4. Study of West African ship and boat building techniques and underwater search for German submarine in the Gambia River. 1966-1968.

5. Study of Indonesian ship and boat building techniques from prehistoric times to the present day including building a traditional Bugis Pinisi and the restoration and recording of an Indonesian Sekoci for the Western Australian Maritime Museum. 1971-1981.

6. Organization with local government authorities and in collaboration with the National Maritime Museum of a program for the recording of sites of archaeological interest in the inter-tidal zone around Britain's coast. 1983-1984.

RESEARCH IN TERRESTRIAL ARCHAEOLOGY

1. Survey and recording of unidentified stone circles in The Gambia. 1966-1968.

2. Expedition to the Tassili and Ahaggar regions of the Sahara for a photographic study of the cave paintings and in the search for the remaining cedar trees (subsequently discovered). 1968.

3. Salamis, Cyprus: Investigation of the remains of the city land site in the shallow waters offshore. 1969.

4. Kyrenia, Cyprus: Observation of the excavation of the 400 B.C. shipwreck site. 1969.

5. Investigation of several prehistoric Donsong sites in Eastern Indonesia. Location of several previously unknown Hindu sites in the eastern islands. Collection of ethno-archaeological material and the establishment of a Museum in Timor and a museum collection in the island of Rote. 1971-1982.

DIRECTION OF MARITIME ARCHAEOLOGICAL EXPEDITIONS

1. The Hadda, Houtman Abrolhos. An expedition to locate, excavate and record the remains of a 19th century ship. 1980.

2. The St. Anthony, Cornwall (continuing); survey and excavation of a 1527 wreck of a Portuguese carrach owned by the King of Portugal. 1981.

3. The Schiedam, Cornwall (continuing); survey and excavation of a 1676 ship wreck of a Dutch fly-boat captured by the British at Tanger. 1981.

4. The Cootamundra Shoals Survey, Arafura Sea-Timor. Deputy leader and chief diver of a major expedition to the Timor Sea to investigate prehistoric and geomorphological surveys. British Sub-Aqua Club Expedition Award. Diving to 60 meters. Patron, His Royal Highness, Prince Charles. 1982.

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5. The Loch Ard, Victoria, Australia. Rescue and recording of artifacts from the exposed site of an 1871 wrecksite. 1983.
6. The William Salthouse, Victoria, Australia. A major excavation of the first direct cargo shipment from Canada to Australia, wrecked in 1841. 1983.
7. The t'Vliegenshart, North Sea, Holland (in progress). Excavating the wrecksite of an 18th century outward bound East Indiaman. 1984.
8. Engaged in excavating various wrecks of many nationalities in the Goodwin Sands area of the English Channel. 1984 to present.

MARITIME ARCHAEOLOGICAL CONSULTATION

Devon Education Authority.

Maritime archaeology taught in secondary schools in England, for the years 1984/85/86.

MARK H. WULF

Address: 199 Tyler, Apt. 17
Cape Canaveral, Florida 32920

Date of Birth: July 30, 1953, Bay shore, Long Island, New York USA

EDUCATION

U.S. Navy Engineman Class A, Great Lakes, Illinois 1971.
U.S. Navy Deep Sea Diving School, Key West, Florida 1972.
Correspondence Courses in Oceanography, Advance Salvage and Deep Diving Techniques 1973 - 1974.
RCA Management Seminar November 1979.

PROFESSIONAL EXPERIENCE

1971 - 1975 Spent four years active duty in the United States Navy, honorably discharged. Primary duties as a diver aboard a submarine tender engaged in underwater maintenance and and repairs on nuclear powered submarines; also the operation and maintenance of a 55 foot diving support boat.

1975 - 1976 Worked on various short term jobs such as diving, marine mechanic work and commercial fishing. Company names and locations furnished upon request.

1976 - 1981 RCA Atlantic Undersea Testing and Evaluation Center, Andros Islands, Bahamas. Position was Diving Superintendent in complete charge of eight divers with responsibilities which included equipment inventory, research and planning for all diving operations from start to finish; a recompression chamber with crew available 24 hours; also the setting up of both training and maintenance programs, semi annual employee evaluations, and annual budgeting for materials and operating cost. Diving work consisted of inspection, maintenance, installation, and repair of all underwater equipment - i.e. electronic arrays, offshore towers, cable laying, research and development projects, recompression chamber operations, and maintaining a fleet of range support vessels ranging in size from 30 to 200 feet.

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1981 - 1985 Master diver for Circle Bar Salvage Company, a Florida based firm engaged in the discovery and excavation of old shipwrecks in Florida and the Bahamas. Also experienced in operation of sonar, magnetometers and other detection equipment. I also have a United States Coast Guard 100 ton Ocean Captain's license.

1986 My most recent diving experience has been as a civilian contract diver employed by the National Aeronautics and Space Administration (NASA) of the United States to recover wreckage from the Challenger space shuttle disaster.

SUMMARY

I have twelve years diversified marine construction experience including commerical diving, rigging, welding, cutting and masonary and carpentry work, diesel mechanics, heavy equipment operation and high seas operations as both a seaman and ship captain. During this same period I participated in numerous commercial salvage operations such as raising modern fishing vessels. During the past five years my work has been in the field of underwater archaeology and commerical salvaging.

LETTERS OF COMMENDATION AND APPRECIATION FROM MAJOR COMPANIES AND THE UNITED STATES GOVERNMENT FOR DIVING OPERATIONS AND LIFE SAVING ACTS, FURNISHED UPON REQUEST.

JAMES E. HILL, JR.

Age: 46

James E. Hill, Jr. has been a diving supervisor with the John W. Mecom Company in Florida and the Bahamas since April of 1983. In this capacity, Mr. Hill has worked under the direction of Mr. Robert Marx during 1983 through 1985 searching for specific sunken ships. Prior to his employment with the Mecom Company, Mr. Hill worked for McDermott International as a supervisor on a barge offshore the Brazilian coast laying pipelines. Prior to this, he was the lead diver and supervisor on McDermott Jet Barge II for Ocean Systems Do Brazil out of Rio de Janeiro. In this capacity, he supervised and inspected underwater pipeline construction. Mr. Hill has also been employed supervising bounce and saturation dives of up to 1,000 feet for drilling support. He has a Bachelor of Business Administration degree from the University of Texas. He has also attended the School of Drilling Practices at the University of Southern Louisiana, and taken courses in underwater photography at the Brooks Institute in Santa Barbara, California, and commercial diving at the Commercial Diving Center in Wilmington, California.

Dr. Harold E. Edgerton

In one way or another, the inventions of Dr. Harold E. Edgerton touch our lives daily. His perfection of the stroboscope in 1930 produced ultra-high speed photography; today, the strobe and his other discoveries are indispensable in many areas of science, medicine, and industry.

Since 1936, awards and citations have recognized his unique talents and eagerness to share his discoveries with colleagues and thousands of students at Massachusetts Institute of Technology where he taught for more than fifty years. Now MIT Professor Emeritus, Dr. Edgerton continues to shape the lives of eager young students.

Childhood interest and experience "on the job" in an electrical plant in his hometown, Aurora, Nebraska, preceded Dr. Edgerton's studies at the University of Nebraska and MIT. His arrival in 1926 as a graduate student presaged a new era in electrical engineering research.

In the 1930s, his strobe was adapted for nighttime reconnaissance by the U.S. Air Force, enabling round-the-clock air photo surveillance of enemy forces in World War II. Later, Dr. Edgerton and his two former students, Kenneth Germeshausen and Herbert E. Grier, developed equipment to film nuclear experiments. This partnership was the forerunner of EG&G.

Dr. Edgerton's pioneering research produced outstanding achievements in the development of underwater cameras, lights, and special sonars. He and Jacques-Yves Cousteau collaborated on unmanned deep-sea cameras which were used in searches for the Loch Ness monster and the battleship *Monitor,* two adventures in which "Doc" was involved. The search for the *Monitor* was the subject of a feature article in the January 1975 issue of *National Geographic.*

While his genius continues to break barriers in research, Dr. Edgerton gathers new friends and colleagues in the diverse fields of oceanography, nautical archaeology, and art.

APPENDIX C

SRI International

10 September 1985

Mr. Robert Marx, Director
Phoenician Explorations
330 Thyme Street
Satellite Beach, Florida 32937

Dear Bob,

Enclosed is our renewed proposal, as per your request.

The price of this proposal is significantly higher than quoted in our previous proposal. Only a small part of this increase is due to salary changes and other annual cost changes. We all felt we wanted to increase our level of effort in development work and testing to build a much better instrument and do the best possible job we can. Technically what we propose to do is very difficult and we feel we should devote extra effort to the task.

Actual testing on site in the Bahamas has not been included as part of this present proposal; we suggest that you or one of your associates join us here in Menlo Park during our final testing before delivery. We also suggest that a follow-on contract would be appropriate in order to permit two members of our staff to accompany you during your next season's work, to gain experience in the use of this instrument. This will help us to build improved models and to add later refinements increasing the utility and cost-effectiveness of the instrument. We believe this will make it a marketable item others will wish to purchase and use for their own applications.

We greatly appreciate your interest and are anxious to do a good job for you.

Sincerely,

Lambert Dolphin
Assistant Director
Radio Physics Laboratory

pdy

Enclosure

SRI International

CALENDAR PAGE 83,47
MINUTE PAGE 2408

10 September 1985

Phoenician Explorations
330 Thyme Street
Satellite Beach, Florida 32937

Attn: Robert F. Marx, Director

Re: SRI International Proposal for Research No. ESC 85-179
"SENSITIVE METAL DETECTOR FOR LOCATING DEEPLY BURIED ARTIFACTS"

Dear Mr. Marx:

In December of 1983 you explained to me in a telephone conversation the practical problems frequently encountered in galleon salvage operations in the Bahamas. You indicated that wrecks were frequently scattered over large areas, and that sand depth over the sites could be as much as 20 to 25 ft. We discussed various metal-locator schemes and their limitations at that time and agreed on the various equipment now available. Your letter of reminder of 10 July 1984 stimulated us to look at both current and innovative equipment design to see if we could make a major improvement in locating underwater small, nonmagnetic metal objects (bars, silver, bronze, and the like).

In my letter of 17 July 1984, I mentioned that Bill Edson and Roger Vickers, both of our Laboratory, recommended a large horizontal loop to increase the depth of detection capability of a metal detector. As you know, most metal detectors are intended for coin-shooting on land or in shallow water. The market is competitive: the price must be kept down and the units need to be light weight and easy to use. The search coil diameter is usually 8 to 12 in., and the power output is a few watts. A few "large coil (approximately 3-ft diameter), deep search" detectors have been manufactured, but as you pointed in our first telephone conversation, no one has been able to achieve more than 6 to 8 ft of useful penetration. (For example, the "Gemini II Deep-Search" metal detector by Fisher Research Laboratory has an advertised sensitivity of 3 ft for a jar of coins, 5 ft for a one-inch diameter pipe, 10 ft for a large metal chest, and 20 ft for a "mineral deposit.") The sensitivity of a loop-type metal detector decreases inversely as the sixth power of the distance from the coil; this means that doubling the distance from the coil decreases the instrument sensitivity by a factor of 64. Increasing the transmitted power in a given system is thus not nearly as

CALENDAR PAGE	83.48
MINUTE PAGE	2409

helpful as increasing the loop diameter, and this is why we suggeste coil size of 25 to 30 ft in diameter. No matter how much we increas the power or are clever with our use of circuitry, we shall not in practice succeed in locating small objects buried 20 to 25 ft in san without a large coil.

As we explained in our proposal, SRI Proposal ESC 84-197, to you last year, a good summary analysis of metal detectors, radars, seismi sounders, magnetometers, resistivity methods, and electromagnetic detectors has been written by J. Jeffrey van Ee of the Advanced Monitoring Systems Division, Environmental Monitoring Systems Laboratory, Las Vegas, Nevada, as part of their 1983 government study "Geophysical Techniques for Sensing Buried Wastes and Waste Migration Their recent study of the limitations of metal-detectors as well as other methods is in substantial agreement with our own experience, an yours.

My colleagues Bill Edson, Roger Vickers, and I have had several good discussions to complement the mathematical analysis Joseph Mosni did for us a year ago recommending coil configurations and calculatin the sensitivity of a large, horizontal-loop metal detector. One advantage in working in sea water is that noise signals from the surf will not be detected by the system, and thus a very sensitive receive may be used. A large loop also covers much area per pass, lessening time required to search a large wreck site. Though very large, the l can be lightweight and designed for ease of towing from a hydrodynami point of view. We also suggested and still recommend equipping the system with a small bottom-finding sonar so that the detector unit ca be "flown" a few feet above the sea floor.

Our calculations indicate that we can expect a detector with a 20-ft coil diameter to be capable of detecting a single gold bar at a depth of 20 to 25 ft. Originally, we thought in terms of one transmitting coil and a large number of receiving coils, but further analysis has shown us that we can do just as well with a few coils. Solid-state components now allow us to build a very sensitive and very small receiver, and we suggest a moderately high-powered transmitter (several kilowatts), which is also now readily available.

We would like to hereby renew last year's proposal in response to your phone call on 28 August. Our basic technical approach has not substantially changed since last year's proposal, so we feel we stand good chance of being able to deliver a working large-scale very sensitive metal detector in time for your summer 1986 diving season, provided we can start work in the next 30 to 60 days. As before, we propose to build a developmental model of the detector for ocean testi (locally) for design optimization. After testing, we would then be prepared to build a more rugged, durable version, incorporating change that prove to be desirable as a result of the testing. Because the instrument will follow an entirely new design, our research progress will be kept proprietary.

We propose on a best-effort basis to design and construct a working model of the new detector system eight (8) months after the start of work. The system would include the following:

(1) Towable, hydrodynamically designed coil package, pressure designed and waterproof, equipped with built-in sonar depth finder and guide fins. Approximate diameter 25 ft.

(2) Supporting electronics and power supply including generator, transmitter, receiver and display unit with both real-time and recorded data collection. (Various data collection schemes are possible.)

(3) All necessary cable, hardware, and the like.

(4) Detailed operating manual.

The objective would be to produce sensitivity which would allow detection of a metal object presenting a cross-section of approximately ten (10) square inches at depths of 20 to 25 ft.

Actual testing on site in the Bahamas has not been included as part of this present effort; we suggest that you or one of your associates join us here in Menlo Park during our final testing before delivery.

Total cost of the work as outlined will be $195,000. Our development and building of the proposed detecting system will require an immediate expenditure of funds, and it is our policy on this type of commercial contract to receive an advance payment before commencing work and a letter of credit for the balance. A down payment of $100,000 (plus a letter of credit for the balance) accompanying one copy of the enclosed signed agreement is all we need to commence work on this project. The second copy of the agreement is for your record.

Because of the experimental nature of this development work, SRI cannot guarantee that we will be successful in producing a detector that will meet your specifications. Therefore, we will only do the work on a best efforts basis.

To discuss technical matters, specifications, and test and delivery schedules, please contact me at (415) 859-4868. Questions concerning contractual matters may be addressed to Barbara Camph at (415) 859-4328. This proposal as priced remains in effect until 31 December 1985. Please contact me should you wish an extension.

CALENDAR PAGE	83.50
MINUTE PAGE	2411

Mr. Johann Rupert
Rand Merchant Bank Ltd.
Marshall Place
66 Marshall Street
Johannesburg
South Africa

Mr. Norman Short
Cap-Man Limited
c/o Guardian Capital Group Limited
48 Yonge Street
Toronto, Ontario M5E 1H3

Mr. Stuart Hubert Wallace
1588 Wesbrook Crescent
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British Columbia
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Mr. Richard Bonnycastle
Chairman
Cavendish Investing Ltd.
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Mr. Garnet Watchorn
Executive Vice-President
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130 Adelaide Street West
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Mr. G.M. Soloway
Soloway and Wylde
401 Bay Street
Suite 2112
Toronto, Ontario

Mr. Louis P. Kelly, President
Eurpac Service Company
170 Mason Street
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Greenwich, Connecticut
U.S.A. 06830

Mr. R.J. Lawrence
President
Burns, Fry Limited
1 First Canadian Place
Suite 5000, P.O. Box 150
Toronto, Ontario M5X 1H3

Mr. Peter Huggler
President
Interallianz Bank (Zurich) A.G.
Stadthausquai 1
8001 Zurich
Switzerland

Mr. C.W. Webster
Frosst Holdings Ltd.
4999 Ste. Catherine Street West
Suite 504
Montreal, Quebec H3Z 1T3

Mr. Frank Rolph
B.W. Rolph Holdings Ltd.
1245 Sherbrooke Street West
Suite 1060
Montreal, Quebec H3G 1G2

Mr. Charles B. Loewen
Loewen, Ondaatje, McCutcheon & Company Ltd.
7 King Street East
20th Floor
Toronto, Ontario M5C 1A2

Mr. Richard M. Ivey
Ivey & Dowler
2100, 380 Wellington Street
London, Ontario N6A 5B5

Mr. W.W. Siebens
President
Candor Investments Ltd.
300 - Three Calgary Place
355 - 4th Avenue S.W.
Calgary, Alberta T2P 0J1

Mr. Donald Lindsay
P.O. Box 227
Vanderbijlpark, 1900
Transvaal
South Africa

Mr. Christoffer Naess
c/o Arne Naess (U.K.) Limited
84 Baker Street
London W1M 1DL
England

Alan and Diana Quasha
130 East 79th Avenue
New York, New York
U.S.A. 10021

CALENDAR PAGE	83.52
MINUTE PAGE	2413

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APPENDIX B

ROBERT F. MARX

Date of Birth: 8 December 1936, Pittsburgh, Pennsylvania USA

Present Address: 330 Thyme Street
Satellite Beach, Florida 32937

Telephone: 305-777-2061

EDUCATION

Los Angeles City College, June 1951 - September 1953; September 1956-February 1957 (evening classes).
University of Maryland estension courses (during military service) December 1953 - June 1956 with 90 undergraduate credit hours in total.
Major: Anthropology and Archaeology

FIELDS OF SPECIALIZATION

Marine Archaeology, with particular reference to the Spanish colonial period in the Caribbean.
Naval & Maritime history, with particular reference to Spanish maritime trade - 1500 - 1800.

MILITARY SERVICE

US Marine Corps 1953-56

- In charge of USMC marine salvage operations, East Coast, U.S. 1953-55.
- Director of USMC Diving School, Vieques, Puerto Rico, 1955-56 (training of over 5,000 marines in use of scuba diving and its use in amphibious warfare).
- Honorable Discharge September 1956; USMC Reserves (inactive) 1953-62.

ARCHAEOLOGICAL EXPLORATIONS & RECOVERIES

1. Location of several Civil War blockade runners and recovery of artifacts, under auspices of North Carolina Development Board, 1953-54.
2. Location of Civil War ironclad, USS Monitor, Cape Hatteras, N.C., 1955.
3. Location of a number of Spanish and English wreck sites from period 1650-1800, Puerto Rico and Virgin Islands, 1955-56.

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4. Discovery of a number of previously unknown Mayan temple sites, cenotes, zacbes (ceremonial causeways), and cave tombs in British Honduras, Quintana Roo, Isla Cozmel, Mexico; mapping of Tulum, Coba, Xelha, and other little known Mayan cities on the east coast of Quintana Roo, Isla Cozumel and Isla Mujeres, in cooperation with the Mexican Department of Anthropology and History; first exploration and recovery of artifacts from Mayan cenote at Dzibilchaltun, under direction of Tulane University Department of Archaeology; Assistant Professor John Goggin, University of Florida, in excavation of Spanish colonial sites, Yucatan: February 1957 - September 1959.
5. Discovery of remains of Spanish galleon, Nuestra Senora de los Milagros (sunk in 1741); organization of three series of excavations on the site, the last sponsored by the official Mexican underwater exploration society (CEDAM), which resulted in the recovery of over 200,000 artifacts, Quintana Roo, Mexico, 1957 - 1959.
6. Discovery and identification of early Spanish wreck sites: La Nicolasa, supply ship of Hernan Cortes' expedition (sunk in 1526); and two ships burned and scuttled by Francisco de Montejo (1526), Quintana Roo, 1957.
7. Exploration of Caribbean waters off coasts of Central and South America, Leeward and Windward Islands and the Bahamas, with location of Spanish French, English, Dutch and Portuguese wreck sites from period 1550-1800, 1960.
8. Underwater survey of submerged Roman cities of Carteya and Bolonia (southern Spain); location and exploration of wreck sites in Cadiz harbour and off Tarifa, Zahara, and Sanlucar de Barrameda, under auspices of the Museo Provincial de Cadiz, Spain, 1960-62.
9. Participation in archaeological excavation, sponsored by the Smithsonian Institution, of 16th century Spanish wreck site, Bermuda, August 1963.
10. Organization and direction of exploratory expeditions to Serrana, Seranilla, Roncador and Quitasueno Banks Isla Providencia (western Caribbean), which resulted in the location of a number of important Spanish colonial wreck sites and exploration of four of the principal sites, June-July, 1963 and May-November, 1965.
11. Direction of program of mapping and excavation of the sunken city of Port Royal, undertaken by the Institute of Jamaica, November 1965 - June 1968.
12. Discovery of two shipwrecks of Christopher Columbus which were lost in St. Anne's Bay, Jamaica, in 1504. Plans are underway to excavate these two shipwrecks in the near future. February 1968.

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CALENDAR PAGE 83 55
MINUTE PAGE 2415

13. Director of Research and Salvage operations for the Real Eight Co. Inc. of Melbourne, Florida. Summer months spent excavating various shipwrecks of a fleet which was lost in 1715 off the coast of Florida. The remainder of each year spent locating and salvaging ancient shipwrecks in the Bahamas, Mexico and Columbia. June 1968 - January 1971.

14. Archaeological survey on some ancient sunken walls and buildings off Bimini and Andros Island in the Bahamas. August 1969, July 1971 and December 1976.

15. Excavation of three Civil War blockade runners off Charleston and Sullivan Island, South Carolina. January - February 1970.

16. Archaeological explorations on land and underwater at various sites in the Yucatan Peninsula under the auspices of CEDAM of Mexico. January, April and May 1971 and February - March 1976.

17. Exploration for marine archaeological sites around nine different Caribbean Islands in the Windward and Leeward Island group under the auspices of the Minnesota Historical Society. February 1971.

18. Archaeological survey in Lake Toluca, Mexico for pre-Columbian artifacts under the auspices of CEDAM of Mexico. June 1971.

19. Underwater exploration for marine archaeological sites on both sides of the Isthmus of Panama under the auspices of the Panama Institute of Tourism. December 1971 - January 1972, April 1973 and March 1975.

20. Participation in exploration aboard the ALCOA SEAPROBE for ancient deep water wrecks off the coast of Florida. March and November 1972.

21. Exploration for an early 17th century Spanish shipwreck in 1800-2000 feet of water south of the Dry Tortuga Islands in the Gulf of Mexico using sonar and a TVSS (television search and salvage system). November 1972.

22. Exploration of the Little Bahama Bank using visual, sonar and Magnetometer methods in which a total of 21 shipwrecks were discovered, including the Nuestra Senora de la Maravilla, a Spanish galleon which sank in 1656. June - October 1972.

23. Exploration of the ancient Phoenician seaports of Byblos, Tyre and Sidon in Lebanon at the invitation of the Lebanese Dept. of Antiquities, during which survey for Phoenician shipwrecks dating from the 5th and 4th centuries B.C. (one with a cargo of terracotta figurines), two Greek shipwrecks from the 3rd and 2nd centuries B.C., two Roman shipwrecks from the 1st century B.C., and a Byzantine shipwreck from the 6th century A.D. were all discovered. Samplings of all cargoes of all the sites were collected for the Department of Antiquities. January and February 1973 and July 1974.

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the Viscaino expedition in which he wrote that Viscaino had put into Drake's Bay to see if he could find any trace of the San Agustin and a quantity of wax and silks that had been left on shore. In this light there may have been deliberate intent on the part of the persons having a vested interest in the ship and goods to keep the true nature of the loss from becoming known to others who might attempt to salvage the wreck."

The fact is that if the ship had totally broken up and gone ashore as some historians and authors believed, there would not have been any possibility of future salvage operations and everything would have been scattered over a wide area and covered over by shifting sands. Likewise, Cermeno and his people would have been able to obtain baldy needed food supplies and some of her valuable cargo - Which did not occur. Recently obtained historical documents from the Spanish Archives indicate that the ship sank in the general vicinity of her anchorage and only some of her upper-works and deck cargo (Such as the wax and silks) were cast upon the shore.

This analysis, then, assumes that the main section of the San Agustin sank at her mooring, or close to it, and lays in waters under the jurisdiction of the State of California and not in the zone closer to shore controlled by the National Park Service.

FUNDING, PERSONNEL AND EXPEDITION RESEARCH VESSEL

Phoenician Exploration Limited

There is still a great deal of preliminary work to be done before the total cost of this project can be determined, but it is expected to cost somewhere between one and three million dollars to first locate and then carry out a proper underwater archaeological excavation of the San Agustin. If wooden remains are located, which is one of the main objectives of this project, additional funds will also have to be spent on the proper treatment and preservation of these wooden remains. We could have another "Mary Rose" on our hands with the San Agustin and this could result in the construction of a major museum to display the ship's hull and her cargo.

Phoenician Exploration, which is a Canadian limited partnership, has been conducting underwater archaoelogical work for the past eight years, under the direction of Robert F. Marx. They have worked in Nova Scotia, Florida, the Bahamas, Brazil, Mauritius Island in the Indian Ocean and in other areas. Recently, this group has formed another limited partnership named Phoenician South Seas for the purpose of locating and excavating Manila Galleons in the Philippines and, hopefully, in Drake's Bay. One of the main objectives of this group is to obtain enough data to enable them to reconstruct an authentic replica of a Manila Galleon and then undertake a voyage in the replica between Manila and Acapulco, with stops along the coast of California, as part of the 1992 celebration of Columbus's 500 year anniversary of the discovery of the New World. Phoenician South Seas will provide all of the necessary fundings for this project. Attached as Appendix A here is a list of the limited partners of Phoenician Exploration, who are also the General Parnters of Phoenician South Seas, as well as a brief resume of some of those involved.

It is anticipated that a large number of people will be involved in this project. We plan to invite archaeologists and divers from the National Park Service to participate, as well as other scholars from California and elsewhere. Hopefully, John Foster and one or more assistants will be assigned to the project by the Division of Parks and Recreation. The research phase which is underway at this time is being undertaken by Dr. Nicholas Cushner and Robert F. Marx. After the shipwreck has been located Dr. Maria-Lusia de Brito Pinheiro Blot will also join the team as both a historian, draftsperson and diver. The search phase will be conducted by Robert F. Marx with the assistance of Dr. Harole E. Edgerton of M.I.T. and also personnel of various seismigraphic firms. The overall excavation will be conducted under the direction of Robert F. Marx. Dr. Ian D. Spooner and Dr. Jean-Yves Blot will serve as assistant archaeologists to Robert F. Marx. Ms. Jenifer G. Marx will serve as artifacts officer. Mr. Marc H. Wulf and Mr. James E. Hill, Jr. will serve as chief of diving operations. Additional divers and qualified experts in cleaning and preservation of the artifacts recovered will also be hired as needed.

During the search phase of the project, a suitable vessel will be chartered from the local area. After the shipwreck has been located, the research vessel Rio Grande, which is owned by Phoenician Explorations, will be utilized. See attached description and photograph of the Rio Grande.

KEY PERSONNEL

Detailed resumes of the principal investigators in this proposal are included as Appendix B.

Robert F. Marx

Mr. Marx has been managing marine archeological recoveries since 1957, including work on the U.S.S. Monitor the galleon Nuestra Senora de los Milagros, the submerged Roman cities of Cartega and Bolonia, the French Soleil Royal, and Greek and Phoencian vessels from the 5th and 4th century B.C.. An accomplished diver, Mr. Marx is well equiped to lead an expedition such as this one.

Dr. Jean-Yves Blot

Dr. Blot has his Doctorate in underwater archeology from the Sorbonne in Paris in addition to a Masters degree in anthropology. He has over 15 years experience as a diver on archeological sites all over the world. He is currently employed as an archeologist for the museum of Archeology in Belem, Portugal.

Dr. Maria-Luisa de Brito Pinheiro Blot

Dr. Blot has her doctorate in history from the University of Coimbra, Portugal. She is an accomplished researcher, with many years of experience checking out wrecks in Europe, India, and Indonesia and the United States. She also dives and is an expert underwater photographer.

Jenifer G. Marx

A diver and writer of many years, Ms. Marx is the author or co-author of several books and articles on history and marine archeology.

Ian D. Spooner

A diver with full archeological training, Mr. Spooner obtained a post graduate diploma with distinction in Maritime Archeology. He is on committees for maritime archeology in Britain and Australia, and has published several findings.

Mark H. Wolf

Over 12 years experience diving in marine construction and salvage, beginning as a diver aboard a submarine tender. Mr. Wolf recently performed as a contract diver for NASA on the Challenger shuttle recovery team.

James E. Hill, Jr.

Mr. Hill has been a diver and diving supervisor for many years. His experience includes work at up to 1,000 foot depths, pipelaying and maintenance work, and drilling support, as well as archeological dives since 1983.

DESCRIPTION OF THE RESEARCH VESSEL — RIO GRANDE

The Rio Grande is a well equipped research vessel for accomplishing shipwreck search and recovery operations. The Rio Grande is valued at U.S. $2,000,000 and her replacement cost is much greater. The vessel has an overall length of 100 feet, weights 61 net tons, has an all aluminum hull and is ocean-going certified by the U.S. Coast Guard. She has four water tight bulkheads, making her nearly unsinkable. The vessel is powered by three large General Motors Detroit diesel engines, carries 7,500 gallons of fuel (and can also carry portable bladder fuel tanks for long ocean crossings) and cruises at 22 knots. She is fully hydraulic powered throughout the vessel, has two large electrical generators and is completely air conditioned for maximum living comfort. At sea, the Rio Grande is totally self-sufficient with two salt water to fresh water conversion units which produce 1,000 gallons of fresh water daily. Her large storage areas, two large deep freezers and refrigerator enable crews to stay at sea for months at a time. The vessel accommodates ten persons comfortably, but has the capacity to berth twice that number.

The Rio Grande's navigation electronics and other equipment has been duplicated to prevent breakdowns from hindering any operation at sea. Among the electronic equipment in the pilot house are:

- a Sperry autopilot
- Ritchie compass
- Furano radar with perimeter defense scanner
- two Furano satellite navigators
- Micrologic Loran C position indicators
- Texas Instrument Loran C position indicators
- Alden Marinefax weather data receiver
- RDI Radar Watch MOD Mark II
- seven marine radio-telephones (including two single sideband units)
- three fathometers

A hydraulic crane on the aft deck can lift up to five tons, and all anchors are powered by hydraulic winches. There is a helicopter landing pad over the aft deck. Two rubber Zodiac boats in addition to a 20 foot fiberglass Aquasport skiff are carried on deck. The Rio Grande can operate anywhere in the world, is totally self-contained, seaworthy and strong enough to weather almost any kind of adverse sea conditions. With her own machine shop and duplicated stock of most equipment and spare parts, the Rio Grande can stay at sea or on a site for up to three months, a vital factor to be considered when involved in offshore operations.

All types of diving equipment are carried on board the Rio Grande, from standard Scuba gear to the more sophisticated Kirby-Morgan gear used for deep diving. Both high and low pressure compressors are aboard for shallow and deep diving. The vessel is outfitted with two large "blasters" or "prop-washes," the primary tool used in excavating shipwrecks. "Airlift" and "water jets," which are also used in excavations, are also carried on board. Even more important is the fact that Mr. Marx has recently developed and produced a portable underwater "blaster" which is hand-held and controlled on the bottom by a diver. This will enable the Joint Venture to excavate at much deeper depths than the conventional "blasters" which require the vessel to be directly over the shipwreck, and which can operate only up to depths of approximately 75 feet. With this new system, the Joint Venture can operate and excavate a site at all diving depths and also in very shallow water such as around dangerous reefs where the Rio Grande cannot maneuver.

SEARCH PHASE OF THE PROJECT

During the last and present centuries thousands of vessels of all sizes have used Drake's Bay as an anchorage. During storms when anchors are dragged and even in lowering and lifting anchors it is a well established fact that the remains of old sunken ships are disturbed and in some cases destroyed. Hopefully, the San Agustin is buried in one of the deeper areas of the bay where there is substantially sand covering the site to protect her. Yet there is the possibility that she has been damaged or destroyed by the dragging anchors or by a later shipwreck ran aground over her remains. Thus, this is another valid reason why the San Agustin, which is without a doubt the most important shipwreck in California waters, should be located and excavated at this time.

One of the most difficult aspects of underwater archaeological work is the actual detection and locating of a shipwreck site. A good recent example is the 1622 Spanish galleon ATOCHA which took fifteen years and $16,000,000 to locate. Over the years I have worked closely with many scientists and organizations trying to overcome this major problem.

Problems in Underwater Shipwreck Detection

The basic tool used in the location of shipwrecks in the Western Hemisphere is the magnetometer which has its limitations. The magnetometer will only detect the presence of ferrous materials such as iron or steel. In certain instances it will not even locate materials made of these metals. In some cases where large bodies of ferrous metals are in close proximity the different individuals objects may null out the magentic properties of one another. It has also been found that some individual large ferrous objects give no magnetic anomalies; when cannon or anchors were cast and the metal cooled on a particular polar axis something causes the object not to show magnetic properties if this object lays on the sea bottom within a 15 degree axis either east or west of the original position the object when cast. Consequently, cast iron objects have one chance in twelve of not exhibiting any magnetic properties which can be detected by magnetometer.

Contrary to popular belief most ships did not sink, but rather were wrecked on a lee shore or hit upon a reef or shoal in relatively shallow water. During the age of sail probably less than two percent of the ships were lost in deep water;

usually as a result of fires aboard or sea battles. In most cases, even when a ship capsized at sea, it would drift into shallow water before breaking up. Deep water shipwrecks (over 100 feet deep) generally have all of their armament and cargo situated in a relatively small area unless they exploded before sinking. However, rarely are these ships sought as potential targets by archeologists or salvors because their locations are generally very vague in contemporary historical documents and their are a great deal more costly to locate and salvage. A good example is the Spanish galleon San Jose which blew up in 1708 and sank in 800 to 2,000 feet of water off Cartegena, Colombia during a sea battle with the British. To date, various oceanographic and treasure hunting firms have spent over $25 million in the search for this rich target with negative results.

In most cases the ships struck a shoal or reef and was scattered over a wide area, sometimes even over miles. Usually the bottom of the ship containing the ship's ballast would stay in the area of the initial impact while the seas and currents would carry the remaining part of the ship to other areas. In some cases, only a large hole would result from the initial impact and the ship would keep moving with not only its ballast falling out but also a great deal of its cargo. I have seen this latter event result in a 1733 spanish galleon scattering its remains along a six mile stretch from its original impact area to its final resting place, resulting in its contents being so badly scattered that most of it was impossible to locate either by contemporary or modern day salvors. Hurricanes which occurred even years after a ship was wrecked could cause a ship's contents to be widely scattered.

So now we must go back to the magnetometer and what it can accomplish. On old sailing ships a sounding lead was always used at least once an hour so the mariners on those old ships generally knew when they were getting into shallow water even if land could not be seen because of darkness or a storm. If unable to bear away from shoal water the captain would order anchors dropped and sails taken in to avert a disaster. In many cases, countless anchors were dropped and when they ran out of anchors as the anchor cables sanpped in storms or were cut on reefs, cannon were even used as anchors. Thus, in many cases, the final resting place of a shipwreck might not have a single anchor left on it and when anchors are located in the general area of a shipwreck they can be miles from the ships location. Naturally, finding a lost anchor doesn't always signify a ship was lost in tho area as the ship which lost the anchor may have managed to escape disaster.

So this leaves us with the only remaining target which can be located by a magnetmeter - the cannon. Generally, the important ships used bronze cannon and these cannot be found with a magnetometer, so if the shipwreck does not have any of her anchors still on or near her, she will go undetected unless the cannon can be located visually, or some other part of her. A good example is Mel Fisher's 1622 spanish galleon Atocha. Six of her bronze cannon were located when a salvage boats anchor was snagged on the bottom and a diver went down to free the anchor and spotted the old guns. Just two weeks ago, eight years after the first six bronze cannon were found on this wreck, Fisher located still another bronze cannon over two miles from the location of the first six. This was accomplished by conducting a visual search from a small plane and videotaping the sea floor from an elevation of 500 feet. The Atocha is a very good example of the difficulties modern salvors face in trying to salvage an old shipwreck which has been widely scattered over a large area and in which most of her cargo is buried under deep sand. Despite the wide amount of publicity that Fisher has received since 1970 when he found a part of the Atocha, to date he has not found the main part of the wreck or the treasures she carried. To date he claims to have spent somewhere between six and ten million dollars in this search, sometimes using as many a six search vessels using the best equipment available.

This still leaves us with iron cannon as potential magnetic targets. When ships were dashed to pieces on a lee shore during a hurricane, such as occurred with some of the 1715 ships lost on Florida's East Coast, the iron guns generally were deposited in the vicinity of the remainder of the wreck - but not always. On one of the wrecks the ship struck bottom about three miles offshore and her top deck and superstructure broke off and drifted right on shore in the breakers, whereas her main hull and cargo are located somewhere in between. On some of the 1715 wrecks the ships and cargoes also went into shore in the breaker zone and although the cannon can be easily found (if iron) her cargo can be spread up and down the coast for several miles. The remains of the Capitana of this fleet are spread along the shore for four miles to the north and one and a half miles to the south of where most of her guns lay. During the past two decades modern day salvors first worked the area where the cannon lay and, after exhausting the area, worked up and down the coastline in hopes of finding more treasures from this wreck. Objects coming ashore in recent hurricanes generally give a vague location of other parts of the wreck hidden under the deep sands.

The same problem occurs when ships are wrecked far from shore. The topsides of the ship, with the cannon and anchors, if any remain, are generally swept far away from the main part of the wreck, making it very difficult to find the smaller non-ferrous items whith are usually buried under sand, mud or reef or a combination of them all.

Added to the problem is the fact that on many shipwrecks, the cannon and anchors which are the signpost of a shipwreck, no longer exists. They were salvaged by contemporary or modern salvors. During World War II for example, when there was a great demand for all kinds of metals, many salvage companies scoured the sea floors up and down the U.S. East Coast and throughout the Bahamas and Carribean, recovering everything which could be found. In recent years, this has also been done, and the most recent example on a big scale took place on the Little Bahama Bank where a Bahamian Government bouy tender was employed for months to pick up all cannon and anchors visable. The reason it was done, according to government spokesman, was to prevent their being pirated by unauthorized divers and salvors. The fact is that many of these sites will be lost forever unless some other method is developed to find the smaller objects still on these buried sites.

Before going further I will cover sonar. There are two types: side scan and sub-bottom profilers. Side Scan Sonar can be useful in locating deep water wrecks in which some part of the wreck, such as a ballast pile, is sticking above the surrounding sea floor. However, few wrecks fit into this catagory in this hemisphere. Sub-bottom profilers give a picture of what is buried directly below the boat and only cover a narrow area of the sub-bottom. They are only useful after a shipwreck has been located by another method to try and pin-point objects hidden under the sea floor. In theory they should solve the problem of finding the non-ferrous smaller objects on a shipwreck but such is not the case. In mud or silt, generally only in harbors or near river mouths, they can be useful. However, in sand, where the majority of shallow water wrecks lay, this type of sonar has very limited penetration - generally less than two meters. Also as mentioned above, you have to be almost directly over the buried object to locate it and this is very difficult when many square miles of sea floor have to be searched.

So lets now assume that a shallow water shipwreck has been located and its remains are scattered over a large area. A magentometer can be placed right on the bottom and either dragged slowly or hand carried by a diver to locate smaller ferrous objects such as cannon balls or ships fittings. Unless these objects are laying in a big mass or are very close to the surface of the sea floor and only a few feet from the magentometer head sensor, no anomalies can be detected, which is the case in most instances. A hand-held metal detector will locate metals of all types but again the objects must be very close to the detector or no reading will be obtained. If a large anchor or cannon (bronze or iron) is more than six feet deep in the bottom sediment, no readings will be obtained. On smaller objects such as hand weapons, tools or coins, the detection range is usually less than a foot. This is fine if the site is only covered by a foot of sand, mud or coral, but this only occurs in very few instances. The average shallow water shipwreck has six to eight feet of sand over it and some, especially in the Bahamas or California, have as much as 25 feet of sand covering them. In one case, we recently found a site with over 30 feet of sand covering it and were never able to identify it because we could not dig deeper with either the prop-washes or airlifts.

The previous three pages all lead up to the most difficult problem we face in location of shipwreck remains - that of finding the smaller items on each site. It is too expensive and time consuming to try and dig up several square miles of ocean bottom and at the moment, with what equipment is presently available, that would be the only solution.

I should also mention at this time that in Florida, the Bahamas, Bermuda and some parts of the Caribbean the magentometers and metal detectors work well because they are being used in areas of sedimentary rock. However, elsewhere they are more difficult to get proper readings, or in some cases any readings, because of the magentic properties of non-sedimentary rocks.

We plan to first utilize the standard equipment for locating the remains of the San Agustin - magnetometers, sub-bottom profiling sonar, metal detectors and visual search. There is little likelihood that any of her remains will be above the sea floor so we will exclude the use of side-scan sonar - especially since this was already undertaken by the NPS in 1982.

After the visual and electronic survey is completed, we will then make small test holes on each target using a small airlift to determine the identity of each one. If we fail to locate the main remains of the San Agustin by using the above mentioned methods, I will then use a very special instrument which is being developed by SRI International in Menlo Park. See attached letter in Appendix C written by

Dr. Lambert Dolphin. This instrument is capable of locating very small objects under 20 to 25 feet of sand. Phoenician South Seas has agreed to provide the funding for the development and construction of this instrument and the initial work on this instrument will commence in the very near future.

EXCAVATION OF THE SAN AGUSTIN

Until the remains of the San Agustin are actually located it is very difficult to determine the exact methods which will be used in properly excavating the site. One thing is certain; the best archaeological techniques and equipment will be used on this project and the maximum effort will be utilized in collecting all pertinent archaeological data. Likewise, the operation will be conducted in a manner which protects the gathering of the archaeological data and protection of the artifacts and wooden remains - if any remain - of the ship's hull. The staff and equipment of Phoenician Explorations, Limited, are as well prepared as anyone in the world today to do as professional a job as can be done on wrecks of this vintage.

There are two different possibilities to consider. One that the ship remains and cargo are scattered over a wide area, which would make the project more difficult and expensive to undertake. However, I do not contemplate this being the case with the San Agustin. The other that the shipwreck is more or less confined to a small area. If this is indeed the case, which I believe it to be, the "blasters" on the Rio Grande will only be used to remove the overburden. Then a grid system will be erected on the bottom over the site and the actual digging will be done by the use of airlifts and hand-fanning, in conjunction with the gathering of the archaeological data - i.e. measurements, drawings, photographs, etc.

Detailed archaeological recovery plans cannot be provided until the completion of the search phase; however, staff of Phonecian Explorations will draw up full plans at such time as the remains of the San Agustin are located and identified. These plans will be shared with qualified archeological staff from the National Park Service, the California State Historical Preservation Office, the State Lands Commission and other agencies having a legitimate interest in the recovery and preservation of such a prize. Actual techniques for such a salvage must maximize the data recovery phase to be acceptable to the partners of Phoenician Exploration, and we fully realize the value of this search to the people of California.

Once the methods and degree of salvage are agreed to, we can discuss and draw up plans for the proper conservation and display of the recovered materials. Again, it would be premature to draw up such plans until we know what we have to work with, but it is conceivable that an on-site museum could be built, as part of the National Seashore, or that institutions in the San Francisco area could share funding of the conservation effort in exchange for displaying them. As we prepare the excavation plans, and before major excavation begins, we will consult with State and Federal experts and present our detailed proposals to archeologists from these agencies for approval.

If we find that the remains of the shipwreck lay in an area of heavy sea swells, making the excavation difficult, we may have to resort to building a cofferdam around the shipwreck and working inside it, such as they are presently doing on one of the Revolutionary War shipwrecks off Yorktown, Virginia. Underwater visibility is another problem is Drake's Bay and this too may be solved with the use of a cofferdam. It is also known that Drake's Bay is the breeding grounds for the White Sharks and the cofferdam might also eliminate the dangers from these predators. If a cofferdam is not required, we will probably have to erect nets around the site to keep the sharks out of the area.

No work will commence on the site until a proper place has been established for the storage and conservation of the artifacts. A laboratory will have to be set up with qualified personnel to operate it.

I also plan to establish a group of advisors who will supervise the overall excavation of the site. Some of these will come from the State of California, the National Park Service as available, and others will be people knowledgeable in different aspects of the history of the site such as Raymond Aker and Edward P. Von Der Porten.

At this time it is impossible to determine the amount of time that this project will take but I think we should count on a minimum of three years and it could take as much as twice that amount of time. Weather and working conditions will be the main factors that will decide this issue.

CALENDAR PAGE	83.70
MINUTE PAGE	2430

ENVIRONMENTAL CONSIDERATIONS

Environmental Setting

Drake's Bay is located on the southern edge of the Point Reyes peninsula, approximately 24 nautical miles west-northwest from the entrance to San Francisco Bay.

The Point Reyes peninsula is roughly triangular in shape, with the longest side lying on the east, along the San Andreas Fault Zone. The angle opposite juts out into the Pacific Ocean, forming Point Reyes and its associated headlands. The most prominent feature of the area is the Inverness Ridge, a forested line of hills reaching a maximum elevation of about 1,400 feet above sea level. This ridge drops steeply on its eastern face, to the San Andreas Fault Zone, which is expressed here by Tomales Bay, Olema Valley, and Bolinas Lagoon. The western slopes of the ridge are gentle, and drained by many streams cut into canyons.

The curve of Drake's Bay itself is sheltered by Point Reyes, and is generally a gently shelving sandy beach. Drake's Estero projects north from the Bay into the center of the Peninsula. It is separated from Drake's Bay by a long sand spit, Limantour spit, which has a variable entrance to the ocean.

Geology

Certainly the most prominent geologic feature in the Point Reyes area is the San Andreas Fault. This fault and its rift zone can be traced for hundreds of miles from the Mendocino County coast north of Point Reyes to the desert regions north and east of Los Angeles. The northward movement of the Pacific plate, of which Point Reyes is a part, was graphically illustrated during the 1906 San Francisco earthquake. During that event, Tomales Point, the northernmost point within the Point Reyes Peninsula, moved approximately 20 feet northward in relationship to the adjacent continental land mass on the east side of the fault. Even the present shape of Point Reyes seems to illustrate the north-northwest direction of movement, for it seems to be bent by forces from the northwest, contorting the peninsula into the hook that forms Drake's Bay.

The backbone of the Point Reyes Peninsula is formed by a core of igneous (granitic) rock, which gives structure and definition to Inverness Ridge. This core is overlain by a series of metamorphic and sedimentary strata. The stratigraphy of these rocks is generally uniform and extends laterally from Inverness Ridge toward the south, west and northwest. At the Point Reyes headlands, the granitic core or basement rock of the peninsula is again exposed. Here the igneous rock is overlain by a consolidated conglomerate of well-cemented sand, gravel, cobble and boulder-sized materials. The hard and resistant nature of the granite and conglomerate along this uplifting fault has created a very impressive and dramatic series of headland cliffs.

Between the headlands and Inverness Ridge, the various sedimentary rocks, marine shales, sandstones, siltstones, and claystone form a shallow dish with its centerline running northwest-southwest through the western part of Drake's Estero. These sedimentary rocks end abruptly at Drake's Bay, forming a series of cliffs. On the more exposed side of the peninsula (Point Reyes Beach) a long, narrow, and uniform beach with hind dunes has been formed. The shore of Drake's Bay has a narrow beach, and a sand spit that lies between Drake's Estero (a flooded stream valley) and the bay also helps define Limantour Estero, which lies behind the spit. Both esteros drain through a break in the spit, whose location shifts continuously east and west due to seasonal storms.

The cliffs facing Drake's Bay are claystones and siltstones of the Drake's Bay Formation, and sandy shales of the Monterey Shale Formation. These formations are generally poorly cemented and erode rapidly; in some places the cliff faces are receding at a rate of 12 inches or more a year.

Within Drake's Bay, the immediate marine substrata are believed to be the Monterey Shale Formation and the lower sections of the Drake's Bay Formation. Overlying these substrata is a layer of unconsolidated marine sands of varying and unknown thickness.

Oceanography

The continental shelf in the project area extends farther seaward than it does along any other portion of the west coast. This area of the continental shelf, known as the Gulf of the Farallons, reaches a width of 26 nautical miles (48 km). The gulf contains two major currents that represent significant components of the northeast Pacific Ocean's circulation system. One current flows southward (the California Current), the other (Davidson Current) flows northward, and there are a number of localized eddy current systems. The California Current has a broad southerly flow, is generally close to the coast, and supplies water which is cooler and less saline than the waters farther offshore. This current normally flows along the coast from August or September through mid-November.

Toward mid-November, dominant northwest winds decline sharply. With this change in wind pattern, the cold surface water sinks and is replaced at the surface by a thin layer of warmer water. The warmer waters belong to the normally deeper Davidson Current, which runs counter to the California Current. Once it surfaces, the Davidson Current forms a wedge between the California Current and the mainland coast. The inshore, northward, and downwelling movement of the Davidson Current usually lasts well into the winter, bringing with it relatively high surface temperatures. However, by mid-February, prevailing winds shift from the south to the northwest, thus diminishing or reversing the northward flow of surface water. As a result, the California Current flows southward, carrying surface water offshore, and deeper water that is cold and dense rises up to replace it.

During each of the seasons, local geography and topography influence local current patterns. The dominant influences of the California Current and the prevailing northwest winds have an effect on the movement of sediment in the survey area that is the reverse of what would be expected. As it flows past the Point Reyes headlands, the California Current sets up an eddying effect within Drake's Bay, and onshore waves, driven by prevailing northwest winds, meet the headlands and deflect, bending east and northward into Drake's Bay. The overall effect is a localized south and east to north and west transportation system for sediment.

The movement of sediment along the Point Reyes Beach (Pacific coast area) is altogether different. While the south-flowing California Current is the dominating element, the eddying effect caused by the Bodega headlands seems to be an effective trap for most of the sediment from the north. In comparison to the California Current, the prevailing northwest winds have a much greater effect on nearshore sediment movement. However, because of the north-northeast to south-southwest orientation of the Point Reyes Beach and the prevailing surface north-northwest winds, there seems to be no significant movement of sediment. And what sediment transport there is results in material being moved past the western extent of the Point Reyes headlands where it is increasingly influenced by the California Current and ultimately carried into deeper water off the headlands. Overall, little sediment is carried to the Drake's Bay area from the north, the sands here are derived from local and southern sources.

Climate and Weather

The climate of the Point Reyes Peninsula and its immediate environs is characterized by cool, dry, foggy summers and cool, rainy winters. Because there are upwellings of colder waters during the summer, cool temperatures and fog are very common along the coast and seaward. The reverse is generally the case during the winter months, with clear but cool weather that is occasionally interrupted by storms from the southwest. High winds are common in this area, which is generally considered to be both the foggiest and windiest location of the Pacific coast. Winds of more that 100 mph are occasionally recorded. This extreme is due in part to the topography of the Point Reyes headlands. However, gale force winds along the Point Reyes Beach are also common. These high winds are most characteristic of late and early winter, and generally occur out of the north and northwest. Winter storms with accompanying winds usually confront the coast from the southeast, and as the storm system moves inland, the winds move to the northwest. End-of-storm winds out of the northwest are usually the most violent. Drake's Bay provides ships a safe refuge during the strong northwest winds, but this area has the potential for unexpected changes in wind direction due to eddying conditions.

Ocean temperatures generally show little annual variation. For example, the mean monthly surface water temperatures at the Golden Gate Bridge (Fort Point, San Francisco) and at North Farallon Island range from 50.9°F to 60.2°F and 52.2°F to 56.2°F respectively, from January to December (1926-1960).

Marine Biology

The area proposed for this permit lies within the Point Reyes/Farallon Islands Marine Sanctuary, and has had its biology studied extensively.

One of the most spectacular components of the area's wildlife is the concentration of nesting seabirds, with a population exceeding 100,000 pairs. The largest concentration of these pairs exist in the Farralon Islands, far removed from the project site, but the Point Reyes headlands, Drake's Estero, and Estero de Limantour are also important nesting areas.

The Point Reyes headlands provides nesting locations for the Common Murre, Brandt's Cormorant, Pelagic Cormorant, Pigeon Guillemot, Western Gull, and the Black Oystercatcher. The population of all these species has been increasing over the recent past and they are not threatened by the proposed project.

Drake's Estero and the Estero de Limantour provide estaurine areas for various diving birds, especially the Black Brant.

Within sight of the project area twenty three species of marine mammals have been sighted, including five pinniped species, 17 cetaceans, and one fissiped (the Sea Otter). Most of the pinnipeds (seals and sea lions) are year-round inhabitants. Again, the most important part of the sanctuary for these species is the Farallon Islands, where major breeding, pupping, and haul-out areas have been established. Within Drake's Bay, only the Harbor Seal has established haul-out areas, mostly along Limantour Spit.

In contrast, the cetacean (whale) species are all migratory through this area, especially the California Grey Whale which are usually observed each year from late November through June or July. None of the cetacean species noted with the Sanctuary spends time in the shallow waters proposed for this project.

Fish resources are abundant over a wide portion of the Point Reyes and Farallon Islands areas. The area has many factors which make it vital to the health and existence of many species.

The area has many diverse habitats, but as this project is restricted to the nearshore part of Drake's Bay, this study focuses on this particular environment. Several studies describing the fish resources of the entire area can be found in the "Final Environmental Impactment Statement on the Proposed Point Reyes-Farallon Islands Marine Sanctuary" put out by the Federal Office of Coastal Zone Management in 1980.

Drake's Bay is important as a feeding spawning, and nursery area for many fin-fish. In addition, Drake's Estero and the Estero de Limantour provide nurseries for Pacific Herring, smelt, Starry Flounder, Surfperch and Silver Salmon. Various bottom fish, such as California Halibut, Rex Sole, adult Starry Flounder and occasionally other soles migrate to the Bay at different times of the year. Sharks and rays use the Bay as a feeding ground throughout the year.

Kelp beds, an important marine community, are established within Drake's Bay. The dominent species near the project area is the Bull Kelp (<u>Nerocystis luctkeana</u>), which is an annual species. Its Winter beds represent only one to five percent of its summer extent. It does not provide the dense substructure or canopy that its better known counterpart, the Giant Kelp, does.

The benthic fauna differs greatly according to habitat type. The project site and surrounding area is smooth, featureless, sandy bottom, with little or no relief. Depending on the severity of the Winter storms, the effect of wave surge can often be felt to the bottom. As a result there is little benthic activity, with burrowing animals predominant. Sand dollars and sea urchins have been noted in the area, but not in the numbers that exist in deeper water.

Transportation and Use

Drake's Bay is outside of the main shipping lanes for San Francisco, but is a sheltered anchorage for many smaller vessels transiting the area. There is also considerable traffic from boats visiting the National Seashore.

While there is little commercial fishing done within the Bay, there is extensive use of the area by party boat anglers and private fisherpersons. The area is included in the Farallon - Point Reyes Marine Sanctuary.

ENVIRONMENTAL EFFECTS

This project will have no significant environmental effects on the area, and will, if successful, have a beneficial effect (Class IV) on the cultural artifacts.

During the initial search phase small boats using non-destructive instruments will cross the area. Since many private or party boats are already in the area this will not be a significant disturbance to either seabirds or marine mammals in the area. If this search gives good indications small test holes will be made, using small airlifts. While this will disturb benthic invertebrates at the actual site of the holes, the small diameter (6-18 inches) in the relation to the whole of Drake's Bay makes this effect insignificant.

If the ship is found and identified, major excavation could begin. A detailed plan will be filed with the permitting agencies when the site details are known well enough to make such planning meaningful; however, analysis of similar projects indicate that there is no danger of environmental effects.

The first step would be to remove the sand overburden from the main body of the wreck, using directed propellor wash. This will disturb the benthic environment over a few hundred square meters at most, including areas effected by the removed sand. Experience in other areas indicates that the invertebrate fauna will reestablish itself within 6 to 9 months following the end of the project. Under certain conditions, it may be advisable to establish a cofferdam around the site before starting work. This would ensure that no fin-fish or marine mammals would inadvertantly enter the site while work was in progress, and would further limit potential damage to the benthos.

The proposed project location is not within any of the kelp beds in Drake's Bay.

The maximum work force would include one major recovery vessel (100 feet long), up to two small skiffs, and possibly a barge. Most of this equipment would be anchored the majority of the time. all are fully self-contained. There will be no discharges to disrupt the water quality of the site. No onshore activity is proposed at this time which could disturb either seabirds or the Harbor Seals.

The remaining issue is the protection and conservation of the San Agustin herself; if she is found. The funding and staff proposed for this project are unquestioably professionally able to extract the maximum amount of archeological data from the site with a minimum amount of damage. By requiring detailed plans for professional review once the site is precisely located, we are protecting the public trust. The people of California and the nation deserve to have a site of this importance professionally evaluated.

The final phase of this proposal, conservation, is probably the most important. Again, the applicant has agreed to remove nothing from the site until specific provisions for conservation and display or storage are agreed to by the permitting agencies. It is very rare that we are presented with an application with the funding and expertise to provide for a full preservation effort. Staff believes that, if the wreck is found in good condition, a permanent display can be established that meets the needs of State and Federal agencies, and returns a priceless part of California's heritage to public view.

1061S

APPENDIX A

MAJOR OCCUPATIONS AND DIRECTORSHIPS OF CERTAIN OF THE PARTNERS IN PHOENICIAN EXPLORATIONS INC.

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CALENDAR PAGE 83.80
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