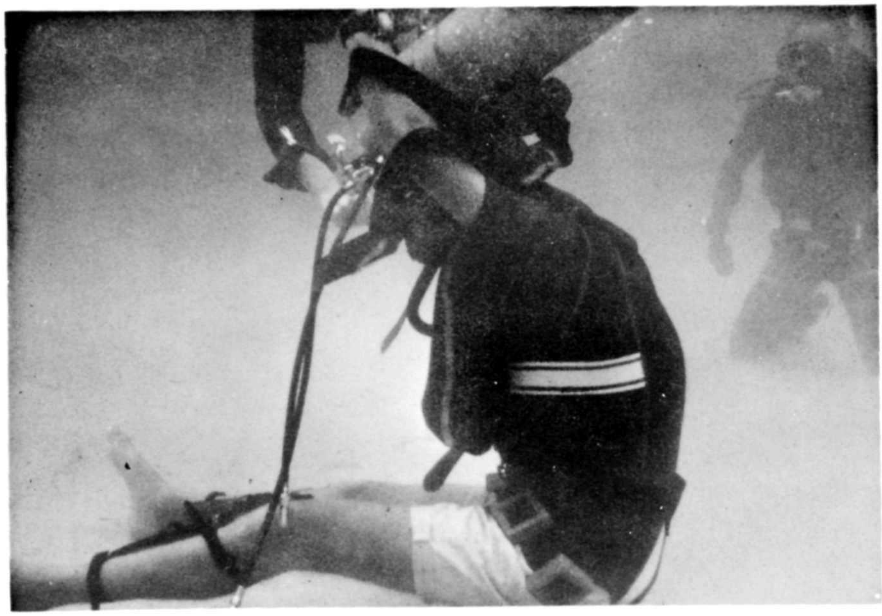
ARCHEOLOGISTS LOCATE SHIP PLANKS AT SITE OF ANOMALY REGISTERED ON THE MAGNETOMETER.

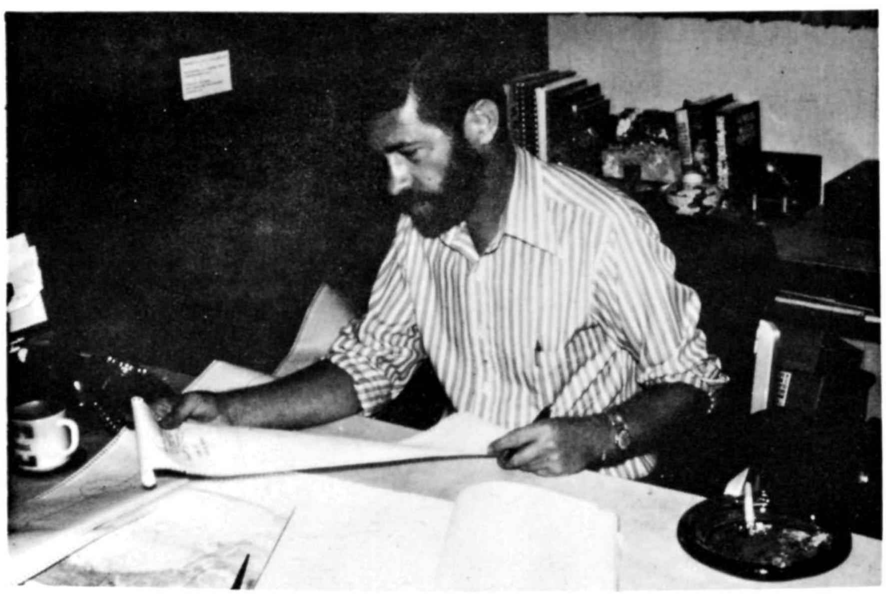
Survey team examines area in which an anomaly was registered on the magnetometer. The spear-like object is a shark protection device

Archeologist brushes sand away to expose ship timbers. A small wood sample will be taken and the timbers will then be recovered with sand.



One ship timber is found covered with copper sheeting, probably as protection against teredos.





George Fischer, Project Director, above going through exercise which was part of "ongoing project training program" at Gulf Islands Project. Below Fischer analyzes remote sensing data back at Southeast Archeological Center in Tallahassee, Florida.

of reading "wreck tracks" and this might have been the case in the instance of Perdido Key. Park officials were notified by the Center's archeologists of this situation, and they will use this information at their discretion to modify visitor use policy in the park lands.

As a result of this operation, groundwork has been laid for future archeological surveys under similar conditions. Papers have already been completed and will be available to appropriate groups which describe in detail the methods and techniques herein developed for solving some of the logistical complexities which accrue when archeological surveys are extended to the aquatic environment. These include magnetometer techniques, diving and boat operating procedures, and dive safety regulations for use in underwater archeological field work.

The Southeast Archeological Center is also interested in developing a comprehensive research design for underwater surveys which will include a set of guidelines for obtaining a generalized systematic body of data on shipwrecks. It intends to define particular foci for problem oriented surveys and excavations which will delimit specific categories of information that would be collected from all underwater sites by Service archeologists and any others wishing to partake in such a system. This means that a minimum baseline of standardized, negotiable information would be gathered from each site thereby forming a basis for setting up testable hypotheses for solving specific problems peculiar to any one site.

It is hoped that the information and experience obtained from the conducting of this preliminary survey will help towards developing such a systemized approach in the field of underwater archeology.

by Daniel J. Lenihan

COMPREHENSIVE INVESTIGATION OF UNDERWATER SITES: AN EXAMPLE IN THE TEXAS ANTIQUITIES COMMITTEE PADRE ISLAND PROJECT

The Padre Island Project conducted off Port Mansfield, Texas, represents a complete scientific excavation of a submerged site in contrast to the preliminary surveys presented thus far. The site required extensive investigations to recover data that otherwise would have been lost through non-scientific activities, and it demonstrates another way that land management problems are being dealt with by underwater archeologists.*

Padre Island is a barrier dune island running parallel to the Texas Gulf Coast from Brownsville to Corpus Christi, being but a segment in an intermittent chain of such islands which occur along the Gulf Coast from Florida to Mexico. The ocean current circulation in the Gulf of Mexico eventually sweeps parallel to Padre Island, running northward from the Yucatan Peninsula toward the mouth of the Mississippi River. Convection currents resulting from the outflow of the Mississippi River causes movement back into the parallel flow from the center of the Gulf. These conditions deposit flotsam collected throughout the Gulf and the Carribean onto the beaches of Padre Island. Further, the major weather patterns of the Gulf, especially tropical storms, move westward from the Atlantic and frequently pass over Padre Island. Such storms and hurricanes have resulted in Padre Island being the final resting place for many seagoing vessels over the centuries.

The Texas Antiquities Committee conducted an archeological excavation of one of these 15th century Spanish ships under the direction of Carl Clausen in 1972 and 1973. Little is known or documented about mid-1550 Spanish ship design since vessel plans and architectural drawings were seldom used prior to the mid-17th century. During the mid-1550's, the precious metals of the New World represented a major factor in European economics. Cultural and socio-economic pressures in Europe had a profound effect on transatlantic shipping, causing radical changes in marine design and armament. The evolution of the structural elements of ship design during this critical period in the history of marine architecture can be understood only from the evidence garnered from submerged remains. Besides providing information on ship design, the remains

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*Because the cultural remains recovered during the course of this "dig" are pertinent to the cultural interpretation of Padre Island National Seashore, an Antiquities Act Permit was involved. Also, due to Park Service's interest in submerged cultural remains, an archeological contract was issued which extended the project into NPS controlled waters.

of a shipwreck also stand as a micro-manifestation of a culture at a particular point in time. The vessel excavated by the Texas group contained artifacts which are the products of Spanish culture during a dynamic phase in that nation's history. Data derived from studying these material remains by marine archeologists supplement and enrich the historical documentation of this era.

The "Discoverer," a custom built 20'x60' steel barge, was anchored over the site during investigations and was manned 24 hours a day. This work platform houses gear and equipment, has crew quarters, and is being outfitted with engines to make it an independent mobile base of operations. The Research Vessel "Anomaly" served as a support vessel. The "Anomaly" is a custom built 36-foot, steel hulled, twin diesel boat, complete with radar, fathometer, magnetometer, and specialized underwater detection equipment.

There were four stages in this multi-phase project to recover scientific information from an underwater historical and archeological site on the Texas Gulf Coast.

Step One of the project included an analysis of material and information recovered from prior commercial and institutional activities and an intensive magnetometer survey of selected sections of the ocean floor to locate and mark all sites present.

Step Two was accomplished early in the 1972 field season and consisted of detailed mapping of the sites located during Step One. "Fine Grained" magnetometer and fathometer records were taken on each site by making a series of parallel runs 5 meters apart, and the data was put through a computer to produce both magnetic and actual ocean bottom maps. (This is the start of a complex site survey-location-recording system now being developed by Clausen.)

Step Three, which is still in progress, is a historical study in the archives of Spain, Mexico, and the United States to provide specific background information about the site.

Step Four was the scientific excavation of a selected site, 41KN10(UW), also designated as "Edie." This site was picked for a series of reasons: it appeared to be representative of the cluster of sites in the surveyed sector; it appeared to be complete, without previous vandalism; it would provide comparative material and data for use in analysis of previous collections made by non-scientific groups; it would provide basic information about this type of site, now lacking because no total scientific excavations have previously been accomplished; and the site was endangered due to the type of artifact material contained therein. (Spanish ships have long been a target for commercial and amateur ventures to recover the precious metals.)

Accompanying and following the excavations were ongoing laboratory preservation and analysis of the materials recovered during two years of field work. The results of the archival research (Step 3) will be incorporated in a scientific publication being written by Carl Clausen.

Actual excavations began in the 1972 field season and were completed in the 1973 field season. In 1972 the project was small and included only Texas Antiquities Committee personnel. In 1973 a full-scale project was undertaken. In addition to Texas Antiquities Committee Staff, the project became a University of Texas underwater archeological field school with 13 students with cooperation from the University of Texas Oceanographic Research Station at Post Arkansas. The staff was also affiliated with the Flower Garden Ocean Research Center - Marine Biomedical Institute (UTMB-Galveston) who provided dive records and control and medical personnel, and there was occasional participation by NPS underwater archeologists.

Three environmental factors--low to nonexistant visibility, continual current, and an all sand bottom--determined the techniques and methods used. Control was maintained from a permanent base line with two theodolite stations on Padre Island, keyed to USGS benchmarks, and a stadia rod through the water to the ocean bottom. Individual artifacts and features were then triangulated in with 50 meter tapes from these sub-base points.

This excavation has yielded a tremendous amount of data on 16th century shipping, and many period artifacts recovered from this wreck are in an unparalleled state of preservation. Park Service personnel, though only peripherally involved in this particular project, plan to endorse many of the techniques utilized by the State of Texas into future research designs for ship excavations on park lands.

by Calvin R. Cummings

FORT JEFFERSON MOAT STUDY

The preliminary underwater archeological research carried out in April of 1969 and December of 1970, and the major underwater archeological project of May and June of 1971 at Fort Jefferson National Monument focused on two distinct operations. One involved a shipwreck survey in the Federal waters surrounding the Dry Tortugas and the other was oriented toward an investigation of the Fort's moat, walls, and seawalls. This report will deal with the work done in the moat and will outline the aims, the procedures used, a description of the archeological investigation and possible solutions to them. First, however, will follow a brief history of Fort Jefferson taken from available historical documents.

HISTORY OF FORT JEFFERSON

During the first half of the 19th century, the United States began a chain of seacoast defenses from Maine to Texas. The largest link was Fort Jefferson, one-half mile in perimeter and covering most of 16-acre Garden Key. From foundation to crown, its eight-foot-thick walls stand 50 feet high. It has three gun tiers, designed for 450 guns, and a garrison of 1,500 men.

Fort construction was started in 1846 and although work went on for almost 30 years, it was never finished. The U.S. Engineer Corps planned and supervised the building. Artisans imported from the North and slaves from Key West made up most of the labor force. After 1861 the slaves were partially replaced by military prisoners, but slave labor did not end until Lincoln freed the slaves in 1863.

To prevent Florida's seizure of the half-complete and unarmed defense, Federal troops hurriedly occupied Fort Jefferson in January of 1861, but aside from a few warning shots at Confederate privateers, there was no action. The average garrison numbered 500 men, and building quarters for them accounted for most of the wartime construction.

Little important work was done after 1866, for the new rifled cannon had already made the Fort obsolete. Further, the engineers found that the foundations rested, not on a solid coral reef, but upon sand and coral boulders washed up by the sea. The huge structure settled and the walls began to crack.

For almost ten years after the war, Fort Jefferson remained a prison. Among the prisoners sent there in 1865 were the "Lincoln Conspirators" -- Michael O'Loughlin, Samuel Arnold, Edward Spangler, and Dr. Samuel A. Mudd.

In the fall of 1867 an epidemic of yellow fever raged over the fort, striking 270 of the 300 men in residence. Dr. Mudd worked day and night to fight the scourge, and two years later was pardoned, partially in recognition of his efforts.

Because of hurricane damage and another fever outbreak, Fort Jefferson was abandoned in 1874. During the 1880's, however, the United States began a naval building program, and looked to this Southern outpost as a possible naval base. From Tortugas Harbor, the battleship Maine weighed anchor for Cuba, where she was blown up in Havana Harbor in February of 1898.

Soon, the Navy began a coaling station outside the fort walls, but the big sheds were hardly completed before a hurricane smashed the loading rigs.

One of the first naval wireless stations was built at the fort early in the 20th century and, during World War I, the area was equipped as a seaplane base. As the military moved out again, fire and storms and salvagers took their toll, leaving the "Gibralter of the Gulf" the vast ruin it is today.

In January of 1935, Fort Jefferson National Monument was established, including an area covering some 50 square miles of land and water, and administrative jurisdiction was transferred to the National Park Service.

RESEARCH AIMS

Diving operations were initiated by the Park Service in the Fort Jefferson moat in an effort to gain an understanding of the structural integrity of the fortress below the waterline as well as to systematically retrieve as much in the way of historical remains and their association as possible, given the limited resources and time.

Men in all cultures are aware of the cleansing properties of water for personal use and it is usually not too long before this notion is extended to all aspects of their lives and they recognize the potential most bodies of water hold as convenient, neat garbage disposals. The inhabitants of Fort Jefferson during the 19th and 20th centuries were no exception and the fortress' moat bears mute testimony to the activities and life styles of the men who were stationed there. Archeology in this sense acts as a scientific "friend of the court" to prior historical documentation and in the case of the underwater excavation of the moat the physical remains provided an interesting and enlightening supplement to the written and photographic records of Fort Jefferson.

This is especially true because during the years when the fort was abandoned, most of the historic objects were removed or stolen and until the moat project there were few site-related artifacts available for study or museum purposes at the monument.

Another intricately related but distinct aim in the Fort Jefferson moat project was that of determining the extent of damage and decay to the structure below the water and it was important to find if these extended below the waterline into the very foundations of the fort. Such information, besides being useful in determining what kind of maintenance and preservation efforts might be called for also is of great interest to the historic architect. As it occurred, some of the most interesting results of the Fort Jefferson project were in the moat site.

PROCEDURES

In April, 1969, and December, 1970, preliminary investigations were conducted in the moat. Working with a lightweight hookah (surface-supplied diving apparatus) device, water jet, and dredge, several test pits were sunk into the floor of the moat. It was found that it was possible to remove the bottom sludge in a reasonably controlled fashion and successfully retrieve artifacts in horizontal context from the bottom. It also proved quite feasible to trace the surface cracks down into the water and the underlying muck with the dredge. Plans were made by George Fischer, Southeast Archeological Center, for a systematic excavation of the moat in the summer of 1971.

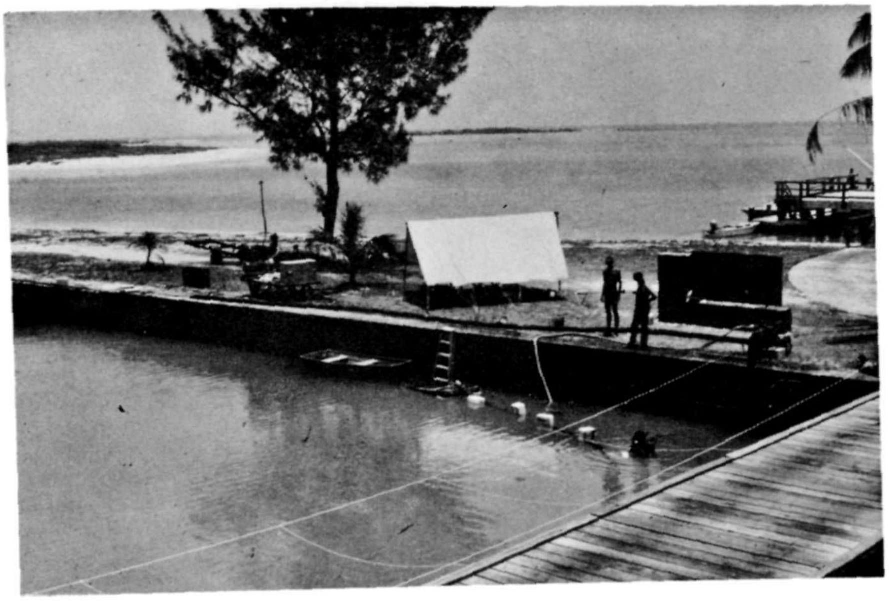
When Fischer returned to conduct the full-scale excavation, he brought a full contingent of divers, archeologists, and other specialists, and much in the way of specialized underwater equipment. A grid system was constructed above the surface which could be rigidly secured in place. A base line was established through the exact center of the Sally port and running southeast lengthwise down the middle of the bridge and across the moat. The grid was in squares, ten feet per side with point 00 located at the outside end southeast of the bridge, and seven-and-a-half feet southwest of a brass National Park Service corner marker. The north-south line is set back two feet on top of the moat wall. At the fort side 70' is even with the wall at the bottom of the moat, but almost three feet short of the wall at bridge level.

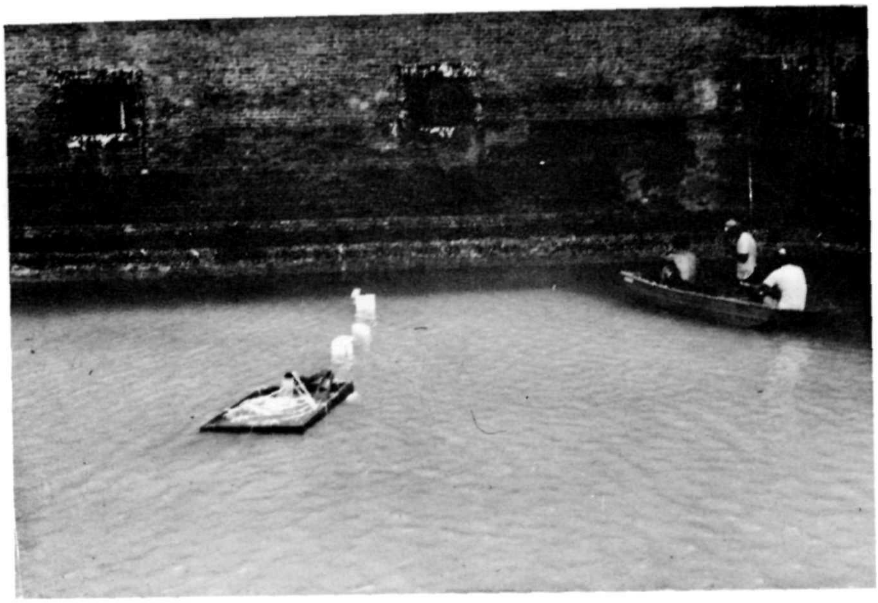
The first four squares were chosen for a starting place because of the likelihood of historic objects being deposited by troops returning to the fort through the Sally port. On June 4 a submersible metal detector was taken into the moat and some areas showing heavy anomalies were also dredged or plotted for future dredging. All material taken from the moat was carefully plotted as to its precise location and retained for further analysis.

MOAT EXCAVATION--TECHNICAL ASPECTS

The moat presented some unique problems to the archeologist in a technical sense. The controlled, systematic collection of historical remains in this shallow, enclosed body of water demanded application of a combination of modified terrestial archeological techniques, some modified conventional underwater archeological techniques, and some raw innovation. The visibility in the moat was variable and subject to the tides as was the water level. The water in the moat is also a natural sanctuary for stinging jellyfish and a variety of coral which inflicts chemical burns on the unwary diver. The extremely shallow (3 to 6 feet deep) exceptionally saline (although this was never verified by chemical analysis and is a subjective observation of some divers) water presented qreat buoyancy problems. Not only is a large amount of weight needed but this depth range causes the greatest pressure-volume change for any apparel or equipment which might have compressible air spaces. Divers and their associated equipment must either be overweight or floating, neutral buoyancy being extremely difficult to maintain if any horizontal movement was called for. This was particularly critical for those doing the initial survey and laying of test pits over the variably deep bottom. In such shallow water depth variations of just one or two feet can cause loss of neutral buoyancy. The lack of current in the moat meant that there was no natural clearing action to disperse the silt once the machinery and overweighted divers had worked it up. In similar operations conducted in open water, one usually can depend on there being at least a slight current into which divers can direct the debris.

To counteract the problems presented by stinging sea creatures and fire coral, divers resorted to long-sleeve shirts, long pants, and tennis shoes. Swim fins were usually discarded because they tended to stir more silt with their increased surface area, and since the divers moved little, they were not needed for propulsion and thrust. Shirts and pants served better than wet suits because they are not compressible and therefore had little effect on the divers buoyant state when the depth changed. Divers were carefully tended from the surface rather than being accompanied by a buddy in the water as the extremely poor visibility and presence of machinery would make for potentially more dangerous situations if the second man should momentarily lose contact with the diver operating the dredge. The individual tending the dredge exhaust screen would also serve as a safety diver in the unlikely event that





The above two pictures illustrate archeological recovery procedures in the Fort Jefferson moat. In top photo, a portable excavation grid is laid. In bottom photo, Service archeologists operate a metal detecting device.

the dredge man became pinned or entangled. With this technique a diver in trouble could be rapidly recovered in the conventional hard-hat method by retrieving him on his safety (air) line if the tender detected erratic breathing. A safety diver was ready to go at a few seconds notice at any sign of trouble.

A dredge was found to work better than the water-jet type system. The water-jet tends sometimes, in a still-water situation, to cycle the disturbed bottom back into the hole being dug.

Another problem which became more and more apparent as the dig progressed was that the above surface grid, although adequate, could have been greatly improved by having an extension at depth. Vertical bars could be dropped to the bottom from the square corners and a duplicate grid constructed of iron pipe, polypropylene, or some other material on the bottom. This would make it much more unlikely that the divers would stray out of the proper square when the visibility was very poor.

RESULTS

The artifacts retrieved from the moat supported archeologically most of what had already been known from written documents and supplied a collection of museum pieces which will eventually become part of the Monument's display center.

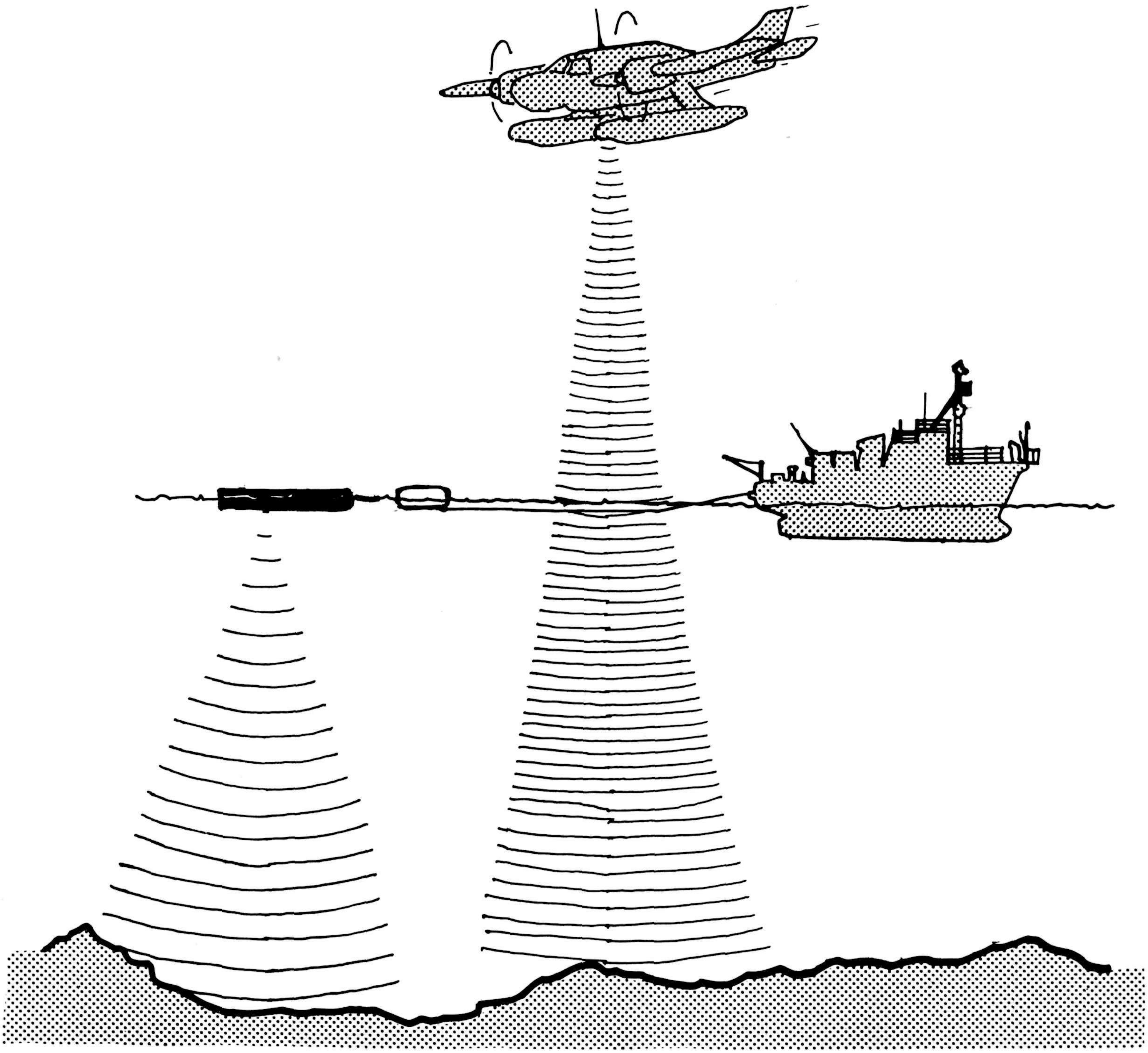
A hypothesis that a rich sprinkling of historical material would be found near the Sally port was not borne out. One of the researchers discovered while perusing some old documents that the kitchen area had been located at Bastion #4, and an alternative theory was proposed that this area should be heavily spotted with debris and that there should be a proportional lessening of the occurrence of material remains as one progressed away from that bastion. This alternate hypothesis was borne out as indicated by the fact that a large number of bottles covering about a 60 to 90 year range in age plus a number of other items were recovered with the predicted frequency distribution. An observation made here was that medical type bottles were found in consistently closer proximity to the bastion than whiskey and wine bottles. Further testing would be necessary to conclusively indicate whether this is a direct function of the superior aerodynamic properties of alcoholic beverage containers of the 19th century over contemporaneous medicine bottles. Or perhaps the bottles' deposition is instead related to the more vigorous and enthusiastic state that the contents of the former type of container put the cultural actors in, over the contents of the latter.

The archeologists were also able to determine from their diving the construction method used on the "belts" of concrete discovered spread across the moat for apparent supportive purposes. They were comprised of burlap packaged sand, tied together or bound through looped brass wire, twisted, covered with steel mesh, sealed with a cheese-like material, and then capped and spanned with concrete. They may have been built at low tide, the gap between pumped dry and the brick foundations for the wall constructed. Construction would then have continued until the sea wall was of sufficient height to allow building of coffer dams within. In other words, the fort foundation and walls may have been built within the sealed "moat" after it had been pumped dry, a section at a time.

The most significant point in regard to the architectural archeology of the moat is that in most cases it was found that the cracks visible from the surface did not extend much below the water level. The main factors which apparently account for this phenomenon are protection from atmospheric erosion and a constant temperature and water content which protected the foundation from expansion and contraction, a finding of considerable significance in regard to future preservation of masonry forts of this style and period.

by Daniel J. Lenihan

REMOTE SENSING



REMOTE SENSING

National Park Service underwater archeological specialists have taken a special interest in remote sensing systems. Given the resource management responsibilities of the Service, efficient methods of locating and recording cultural resources in large submerged areas has become a priority issue.

Preliminary survey methods utilizing magnetometers, aerial survey, metal detectors, and sonar devices have been experimented with and studied for future application in Service archeological projects.

Following is a report dealing with an aerial remote sensing operation. The report was developed for the National Park Service Southeast Archeological Center by Roland Wood of Florida State University and Frank Stapor of the South Carolina Wildlife and Marine Resources Department. Their work exemplifies one application of remote sensing data to underwater archeological concerns.

D.J.L.

REMOTE SENSING INVESTIGATION OF FORT POINSETT

This is a report of findings of a research project conducted for the National Park Service, United States Department of Interior, and by the Florida Resources and Environmental Analysis Center, Florida State University. The National Park Service hoped to find the remains of Fort Poinsett and determine rates and forms of shoreline change in the site area. The project consisted of a remote sensing-historical investigation to achieve the above goals, and, once the most likely sites of the fort were located, a magnetometer survey was to be conducted to verify or precisely delimit the postulated fort site. This report summarizes the remote sensing-historical investigation portion of the project.

HISTORICAL BACKGROUND

Fort Poinsett was named for Joel R. Poinsett, Secretary of War during the Second Seminole War (Fischer 1973). The fort was established by Surgeon General Thomas Lawton on East Cape of Cape Sable, Florida in 1838 (Tebeau 1968), and was occupied intermittently until the late 1850's when the newly established Fort Cross on Middle Cape, about five miles to the northwest, apparently became more important than the older Fort Poinsett (Tebeau 1968). Presently, there is no ground evidence of the fort, but the remains were visible on the ground until 1935 when an extremely violent hurricane passed over the cape. The last record of the fort dates from the early part of the present century when it was reported that ditches and heaps of sand were observed. The last metal objects such as round shot and scattered unrelated items disappeared in this century also (Tebeau 1968). The fort would have been easily destroyed because it was not a very substantial structure. It was constructed mostly of logs, which would eventually disintegrate, and sand, which would be scattered easily by hurricane surges.(Tebeau 1968).

SOURCES OF INFORMATION

Published accounts and historical charts and maps of the area were consulted. Notable historical maps and charts date from 1856, 1857 and 1891. A 1971 Nautical Chart of the area was also inspected. Aerial photographs for 1928, 1953, and 1973 were obtained; a flight was conducted to obtain multi-band photography and a field check was carried out.

METHODS AND RESULTS

As stated above, there was a general consensus that Fort Poinsett was constructed somewhere on East Cape. Further, National Park

Service officials thought that the fort may be underwater today as a result of shoreline erosion. In order to locate the fort an initial step was to consult historical materials, first to substantiate whether it was, in fact, built on East Cape, and also to attempt to locate the fort precisely. These historical materials were of four types: articles, books, navigation charts, and maps. Articles and books clearly stated that the fort was built on East Cape (Covington 1938) but were of no use in locating the fort precisely. Navigation charts proved to be of little utility also. The earliest chart found (Figure 1) shows Fort Poinsett, but the scale was so small and the chart so inaccurate that it was of no utility. Configuration of Cape Sable is more accurately shown on a map made in 1856 (Figure 2). This map shows Fort Poinsett, but again the scale is so small and the coastal configuration so inaccurate that it was of no use in locating the fort precisely. A map made in 1850 is much more accurate as it was on a large scale and restricted to the East Cape area (U.S. Coast Survey, 1850). This map depicted Fort Poinsett, but the area mapped was so small (only 5 coastline miles) that one is not able to precisely locate points because there is no surrounding coastline shown which may be used for orientation purposes. Also, naming is confusing, i.e., the names "Lower Cape" and "Cape Sable East" are used in different areas of the map, whereas other historical sources refer to these as the same place, i.e., East Cape. The most accurate historical map was made in 1857 and shows Fort Poinsett in the tip of East Cape (U.S. Coast Survey, 1857). The final historical chart of interest was one made in 1891 (Figure 3) (National Archives, chart #168). This is a reasonably accurate chart of Cape Sable, but by this time the fort had been abandoned so long that it was not shown. In sum, articles and books indicated that Fort Poinsett was located on East Cape of Cape Sable, but historical charts and maps did not locate the fort precisely. Therefore, more precise information was needed. Obtaining this information became the role of remote sensing.

Aerial photography was obtained for the purpose of finding photographic evidence of the fort remains and documenting change in the shoreline of East Cape. The history of shoreline change was considered to be important because the fort was believed to be presently underwater; therefore, if areas of erosion could be identified, a magnetometer survey could be directed to the specific area where erosion had occurred. A trimetrogon aerial survey was flown by the U.S. Army Air Corps in 1928, and this photography was obtained and studied for precise location of the fort. (East Cape was included in the vertical portions of the trimetrogon photos.) It was extremely fortunate that such early aerial photography existed for the Cape because in 1928 the fort should have been visible (before the 1935 hurricane which obliterated the fort remains). On the east side of the Cape a circular form was identified - one which is not of natural origin and has the dimensions of a small fort of this period (about 220 feet in diameter). See Figure 6. The postulated site of the fort is outlined.

Believing now that the fort was underwater, and because the circular form could be of some other origin, it was necessary to document history of the coastline change of East Cape. This was done using existing aerial photography and photogrammetric techniques. Three sets of aerial photographs were used: 1928 U.S. Army Air Corps (scale approximately 1:17,600), 1953 U.S. G. S. (1:20,000) and 1973 Mark Hurd (1:80,000). The U.S. G. S. photography was used as the primary base (Figure 4). The coastline was traced on an acetate overlay from the U.S.G.S. photography and then the 1928 and 1973 images were superimposed, and the coastline for those two years traced on the same sheet of acetate. The superimposition was done with a zoom transfer scope (Bausch and Lomb, Model 2T). From this photogrammetric measurement, it was found that the east side of East Cape has eroded a maximum of about 450 feet since 1928. Figure 5 illustrates change in the coastline of East Cape between 1928 and 1973. Note that the east side of the cape is the only area of significant erosion. Other portions have been relatively unchanged (1, 2).

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[1]In making such a measurement, tide differences must be considered because, if the tide were significantly higher or lower at the time of flights, there could be a significant difference in the location of water-beach interface which would be due to tide level rather than shoreline change. In order to find whether the tide level was significant, tide tables were obtained for the three dates. For all three flight times, the tide level was above the mean low tide and ranged from about 0.45' to 2.00', a difference of 1.55'. This is a small difference, and considering that the beach has a steep incline (more than 5 degrees) the position of the water-beach interface could be affected but little by tide level. Also, the authors observed the effect of tidal fluctuation on water-beach interface position during the field check and this difference was less than 25 feet at all points on East Cape. It is concluded that error in mapping shoreline position due to tide level is small. Further, the error factor resulting from image projection is small because of the high quality of optics of the Bausch and Lomb zoom transfer scope. Error is estimated to be less than 50 feet.

[2]The 1857 U.S. Coast Survey map, which showed Fort Poinsett, was superimposed on the acetate drawing of coastline positions taken from the aerial photography. Because inland features did not match those on the photographs, it was not possible to register the map with the photography precisely. Therefore, no attempt was made to quantify

Another technique was employed to locate the fort. In the initial stage of the project, it was expected that color infrared photography might provide useful information which might not be obtained from existing aerial photography. The rationale was that, since site conditions would be disturbed by the fort, there might be evidence of this in the vegetation on the site. Multi-band photography frequently illustrated very subtle differences between sites. In this case it was hoped that differences in vegetation due to disturbance of the site could be observed, which would exhibit a pattern on one or more of the bands. Also, because the green band of the electromagnetic spectrum is optimal for penetration of turbid water, it was hoped that this band would give sufficient water penetration to detect the remnant pattern of the fort. As the fort was discernable as late as the early part of this century, vegetation could reflect the site today. A mission was flown with a multi-band camera using four bands (blue 395-510 nanometers, green 485-590 nm, red 585-715 nm, and near infrared 700-900 nm). Focal length of the lens was 6 inches and flight altitude was 1,800 feet giving a scale of 1" to 300 feet. The multi-band photography was interpreted with the aid of an I^2S color additive viewer which projects filtered light through each of the four film images and displays the scene on a screen. One is able to compose a multitude of scenes by manipulation of individual bands and color intensity, i.e,. any combination of bands may be chosen and color intensity varied. A major reason multi-band photography was obtained was the possibility that one of the bands (green) might provide good water penetration, thus if the fort were under water the pattern might be detected. (Unfortunately, virtually no water penetration was achieved because of turbid water conditions at the time of the flight.)

The entire area of East Cape was inspected on the multi-band photography for anomalous forms which might indicate remnants of man-made features. The only such patterns found were a circular form and an arc of a circle in the same area as the circular form detected on the 1928 U.S. Army Air Corps trimetrogon photography. The more pronounced circular form was detected in the blue band and was not visible in most combinations of bands and color intensities. The diameter of the circle was approximately 150 feet. The other form (the arc of a circle) was more subdued and measured

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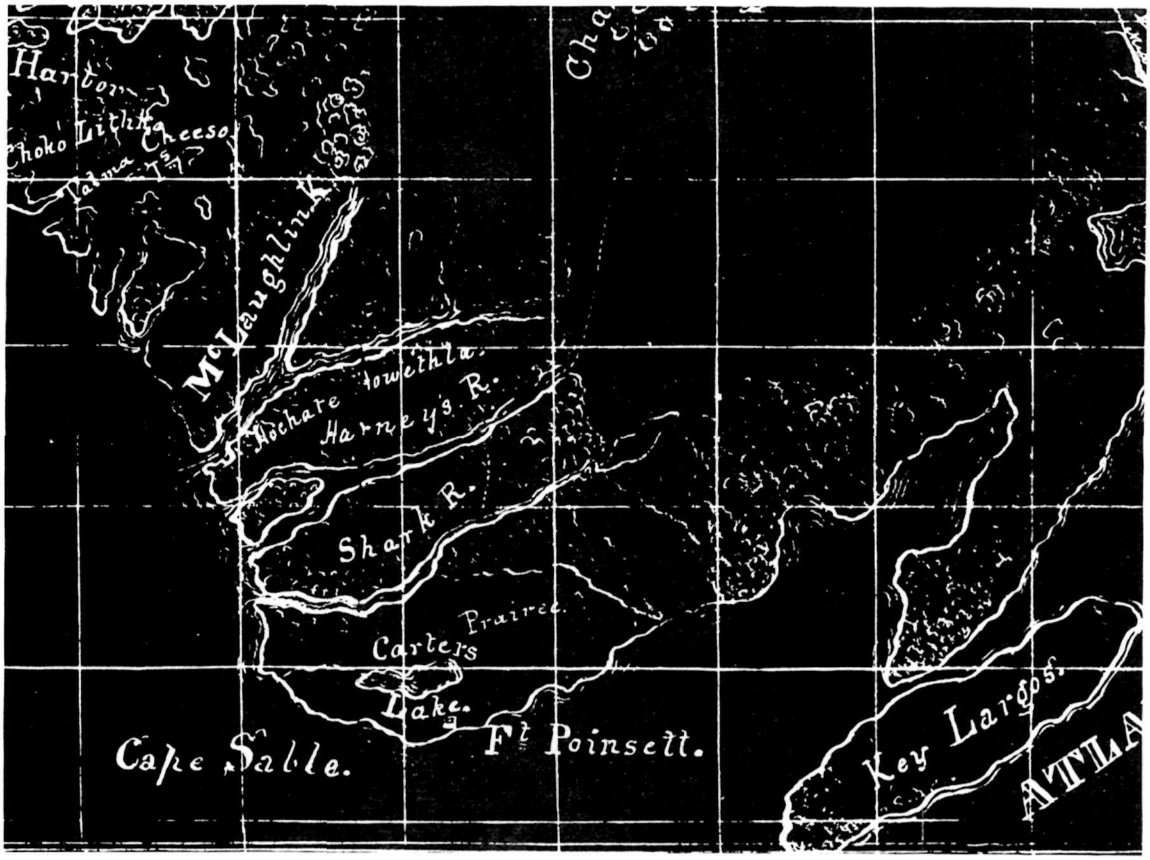
coastal change between 1857 and 1928. However, it appears from comparison of the 1857 map with the 1928 photography that the area of major erosion during this period was along the east side of East Cape and other portions of the Cape have been relatively stable, thus indicating that trends in coastal change since 1928 are but a continuation of trends between 1857 and 1928.

fig. 1


Harbor
Choko Lithla
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Prairie.
Carters
Lake.
Cape Sable.
Ft Poinsett.
Key Largos.
ATLA


KEY Mc LAUGHLIN
Harney's River
Shark River
WHITE WATER BAY
MANGROVE
LONG KEY
White Bluff or N.W. Cape
Ft Poinsett
CAPE SABLE
Sandy Key
FLORIDA BAY

fig. 2

fig. 3

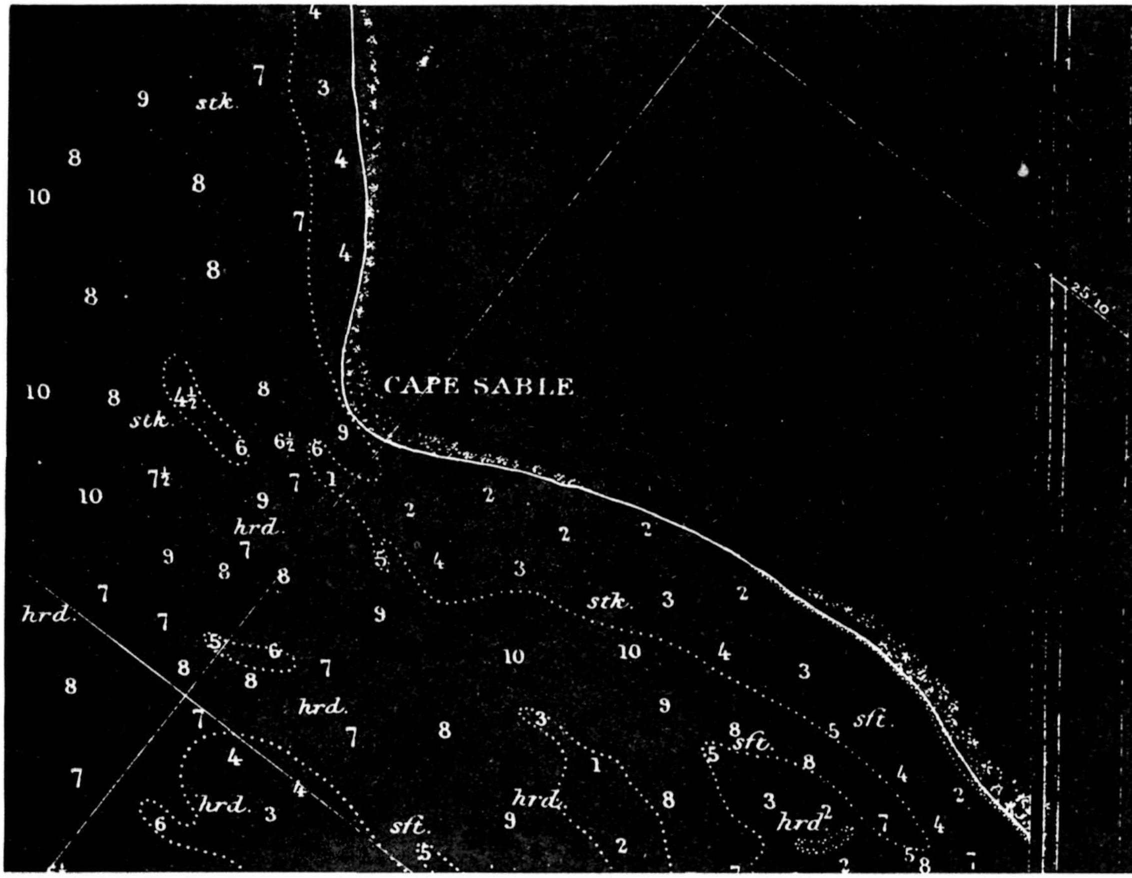
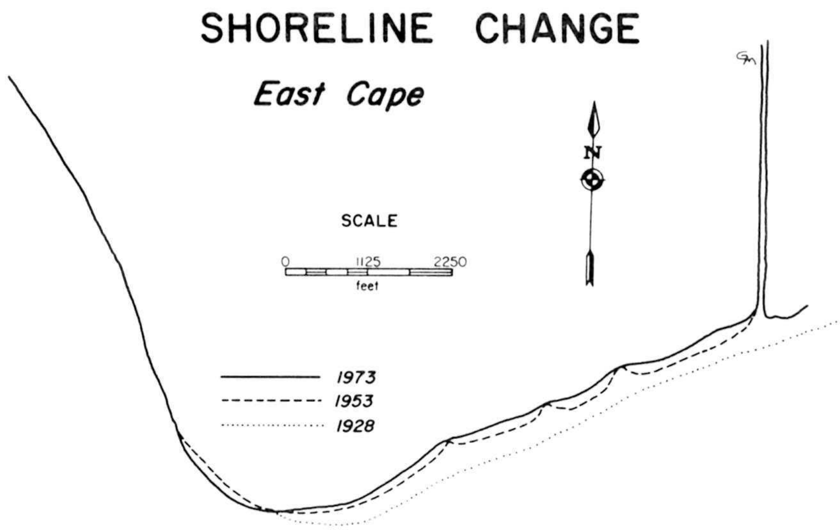


fig. 4

fig. 5


SHORELINE CHANGE
East Cape
N
SCALE
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1125
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1973
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1928

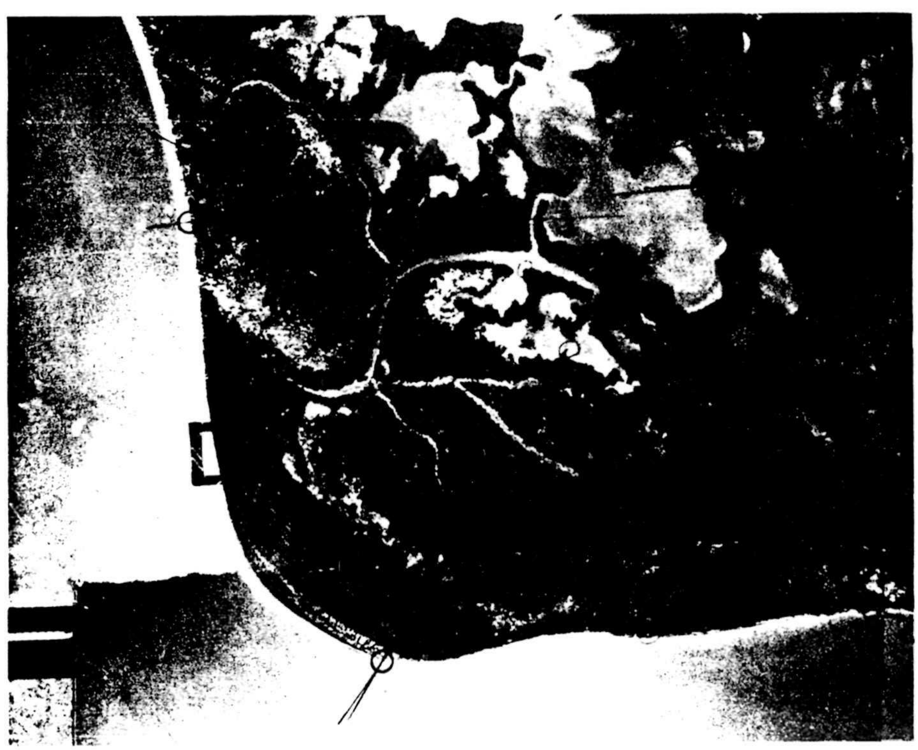

fig. 6

approximately 200 feet in diameter. Which one of these forms is the more probable site of the abandoned fort is of little consequence as they are located so close together that they overlap.

A field check was conducted with the purpose of familiarization with the Cape, gathering information from records and National Park Service personnel at Flamingo Ranger Station and Everglades National Park Headquarters, and on-ground inspection of likely sites. In addition, samples of old beach deposits were collected along a transect inland from the beach. As the beach ridges are totally composed of shell, it is possible to date the deposits (carbon 14) and reconstruct the history of formation of East Cape. Dating of the shells has not been done yet, but will be done if and when funds are available. Dating of the shells should confirm or nullify the proposition that the Cape's origin is post Pleistocene and that the oldest part (farthest inland portion) is no older than 2000 years. Unfortunately, the 1928 photography had not been received by the time of the field check, therefore, the postulated fort site was not examined in detail from the ground. However, most of the near-beach portion of the Cape was inspected on foot and no indications of the fort site were found.

CONCLUSION

After inspection of published historical materials, charts, maps, aerial photographs and a field check, it is concluded that Fort Poinsett was located on East Cape of Cape Sable. Precise location is postulated to be approximately 880 feet at a bearing of 195 degrees from geographic north, from the origin of the stream channel immediately to the north-northeast (shown on the accompanying photography). Along this transect line, the fort would be located about 35 feet inland from the beach. A magnetometer survey should be carried out in this area. If results are negative, a magnetometer survey should be carried out in the area of the point of East Cape. Should a survey here be unsuccessful, a magnetometer survey should be carried out along the eroded portion of the cape for a maximum distance of 500 feet away from the shoreline.

by Roland Wood and Frank Stapor

DATA FROM UNDERWATER ARCHEOLOGICAL SITES

The following paper was first delivered at the Southeast Archeological Conference section on Underwater Archeology organized by George Fischer of the National Park Service. Curt Peterson is presently a conservator at the Florida Bureau of Historic Sites and Properties.

This Bureau has the responsibility of dealing with large amounts of artifactual material recovered from underwater contexts, both from its own research efforts and from commercial salvage programs. Mr. Peterson has consequently accumulated an extensive background in this specialized area of conservation, and in this paper discusses some of the major factors to be considered in developing an effective approach for retrieving useful data from submerged remains.

D.J.L.

THE NATURE OF DATA FROM UNDERWATER ARCHEOLOGICAL SITES

Data recovered from archeological sites located under water are often embodied in objects, artifacts, and related materials. The varied types of data found in conventional investigations of land sites such as soil stains and disturbances are not always available under water. The fact that the water-site interface is often a dynamic place with the water acting upon the exposed surface of the sites (imparting to it energy by its motion and infusing it with its load of dissolved minerals, its pH, and whatever organic material happens to be carried) means that what is uncovered and observed is not necessarily as it was when laid down by the subjects of our investigations. Relationships between observed phenomena such as artifacts, soil layers, and natural constituents of a site are often quite transitory and can be gone before they are recorded or even observed. The problem of contamination of a particular provenience with material from elsewhere in the site or out of it is greatly intensified.

The preservation of organic material under water can be excellent; it is complicated by the fact that these often fragile remains can be dispersed and lost by a casual inadvertant wave of the hand. Environmental samples can be and are taken. Excellent samples can be obtained by the coring method, but samples of matrix in contact with cultural material can be difficult to obtain because of the dynamic nature of the surface of the site, and the actual association is often doubtful.

The most reliable, and often the only data recovered from underwater sites consists of objects, principally artifacts. These artifacts when recovered cannot always be examined and their data extracted, abstracted, and analyzed due to a variety of factors. There are, almost invariably, changes in the form and substance of the object, due to its prolonged submergence in water. Certain exceptions are vitrified ceramics, most igneous rocks, and certain "noble" (high atomic #) metals, most notably gold. Some of these changes can be beneficial to the archeologist and lead to the preservation of the material, such as the mineral replacement of organic material in bone. Others are not so beneficial, for instance the dissolution of cellulose in wood. An insidious variety of this process is the removal of certain parts of artifacts, without materially altering the rest. Metallic glazes and decorations on ceramics can disappear totally, or inpart, leaving the surface decoration severely altered, discolored, or even non-existent, giving rise to serious errors in analysis. Finally, the entire artifact may be gone, leaving, if we are lucky, a cast of its form, but more often nothing to mark its passing.

Under water especially, one encounters the effects of selective preservation. This is a more complicated process than is generally encountered on land sites where, due to soil pH, temperature, rate of leaching, and the availability of oxygen within the soil, one can often accurately predict the degree to which organic material, ceramics, and metals will be preserved. In underwater sites, especially marine sites, there can be the complete gamut of preservation--from appearing no different from the day of submergence to completely gone. The fact of an artifacts location, relative to others of different or similar material can be important to whether or not it will be preserved.

The sea is a vast electrolytic soup with almost every naturally occurring element, and some that are not naturally occurring, present in solution to some degree. Metallic corrosion, the process of changing from metal, which is an unstable state for most metals, to mineral, is essentially an electrolytic phenomenon in which the surface of the metals becomes ionized and loses or gains molecules depending upon its atomic number and the atomic numbers of neighboring materials. In a contact situation, the metal with the lower atomic number will corrode preferentially to the metal with the higher atomic number which in turn is preserved at the expense of the lower.

Once the excavation of an underwater site has been accomplished, and the data reaches the surface to begin analysis, a new genre of problems emerges. Artifacts from underwater sites, especially marine sites, almost immediately begin to self destruct. Bone may crack and warp, ceramics lose their glaze and start to spall, metals fall apart or turn to dust, leather and paper begin to resemble old meadow muffins, and wood cracks and undergoes contortions that would make a pretzel envious. The forces which cause these changes to take place are basically quite simple, but their prevention and undoing can be very complex. Almost all destructive changes which take place after removal from the water can be prevented by proper treatment. Proper treatment involves three main processes: STORAGE, EVALUATION, and CONSERVATION.

Proper STORAGE entails principally keeping the artifacts submerged in water, applying such biocides as are necessary to keep them from being bio-degraded, and reducing the access of oxygen to them. (Most materials owe their being preserved under water to lack of available oxygen for oxidation.)

EVALUATION often involves specialized cleaning of the artifacts to remove encrustations of various natures which may surround them. The original surface of the item, or what is left of it, is what we are after. The cleaning must be carefully and intelligently done so that sufficient encrustation is removed to reveal the original surface of the item but no more. When the artifact has been cleaned, it may then, in most cases, be examined.

CONSERVATION, the last process I will deal with here is often shrouded in mystery, perpetuated in part by the conservators themselves, who have a tendency to practice their art covertly. When one considers conserving (not to be confused with preserving) an item, it is important to remember that conservation does not bestow general beneficience upon the subject of its attention. Conservation is goal oriented, with the goal to be determined before any conservation is undertaken. In order to decide whether or not to undertake to conserve an item or category of items, one must consider several things: (1) The potential of conservation, what are the possibilities? I do not mean here "How to do it" but what types of things can be done. (2) Does the material in hand warrant conservation? (3) And certainly not the least question, does the budget allow it?

WHAT ARE THE POSSIBILITIES?

The potential of archeological conservation is finite. Its principal function is to salvage such data as are available in an object or set of objects by salvaging the objects themselves, by documenting a history of the changes that have taken place within the objects and why these changes have happened. Conservation provides a name, an analysis: what it is, how it was made, what has happened to it; and it provides a face: an object can be stabilized in its present condition so that it will deteriorate no further (a strange state at best) but will bear the signs of its experience. It can be restored; certain changes can be undone, missing pieces added and the item can, in many instances, be made to appear as it may have once appeared when in use. And of course there is the reconstruction, the manufacturing of an object to match a case or impression of what once was but is no more.

DOES IT WARRANT CONSERVATION?

The answer to the question of whether or not any item warrants a particular type of conservation must be made in the context of the overall excavation problem: the type of data that will be considered by the investigators. For example, the taxonomy and ecology of algae found growing on a portion of a shipwreck site, though included in the universe of data present in that site, may not be pertinent to the problems which excavation of the site is designed to solve, but the effect that the algae might have on the preservation of the material from the site may.

DOES THE BUDGET ALLOW IT?

Ah, the budget; this, perhaps more than any other single factor, determines the nature and extent of archeological endeavor, and certainly plays a prominent role in determining the nature and extent of conservation to be undertaken. When considering the nature and the form of most of the data recovered from underwater contexts, I would be forced to conclude that if there are not sufficient monies to consider the conservation of the data from a site, then by definition there are not sufficient monies to adequately excavate that site. Adequate conservation of the data from a site certainly does not mean preservation of all the artifacts from that site. It does mean, however, adequate storage, careful cleaning and evaluation, and the preservation of objects of significance.

The archaeological excavation of sites located underwater, while not new, is still in its methodological infancy. Techniques in use range from mere goodie grabbing to painstaking, well documented excavation.

The sites available to researchers (and looters) range from undersea sunken ship "time capsules" of almost every historic era and area to early man sites, exhibiting such excellent preservation that it is not inconceivable that a hafted Clovis point may be found.

In the light of the potential richness of underwater sites, their increasing availability to investigators and the nature of the data recovered, I would suggest that without consideration of the conservation problems, which are to be encountered in the excavation of underwater sites, no competent excavation is possible.

by Curtiss Peterson

THE QUESTION OF DIVE SAFETY IN UNDERWATER ARCHEOLOGICAL PROJECTS

This paper will examine the unique set of safety problems involved when archeological projects are extended to the aquatic environment. It will discuss designs for the implementation of specialized safety procedures for underwater archeological projects and present, as a model for consideration, the philosophy of dive safety as developed and operationalized by the Southeast Archeological Center of the National Park Service.

THE NATURE OF THE PROBLEM

Underwater archeology is an enterprise necessitating the successful combination of two fundamental, independent skills. The first is the ability to do acceptable archeology which is contingent on participants having the requisite amount of archeological training and experience. The second is the ability to operate safely and efficiently in an entirely alien and often hostile environment.

There have already been a number of serious accidents associated with underwater archeological projects dating back to some of the very first hardhat efforts. With the advent of SCUBA and with the swiftness that the field is presently burgeoning, safety problems can be expected to increase proportionately. This is especially crucial to the field's development now in that to maintain high quality archeological field standards, students of archeology are being increasingly utilized as personnel on projects. It would not take the loss or injury of many students to deal a serious blow to underwater archeological activities.

It has become a cliche in the field to say that it is easier to make divers out of archeologists than archeologists out of divers. This is essentially a true statement, but a dangerous one if not carefully qualified. Underwater archeology, when taken seriously and professionally, demands the use of not just divers, but good divers, and the making of a really competent, safe diver qualified to do occupational diving is not an easy thing to make out of an archeologist or anyone else. Frederic Dumas states in Marine Archeology that:

> Only a man grounded in the skills and disciplines of his craft, who dives regularly throughout the year, is in a position to notice how certain operations could have been carried out more efficiently, and then to correct his own mistakes. Archeologists devoting two months to field work would have to experiment for years (perhaps on ancient

> wrecks!) before reaching the same degree of proficiency... The word 'diver' is itself misleading, since it covers both professionals and men who have merely learned to use autonomous apparatus. (Dumas, 1965)

The element of the activity of diving that is most treacherous is that it is deceptively easy. Most seventy year old crippled women, outfitted with standard SCUBA gear and with no prior instructions, could dive to 100 feet and, granted ideal conditions, return unscathed. It is very possible therefore to become overconfident and not take seriously the very real potential dangers involved in an underwater archeological operation. It is tempting for a field archeologist to neglect many of the formalities and intricacies of a rigorous diving program in the interests of increased productivity. This tendency is further reinforced by a prevalent attitude that most safety regulations have been created for sport divers and need not apply as stringently to working situations. These factors, plus the lack of formal training in advanced diving procedures of many involved in marine archeology, contribute to the development of projects that may be sound scientifically and archeologically, but quite unprofessional and even unsafe in regard to diving techniques utilized. This problem is further compounded when a professional archeological group such as a state agency must oversee and manage the operations of salvage contractors. They are often saddled with the responsibility of overseeing a diving operation without being given the political backing or funding to do it correctly.

CHIEF PROBLEM AREAS

There are four chief problem areas that will be examined. They are: 1) Myths that kill, 2) Adequate initial training and maintenance of diver competency, 3) Development of adequate standardized regulations to deal with problems peculiar to the specific project situation, and 4) Decompression considerations in research diving.

1. Myths that Kill

There are several widely held misconceptions that can have serious consequences for all people involved in research oriented diving programs. These are: a) that any certified diver is qualified to dive in a work situation; b) that shallow water diving is intrinsically safer than deep diving even though visibility may be poor and machinery is in operation; c) that anyone is qualified to be a Dive Officer if he has a fair amount of diving experience; and d) that the buddy system can be dropped if it is too inconvenient and limiting production.

a) The first of these misconceptions is based on the fact that for a long time even the most experienced divers in the field did not possess basic certifications, as recognized certification programs are comparatively recent. There is now a tendency to accept such a certification as proof of adequacy of diving ability in work situations which is contrary to the purpose of those certifications. They are intended as permits to learn and gain experience gradually in sport diving, and that is all. It is highly recommended, therefore, that divers on an archeological project, just as in any other professional diving enterprise, should have specialized training under the particular conditions, and with the particular people that they will be working with beyond the sport-diving level.

b) The second misconception is the notion that shallow water diving is not as serious as deep diving, even when done in murky water or around machinery. One of the major causes of diving fatalities is air embolism and the depth range in which this is most likely to occur is in the first ten meters. The volume to pressure ratio becomes greater the shallower a diver is, and it is, therefore, quite possible to embolize in the shallow end of a swimming pool. The University of Rhode Island accident reports on compressed air diving list, as a matter of fact, examples of individuals dying of air embolism while in training in swimming pools. Extend this potential hazard of shallow water diving away from the clear, comparatively safe environment of a swimming pool to the murky waters surrounding a down-thruster or an airlift and one can easily see the fallacy of the shallow water myth.

c) The next question is that of the Dive Officer. There are many long time experienced divers who would seem likely prospects for such a job. It should be remembered, however, that this particular responsibility is one which demands not only personal experience at diving but an expert knowledge of the technical aspects of physiology and physics of diving, the mechanics of diving, formalized training in such a leadership role, and, finally, good judgment. That is an extremely hard bill to fill, and when an individual is found there is then the difficult step of giving him final authority in all matters which involve the safety of project divers. This is particularly hard for the project head who must forsake a certain amount of control over his own project.

d) The last problem in regard to "myths that kill" is the question of the buddy system. Some feel that this basic dive safety practice can be disregarded if it proves too inconvenient or slows production. Although each diver should be trained rigorously in techniques of self-survival, the presence of another complete life-support system available and ready to help him in an emergency is a safety factor that should under no conditions be absent. It is imperative, however, that we realize a buddy system only exists when there are two or more trained people in the water constantly monitoring each others' condition and each having the capacity to aid the other in a serious predicament. Two people diving at the same time does not comprise a buddy system! The University of Rhode Island statistics point out that the majority of diving accidents happen with "buddies" present, but that insufficient training and practice in buddy breathing and other rescue techniques negate the value of the system. Twenty-four cases of buddy breathing failure alone were documented as being causes of fatal accidents. A viable buddy system can be worked out no matter what the conditions encountered and the time should always be taken to develop such a system.

2. <u>Adequate Initial Training and Maintenance of Diver Competency</u>

The second major problem to be considered is that of receiving adequate initial training. Such training is not accomplished in a week long cram course conducted before a particular project, nor can it usually be done adequately on the job. This is not to say that these alternatives are not often the only options available and should never be utilized, but it is of crucial importance that the limitations of personnel trained in such a manner are recognized. Even though certified as divers they should be used in limited capacities and allowed very gradually to gain experience in the water. It is noteworthy that the URI statistics show that a greatly disproportionate amount of diving accidents occur among newly trained neophyte divers.

There are a number of recognized diver instructor certifying agencies. Among the more well known in the United States are the National Association of Underwater Instructors (NAUI), the YMCA, the National Association of Skin Diving Schools (NASDS), and the Professional Association of Diving Instructors (PADI). These agencies certify instructors who then train and issue certification cards to sport divers. The quality of this training varies somewhat with the individual instructor but is usually adequate for the purpose intended which is <u>not</u> working diving. The project dive officer should make certain that each of the participants has demonstrated adequate survival and rescue skills in line at least with standards established by NAUI and YMCA, and that he is at least basically certified. From there he should go through a project-specific training period in which he is acclimated to working under the specific demands of the local environment and in coordination with a specific team of individuals.

In recognition of this problem the University of Miami has instituted, and Florida State University is in the process of instituting, formal courses in diver training that go well beyond the level of sport diving competency and are geared to preparing students to perform as professional research divers. The Florida State University Anthropology Department is speaking further to the problem by developing a formal course in underwater archeology which will be run by marine archeologists from the Florida State Bureau of Archives and History (W. A. Cockrell) and the National Park Service (George Fischer). This theory oriented course for archeology majors in conjunction with the University's proposed diving program will provide a well balanced orientation toward training underwater archeologists which will not sacrifice professionalism in either the archeological or diving aspects of the program. It is further hoped that a close working relationship between this program and the Scientist-In-The-Sea Program can be arranged enabling students to make application both to underwater field schools and this extremely high level diving operation in the summer months.

A need associated with adequate initial training is that of maintaining diver competency after it has been established. This should be accomplished through periodic rescue and practice drills during the course of the project. A viable rescue procedure should be worked out and practiced for every diving environment the divers are exposed to. Diving when done correctly and safely demands that the individual research diver be in good physical condition, accustomed to the gear he is using, and familiar with standardized procedures worked out on his project for dealing with emergencies. This is an ongoing process.

3. Developing of Adequate Standardized Regulations to Deal With Problems Peculiar to the Specific Project Situation

It is incumbent on the Dive Officer of a project to recognize the peculiar demands and stresses that the particular area and working conditions of a specific project are going to place on a diver. Variables here can include a wide range of considerations such as water conditions, visibility, temperature, bottom conditions (silt, coral, sand), presence of dangerous marine animals, proximity to machinery or cables, depth, decompression needs, lack of air-water interface (caves and inside of shipwrecks), nature of the diving platform, ease of entry, and many others. These must be assessed along with the project goals which might be oriented towards a survey where divers are constantly changing location or excavation work, etc., and a precise simple set of operation routines devised. These should be geared toward obtaining a high degree of efficiency and productivity, but there should be no doubt that the priority in all matters of decision making is strictly that of dive safety.

As a model for this type of specialized set of regulations and operating procedures, there follows a sample of such a set of guidelines devised by the Southeast Archeological Center for a shipwreck survey in the Gulf Islands area of north Florida. It should be remembered that the following is intended as a concise set of field regulations and is only a supplement to the overall National Park Service diving policy. It is recommended that short written statements like this which speak to anticipated problem areas in specific projects be distributed and discussed with project participants.

SOUTHEAST ARCHEOLOGICAL CENTER DIVING SAFETY REGULATIONS FOR GULF ISLANDS SHIPWRECK SURVEY*

General Philosophy of Application

Any individual officially a part of a Center project, any collaborator, contractor, visitor, or observer diving from project craft or with project personnel must observe the regulations herein stated. All rules, except those which are Service wide regulations, are subject to modification by the DSO or during project seminars by project members, but are not to be violated or changed by individuals in the field. If an extraordinary situation should arise that reasonably demands one of the regulations or procedures be violated or waived it should be brought to the attention of the DSO as soon as possible.

Diver Familiarization and Standardization of Emergency Procedures

In addition to having a standard NPS diving certificate, divers at a SEAC project must undergo at least one checkout dive and practice session in conditions similar to those they will be working under and with the individuals they will actually be diving with in the project. They will familiarize themselves with each other on these occasions and practice project-specific techniques for reacting to emergencies. Buddy breathing and all rescue procedures once agreed upon must be standardized and practiced until they become a reflex action.

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*These regulations were originally drawn up by the author of this paper and were later modified by project participants. The author's comments on these regulations are for the purpose of this publication double spaced.

Buddy System

A. SCUBA and Hookah

Any diver using compressed air will be accompanied by one or two other divers for whom he is held responsible and who in turn are responsible for him. Two men in the water at the same time do not comprise a buddy system nor do two men in the water in sight of each other necessarily comprise a buddy system. A diver must be constantly aware of his partner or partners (there never may be more than three individuals in one team) and close enough to assist his buddy immediately if an emergency should arise. In some cases an individual or individuals will be relieved of the responsibility of monitoring their associates in the water, but in such a situation a team of safety divers will be on hand to watch over the working divers and shall be there for that purpose only.

To further insure the workability and dependability of the buddy system there will be buddy breathing practice sessions. The statistics have shown that too often, even if the buddy does respond to his partner quickly in an emergency, the stress of the situation is such that if the individuals are unfamiliar with each others' buddy-breathing techniques and respiratory rate, the usually simple process can become unmanageable. Each individual taking part in the project will therefore be asked to buddy-breathe at least five minutes with anybody he might conceivably be diving with during the course of the survey. During these five minutes the individuals should use a standard project-wide method which will be demonstrated to them and they should practice it in static, dynamic, vertical, and horizontal attitudes.

No diver was permitted to be in the water as a part of a buddy team until he had also demonstrated rescue capability in the prescribed fashion. This was demonstrated in the project checkout dive when each man had to do a complete rescue of his buddy alone, including towing to shore, dragging through the surf and performing cardio-pulmonary resuscitation.

B. Skin (Free) Diving

Due to the problems associated with Shallow-Water-Blackout and other free-diving hazards, the buddy system will be strictly observed but with some modification. Divers should try to descend and ascend together, but given the individual differences in breathing capacities and other variables, the sequence of dives can be altered to maintain the comfort and observe the personal limitations of each diver. This means that one diver may wait on the surface while his buddy is down, but he must be able to monitor his progress and be able to assist him immediately.

Decompression

All dives on compressed air will be closely monitored as to time and depth. Depth guages and watches should be worn by all individuals and time of entry, maximum depth, and time of surfacing must be recorded in all cases. Simulated decompression dives will be carried out if on-the-job decompression diving is even a remote possibility. Spare tanks and regulators should be available at decompression stops.

Men down are responsible for their own bottom time and depth; the safety diver serving only as an emergency back-up system in this regard. All teams will carry submersible dive tables.

Equipment Requirements

All divers whether on SCUBA, hookah, or free-diving must at all times have on their person a sharp knife which is used for no other purpose than an emergency. A diver who uses his knife as a prying tool or some other utilitarian purpose must reserve three inches nearest the handle as a sharp cutting edge.

All divers must be using a submersible pressure gauge when on SCUBA. A submersible gauge is required as it enables a more accurate computing of air consumption which will help in further dive planning.

Safety vests or buoyancy compensators must be worn by all divers at all times when in the water. There is much controversy in this area and it will be left up to individual preference which style is used, except that any vest used must have an emergency release valve.

At all times that a diver is in the water, he should have attached to his person somewhere a snorkel with a day-glo tip, the colored tip being a minimum of two inches long. Modified "J" is the preferred type. A wet suit top or vest is highly recommended even in warm water as a back-up flotation device and protection from cuts, scrapes, stings, etc.

If operating from a craft, the boat must contain a whistle, a flare, dye, signal cloth set, fire extinguisher, freon horn, and first aid kit. If possible, a radio should be operable on the craft and radio contact maintained with project headquarters.

General

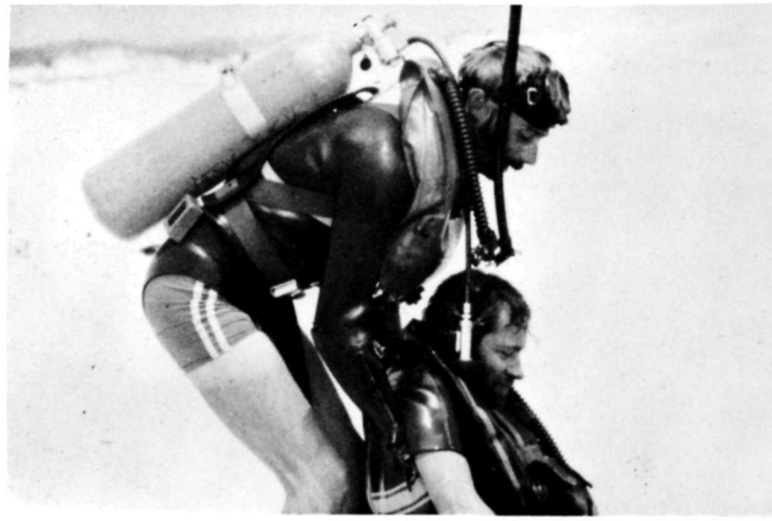
An emergency rescue drill must be carried out at least once from any craft or facility which is being used to conduct diving operations.

Before any boat was used in project activities, a complete rescue routine had to be worked out for that specific craft. The majority of the project diving was done from a 15' Pirelli inflatable boat and a way was devised and practiced by which an injured diver could, within seconds, be pulled in, feet up (in case of embolism), and placed on the hard deck surface in postion for CPR.

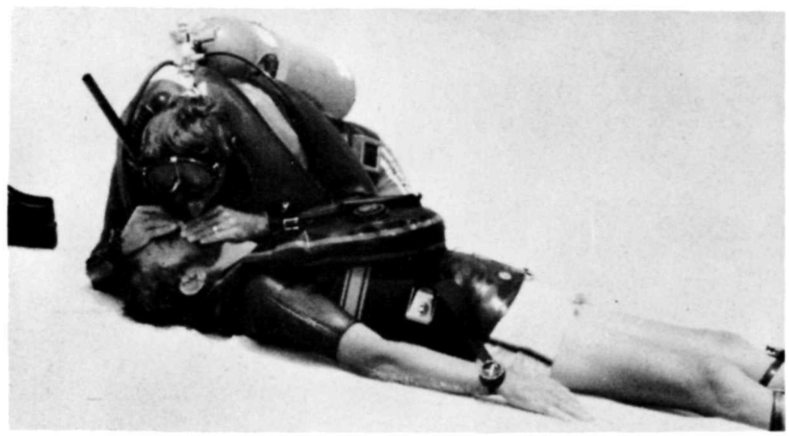
Any diver who feels that for physical or psychological reasons he is not up to diving on a particular day should feel free to excuse himself without prejudice. By the same token, if the Dive Officer on duty should decide that for any unnamed reason an individual should not dive that day, this decision should be observed without argument.

Operating Procedures

There are to be a minimum of three fully equipped divers on any craft from which diving operations are being conducted. One fully capable and ready to assist diver will stay in the boat while two others are down. The man



As part of project ongoing training program, Cal Cummings drags George Fischer to land from 100 yards off shore.



He then administers mouth-to-mouth resuscitation . . .

. . . and simulates cardiac massage.

A quick, efficient rescue technique had to be devised for all craft that were used for diving. In above two pictures, Ron Gibbs of the Park Service is pulled into boat in feet-up position and placed on his back for simulated cardiopulmonary resuscitation.

in the boat is responsible for monitoring the divers' whereabouts through observing bubbles and keeping other vessels away. To facilitate the latter he will be provided with a freon horn or similar warning device.

All SCUBA diving will be done from anchored boats or from the shore and "Diver Down" flags will be flown from any craft employed for this purpose with a second flag being flown from a float trailing fifty feet behind.

When diving on a visible wreck or investigating the channel bottom, which are situations when the divers are likely to stray a good distance from their starting point, a cave diving reel was used. This proved an effective device for covering ground in poor visibility, as it enabled the diver to return precisely and quickly to his anchor line, the only safe point of ascent in a busy channel even with diver-down flags. Divers found this had the added benefit of allowing them to return to artifacts or points of interest on their way back if they simply looped the line over the item itself or a handy projection.

The Santa Rosa Island area has a respectable shark population and in all cases at least one diver carried a shark dart strapped to his leg. When visibility permitted, however, at least one diver also carried a dart secured to a long pole. The latter was thought to be a questionable practice in water with very low visibility as it would be rather difficult in the turmoil to distinguish one's buddy from a shark. It was felt, however, that when possible the pole dart should be carried as none of the divers relished getting close enough to a shark to stab him in the belly with a six inch tube. When a three-man team was in the water, two would usually probe and the third man, armed with a pole dart, would pull the float or run the reel while he watched for sharks.

Regardless of what search technique was being used or the water conditions or any other pertinent factors, the buddy system was strictly followed by all divers at all times.

In addition to open water practical training sessions, there was on-going training in the form of evening seminar sessions. Project regulations were talked out and modified, and discussions were held on dive safety, diver to diver communications, rescue, first aid, cardio-pulmonary resuscitation, physics and physiology of diving, marine life and small boat safety and handling. Besides these formal seminars there were also short debriefing sessions which were held at night over dinner when divers who had worked together analyzed the day's diving.

It is important to note it was the consensus of project participants that although strict and often demanding, the safety procedures and regulations on the project were not felt to be either confining or limiting in regard to the performance of the task at hand. Much of the on-going training, as a matter of fact, even though logged as project time in the chart, was actually done on the divers' own time and of their own volition.

4. Decompression and Research Diving

The last question this paper will examine is the disturbing and controversial issue of decompression. The parameters of this problem widen and become even more diffuse when seen in the context of a working situation. From the earliest marine archeological ventures this poorly understood spectre of crippling injury haunted research divers:

> "The old divers among us knew that we were ready to be hit by the bends, and although no one talked about it, the rest of us knew too. In the end, late in the year, diving deep, even with the aid of the decompression tables, our boat stank of fear." (Throckmorton, 1969, p. 138)

One of the most effective systems yet devised to deal with the dangers of decompression are the U.S. Navy Standard Air Decompression Tables. (The author feels that decompression meters marketed by certain commerical concerns are unreliable.) The system is far from perfect, however, and besides the fact that bends cases still occur even following the tables, there is the associated problem of silent bubbles or non-symptomatic decompression sickness which may manifest itself years later in the form of aseptic bone necrosis. Only limited research has been conducted in this area and little is known about the pathology of this disease or for that matter the more immediate dramatic manifestations of decompression sickness. It is still an area of much medical controversy and present theories explaining decompression effects are not totally satisfying to all researchers. Most sport divers avoid diving conditions which demand stage decompression, and when they do it they usually follow the tables quite conservatively. This sport diving orientation has been adopted by many in underwater archeological projects but has proved to be both limiting as far as production efficiency and inappropriate safety-wise in the sense that a working situation aggravates factors that contribute to the onset of decompression sickness such as cold and fatigue. Some research facilities, if well funded, have turned to the use of habitats and submersibles for underwater projects, but this is an extremely sophisticated and expensive way to go which is out of the reach of most agencies and institutions engaged in underwater archeology. What then can be done to improve both the efficiency and safety of underwater projects that require a fair amount of repetitive diving as most work situations do, or decompression diving when no recompression chamber is available? It is the opinion of this author that the answer lies in the controlled utilization of oxygen during decompression as a practice during heavy diving situations. This, it must quickly be pointed out, is a controversial area and what is being suggested here is simply that the potential of using this method be put up to more intensive consideration by state and federal agencies and institutions involved in underwater archeology or similar research activities.

What is being specifically suggested is that in stage decompression diving oxygen is used to decompress on at the 20 and 10 foot stops rather than air. If the standard air decompression tables are still followed with oxygen substituting for compressed air a great safety factor has been introduced into the denitrogenation process. The gradient between nitrogen in the vascular system as opposed to that in the alveolar tissue in the lungs, which is what controls the rate of release of the gas, is five times greater. This does not necessarily translate into a direct conclusion that the decompression process is therefore five times faster but it does indicate a very significant facilitating effect. In situations where a lot of heavy repetitive diving is done at shallow depths and staged decompression stops are not indicated or are very short, having divers breathe oxygen at the ten foot level for three to five minutes should be considered. There are inherent problems that revolve around the use of oxygen. Most of them have to do with the volatile nature of the gas. In a diving situation which was not controlled or extremely rigorous the dangers of oxygen use would probably offset the benefits, but in a controlled professional program this technique could provide almost fail-safe diving conditions in terms of decompression. It is imperative, however, that standard air tables are followed strictly with one possible exception. A well-known diving physiologist stated in response to a question asked by the author that using such a system would negate the need to go to greater depth and time schedules in the tables owing to fatigue factors as recommended in the U.S. Navy Diving Manual. That is, a vigorous working dive could be accomplished at depth or under cold or fatiguing conditions using just a normal decompression schedule and there would still be an enormous safety factor if oxygen is utilized.

CONCLUSION

It is a given fact that an underwater archeological project places a dual set of demands on a project coordinator. The first is that he must accomplish a certain archeological objective in a given amount of time with a given amount of funds (often inadequate). The second is that he must do this through the maintenance of a safe, professional diving program. It is natural to see these as conflicting needs but this is categorically not the case. A rigorous, well planned diving program is not only the safest but also the most efficient means for accomplishing underwater archeological ends. It is hoped that communication between groups involved in underwater archeological research will increase and that dialogue on dive safety will develop accordingly.

The successful solutions that are worked out for the countless problems encountered in underwater survey and excavation should be made available by the agencies that undertake the projects so that others may benefit by them. Likewise, mistakes and blunders that one must expect to commit in such an enterprise should also be publicized. It is sometimes hard to dwell in print on mistakes that one is not proud of having made but doing so may save time, money, and even the lives of others in the field. It is felt that the circulation of such reports and also reports on accidents when they occur would be of great value.

by Daniel J. Lenihan

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THE POTENTIAL OF HABITAT DIVING IN UNDERWATER ARCHEOLOGY

The majority of historically significant shipwrecks in the New World are located in the Gulf of Mexico, Caribbean and along the east coast of Florida. As the cause of sinking was usually running aground, it is axiomatic that most are in shallow water. A small percentage, however, were sunk by military action, foundered, or drifted after reefing and eventually sunk in deeper water.

Although deep water wrecks are a minority of the total population, their potential importance is great. Contrary to popular conceptions, wrecks of wooden hulled ships are almost totally destroyed by the action of teredo worms and other destructive forces. Wood not covered by sand generally does not survive, and other organic materials are also quickly destroyed.

At depths in excess of 300 feet preservation is greatly improved, and all evidence suggests that beyond 600 feet the state of preservation would be excellent. In addition to the fact that teredos do not inhabit these depths, lower water temperatures, decreased water movement, the lack of oxygen and sparsity of marine organisms which could cause destruction contribute to preservation of a ship in nearly the condition it was in at the time of the sinking.

The problems facing archeologists interested in these deep sites are locating the sites and then finding a practical method for their investigation. The technology for finding the sites does currently exist at a practical level. One of the more innovative systems is the Alcoa Seaprobe (Bascom, Marx). The techniques and some examples of application for this system are briefly described in "New World Underwater Archeology, 1972" (Fischer:6-9). On-site investigation or excavation of deep wrecks is quite another matter. The time that researchers can safely work under water is inversely proportional to the depth of the site. An underwater habitat enormously increases the effective work time of archeologists working at great depths because it is not necessary, using saturation diving techniques, to undergo long decompression stops after each working dive.

The Bascom-Marx technique appears effective for locating deep water wrecks, but questions exist as to whether this method of recovering materials, or whole shipwrecks, might not be highly destructive. Investigating such sites from underwater habitats might be a much more productive research approach.

Certain specific sites should lend themselves well to investigation from habitats. The Nuestra Senora de Atoche of the 1622 Spanish

Fleet, the object of search for several Florida treasure salvage companies, is located in 70 feet of water somewhere in the lower Florida Keys. This wreck is almost without doubt going to prove to be the richest in treasure and best preserved of the Spanish ships investigated in Florida, as it is located at a greater depth than any other which has been excavated, and was not salvaged at the time of sinking. Considering the total amount of bottom time required to investigate a wreck of its size, habitat diving might prove practical in this case.

The famed Civil War ironclad Monitor was recently located approximately 15 miles off Cape Hatteras, North Carolina. Investigating this wreck would be of considerable historical importance and public interest. The depth of the Monitor definitely suggests advantages of investigation by use of a habitat, although conditions of weather and currents off Cape Hatteras would make this an extremely difficult and hazardous undertaking.

Moving west and north, considerable potential for the use of habitats exists in the Great Lakes. Although the ships in that area are of more limited historical importance, almost exclusively 19th century merchant vessels, there are values to be accrued from investigating them. Most were sunk in storms and lie virtually intact at depths well in excess of 100 feet. Conditions of preservation in the cold fresh water are excellent, so although the materials which would be recovered are comparatively recent, the artifacts would be excellently preserved and would not require the extensive conservation treatment necessary for chloride impregnated materials. Additionally, although recent, such wrecks have much to say about the technological history of our culture. Names, dates and events are well documented in history, but details of the life of the lower classes, specific information on forms, periods of use, etc. of mundane artifacts are often poorly documented. A shipwreck which can be precisely dated therefore constitutes a "time capsule" which has a surprising amount to tell of our history. An example of the type of shipwreck situation encountered in the Great Lakes is contained in the accounts of the raising of the Alvin Clark from Green Bay, Wisconsin (Quinn: a & b).

The West Coast offers a far different set of problems and a different potential. Although the water depth would suggest advantageous use of habitats, the shipwreck population prior to the 19th century is nearly non-existent. A few wrecks are known to exist, but their locations are highly uncertain.

The only specific wreck which to my knowledge would be of major importance is the Manila Galleon San Agustin, which sank somewhere off Point Reyes, California, in 1595. In all probability, however, this site is in water too shallow for saturation diving to be considered (Breiner). One 19th century site well worth investigating, and in which habitat diving would be of value, is the Brother Jonathon, which foundered off Crescent City, California, in 1865. This luxurious 220-foot side-wheel steamer went down in 120 feet of water off Seal Rock with full cargo, including a $200,000 military payroll (Bearss: b & NPS files).

In the Old World the potential for investigating historic shipwrecks through the use of habitats is much greater than in this continent. The raising of the Swedish warship Vasa from 100 feet of water in Stockholm Harbor would possibly have been accomplished much more efficiently by employment of a habitat. Many similar early wrecks, some dating back to Viking times, inevitably exist in the deep, still harbors and fjords of Scandinavia.

The area of greatest potential is almost without doubt the Mediterranean Sea. Dr. George F. Bass has stated that he would be extremely interested in the opportunity to utilize a habitat in the investigations he has been conducting in the Mediterranean Sea. Although problems of supporting a habitat system would be more complex in this geographical location than elsewhere, the types of shipwrecks encountered are such that it would probably be more worthwhile to attempt such a program in the Mediterranean than elsewhere. Typically, early Mediterranen wrecks occurred when merchant vessels were blown by storms into the steep cliffs of the shoreline, then drifted back and sank in deeper water. The wrecks investigated by Bass, Katzev, Throckmorton and Owen lie typically in about 100 feet of water (du Plat Taylor: a & b).

Several very challenging possibilities exist in excavation of aboriginal sites in the New World. Every indication is that because of shoreline subsidence and sea level changes, the earliest archeological sites in Florida are presently submerged. Recent investigations in Warm Mineral Springs have produced radiocarbon dates of 10,000 B.P. for skeletal remains from the 50-foot depth level. Other, earlier cultural remains are suspected to exist at the 90-foot level of the spring and possibly even as deep as 160 feet. If in situ materials do not exist on the bottom of the spring, at a depth of 200 feet, incidentally deposited material inevitably does. Logistically, this would doubtless be the simplest location for conducting underwater archeology from a habitat of all the areas mentioned.

Off the coast of Florida some aboriginal remains have been found at varying depths in submerged river courses (Clausen). Although such sites are extremely difficult to locate, concentrated searches, possibly from habitats, might provide significant site survey data, and investigation of the deeper sites would almost certainly be practical from habitats. Similar situations seem to exist off the southern coast of California (Moriarty: a & b) although considerably less is known of the sites.

In summary, it would seem that saturation diving in conjunction with underwater archeology would in many cases be a desirable method of investigation, and in some instances the only practical approach. Obviously, problems of funding exist, as the amount of money presently available for underwater archeology is miniscule in comparison to the cost of a habitat diving project. However, as an adjunct to a saturation diving research project, underwater archeology would have considerable value, as the required bottom time and complex team activities necessary would make this an excellent method of testing techniques and applications of saturation diving.

by George R. Fischer

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SUBMERGED CULTURAL RESOURCES ON THE OUTER CONTINENTAL SHELF

Recent developments in regard to the leasing of oil, gas, and mineral rights on the Outer Continental Shelf of the United States have made this a prime area of concern for federal archeologists. The impact of accelerated leasing activities on submerged historic and prehistoric archeological sites could be considerable, and the federal agencies concerned are working to develop research designs for surveys that will provide an adequate picture of the cultural resources in areas which are slated to be disturbed.

There has been a growing awareness of the archeological significance of the Continental Shelf in general since the early sixties (Solecki 1961, Salwen 1962, Shepard 1964, Powell 1965, Lazarus 1965, Emery and Edwards 1966, whitmore et al. 1967, Gluckman 1967, Bullen 1969, Snow 1972, and Cockrell 1974). Although it has long been common knowledge that historic shipwrecks occur in coastal offshore areas, it is only in the last decade that there has been an increasing consciousness of the potential existence of important prehistoric sites on the shelf. This increased interest by archeologists has come about largely as the result of the application to archeology of geomorphological data in regard to eustatic sea level changes (Fairbridge 1961 and Shepard 1964). Eustatic changes are those changes in sea level as they relate to local uplift or subsidence factors of the land. The combination of these different factors determines if, at a particular point in time, a land area was above or under the sea. Although there is a fair amount of controversy about the exact nature of the process of change, the evidence seems to indicate that the level of the sea varied very considerably along the continental shelf of the United States during the period of early human habitation. Specifically it means that large areas of the continental shelf of the United States now submerged were dry during the Archaic and Paleo-Indian periods. The implications of this for archeology in the United States are tremendous when seen in the light of the impending intensive commercial exploitation of offshore resources in the Gulf of Mexico and off the Atlantic and Pacific coasts.

Many of the prehistoric archeological sites present on the continental shelf are the only representatives of maritime cultures of a particular period. Information on settlement patterns, environmental interaction, and general life ways of these prehistoric seaboard population aggregates can only be obtained from underwater archeological investigations performed on the continental shelf.

Information probably contained in those sites will also be extremely important in terms of developing correlations with cultural remains found in inland fresh water bodies where the piezometric level has varied significantly over the same time spans. Human activity areas have been located in now submerged sinkholes in Florida, with early man remains dating back to circa 10,000 B.P. (Royal and Clark 1960, Lazarus 1965, Clausen 1972, and Cockrell 1973 a & b). Reynold Ruppe, of Arizona State, is presently working on archeologically establishing relationships between these spring sites and nearby submerged offshore middens.

It is little wonder, therefore, that the possible threat posed to some of these sites through the imminent increase in offshore leases is of great concern to the archeological profession and poses a cultural resource management problem of tremendous proportions to federal agencies.

The U.S. Geologic Survey, Bureau of Land Management, and the National Park Service have all become involved in this problem at one level or another. Besides the moral issue in regard to the potential impact of drilling and strip mining on these sites which may cause irreversible damage to non-renewable cultural resources, there is also a whole sequence of federal antiquities legislation which applies in various degrees to offshore lands. To further complicate the issue, there is a specific Federal law applicable--the Outer Continental Shelf Lands Act--and there are further problems that occur in reference to questions of sovereignty and international law.

Aside from all of the legal turmoil, there exist a number of operational problems. Assuming time and funding is appropriated for performing archeological surveys, what then comprises adequate archeological coverage? What research design will be standardized and will serve as a minimum for archeological research? What is the criteria for picking competent professionals to accomplish this research?

PROBLEMS WITH GENERAL RESEARCH DESIGN

Various approaches have been proposed to deal with this problem, but they are controversial in nature. It is the opinion of some that high probability areas could be identified using predictive models which are derived from what is seen as analogous situations in terrestrial archeology. These high probability areas would require surveys before any impact takes place while the low probability areas such as ancient Pleistocene plains would be cleared without on-site surveys.

There is a legitimate basis for assuming that communication lines in paleolithic times were largely confined to river drainage systems (Williams and Stoltman 1965), and that cultural activity centers will tend to coincide with points where ancient shoreline and riverine valleys converged (Ruppe, personal communication). It is questionable, however, that archeological clearances for areas which are not in association with drainage systems could be safely neglected on that basis.

Analogy as an archeological tool has had undisputed value, but there has been more than a little reaction traditionally to its being used in itself as a basis for forming firm conclusions about cultural activity. It is for this reason that some archeologists see this type of approach as being unacceptable. They also feel that a larger issue is at stake here; i.e., the relative status of underwater sites as opposed to land sites. If an underwater archeological site is treated differently in the light of federal legislation than sites in other environments, a dangerous precedent may be set on a national level. Surveying high probability areas would in fact comprise "different treatment" of these sites, as land sites are not cleared on such a basis. It should be noted, however, that there are many complicating elements to this whole picture, and the federal agencies involved will be faced with a set of options on the administrative level far less clear cut than the purely archeological considerations presented here.

TECHNICAL CONSIDERATIONS

The purely technical problems of practically securing adequate information on the whereabouts of prehistoric sites also remain to be solved. The capability for doing this probably already exists, given the present state of the remote sensing art. What is needed is a concerted effort to adapt presently existing instrumentation for this purpose.

The Bureau of Land Management has devised a set of minimum standards which must be adhered to by the lessees if they intend to operate in an area where surveys are required. The survey format must include a "high resolution geophysical survey in the immediate area to determine the possible existence of a cultural resource" (BLM 1974). Specific instruments required include magnetometers, side scan sonars, depth sounders, and sub-bottom profilers.

Combining data from the various remote sensing systems mentioned in the BLM guidelines in conjunction with the use of deep core samplers, underwater TV and possibly radiometry backed up by diver investigation of sites registered by instrumentation will probably be adequate.

There has been some controversy, however, over the effectiveness of the suggested research design which accompanies the BLM package in locating both historic and prehistoric resources. The required minimum water survey pattern, for example, ensures full coverage of only a small percentage of the lease area in so far as historic shipwrecks are concerned and is even less efficient in regard to prehistoric site locations.

In response to the problem, several research organizations known to the authors are preparing for prehistoric site surveys by practicing on known submerged non-ferrous sites. They are testing to see what sort of "signature" early aboriginal sites leave on their recording equipment for each sensing device used. It should then be possible to program a data retrieval system to isolate points in a survey area in which responses from various combinations of the sensors indicate the presence of a drowned site.

THE QUESTION OF QUALIFIED PERSONNEL

The Outer Continental Shelf leasing issue has created a situation in the area of marine archeology very much like that which is currently developing in the archeological profession as a whole. The passage of the Moss-Bennett Bill, and other recent federal antiquities legislation, is likely to increase at a geometric rate the amount of archeology needed to be done on federal lands. Much of required surveys and clearances will, as in the case of marine archeology on the OCS, be contracted out to state, university, and private research groups. This snowballing workload will put a heavy strain on the available archeological research institutions in the United States, and many in the profession feel the time has come for strict standards to be set detailing just what it is that comprises minimum archeological expertise.

In so far as marine archeology on the OCS is concerned, responsibility for setting these professional criteria will probably rest with the National Park Service, which will rely heavily on input from the profession. The situation is less clear in regard to terrestrial archeology--some professional associations, e.g., the American Society for Conservation Archeology, are developing guidelines with no assurance that they will be accepted or even considered on a national level.

It develops, therefore, that the comparatively nascent subdiscipline of underwater archeology may end up becoming the pilot or model program for the entire profession in regard to certification and quality control.

Those in the Park Service directly involved with the setting up of standards for marine archeologists have become increasingly concerned, however, over the dearth of qualified personnel. Working in an advisory capacity on offshore site surveys and investigations requires a person with two highly developed skills: those of an archeologist and those of a diver. It should also be noted that the diving skills involved in supervising deep water surveys are far more than can be gained from a basic sport diving certification course. Problems of depth, possible use of mixed gases, and work-diving conditions demand quite advanced underwater training. There are also many purely archeological considerations in the performance of offshore site studies which strongly indicate the need for specialized training. Giving a competent terrestrial archeologist basic diving training, in other words, is no longer seen as being adequate. It is up to the archeological profession at large to realize the urgency of this situation and respond to it accordingly. National energy demands are stimulating and accelerating offshore drilling and mining activities, and if archeological responsibilities are to be met in these areas, specially trained marine archeologists must be produced.

Very few universities have or have had special courses in underwater archeology. Florida State University, the University of Texas, and the University of Pennsylvania, among others, have on occasion provided such courses, but what is now needed are permanent comprehensive programs.

It is hard at this point to anticipate the overall effect that the intensive Outer Continental Shelf leasing program will have on archeology in the United States. It has become obvious, however, that the outcome of present deliberations will have implications far beyond the sub-disciplinary confines of underwater research. The prehistoric sites on the continental shelf are simply cultural resources in a particular ecosphere. The manner in which they are handled, the standards which are developed to meet the urgent research needs, and the commitment towards cultural research that is displayed by controlling governmental agencies will all serve as a precedent for future situations that may develop with archeological resources in other environments.

by Calvin R. Cummings and Daniel J. Lenihan

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THE FUTURE

It is hoped that this publication has been able to clarify the nature of the underwater archeological research efforts undertaken by the National Park Service thus far. The future of this particular branch of archeology in the New World will be greatly affected by the directions established on a Federal level.

The degree of commitment in the Park Service to underwater research has grown greatly in the last decade but it has tended to localize, until recently, in those few regions having archeologists with an underwater background. The growing realization of the importance of a firm commitment to meeting underwater archeological responsibilities in the Service is often accompanied by a lack of equipment and specialized personnel needed to deal with the problem.

At this point only two regions (Southeast and Southwest) have the capacity for carrying out underwater research functions, and this quite often can only be accomplished through borrowing personnel from other regions.

One answer to this growing problem would be the establishment of an underwater research center in the National Park Service which would be composed of teams of underwater archeologists that could operate at the request of a particular region. A good deal of the equipment and personnel are already available; all that is needed is an administrative development that would consolidate these fragmentary capabilities into a streamlined, efficient professional support team.

Whatever course is adopted, the responsibilities remain and efforts towards meeting them will continue whether on a regional or centralized basis. One of the prime areas of concentration in future underwater projects will have to be the development of techniques to deal with the increasing number of prehistoric sites being threatened through reservoir construction in the United States. The Southwest Region is submitting proposals at this time to do comprehensive inundation studies and has already selected test areas for doing problem-oriented research in that realm.

Publications are planned that will include a technical operations manual for underwater archeological research. Such a work would include explications of underwater mapping and recording systems, excavation and survey techniques, and guidelines for setting up problem-oriented projects.

There is a saying that "archeology is anthropology or it is nothing." If this is the case, it means that underwater archeological activities no less than terrestial archeological efforts must be geared towards creating systematic bodies of knowledge negotiable in the context of understanding human behavior. This orientation in the future, no less than the development of specialized capacities for retrieving data, should be a primary focus of underwater research efforts in the Park Service.

It is important to emphasize that such pure research motives in no way conflict with but rather complement good resource management policy. Intelligent development of underwater archeological activities in the Park Service will result in dividends in terms of visitor use and interest not easily matched in terrestial archeological efforts. This is because there is something in the nature of an artifact removed from the sea that has a special appeal to human nature. There is a wealth of potential here for rich interpretive programs. This fact, combined with the status of underwater archeology as a burgeoning scientific discipline ripe for innovation and direction that will best exploit its potential, makes it an excellent area for the investment of energy and money by the Park Service even beyond what is simply needed for meeting legal obligations.

D.J.L.