

Docent Training Manual

(Revised 2017)



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Docent Training Manual

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*“The sea has never been friendly to man. At most it has been
the accomplice of human restlessness”*
Joseph Conrad (1857 – 1924)

Mission

“The mission of the Maritime Museum of San Diego is to serve as the community memory of our seafaring experience by collecting, preserving, and presenting our rich maritime heritage and historic connections with the Pacific world.”

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This Docent Manual is designed to provide the docent with information considered essential to his or her accurate and effective representation of the Maritime Museum’s fleet, exhibits, and artifacts to visitors. Each Docent will probably find a favorite among the Museum’s fleet and desire a more in-depth knowledge of that particular vessel. Those seeking more information on a particular subject should avail themselves of the resources of the Museum library and the additional materials cited in this Manual’s bibliography.

In the years since the Maritime Museum’s first Docent Manual was prepared the Maritime Museum has acquired several major vessels, opened many new exhibits, refined existing displays and added interpretive information. As changes occurred the manual was revised and new chapters were prepared and distributed, but eventually it was recognized that a major revision was needed. The following docents joined together in writing, reviewing editing, and formatting of the Docent Manual.

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“You cannot teach a man anything: you can only help him find it within himself.”
Galileo Galilei (1561 - 1642)

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I. Maritime Museum History and Organization



Chapter I. Museum History and Organization

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Chronology

- 1926 The iron bark *Star of India* purchased for \$9,000 by Aquarium Committee of the San Diego Zoological Society with funds donated by James Coffroth
- 1927 *Star of India* towed from Alameda to San Diego to be used as harborside aquarium and maritime museum
- 1937 Reporter and historian Jerry MacMullen formed the Maritime Research Society to promote interest in preserving *Star of India*
- 1957 Australian author, maritime historian and square-rigger captain Alan Villiers visited *Star of India* and called for the public to restore the historic ship
- 1958 The Maritime Museum of San Diego was incorporated for restoration of *Star of India*
- 1963 Partially restored *Star of India* was honored on 100th anniversary of her launching
- 1966 *Star of India* recognized as National Historic Landmark
- 1973 Museum acquires historic ferryboat Berkeley to serve as headquarters and the steam yacht *Medea* is given to Museum by Paul Whittier.
- 1976 On U.S. Bicentennial, July 4th, *Star of India* sailed for the first time since 1923
- 1996 Retired San Diego harbor pilot Ed Silva donates the *Pilot* to the Museum and after an extensive rebuilding *Pilot* was re-launched in 2002.
- 2002 The topsail schooner *Californian*, official Tall Ship of California, was given to the Museum by the Hughes and Sheila Potiker Foundation of San Diego.
- 2003 *Surprise*, aka "*HMS*" *Rose*, loaned to the Museum for public display by Fox Studios and is subsequently purchased by the Museum the following year
- 2005 *B-39*, a Soviet attack submarine, is leased by the Museum for public display
- 2008 The U.S. Navy deep diving research submarine *USS Dolphin* is donated to the Museum and opened for visitors on July 4, 2009
- 2011 The keel for the *San Salvador*, the Museum's representation of Juan Rodriguez Cabrillo's galleon, was laid on April 15, marking the beginning of this major ship building project.

- 2012 On August 29, Swift Boat *PCF 816* arrived in San Diego to undergo restoration by the Swift Boat Sailors Association prior to being added to the Museum's collection of active vessels
- 2014 *PCF 816* restored to Vietnam era condition and equipped with USCG approved hand rails and seating for passengers; began providing harbor tours for Museum visitors June 2nd

History of the Museum

In 1926 the iron bark *Star of India* was purchased by the Aquarium Committee of the San Diego Zoological Society for the sum of \$9,000; the purchase amount was donated by local sports promoter James "Sunny Jim" Coffroth. The ship was towed from Alameda to San Diego in 1927 for the purpose of establishing a waterfront aquarium along San Diego's embarcadero. The zoo's ambitious plans never came to fruition due in great part to the state of the national economy at that time; thus *Star of India*, at the end of her productive sixty-year working career, became an idle fixture in San Diego's harbor—an object of many plans, dreams and schemes, none of which were successfully realized.

Ten years had passed by the time the Maritime Research Society was formed with the goal of stirring public interest in *Star of India* and contributing to her preservation. Reporter Jerry MacMullen was a driving force behind the group, but due to the economy's slow emergence from the depression and with World War II on the horizon, progress on restoration was delayed. Members of the society contributed funds and labor to effect minor cosmetic enhancements but *Star of India* needed major work.

In 1957, three long decades after *Star of India* arrived in San Diego, Captain Alan Villiers, a famous author and windjammer master came to San Diego on a lecture tour. Villiers visited the rundown *Star* with some local VIPs. He later delivered an embarrassing broadside to the "San Diego Union" calling for the public to wake up and recognize the historical value of this ship. The following year, 1958, the Maritime Museum of San Diego was incorporated for preservation and restoration of *Star of India*.

In 1963, *Star of India* was restored to respectable dockside condition and rededicated with a special christening on her 100th anniversary. As restoration work continued and a volunteer sail crew began training, in 1966 *Star of India* was recognized as a National Historic Landmark by the U.S. Department of the Interior. Ten years later, on the U.S. Bicentennial, July 4, 1976, *Star of India* sailed for the first time in 53 years.

In 1973, the Maritime Museum acquired the ferryboat *Berkeley*, the first successful propeller-driven ferryboat on the Pacific coast, and brought her to San Diego to join *Star of India* as an historical attraction and to serve as the Museum's headquarters. As

the Chronology on the previous pages indicates, other important vessels have been added to the collection making the Museum a major presence on San Diego's waterfront. (See Supplement 2 at the end of this section).

Organization

- **Board of Trustees** consists of volunteer members. The trustees elect the officers of the San Diego Maritime Museum Association. The Officers are: President, First Vice-President, Second Vice-President, Treasurer, and Secretary.
- **Staff** includes all paid employees of the Museum. The museum's multi-tasking staff manages operations, finance, marketing, public relations, volunteer coordination, curatorial and exhibit services, security, ticket sales & gift shop and library as well as a skilled maintenance crew. The senior staff position is that of Executive Director, to whom the museum staff reports.
- **Maintenance Crew** are paid employees. Each crew member brings a specialty skill to the job, but they all work on all the museum vessels. The maintenance crew draws on a large volunteer force for support on various projects.
- **The Model Shop** is manned by volunteers and supervised by a Museum employee who is a modeler and normally a maintenance crewman.
- **Museum Volunteers** may serve in one or more of the following categories:
 - **Star of India Auxiliary**, a social and fund raising organization.
 - **Docents** are trained to lead tours, greet visitors and answer questions about our vessels and exhibits.
 - **Sail Crew** members are trained to sail *Star of India*, *Californian*, and other Museum ships. They also do maintenance work for the Museum.
 - **Library Assistants** help file and catalog Library materials.
 - **Speakers Bureau Members** visit schools and organizations and give talks about various aspects of the Museum.
 - **Other volunteers** work on ship maintenance, exhibit upkeep, the model shop, general office tasks, and other activities as needed.

Finances

- The Museum is a non-profit, public-benefit corporation, qualified under 501c (3) as a tax exempt corporation. Operating revenues come from gate receipts, store sales, special events, member dues, contributions, donations, and grants from public and private sources.
- *Star of India* Auxiliary plays a special role in fund raising. Since its founding in 1963, the Auxiliary has raised hundreds of thousands of dollars for the Museum.
- The Museum's wharfage is provided by the Unified Port District of San Diego.

Educational Programs

The Museum has educational programs in accordance with its mission statement. We preserve and interpret maritime history through our ships, exhibits, programs, and publications, and keep that history alive by sailing *Star of India*, *Californian*, *Medea*, *Pilot*, *PCF 816*, and *San Salvador*.

- **“Mains’l Haul”** The quarterly historical journal of the Maritime Museum, it has been published continuously since 1964. The journal focuses on Pacific Ocean and West Coast of North America maritime history.
- **“Full and By”** The bi-monthly newsletter of the Maritime Museum. It keeps members posted on Museum events, development news, changes in personnel, new programs, and other items of interest to our members.
- **Book Publishing Program** As funding permits, books are published about the Museum's ships and collections. Recent works have included, “*Euterpe*”, “*Medea*”, and reprints of Jerry MacMullen's books “*Star of India*” and “*They Came by Sea*”, as well as a coloring book for children visiting our vessels.
- **Member Nights** Presented several times a year, member nights include feature films, slide shows, and interesting speakers on various maritime history topics.
- **The Museum Living History Program** Hosts exciting overnight programs for schoolchildren aboard *Star of India* and *Californian* by which the students are taught the meaning of teamwork. The programs focus on three periods of history: a) 1774 - The Eve of the Revolutionary War; b) 1851 - The Gold Rush; and c) 1874 - Emigration in the Great Age of Sail.
- **Museum Tour** Available to students or other groups. Currently, docents or Education Department staff lead tours for more than 5,000 children per year. Special tours are also given to many adult groups, such as ElderHostel or Road Scholar programs.
- **Speakers Bureau** Trained speakers are available to talk about Museum programs and local maritime history to city schools, civic groups, service clubs, etc.
- **Research Library** The library aboard *Berkeley* is open to visitors, Tuesday through Friday from 9 a.m. to 5 p.m. The Library houses over 5,000 books, over 11,000 photographs, and thousands of ship plans, journals, charts and other items. Museum members may check out library books, and researchers from around the world regularly consult this facility for maritime information.

Tours

- Docent-conducted tours may be arranged for groups of ten or more by calling the Museum office at (619) 234-9153. Reduced rates are provided for groups. Members are free. If special emphasis on any aspect of the Museum is requested, the Docent will tailor the tour to the special interest of the group.
- The *Star of India* orlop classroom can be scheduled for lectures or meetings related to maritime history.

Living History Programs

- The living history programs aboard *Star of India* began in 1995. Maritime living history programs have proven to be astonishingly effective at engendering interest in history while equipping students with essential life-coping skills. Students sign aboard *Euterpe* and "step back in time" on an imaginary voyage of discovery during which they are challenged with real shipboard activities that demand critical thinking and clear communication skills.
- The instructors are Education Department staff members in costume and historic character. They know nothing of the future (our present), only the past. Through the willing suspension of disbelief, students learn lessons about history and themselves that could not be duplicated in a conventional classroom.
- The educational programs aboard *Star of India* are modeled after the nationally recognized, award-winning programs on *Pilgrim* in Dana Point and aboard *C.A. Thayer* in San Francisco. The Museum's programs have been awarded the Walter Cronkite Award for Excellence in Maritime Education by the National Maritime Historical Society and the Sea Education Program of the Year awarded by the American Sail Training Association.
- Living History Programs are also provided on *Californian* and *Pilot*.

Visitor Services

- Heads (restrooms) are located on the 'tween deck of *Star of India*, on the passenger deck of *Berkeley*, and the gun deck aboard *Surprise*.
- Scuttlebutts (water fountains) are by the entrance to the Museum Store on *Berkeley* and just forward of the deckhouse aboard *Star of India*.
- The Museum store aboard *Berkeley* sells books, cameras, postcards, stamps, and gifts.
- No smoking, eating, or drinking is allowed on board any of our vessels, except during certain special events.

Supplements

1. Docent Duties and Responsibilities

Docents are trained tour guides or Museum hosts that provide factual information about the Museum and its collections. We are also ambassadors, who represent the Museum to its visitors and other members of the community in many ways. The primary objective of the docents is to enhance the Museum experience for visitors. As ambassadors, it is important to present a professional image when we are on duty.

Requirements for Becoming a Docent

- Be a member in good standing of the Maritime Museum of San Diego.
- Attend a majority of the docent training sessions held each Tuesday morning from January to March or April.
- Choose a mentor from among the roster of experienced, active docents.
- Follow at least three tours led by three different experienced docents. Include at least one adult tour and one school tour.
- Take the final examination from the docent class
- Conduct and pass a final Museum tour with a member of the docent board or their designee.

On-duty Dress Code

- Docents should wear blue, collared shirts with their name badges prominently displayed.
- Long pants are preferred but shorts are acceptable. Our goal here is to present a neat, professional appearance.
- Hats are optional.
- Neck scarves and other additions are discouraged.

Protocol for Leading Tours

- Please arrive at least 15 minutes prior to the scheduled tour.
- Greet the group on the Embarcadero and locate the person in charge.
- Have the group leader complete the financial arrangements for the tour.
- Determine the size of the group, how much time they have allotted to the tour, and any special desires or requirements they may have.
- If the group is large and multiple docents are available, divide the group on the Embarcadero and agree among the other docents where each one will begin their tour. In rare instances with especially large groups it may be advantageous to station docents in various places in the Museum to explain the area when the group arrives there.
- Decide on a meeting place at the conclusion of the tour.

- During the tour be sure to speak clearly and loudly. Make time for the group members to ask questions. Their questions will guide you in satisfying the particular interests of the group.
- Demonstrations will enhance your tour. The capstan on the main deck is a good example.
- If you encounter behavior problems, ask the teacher or other responsible adult to handle the situation. If that doesn't work, you can ask the adult to accompany the student to the Embarcadero. The adult must then stay with the student until the group returns. If a group is very unruly the docent can terminate the tour and accompany the entire group to the Embarcadero. It is appropriate to report such disciplinary actions to the docent board so they can inform the Museum. This allows feedback to the school or group sponsor.
- If you are scheduled to lead a tour and are unable to do so, please contact the designated docent coordinator in plenty of time so that you may be replaced.

Safety

- In case of fire, flooding, accident or other threatening incident:
 - **Stay with your group and lead them away from the area.**
 - **Call Security 619-921-3261 (put this in your cell phone); or**
 - **Send someone to the nearest ticket booth to report it.**

It is not your task to fight a fire, deal with water problems, remove an intruder or belligerent visitor, provide medical treatment, or take any action other than leading your group to the nearest exit and safety. In the case of a "trip and fall" accident, it is important for you to stay with the victim and follow the foregoing procedure. If a cell phone is not available, the ticket booths have telephones and paging systems with which to seek appropriate help. Once you have led your visitors to safety, stand ready to render whatever assistance is requested of you by staff.

Man Overboard

- If you see someone fall from the Embarcadero into the water or overboard from one of the Museum's vessels:
 - **Do not jump in the water.**
 - **Keep your eye on the victim.**
 - **Call Security 619-921-3261 or send someone to the nearest ticket booth to report it.**

It is of primary importance to keep an eye on the victim. If feasible, have someone seek out a life ring. They are available on all Museum vessels. Familiarize yourself with their locations so you can give proper instruction to locate one. Throw the ring near to the victim.

Deck Watch

- In addition to leading tours, docents interface with visitors to our Museum through "deck watch." This involves staffing a ship and talking or leading tours

for visitors who simply walk aboard. The dress code for “deck watch” is the same as for leading tours. Period costumes may be allowed in some instances as approved by the docent board.

Manning Museum Booths

- The Museum has occasion to set up promotional booths at boat shows and special events. The objective is to *engage* the public to encourage them to visit the Museum and to join it. The booth will usually have something to exhibit as well as a banner and promotional materials to hand out to passersby. Please keep the following in mind.
- Engage passersby by standing in front of the booth, though not in front of the banner or exhibit. These are the eye catchers and announcements of who we are. There should be one or two chairs in the booth so docents can rotate resting.
- Be familiar with what you are going to say as an opener (for instance, “Hi, have you been to our Maritime Museum?”) or make an appropriate reference to an exhibit, if there is one. Be familiar with the theme of the event and/or booth to carry on the conversation.
- Have handout materials in hand when talking to people, so you can give them something to remember us by.

Dealing with the Media

- The Museum needs to speak with one authoritative voice, so docents are requested to steer representatives of any media outlet to those who are authorized to speak for the Museum, viz., the President of the Board of Directors, the Executive Director, the Museum Media Director, or the most senior Museum official available.
- Explain to the media representatives that you are not authorized to discuss Museum policy matters or incidents or events that affect the Museum, but that you will help put them in touch with someone who is. Use the telephones at the ticket booths to find an authorized spokesperson. Docents may, however, provide information on the Museum’s exhibits as they normally do.

Logging Hours

- The Museum benefits in several ways from volunteer hours, so it is very important to record your hours. Please enter hours worked, including total travel time to and from home, in the Docent Log. The hours accumulated will be used as the basis for service awards. The log is located in the Information Booth on the Embarcadero.

A One-of-a-Kind Docent and Mentor: Barbara Sarda 1924-2002

Barbara was born in England and reached her teen-age years as her country faced a bleak future. During the war, Barbara served in the Women's Auxiliary Air Force. She had the unique experience of being knocked off of her bicycle by an incoming airplane. She came to the United States in 1946. Barbara made friends wherever she went. She was even offered the gift of an elephant from an Indian Prince she had befriended.

Barbara's first view of the *Star of India* was on its 100th anniversary. She had her son, Stefan, with her as a babe in arms. She watched him later become a member of the crew. Barbara became a volunteer at the museum in 1991, and a docent in 1994 where she served as a mentor to many newcomers and as docent chairman.

Barbara lived in this country as a British citizen. She occasionally commented on the political turmoil she observed. After the attack on 9/11, Barbara greatly admired the American Spirit and wished to join us in that Spirit. Accordingly, after living here for 55 years, she became a US Citizen in the presence of her many friends and admirers. She did this just a short time before a debilitating stroke ended her service to us and ultimately her life.



Barbara greatly influenced all who knew her. This included the Greyhound Adoption Center (she took four into her home) and the Maritime Museum. Barbara would have been welcomed by any group she chose. It was our good fortune that she chose to sail with us. Her influence on her friends is indicated by these sample statements . . .

"Barbara volunteered in almost every facet of the museum's activities. During her tenure she piled up more volunteer hours than those who had been here for over 25 years."

Elizabeth Schlappi

"For many of us the *Star* will never sail without Barbara, who always gave so much of her time and herself."

Don Lenox

"She set her sails for the best, not only in herself, but in all of us who knew and loved her."

Tommie Lenox

Barbara was ". . .gentle and wise," ". . .unstintingly generous in her gifts of perception and wisdom."

Ray Ashley

"A compassionate loving person who genuinely cared for others," "Gifted intellectually but not pedantic," "Profound wisdom and knowledge affected all facets of the museum."

John Reid

"A proper English lady."

Ray Lyttle

"The Grand Lady of the *Star*."

Gale Acker

"I find myself in an emotional swirl of sadness, mourning, tears and gratitude ... were she to witness my maudlin reaction, it's likely she would gently suggest something like, 'Well now, we'll need to get a grip on this, won't we'? Such was her knack for immediately partnering with a friend, letting others know they needn't walk alone with any burden."

Bruce Gordon

"No one is irreplaceable...the question here is how many of us it will take to replace her."

Joe Jensen

"From birth we all began climbing the shrouds of life. You undertook this with dignity and grace - always a cheerful smile and kind word, but occasionally a stern admonition...ultimately you reached the royal. 'Stepping on starboard,' you said in your delightful accent, and God answered, 'Stepping on aye, Barbara. Welcome. We have a snug harbor here where the wind is always fair and the seas calm.'"

Den Hemingway

"I will forever think of her when driving by *Star of India*. I have no doubt her spirit inhabits that ship and will continue to do so. Being knighted by the Queen would take a back seat to Barbara's affection. How fortunate we all are to have had her in our lives. I miss her terribly..."

Joe Dittler

2. Evolution of the Museum Fleet

1927 – 1973: Bark *Star of India*

Zoological Society of San Diego purchased *Star of India* for \$9,000 in 1926 for floating aquarium. Moored at foot of Ash Street (1927-1935). Minor use a tourist attraction between 1926 and 1938. In 1935 moved to State Street (1935-1959). In 1958 dry-docked at National Steel and Shipbuilding: reballasted, cleaned, painted hull, added steel belt. Moored at the Embarcadero (1959-1963). Displayed at Broadway Pier (summer of 1963). Moved to current location at the foot of Ash Street (1963-present). 1998 dry-docked for hull cleaning. 2009 dry-docked for hull cleaning and repair with epoxy-ceramic coating.

1973 – 1998: Bark *Star of India*, Steam Yacht *Medea* and Steam Ferry *Berkeley*

Berkeley purchased by MMSD in 1973, towed to San Diego, operated as a floating museum and administrative offices. In 1990 finding substantial corrosion in the bilges they were cleaned, scaled and a two-stage urethane coating was applied (water-resistant primer and closed-cell grow-foam). When dry-docked in 2003 *Berkeley* underwent extensive hull repairs and an epoxy-ceramic coating (CeRam-Kote) was applied to her hull.

Medea was presented to MMSD by Paul Whittier in 1973 after overhaul. She was taken out of service in late 1989 due to hull deterioration, the hull was sandblasted and a foam core with a multi-layer epoxy/urethane cloth coating was vacuum-applied to the exterior and the interior (below the cabin soles, except the engine room). She returned to service in 1990 and has been dry-docked on a regular basis since.

1998 – 2002: Bark *Star of India*, Steam Yacht *Medea*, Steam Ferry *Berkeley*, and San Diego Harbor Pilot Boat *Pilot*

Pilot acquired by MMSD in 1998. Completely restored then re-launched 2002, dry-docked again in 2009 and 2011 for repairs to keel and stern. New engine installed in 2012.

2002 – 2003: Bark *Star of India*, Steam Yacht *Medea*, Steam Ferry *Berkeley*, San Diego Harbor Pilot Boat *Pilot* and Replica Revenue Cutter *Californian*

Californian launched 29 May 1984 from USCG landing. Originally built and operated by Nautical Heritage Society. Donated to MMSD in 2002, restored in 2003, *Californian* dry-docked in fall, 2010.

2003 – 2005: Bark *Star of India*, Steam Yacht *Medea*, Steam Ferry *Berkeley*, San Diego Harbor Pilot Boat *Pilot*, Replica Revenue Cutter *Californian*, and Replica Frigate *HMS Surprise*

HMS Rose replica converted by Fox Studios to represent *HMS Surprise*, a French-built British prize frigate. In 2003 loaned to MMSD for public display following release of Fox movie "Master and Commander: The Far Side of the World" and purchased by MMSD in 2004. Dry-docked in 2007, certified by USCG, sailed with *Star of India* and *Californian* in November 2007. Dry-docked again in 2010, due to "hogging" not certified for passengers by USCG.

2005 – 2008: Bark *Star of India*, Steam Yacht *Medea*, Steam Ferry *Berkeley*, Replica Revenue Cutter *Californian*, San Diego Harbor Pilot Boat *Pilot*, Replica Frigate *HMS Surprise*, and Russian Navy Foxtrot Class Submarine *B-39*

B-39 was decommissioned by the Soviet government in 1994. Acquired by investors and brought to Canada for use as tourist attraction, the submarine was displayed in several locations in the Pacific Northwest. *B-39* was leased by MMSD in 2005 and opened for display.

2009 – 2011: Bark *Star of India*, Steam Yacht *Medea*, Steam Ferry *Berkeley*, Replica Revenue Cutter *Californian*, San Diego Harbor Pilot Boat *Pilot*, Replica Frigate *HMS Surprise*, Russian Navy Foxtrot Class Submarine *B-39*, and USS *Dolphin* (AGSS-555)

USS Dolphin the U.S. Navy deep diving research submarine was decommissioned in 2007. Acquired by MMSD, *Dolphin* was opened to Museum visitors on 4 July 2009.

2011 – 2012: Bark *Star of India*, Steam Yacht *Medea*, *Berkeley* Steam Ferry, Replica Revenue Cutter *Californian*, the San Diego Harbor Pilot Boat *Pilot*, *HMS Surprise* Replica Frigate, Russian Navy Foxtrot Class Submarine *B-39*, USS *Dolphin* (AGSS-555), and Spanish Galleon *San Salvador*

San Salvador's keel laid on 15 April, 2011 as construction began on the Museum's full-size representation of the Spanish galleon used in Juan Rodriguez Cabrillo's 1542-1543 expedition to explore the coast of Alta California. On 28 September, 1542 Cabrillo's landing party was the first European group to step ashore in what is now San Diego.

2012 to Present: Bark *Star of India*, Steam Yacht *Medea*, Steam Ferry *Berkeley*, Replica Revenue Cutter *Californian*, San Diego Harbor Pilot Boat *Pilot*, Replica Frigate *HMS Surprise*, Russian Navy Foxtrot Class Submarine *B-39*, USS *Dolphin* (AGSS-555), Spanish Galleon *San Salvador* and Swift Boat *PCF 816*

PCF 816 the former U.S. Navy Swift Boat arrived back in San Diego on 29 August 2012 after an absence of 44 years. The Republic of Malta's Maritime Squadron retired the vessel and donated her to the Swift Boat Sailors Association who pledged to restore the craft and turn it over to the Museum. The only operational Swift

Boat on the west coast honors the sailors and boats of the coastal and riverine force known as the Brown Water Navy. Fully restored, *PCF 816* began conducting harbor tours for Museum visitors in June 2014.

II. Star of India



Chapter II. *Star of India*

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Chronology

- 1863 Launched, Gibson, McDonald, & Arnold yard, Ramsey, Isle of Man, 14 November 1863
- 1864-1871 General cargo trade between Britain and India.
- 1871-1898 Emigrant trade between Britain and New Zealand in employment of Shaw, Savill & Albion Line.
- 1898-1901 Lumber trade between U.S., Australia and Hawaii with Pacific Colonial Shipping Line. On June 14, 1900 the U.S. Congress passed the Hawaiian Organic act, which contained a provision that *Euterpe* and four other ships claiming Hawaiian registry were to be entitled to full American Registry.
- 1901 Sold to Alaska Packers Association and re-rigged as a bark.
- 1902-1923 Operated by Alaska Packers Association under U.S. registry. Sailed annually between San Francisco and Nushagak, Alaska, in support of the Alaska salmon industry, wintering in Alameda, California.
- 1906 Renamed *Star of India* by Alaska Packers Association.
- 1923 Retired and laid up at Alameda.
- 1926-1927 Purchased by San Diego group for the San Diego Zoological Society. Towed to San Diego in 1927.
- 1927-1959 Docked in San Diego harbor in a slowly deteriorating state. Early in WWII the Navy requested that the upper masts be removed so that they would not interfere with their seaplane development and testing.
- 1959-1976 Restoration period. Navy paid to have upper masts restored.
- 1966 Designated as a Registered National Historic Landmark by U.S. Dept. of Interior.
- 1976 4th of July: *Star of India* sails again for the first time in 53 years!
- 1998 9th of August: *Star of India* is presented with the World Ship Trust Award.

History

Launching

On Saturday, 14 November 1863, an iron-hull vessel built for general cargo and passenger service under British registry was launched from the yard of Gibson, McDonald & Arnold at Ramsey, Isle of Man. Constructed of wrought iron, she was originally named *Euterpe* after the ancient Greek muse of music and lyric poetry.

The ship was constructed for the mercantile firm of Wakefield, Nash & Co. and was christened with a bottle of port wine by a Mrs. Brown, wife of Captain Brown, one of her owners. *Euterpe* was to be employed principally in the India trade, carrying cargoes of finished goods and raw materials between England and India via the Cape of Good Hope.

Euterpe was launched without topmasts, as was the custom at the time, but was fully rigged four weeks later as a three-masted ship. The building cost of the vessel was £25,000. *Euterpe/Star of India* survives today still ready to sail as the oldest active iron-hulled sailing ship in the world. For historical perspective consider that this event took place five days prior to Lincoln's Gettysburg address. In England it was the reign of Queen Victoria, a time of industrial revolution and a rapidly expanding commercial and colonial empire.

Commercial History

On 9 January 1864, *Euterpe* departed England on her first voyage with Captain William Storry in command. Four days out she collided with an unlighted brig off the coast of Wales. Damage was considerable but the captain thought repairs could be made without returning to port. However, as most of the crew refused to proceed, Captain Storry decided to put back to Liverpool for the safety of the ship and cargo, and to avoid a mutiny. When the ship reached port, seventeen of the rebellious crew were committed to jail. Aboard ship the captain's word was law, and those who disobeyed were punished.

The ship was soon repaired and set off for India with a new crew. This voyage from Liverpool to Calcutta and return took ten months. A few days after returning a fire was reported on board. Very little damage was done, but it was suspected that the fire was set by a disgruntled crewman.

On her second voyage to India, *Euterpe* was forced to slip her cable and leave Madras in the face of a Bay of Bengal cyclone. During this storm, her top masts were cut away to keep her from foundering. She was later repaired at Trincomalee and Calcutta, but on the passage home Captain Storry, her first master, died and was buried at sea.

Having experienced such misfortune on the first and second voyages, Wakefield, Nash & Co. sold *Euterpe* to East India merchant David Brown, who continued to use her in carrying general cargoes to and from India. Under Brown's captains, she made four more voyages to India.

The opening of the Suez Canal in 1869, which lopped 8,000 miles off the sea route to India, had enabled steam-powered ships to compete with sail in this lucrative sea trade. *Euterpe*, like other great wind ships of that time, was relegated to lower-priority, long-distance sea routes where speed was not as important.

In October 1871 *Euterpe* entered the heyday of her long career. With her purchase by the Shaw Savill Company (later became Shaw, Savill & Albion after a merger), her role in carrying emigrants and cargo between England and New Zealand and Australia began.

On outbound passages *Euterpe* carried up to 410 passengers—mostly emigrants—from the British Isles to the new colonies. Following the prevailing winds and currents of the great southern ocean, she returned to England by way of Cape Horn. Under the Shaw, Savill & Albion house flag she rounded the world twenty-one times, occasionally calling at San Francisco and at Chilean and European ports.

On 3 October 1897, *Euterpe* left the East India Dock, London, for the last time. After touching in New Zealand and Australia, she sailed on to Hawaii. The advancing technology of the age had displaced *Euterpe* from her appointed sea routes—this time with faster, more economical steamships capable of regular, reliable service.

Early in 1898 Shaw, Savill & Albion sold *Euterpe* to J.J. Moore of San Francisco, who in turn sold her later that year to Lincoln Spencer of Hawaii. This placed the former British ship under Hawaiian registry.¹ In July 1898, Hawaii was annexed to the United States, and *Euterpe* became a party to court fights concerning her registry. On 14 June 1900, the Hawaiian Organic Act was passed by Congress. It contained a provision that *Euterpe* and four other ships claiming Hawaiian registry, which were owned by American citizens before 12 August 1898, were to be entitled to full American Registry.

On 30 October 1900, *Euterpe* officially became an American ship, owned by the Pacific Colonial Shipping Company. From 1898 to 1901 *Euterpe* sailed between the Pacific Northwest, Hawaii, Australia and San Francisco carrying various cargoes including sugar, lumber and coal.

In January 1901 Pacific Colonial sold *Euterpe* to the Alaska Packers Association of San Francisco, a salmon fishing and canning cooperative. During a shipyard period the following winter, she was down rigged from a ship to a bark and her hull was painted black. This prepared her for her new role of carrying fishermen, cannery

¹ A temporary certificate of Hawaiian registry was issued at Seattle for the vessel by the Hawaiian consul, who, in doing so, was acting contrary to his orders from the Hawaiian executive.

workers, and supplies to the Alaskan salmon grounds each summer until her final return in 1923.

In the winter of 1901-02 extra water tanks were placed in her hold and a new donkey engine and boiler were installed in the rebuilt deckhouse. A Chinese three-pot galley was set up to starboard of the forward hatch. The poop and after cabin were extended forward to the main mast shrouds to provide quarters for up to fifty-four fishermen and cannery hands. Tiers of bunks built into the after end of the 'tween deck accommodated sixty-three more. The remainder—up to a total of about two hundred, were quartered forward.

Between March and September 1902 *Euterpe* made the first of twenty-two annual voyages between San Francisco and the salmon fisheries in Bristol Bay and Nushagak, Alaska and back. On the trip up, she was loaded with such items as coal, tin plate, box shoo (wood for making boxes), and oil in which the fish would be packed, plus the polyglot ship's company of fishermen and cannery hands.

On the return trip she brought back the same passengers, with her hold filled with cans of salmon in wooden crates. En route, the chief diversion on board was gambling, with fan-tan games operated under the aegis of the Chinese in the fishing crew. Wheel and lookout watches were performed by her small group of sailors, and all manner of maritime housekeeping tasks were accomplished and duly recorded.

By 1906 the Alaska Packers Association had a fleet of eight iron and steel sailing ships, with *Euterpe* being the first of the iron-hulled ones. They changed all of the ship names to begin with "*Star of*" following the lead of four ships purchased from the Corry's Irish Stars line out of Belfast, Ireland. In that year *Euterpe* was renamed *Star of India* commemorating her trade with that country in the 1860s.

A new anchor replacing one lost in 1907 was brought aboard during the 1907-08 winter, along with two 135-fathom lengths of chain from *Star of France*. New fishermen's quarters with berths were installed in the after part of the 'tween deck.

After arriving home on 30 August 1923 from her last trip north, *Star of India* was finally laid up with other sailing ships of the Star fleet at Alameda, California.

Establishing the Museum

Inspired by efforts made on the East Coast to save *Benjamin F. Packard*, a small group of public-spirited citizens became interested in establishing a combined aquarium and maritime museum in San Diego in the mid-1920s. After considering three available ships, the group purchased *Star of India* for \$9,000 in 1926. The money was provided by "Sunny Jim" Coffroth of San Diego after listening to an appeal by a longtime friend, Jim MacMullen. Jim's son Jerry MacMullen, a newspaper reporter, Navy veteran, and maritime historian, was an early booster for the project

and became co-founder and later president of the San Diego Maritime Museum Association.

In July of 1927 *Star of India* was brought to San Diego. The steam schooner *Wapama* towed her from Alameda to San Pedro, and the Navy offered the services of the WWI minesweeper *USS Tern* to deliver her to San Diego where she was to begin her new life as a harbor-side museum and aquarium. Her hopeful arrival in San Diego turned into a slow downhill slide for the ship because too little effort was made to maintain her. The lowest point occurred during WWII when *Star of India* was surveyed to determine the value of her iron hull as scrap, and she was declared to be composed mostly of rust and not worth the cost of cutting her up. Several months later, when the risk of turning *Star of India* into scrap had subsided, the surveyer admitted he had vastly overstated the vessel's state of deterioration to keep her from being cut up. Not long after this episode the U.S. Navy requested that her tall masts and upper yards be removed, being a menace to seaplane operations. Navy workers cut away her top hamper (upper masts, yards, and rigging) leaving only her lower masts and the two lower yards. The downward skid was finally halted and gradually reversed following a visit in 1957 by experienced windjammer captain and author Alan Villiers, who made headlines in the "San Diego Union" when he bemoaned *Star of India's* pitiful condition and called for a public effort to restore her before it was too late. Her ultimately successful restoration forged slowly ahead with growing support, and on 4 July 1976, she sailed for the first time since 1923.

Since that American Bicentennial celebration *Star of India* has ventured out of the bay with her volunteer crew for many one-day sails. (Supplement 2 at the end of this chapter lists *Star's* modern sailings.) Today the goal of *Star of India's* maintenance program is to keep her in sailing condition.

Quick Tour

Saloon

- The saloon contains accommodations and dining for the ship's officers and first-class passengers.
- Currently, there is space for six staterooms on the port side and five staterooms and a head (toilet) on the starboard. Note the shortness of the bunks. They are only 6' long.
- The captain's double stateroom is farthest forward on the starboard side. It contains a full bed.
- The pantry is used for serving food brought from ship's galley, where it was cooked.
- The saloon table has fiddle racks to keep dinnerware from sliding off when the ship is rolling.
- Note the painted glass skylight above. The skylight and painting of Euterpe are original.
- The chart room contains nautical charts, navigational instruments, books and signal flags.

- The space abaft the saloon was originally a sail locker. Part was later converted to a cabin for the captain during the Alaska Packers Association period. Note the wooden companionway steps leading up to the poop deck between this space and the saloon. During Alaska Packers days, the captain's cabin occupied the port half of this space. The starboard half was a lazarette (a place for keeping supplies).

Poop deck

- This deck has the ship's wheel (helm), a binnacle containing a magnetic steering compass, a watch bell on the wheel box, and a rudder angle indicator.
- This was the place from which the captain and ship's officers commanded the steering of the ship and the handling of the sails. Note the fine view of the entire rig from this location. Twenty sails can be set on three masts - fore, main and mizzen - for a top speed of ten to twelve knots. Average cruising speed was about five to six knots. Speed was measured by streaming a taffrail log or chip log. A sounding machine was furnished in 1911.
- The teakwood seats were used by first-class passengers in fair weather.
- When the ship was under Alaska Packers, the poop was longer (extending almost to the mainmast shrouds). See the models on the 'tween deck for the differences.

Main deck

- The main deck has wash ports, a capstan, a bilge pump and the "booby" hatch. This small hatch and a similar one abaft the forecastle provided access for passengers and crew to the lower decks.
- The main cargo hatch was used for stowing cargo below. It was covered with hatch boards and battened down before the ship left port. Note the registry and tonnage markings on the main hatch coaming. A companionway was built into this hatchway during the period of emigrant trade.
- The deckhouse contains the galley and cook's cabin. The aft portion was the carpenter's shop. A donkey engine (an engine used to raise the anchor, not for propulsion) was installed in 1901-02.

Forecastle (pronounced foc'sle)

- The foc'sle contains crewmen's berths and the anchor windlass.

Foc'sle Head

- The windlass capstan, the station for the forward lookout, the original Euterpe ship's bell, and running lights are contained on the foc'sle head.
- The decking of the foc'sle head has been replaced several times. The most recent repair, completed in 2010, included several layers of marine plywood and epoxy sealer under the Douglas fir planking.

'Tween deck

- The exhibits on the 'tween deck consist of:

- A display of the evolution of the sailing ships from ancient days to the period of the industrial revolution;
- A boatswain's locker forward (note the anchor chains);
- A world globe showing the routes of the ship's voyages including twenty-one circumnavigations of the world from West to East;
- Ship models that show *Euterpe/Star of India* in ship and bark rigs;
- House flags of Shaw, Savill & Albion, and of the Alaska Packers Association;
- On the port side typical emigrants quarters have been constructed. These quarters were set up for passages to New Zealand and then knocked down to make room for general cargo on the return to England;
- The display cases aft originally served as fishermen's bunks, which were installed during the Alaska Packer days;
- There are two lumber ports (square openings) in the stern. These were constructed when *Euterpe* engaged in the lumber trade. Timber pieces too long to fit through the cargo hatch could be loaded through these ports;
- Note also an opening to the lower hold for the main hatch on the 'tween deck.

Hold/Orlop Deck

- Note the riveted iron construction of the hull, frames, and watertight collision bulkhead.
- The orlop deck contains a small sailing vessel for children to play on and a knot board showing samples of knots used by sailors.
- Listen for pistol shrimp - their clicking can be heard through the hull.
- Observe the examples of general cargo in boxes, barrels, and crates.
- The orlop deck is sometimes used for crew rigging work or special projects.
- The mockup of a yard allows visitors to safely experience handling sails aloft while standing on footropes.

Full-length Tour

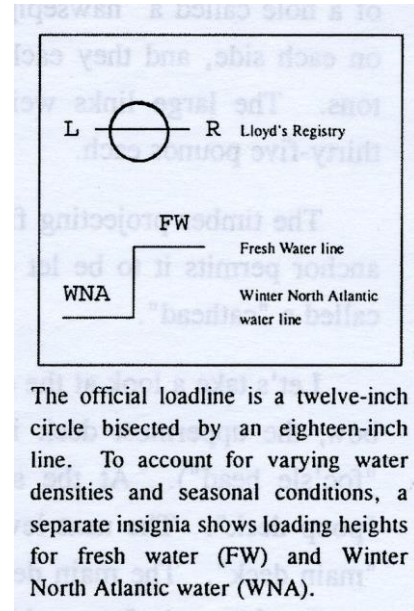
View from the Embarcadero

Note the small size of the rudder for such a large ship. It is used primarily to fine tune the direction of the ship since the primary way to steer the ship is by the set of the sails. If the rudder were any larger it would tend to be broken off by the waves coming from behind the ship.

In the mid-1870s, Samuel Plimsoll, a member of the British Parliament, came to the conclusion that the reason so many ships went to sea and never returned was because they were loaded too heavily and could not withstand the storms or sea conditions. He pioneered the issue of weight restrictions that limited each ship's maximum weight. This was done by painting lines on the outside of the ship's hull.

Even today the maximum weight is marked on ships, usually by different bands of color. If the ship were to be loaded over her marks, she could lose her insurance. On each side of the hull at about an equal distance between the stem and the stern are the Plimsoll marks or lines. The port mark can be seen from the Embarcadero.

From this vantage point, imagine a line running parallel to the deck about three feet below the portholes. The Plimsoll mark refers to the ship's freeboard and, as a safety measure, governs the draft of a ship when it is fully loaded with cargo. For a more detailed explanation of the Plimsoll mark, see Chapter XIII, Appendix D, "Plimsoll Load Line Marks."



Though not visible the bottom of the ship has been specially prepared to help it last. In August 2009 *Star of India* went into drydock for a Coast Guard inspection and some routine maintenance. Normal routine maintenance of her hull below the water line included scraping, patchwork, and painting; *Star of India* also received a layer of CeRam-Kote², a ceramic coating intending to extend the life of the her hull.

Tucked under the jibboom and bowsprit, the carved figure in the long white dress is the ship's original namesake, Euterpe. This is the original figurehead carved by George Sutherland of Glasgow, Scotland. She was damaged in one of the ship's collisions. Her left arm was restored in 1987 by carver Walter Jacobsen.

The big iron anchor hanging on the chain is coming out of a hole called a "hawsepipe." There are two anchors, one on each side, and they each weigh two to two and one-half tons. The large links weigh approximately thirty-five pounds each. The timber projecting from the ship's side just above the anchor permits it to be let go clear of the ship's side. It is called a "cathead."

As you look up at the rigging, you will notice that some lines are coated with black tar, and others are not colored. The black lines which are primarily stays are called "standing" rigging because they don't move; the others are called "running" rigging because they are moved and adjusted when sailing.

Let's take a look at the different levels—or decks. At the bow, the uppermost deck is the forecastle head (called the "foc'sle head"). At the stern, the uppermost deck is

² This is an epoxy material that creates a coating over the metal and protects it from sea life growing on it and from galvanic action eroding it. CeRam-Kote SPG fights corrosion with tiny ceramic beads that block moisture intrusion. The sprayable grout also forms a smooth, slick, dense, and hard surface that makes it difficult for marine growth to take hold. It is also more environmentally friendly than paint or other bottom coatings. The number of sacrificial anodes required to prevent the galvanic action has been significantly reduced by the use of this coating, from 30 per year to 2.

the "poop deck." The next level down from these decks is the "main deck." The main deck is the longest continuous deck running fore and aft on a ship.

One level below the main deck is the "'tween deck," distinguished on the outside by a row of portholes running along each side of the ship. The space below the 'tween deck is the "hold" where most of the cargo is carried. On our tour we will visit all the decks. When we go up or down the ladders on board, remember to hang on to the handrails and urge your tour groups to do so. These are Museum regulations.

Saloon

The saloon on board a ship was the name given to the main meeting place or assembly room. The French word for such a space is "salon"; the English is "saloon". The saloon area housed the first-class passengers (approximately twelve) and the captain and first mate. The second mate was put forward with the crew unless there was an extra empty cabin. There were originally eight staterooms, a bath and toilet, and the first-class passengers had their own pantry. There were twenty-two captains in the *Star's* sailing history. The captain's cabin is now farthest forward on the starboard side. The first mate's cabin is farthest forward on the port side. Notice the short (6-foot) berths in the first-class cabins.

The saloon's table had strips across it called "fiddle racks." These are fitted in rough weather to keep the dishes on the table when the ship is rolling. The bench backs are hinged, so that people could sit at the table or reverse the backs when the area was used as a lounge. Above the table note the curved skylight with its paintings at each end. The one of the muse Euterpe is original, while the coat of arms of the city of Liverpool is a 1960s reproduction. The Latin translates as "God has given us this leisure." The skylight is also original. On fair days it could be opened to ventilate the saloon. Heating in the saloon was provided by a small stove. The pantry was used to prepare for serving the food which had been cooked in the deckhouse galley. Food could get wet or cold when it was brought to the saloon in poor weather. The dishes are ironstone in a tea-leaf lusterware pattern.

At the forward end of the saloon is the chart room. Here the navigator spread out his charts to plot the ship's position as determined from celestial observations taken on the poop deck above. Note the two types of barometers and the signal flag locker. The mercurial barometer (the long ornate one) consists of a long tube containing mercury, with a vacuum at the top of the mercury column. The height of this column is the measure of atmospheric pressure. The other barometer, called the aneroid, has a thin circular metallic chamber partially exhausted of air and hermetically sealed so that it is very susceptible to the slightest change in external pressure. The mercurial barometer was given to the museum by T.A. McDonald. It was originally used aboard the four-masted bark *William Dollar*, one of the largest sailing ships to fly the American flag. The mercurial barometer is more accurate than the aneroid because it is not subject to the problems of mechanical devices. It is used as a standard to adjust the aneroid barometer. The navigator took daily observations of the celestial bodies with

a sextant, and with the use of the nautical almanac and tables he could reduce these observations to lines of position which established the ship's location at sea. The captain rarely trusted anyone else's judgment fully, so he also took readings of his own.

Signal flags were developed in an international code so that ships at sea could identify and communicate with each other in the days before wireless telegraph and radio. The flags were also used to relay messages to port by way of another ship heading that way.

The large space abaft the saloon and the companionway ladder was originally a sail locker. At one time it was used as the Maritime Museum's office. Now it is an exhibit area and place where visitors can sit and rest. The vertical shaft passing through this space is the rudder post. Aft of the rudder post is an artist's rendering of *Star of India* under sail and about to pass Point Loma on November 11, 1984. The photograph on the port side shows *Euterpe* just prior to her launching in 1863.

The saloon area was substantially changed when the ship was operated by the Alaska Packers Association (1901-1923). The chart room was removed and the deck above was extended forward almost to the main mast. This was done to make room for the fishermen the ship carried to and from Alaska. In 1912-13, additional berths for fishermen were built in the 'tween deck aft. The Chinese were put below and forward; the Mexican-Americans below and aft; and the Americans and Scandinavians occupied the enlarged saloon area. The Asians had their own galley and did their own cooking. During restoration the saloon was returned to its original size and design. The walnut panels with maple moldings, the table, the settee and most of what is seen today is thought to be original.

Poop Deck

For many years English-speaking people have called the raised rear deck of a sailing ship the "poop deck." This term is derived from the Latin word "puppis," meaning rear end of a ship, or stern. The poop served a number of purposes. Its main function was to form a platform from which the ship was controlled.

The captain and mates sailed the ship from this deck. The wheel was here for two major reasons. One, the helmsman often steered with the sails as close to the wind as possible, and to keep them full—known as sailing "full and by"—he had to be in a position where he could see them to check their trim. Two, the rudder post came up through the deck at the stern and was connected to the wheel at this point.

The wheel is used to steer the ship. It is connected to the rudder by a wormgear mechanism, technology which came into use around 1850. This gear can be seen by lifting the cover on the housing behind the wheel. Like almost everything on *Star of India*, it still works.

The helmsman stood on the windward side of the wheel facing forward. In stormy weather another sailor would stand on the leeward side to help the helmsman keep the ship on course. It was difficult to see what was happening ahead while at the helm, so a lookout was stationed on the foc'sle head.

Ringling the time on the watch bell was also the duty of the helmsman. The clock at the top of the ladder kept the official time for the ship. In earlier times a half-hour glass had to be turned and this was signaled by ringing the bell. A series of eight bells was rung every half hour in four hour increments, beginning at 12, 4 and 8 o'clock.³ These ringings were answered on the ship's bell on the foc'sle by the forward lookout. If he failed to answer someone would be sent to see what had happened to him. This system defined the four-hour watches stood by most of the crewmen. The lookout stood only a two-hour watch because of the importance and danger of his task. If he saw danger ahead, it was his responsibility to ring the ship's bell rapidly. This would signal all hands on deck—"we have trouble."

The compass forward of the wheel was in constant use by the captain and the helmsman to guide them in keeping the ship on course. The helmsman, when not steering full and by, followed a compass course as directed by the captain or the mate on watch. The compass is housed in, and protected by, the binnacle. There are lamps on either side of the hood to illuminate the compass at night, and the iron compensator spheres helped offset the magnetic influence of the ship. This compass binnacle originally belonged to *Star of France*.

The companionway provided access to and from the saloon and sail locker. It is made of teak. The captain would use this ladder when proceeding from the chart room to the poop deck to check the compass, take sextant readings, and give the latest instructions to the helmsman.

In fair weather, first-class passengers were allowed up on this deck to enjoy the fresh air and sun and to stretch their legs. On Sunday, weather permitting, the captain would hold church services here and participants would sit on the teak-wood benches.

The club-like wooden pins inserted through the rails here and all around the rails of the ship are used to secure and make fast or belay the running rigging. They are called belaying pins, and they are located on pinrails and fiferails.

The ship's officers took daily sights with a sextant from the poop deck and then, with the measured angles of the celestial bodies in hand, they went below to the chart room to calculate the ship's position at the exact time of the observation. Each ship carried at least one chronometer since time is a vital element in establishing a ship's position by celestial navigation.

³ 1 bell – 12:30; 2 bells = 1:00; 3 bells = 1:30; 4 bells = 2:00; 5 bells = 2:30; 6 bells = 3:00; 7 bells = 3:30; 8 bells = 4:00. And then the cycle would begin again – 1 bell – 4:30 ... etc.

Originally *Euterpe* was rigged as a ship with five yards on every mast. The crew was about thirty. When the Alaska Packers Association purchased the ship they replaced the iron mizzen mast with a wooden mast and a topmast. These were topmast-rigged with a boom and gaff, a spanker sail, and a mizzen topsail. (Later the Alaska Packers used a mutton spanker). This changed *Euterpe* from a "ship" to a "bark," which allowed the crew size to be reduced, reduced aft weight to enable the poop to be extended without increasing the draft aft, and also provided improved maneuverability for the vessel. Note how different the mizzen mast is from the fore and main masts.

The mizzen's boom and gaff are approximately in line with the ship's keel, while on the two remaining square rigged masts forward the yards are set at approximately 90 degrees to, or "square" with the ship's keel when at rest. The lower sections of each of the original three masts and the lower yards were made from wrought iron.

Star of India's original sails as a full-rigged ship were made of flax (heavy linen). When the ship was moved to San Diego, only two of her original sails were left: a jib and one of the lower topsails. They bore the stenciled three-legged emblem of the Isle of Man. When the restoration began here, no sailmaker could be found who knew how to design and fabricate sails for square-rigged vessels.

It took several years and 21,000 square feet of material to make all of the sails. Since flax was no longer available, a durable synthetic canvas was used. Under full sail as a bark *Star of India* now uses up to twenty sails. The sails are bent to the yards each spring so that they can be set during the spring, summer, and fall. Most are taken down in the fall for inspection and maintenance during the winter rainy season.

Euterpe was not a particularly fast vessel, and she never made the trip to New Zealand in under one hundred days. The passage usually took three to four months. On one passage it took five months to get to New Zealand. A shade under 12 knots was her best record run for any 24-hour period. A knot is one nautical mile per hour. A nautical mile is one minute of arc on a great circle of the Earth or about 6,076 feet.

Main Deck

The hatch abaft the main mast, plus a similar one abaft the foc'sle, provided access to the 'tween deck for passengers and crew. This after one, called the "booby hatch," was originally half this size but was widened for easier Museum visitor access. Notice the coaming that must be stepped over. Its purpose was to keep water out when the main deck was awash.

The capstan is a revolving drum for hauling on lines used to control the sails. The one forward of the companionway provides a significant mechanical advantage for handling the running rigging. The line is wound around it a few times and then crew members rotate the capstan by pushing oaken poles, or capstan bars, that are

inserted in the holes around the top of the drum. A topsail yard weighs over 3,000 pounds, so this mechanical assistance is helpful in lifting it. There is another capstan on the foc'sle head which is used to lift the anchor (or other heavy loads).

Wash ports and scuppers were built into the upper sides of the ship to let sea water drain off the main deck quickly. In the ship's log the First Mate made entries such as "winds of gale force—seas mountain high—ship laboring in a most distressing manner—shipping great quantities of water fore and aft." The square ports on either side of the main deck (wash ports) were used to rid the ship of water splashed aboard by rough and stormy seas. *Star of India*, being overbuilt, earned a reputation as being a "wet" ship.

Aft of the main mast is the ship's original hand-operated bilge pump. It was used to pump water out of the bilges as necessary. Too much water in the bilges was dangerous and could lead to a ship sinking. The riveted, wrought iron construction, however, made for a relatively dry bilge, so the pump was seldom needed. Normally, two men would operate the pump.

Forward of the main mast is the main hatch, which was used for loading and unloading cargo from the 'tween deck and hold. These decks can be seen by looking down through the hatch. Cargo was loaded by cockbilling (adjusting to a diagonal position) the main yard and the mainstay tackles over the hatch so that the yard could be used as a cargo boom. Whips and falls were employed to work the cargo off the pier and into the hold. Once loaded, the hatch was covered over with planks and canvas tarpaulins which were secured by battens and wedges on the hatch coaming to provide a water-tight seal.

On some of *Euterpe*'s voyages a companionway was built for access through the main hatch. It was liable to be washed away by a boarding sea, with consequent flooding below decks.

The deck bitts have a special provision for extra ventilation to the 'tween deck. The caps on each upright hollow bitt could be partly unscrewed to allow air to pass under the cap down into the 'tween deck.

The deckhouse has gone through a number of changes under the numerous owners of the ship. When she was serving as *Euterpe*, the after end was used by the sailmaker and ship's carpenter. The Alaska Packers Association lengthened the deckhouse and installed a donkey engine, boiler, and water tank in the after end.

In the center section of the deckhouse is the galley, where food was cooked for the ship's company, passengers, 200-400 emigrants, and later, under the Alaska Packers, fishermen. The Chinese cannery workers of the Alaska Packers had their own galley forward on the starboard side of the main deck. Each passage of approximately four months to Australia and New Zealand began with fresh food, pigs, sheep, chickens, and liquor for first-class passengers. Food was rationed for second-

and third-class passengers, and water was rationed for everyone. The animals were penned atop the main hatch. The stove in the galley is similar to the one installed by Alaska Packers. The stovepipe, in sailor's parlance, is called the "Charlie Noble."

The forward end of the deckhouse was used in part as living quarters for the "idlers" or non-watchstanders, such as cooks, apprentices, the ship's carpenter, and the sailmaker. A coal bin was also located here to hold fuel for the galley stove and the donkey engine.

The small hatch abaft the foc'sle (forecastle), as well as the similar one abaft the main mast, were used by passengers (emigrants) to come on deck during times of good weather at sea. Legend has it that crewmen aboard sailing ships thought passengers were foolish to travel such long distances under the confining conditions they encountered, so called them "boobies." Since they used such hatches, they often gained the name "booby" hatch, like the one abaft the main mast.

The foc'sle is where the seamen lived and slept when off watch. In *Euterpe*, twenty-five bunks were in the foc'sle, and an earlier log windlass was located on the foc'sle head above. The Alaska Packers installed the current windlass. Fewer bunks were needed then, as fishermen also served as crew. The bunks are six feet long. Sea chests were used by sailors for their extra clothing and for personal belongings. The two small locked spaces on either side of the openings to the foc'sle served as a head (toilet), and a store room or lamp locker where oil for the lamps was stowed.

Foc'sle Head

This raised partial deck is called the foc'sle head. As noted earlier, the decking was rotten and had to be repaired. This repair was more than plank replacement but was designed to maintain the look of the original material. The decking repair was done in layers. The entire hardware was removed and the rotten wood was taken off until they got down to the iron frame. This was cleaned and sealed to protect it from rust with an epoxy and rust preventive coating. The next layer was done with shims and cedar boards to look from the underside like planking. On top of this, layers of marine plywood were laid down and topped by fiberglass to add thickness and moisture wicking and thereby prevent more rotting. Finally, a layer of fir 1.5x5 boards were laid down. This was then sealed and all of the hardware replaced.

This deck served an important function at sea as the station for a forward lookout. The watch schedule was set so that one man was stationed here at all times when the ship was underway to be on the lookout for possible collision and other hazards, and especially during conditions of poor visibility. Because of exposure to the weather this area was one of the roughest duty stations on the ship. It was no wonder that the lookout watch was only for two hours rather than four. Note the distance back to the poop deck. Another important function performed here was anchor handling and a capstan is located here. This capstan and the windlass below it were used for raising

and lowering the anchors. This raised deck also served to keep large amounts of water off the main deck in rough seas.

Note also the two kerosene lamps. These are the running lights. They were kept lighted at night to increase the ship's visibility and give lookouts on other ships an idea of the ship's heading. The starboard light has a green lens and the port light has a red lens.

The large ship's bell is the original one from *Euterpe*. Although the name of the ship has changed, traditionally the original bell stays with the ship. This bell was used by the lookout as an alarm bell to alert the ship to impending danger. He also used it to answer the helmsman's bells that marked the passage of time. The ringing of the bell also ensured that the lookout was on station and awake. The helmsman kept track of the time by means of a thirty-minute sand glass.

When raising the anchor, the sailors manned the capstan to turn the windlass below and heave in on the chain and anchor. When the anchor came into sight after having broken clear of the bottom, a sailor went over the side with the cat-fall, which was suspended from the cathead, to put a hook in the ring of the anchor.

The anchor was then hoisted up to the cathead by taking the catfall to the capstan. The heavy tackle coming from the topmast head—called a fish fall—was hooked onto the crown (arc and flukes) of the anchor, which was then hoisted on deck. The anchor chain was unshackled and the hawse pipes were filled with bags of oakum called "jackasses." These bags kept water out of the foc'sle.

Letting go the anchor was much the same process in reverse. The anchor was suspended under the cathead by the chain stopper until the order was given for the ship's carpenter to knock out the wedge releasing the chain pennant. A video of the anchoring procedure is available from the library aboard *Berkeley*.

During Alaska Packers days the windlass was connected by way of a continuous chain with the deckhouse donkey engine, which provided the power necessary to heave in on the anchor. The openings in the capstan's base are where the chain entered.

In 1915-16 *Star of India* had two derricks installed, one at her foremast and the other at her main mast. These were used mainly to launch her boats, which were carried on skids over her deckhouse and at her quarterdeck. Davits were also furnished for the ready lifeboat, forward of the break of her poop.

‘Tween Deck

The displays on the ‘tween deck demonstrate the evolution of sailing ships from ancient days to the period of the industrial revolution. Notice the dates on the overhead beams. The exhibit starts with a representation of a stone carving/painting of

a boat with a sail. Following this along the starboard side toward the bow you will see models of small sailboats, a caravell, *Mary Rose*, *Vasa*, *Batavia*, and Nelson's *HMS Victory*. Notice that these models start primarily as cargo vessels and progress to warships with guns. The next display is a depiction of Admiral Lord Nelson's famous battle at Trafalgar, where he defeated the French and Spanish fleets. Following this you will find a display about technology innovations, a model of *SS Great Britain* (1843), and three models of *Euterpe/Star of India* (1863). The three models show *Star* rigged as a ship, rigged as a bark, and with later modifications made during the Alaska Packers period.

Next is a world globe with lights that indicate the routes of the ship's voyages including twenty-one circumnavigations of the world from west to east. The four routes represent *Star*'s working career, India trade, the New Zealand/Australian, voyages, the Pacific/Hawaiian trader, and the Alaska Packers era. Visitors must circle the globe to view all the routes.

Following the globe comes the beginning of the story of the restoration of *Star of India*. In the 'tween deck area are the house flags of the Shaw, Savill & Albion line, and of the Alaska Packers Association.

The large inlaid wood world map on the forward bulkhead shows the main trade routes sailed by *Euterpe/Star of India* during her long career: England to India via the Cape of Good Hope, England to New Zealand or Australia and back via the Cape of Good Hope (out) and Cape Horn (return); Hawaii to U.S. and Australia; and San Francisco to Bristol Bay, Alaska.

The heavy sheet of iron plates forward is a watertight collision bulkhead. It extends from the main deck into the bottom. Its purpose is to provide a watertight barrier in case of a bow-on collision. The idea under such circumstances was to confine any flooding to a small area forward of the bulkhead. Access to the boatswain's locker and the anchor chain locker is through the watertight door in this bulkhead.

Various ship's work takes place in the boatswain's locker to overhaul and maintain gear necessary to keep the ship in an operational sailing status. Notice the chain locker through the small hatch. There are 135 fathoms of chain shackled to each anchor.

Aft of the boatswain's locker is a display showing what the sailors did in their spare time—building models, carving ivory, playing musical instruments, etc.

Over the years, the 'tween deck served a variety of uses as a place for storing or housing general cargo, passengers, lumber, cannery workers, and fishermen. During the emigrant days, passengers to New Zealand and Australia lived in the 'tween deck. When emigrants traveling from England to New Zealand and Australia were carried, temporary bunks and compartments were built here for up to four hundred people.

Families were berthed in the center area, while single women were housed in the stern and single men in the forward end of the deck.

Accommodations were crude. Flimsy curtains divided individual areas. On the port side typical emigrants' quarters have been constructed. These were set up for passages to New Zealand and then knocked down to make room for general cargo on the return passage. In the center, tables and pot holders have been constructed that would have been found during the emigrant voyages. Notice the drawings on the walls showing what the area was probably like during these voyages.

Aft of the emigrant quarters are examples of the various methods of carrying cargo. They used chests, barrels, crates, and bags, plus other things to carry cargo. This cargo included food, clothes, disassembled furniture, coal, etc.

Just past the cargo display in the center is a display of the use of pulleys to make work easier. This allows visitors to pull on the ropes to feel the difference that pulleys can make in lifting three identically weighted bags of sand.

Note the display cases in the after end of this deck. They were originally bunks, which were put in for fishermen in the Alaska Packers days after 1901. The Alaska Packers made many changes to the 'tween deck. They also installed rows and rows of bunks—some three-deep down the center. These display cases now contain musical instruments, carved figureheads, small model ships with different sail rigs, and tools used by the sailors.

At the stern, cut into the ship's counter, are two large square openings. These were constructed when *Euterpe* engaged in the lumber trade. These were lumber ports, which permitted the loading and unloading of timber which was too long to be put down through the main hatch. When the ship was fully loaded these ports were covered and dogged down tight. The bars across the ports were added later for safety purposes.

The glass-fronted exhibit cases are self-explanatory and relate to various aspects of maritime history. The free-standing panels are also used for various types of exhibits including the pictures of fishing boats sketched on the sides of these former bunks. They may have been made by Alaska Packers fishermen.

Note also the two house flags of the Shaw, Savill & Albion and the Alaska Packers Association. These flags were flown at the main truck when the ship was leaving or entering port, or upon signaling another vessel at sea.

The Hold

The entire hold was originally open like the area forward of the foremast. The partial deck, or "orlop" seen here, was installed by the Maritime Museum for exhibit

and maintenance purposes. Along the starboard side is a label showing the waterline of the ship as she now rides in the water.

Listen carefully against the side of the hull for a clicking sound. This sound is emitted by inch-long shrimp, commonly called "pistol shrimp," outside in the water. They cock a hammer-like claw, and then snap it—thus paralyzing their prey with the sound.

Note the ship's ribs, which run transversely, and the stringers that run fore and aft. The raised strip running down the center, which is called the box keelson, reinforces the keel below. The three masts of the ship are stepped into the keelson. Iron plates were riveted together to form the hull. The plating is 13/16-inch thick from the garboards to the upper part of the bilge, and the frames are spaced every eighteen inches—thus making a very solid hull. Other hull plating thicknesses are: at the waterline 15/16-inch, 'tween deck 3/4-inch, and main deck 5/8-inch. This "overbuilding" (Lloyds changed the regulations soon after her construction) has undoubtedly contributed to the longevity of *Euterpe/Star of India*.

In the bilge are heavy slabs of concrete ballast. The ballast is necessary to stabilize the ship to counteract all the weight above. Currently approximately eight hundred tons of ballast is in *Star of India*.

Cargo could be shipped in barrels or boxes, or could be stowed loose when it was in bulk, such as coal or grain. Provisions for the ship's company and passengers were also stowed in barrels. The method for loading cargo was very important, since it could not be allowed to shift and endanger the stability of the ship. Under the Alaska Packers, on the return to San Francisco, *Star of India* could carry 20,000 to 35,000 cases of canned salmon stored in the hold and 'tween deck.

The knot display includes virtually all those used on the old sailing ships. Some sailors became very skilled at tying knots and were probably the inventors of macramé. Various turksheads, braidings, servings, and other fancywork appear on stanchions and railings about the ship. Sailors also did scrimshaw. They etched designs on whalebone and filled in the cuts with ink.

The tank aft of the main mast was used for fresh water. It was filled prior to a passage. The ship's coal-burning evaporator could make a limited amount of fresh water. During *Euterpe* times, one hundred gallons of fresh water a day could be distilled from salt water. New apparatus installed by Alaska Packers could distill as much as thirty-five gallons per hour. Barrels, which were filled before the ship left port, were also used for fresh water. *Euterpe* originally had two 4,000 gallon tanks. Under the Alaska Packers, *Star of India* could carry 17,915 gallons in six tanks.

The *Star of India*'s present tank holds 6,000 gallons of water. Fresh water was conserved carefully, and was used mainly for drinking and cooking. Salt water was used for bathing and washing clothes.

Running alongside the keelson are two small tracks with pull ropes between them. A small car with wheel casters enables the crew to go quickly back and forth with their tools and equipment. This is the "Captain's Railroad." It was not in the original ship. It was installed during the restoration process to make easier the difficult job of keeping the bilge clean, free from rust, and painted.

Specifications

Launched:	Saturday, 14 November 1863 at the yard of Gibson, Mc Donald & Arnold, Ramsey, Isle of Man. Constructed of wrought iron with two decks and two watertight bulkheads.
Owners:	Wakefield, Nash & Co., David Brown, Shaw, Savill Company (later Shaw, Savill & Albion), J.J. Moore, Lincoln Spencer of Hawaii, Pacific Colonial Shipping Company, Alaska Packers Association of San Francisco, San Diego Zoological Association and the Maritime Museum of San Diego.
Length:	205 feet at waterline; 278 feet overall
Beam:	35 feet
Draft:	21 feet 6 inches loaded
Tonnage:	1197 as <i>Euterpe</i> ; 1247 as <i>Star of India</i>
Passengers:	416 in 1874 was the most carried
Power:	20 sails (approx. 20,000 square feet) bark rig
Main Mast:	124 feet 8 inches (main yard 72 feet)
Speed:	5 or 6 knots average; best 24-hour run 284 miles (average 11.8 knots)
Hull:	Wrought iron; a steel band was added at the waterline during restoration

Supplements 1 thru 5

1. Voyages and Masters of *Euterpe* During the India Trade

Sailed from	Sailed to	Returned to	Master
Liverpool, England 9 Jan 1864	Calcutta, India	Liverpool, England 15 Nov 1864	William J. Storry
Liverpool, England 31 Dec 1864	Calcutta, India Madras, India Colombo, Ceylon	London, England 29 Nov 1866	William J. Storry* A.J. Whiteside
London, England 23 Feb 1867	Calcutta, India	London, England 22 Jan 1868	William Murton
London, England 25 Mar 1868	Colombo, Ceylon Calcutta, India	London, England 10 Jul 1869	John Kyle
London, England 31 Aug 1869	Bombay, India Rangoon, Burma	London, England 6 Oct 1870	William Cosens
London, England 5 Nov 1870	Bombay, India	Le Havre, France 4 Oct 1871	William Cosens

* *Euterpe* was dismantled on this voyage; Captain Storry died en route home, and *Euterpe* was brought in by the First Mate.

1. Voyages and Masters of *Euterpe* during the Emigration Period

Sailed from		Sailed to		Returned to		Master
London	23 Dec 1871	Melbourne, Aus ⁴	20-1 Apr 1872	London	21 Oct 1872	T.E. Phillips
London	4 Dec 1872	Dunedin, NZ ⁵ Newcastle, Aus San Fran, CA ⁶	4 Apr 1873 28 Jun 1873 24 Sep 1873	Falmouth, Eng. Antwerp, Belg. London	3 Mar 1874 18 Mar 1874 8 Apr 1875	T.E. Phillips
London ⁷	28 Apr 1874	Capetown, S.A. ⁸ Wellington, NZ ⁹ San Fran, CA	3 Jul 1874 30 Aug 1874 Dec 1874	Liverpool	2 Oct 1875	T.E. Phillips
London ¹⁰	13 Dec 1875	Lyttelton, NZ ¹¹	11 Apr 1876	London	8 Oct 1876	T.E. Phillips
London ¹²	1 Dec 1876	Dunedin, NZ Callao, Peru Iquique, Chile	4 Apr 1877 2 Jul 1877 18 Oct 1877	London	3 Apr 1878	T.E. Phillips
London ¹³	5 Jul 1878	Dunedin, NZ ¹⁴	21 Oct 1878	London	23 May 1879	T.E. Phillips
London ¹⁵	2 Aug 1879	Lyttelton, NZ ¹⁶	24 Dec 1879	London	30 Jun 1880	T.E. Phillips
London ¹⁷	25 Oct 1880	Wellington, NZ ¹⁸ Timaru, NZ	8 Feb 1881 23 Mar 1881	Falmouth, Eng. Bordeaux, Fra. London	25 Jul 1881 8 Aug 1881 14 Sep 1881	T.E. Phillips

⁴ No passengers.

⁵ 104 passengers: 4 cabin, 98 steerage, 2 infant (3 born 1 died). Back in London one crew died working over the side.

⁶ Loaded cargo for Dickerson, Wolf & Co.

⁷ 410 passengers (407 assisted).

⁸ Stopped for water and distiller repair.

⁹ Off loaded 410 souls. 2 deaths, 6 births, 1 AB lost overboard.

¹⁰ Capt. C. McBarnet of the 95th Highlanders, a saloon passenger, committed suicide on 20 Dec. 1875

¹¹ Arrived with 30 passengers. Steward died of erysipelas. Apprentice Oswald Letts died falling from aloft 24 Jul 1876.

¹² Departed Gravesend with 2,400 tons general cargo, 7 tons powder, and 48 passengers.

¹³ Left London with 29 crew, 3 apprentices, and 44 passengers.

¹⁴ Off loaded 44 passengers, 2,000 tons cargo including 6,169 packages, 316 packages powder

¹⁵ Towed to Gravesend. SS *Talfour* struck *Euterpe*, broke her moorings, drifted down on bark *Hanman*. *Euterpe*'s hull plates stove in, head gear and figurehead damaged, two men injured, taffrail and steering gear severely damaged. 14 Nov 1879 main hatch cover carried away, 'tween deck flooded.

¹⁶ Arrived with 12 cabin, 154 2nd class and 3rd class passengers. First vessel to berth at extension of Gladstone Pier, stuck in mud for 3 days.

¹⁷ Left Gravesend with 3 passengers aboard.

¹⁸ Arrived with 8 passengers (as per newspaper), carrying new hospital furniture. Loaded 1,600 bags of grain.

1. Voyages and Masters of *Euterpe* during the Emigration Period (cont.)

Sailed From		Sailed to		Returned to		Master
London ¹⁹	19 Oct 1881	Wellington, NZ ²⁰ Lyttleton, NZ	7 Feb 1882 18 Mar 1882	Dunkirk, Fra. London	7 Aug 1882 7 Sep 1882	T.E. Phillips
London ²¹	9 Oct 1882	Sydney, Aus ²² Newcastle, Aus ²³	6 Feb 1883 12 Mar 1883	San Francisco Liverpool	7 Aug 1883 1 Mar 1884	T.E. Phillips ²⁴
Glasgow, Scotland ²⁵	9 Apr 1884	Dunedin, NZ ²⁶ Napier, NZ	1 Aug 1884 3 Oct 1884	London	4 Apr 1885	G.E. Hoyle
London ²⁷	9 Jul 1885	Auckland, NZ ²⁸ Napier	6 Nov 1885 5 Dec 1885	London ²⁹	28 Jun 1886	G.E. Hoyle
London ³⁰	20 Aug 1886	Auckland, NZ ³¹ Napier, NZ Lyttleton, NZ	12 Dec 1886 24 Jan 1887 30 Jan 1887	London	10 Aug 1887	G.E. Hoyle H. Boorman ³²
London ³³	3 Oct 1887	Melbourne, Aus ³⁴ Pt. Chalmers, Aus ³⁵		London	7 Aug 1888	H. Boorman

¹⁹ Left Gravesend with 23 passengers and 6 brood mares.

²⁰ Apprentice D. Peddie died of consumption on 10 March. Arrived with 26 passengers (per newspaper). Six mares from son of late Sir Donald McLean to Messrs. Bethune and Hunter.

²¹ Crew of 39, 3 apprentices. 25 Oct left Plymouth with 371 immigrants aboard.

²² Ten deaths, including steward (of dysentery), 2 children of scarlet fever.

²³ Loaded 992 tons of coal.

²⁴ Capt. Phillips takes over command of ship *Zealandia* Mar 1884.

²⁵ Capt. Hoyle in command. Mrs. Hoyle and their child and 28 passengers aboard. 9 Apr collided with *SS Canadian*. En route theft incident, 2nd mate drunk, three stowaways, one stowaway (John Campbell) fell from aloft and died. A cabin passenger (Francis D. Orr) died of dropsy.

²⁶ Off loaded 28 passengers (6 saloon, 22 in 2nd cabin) 1,700 tons cargo: pig iron, a boiler, 600 drums of oil, coal, small and large pipes, bluff pipes, whiskey casks, tanks, and general cargo.

²⁷ 33 passengers. One died of consumption. 6 & 20 Aug actors presented plays "Box and Cox" and "A Regular Fix".

²⁸ Off loaded 36 passengers (per newspaper), cargo of cloth, clothing, millinery, dried goods, hardware, household merchandise, etc.

²⁹ Enroute a ship's boy, W. George, died.

³⁰ Departed London with 3 apprentices, 17 passengers, including Mrs. Hoyle and two family members.

³¹ Grounded temporarily at Takapuna Beach in mud. Off loaded 21 passengers (per newspapers) and cargo of store goods, hardware, spirits, millinery, sundries, furniture, construction materials, groceries, 20 tons of gunpowder, to A. Heather, agents. Capt. Hoyle received a testimonial from passengers.

³² Capt. Hoyle and his family disembarked at Lyttelton. Capt. Boorman became master on 8 Feb 1887.

³³ Severe storm, boom of spanker broke off, broke steering wheel.

³⁴ Discharged 3,000 packages of gunpowder in stream. Moved to Williamstown wharf, discharged cargo, painted sides, took on ballast & water.

³⁵ Took in cargo of wool, tallow, coal and coke. Unloaded ballast; maintenance work done.

1. Voyages and Masters of *Euterpe* during the Emigration Period (cont.)

Sailed from		Sailed to		Returned to		Master
London ³⁶	29 Oct 1888	Wellington, NZ ³⁷ Port Pirie, NZ ³⁸ Iquique, Chile ³⁹		Falmouth, Eng. Hamburg, Ger.	18 Mar 1890	T. Bowling
Hamburg ⁴⁰	21 May 1890	Melbourne, Aus ⁴¹ Napier, Aus ⁴²		London	2 May 1891	T. Bowling
London ⁴³	13 Jul 1891	Wellington, NZ ⁴⁴		London	17 May 1892	R. Streater
Glasgow ⁴⁵	13 Aug 1892	Pt.Chalmers, NZ Dunedin, NZ ⁴⁶		London	12 Sep 1893	R. Streater
Glasgow ⁴⁷	2 Dec 1893	Auckland, NZ Dunedin ⁴⁸		London	17 Jan 1895	R. Streater
London	2 Feb 1895	Liverpool, Eng	19 Feb 1895			A.S. Banks
Liverpool ⁴⁹	9 Apr 1895	Wellington, NZ Dunedin, NZ Napier, NZ		London	29 Apr 1896	A.S. Banks
Glasgow ⁵⁰	19 Jun 1896	Dunedin, NZ Wellington, NZ		London	29 May 1897	A.S. Banks

³⁶ 7 passengers, 28 crew.

³⁷ Off loaded passengers and cargo of flax and powder. Loaded hides, wool, tallow, and coal.

³⁸ Off loaded coal, loaded ballast.

³⁹ Loaded sacks of nitrates. Drafts 21'3" forward, 20'11" aft.

⁴⁰ Capt. Bowling and 26 crew joined at Brunshausen (on Elbe west of Hamburg). Loaded 1,249 kegs and 19 cases of gunpowder. Returned to port to repair split topmast. Pilot left at Cuxhaven. Draft 20'11" forward, 20'7" aft. Shifted cargo aft.

⁴¹ Discharged powder at Williamstown powder grounds. Wheel replaced.

⁴² Loaded bales of wool, discharged ballast. 29 Nov 2 seamen stole painting punt borrowed from *Balclutha* and deserted.

⁴³ Loaded 440 packages of powder in No. 3 hatch, 197 packages of cartridges in main hatch. In cabin loaded 19 cases of fuses. Draft 20' 6" forward, 20' aft.

⁴⁴ Off loaded part of cargo for transfer to Napier. Ballasted and left for the stream, then returned to railway wharf for flax and wool, 158 casks tallow, 21 sacks hides. Draft 19'8" forward, 20'6" aft. Left the railway wharf; trouble getting crew back sober.

⁴⁵ Loaded 1470 tons coal (1250 for Dunedin), crew of 34, 2 passengers, including Mrs. Streater. Cross sea struck rudder on 12 Nov, broke wheel spokes, carpenter fixed it. Coal cargo steaming; cooled down.

⁴⁶ Discharged coal, off loaded pig iron, loaded ballast, transferred cargo for Wellington to the *Canterbury*, loaded tallow and wool from *Invercargill*: 4,389 bales wool, 214 casks tallow, 1,000 sacks wheat.

⁴⁷ Extremely bad weather; spent most of December in shelter of Belfast Harbor.

⁴⁸ Off loaded 1,500 tons powder.

⁴⁹ Six apprentices aboard. Cargo including 400 packages of gunpowder for Dunedin, total 1204 tons cargo for Wellington.

⁵⁰ Left Glasgow with five apprentices. Towed to Greenock. Loaded detonators and dynamite. Crew used oil bags to calm rough sea. No passengers.

1. Voyages and Masters of *Euterpe* during the Pacific Lumber Trade

Sailed from	Sailed to	Returned to	Master
London, Eng. 3 Oct 1897	Glasgow, Scotland 8 Oct 1897		Hugh Longmuir
Glasgow, Scot 25 Nov 1897	Pt. Chalmers, NZ Newcastle, Aus Honolulu, HI	Royal Roads, B.C. Pt. Townsend, WA Tacoma, WA Pt. Townsend, WA 5 Oct 1898	Hugh Longmuir
Tacoma, WA 20 Nov 1898	Port Adelaide, Aus Newcastle, Aus Honolulu, HI	Pt. Townsend, WA Port Ludlow, WA Seattle, WA 1 Sep 1899	C.G. Saxe
Port Ludlow, WA 31 Oct 1899	Fremantle, Aus Newcastle, Aus Kaholui, HI Honolulu, HI	San Francisco, CA 20 Dec 1900	C.G. Saxe
San Francisco, CA 10 Feb 1901	Melbourne, Aus Newcastle, Aus	San Francisco, CA 17 Sep 1901	George Swanson

1. Voyages and Masters of *Euterpel/Star of India* during the Alaska Packers Period

Sailed from		Sailed to	Returned to		Master
San Francisco	17 Apr 1902	Nushagak	San Francisco	1 Sep 1902	Sam Christianson
San Francisco	13 Apr 1903	Nushagak	San Francisco	8 Sep 1903	George Swanson
San Francisco	15 Apr 1904	Nushagak	San Francisco	11 Sep 1904	George Swanson
San Francisco	14 Apr 1905	Nushagak	San Francisco	16 Sep 1905	George Swanson
San Francisco	14 Apr 1906	Nushagak	San Francisco	10 Sep 1906	George Swanson
San Francisco	8 Apr 1907	Nushagak	San Francisco	7 Sep 1907	S. Christensen
San Francisco	10 Apr 1908	Nushagak	San Francisco	14 Sep 1908	S. Christensen
San Francisco	10 Apr 1909	Nushagak	San Francisco	15 Sep 1909	S. Christensen
San Francisco	13 Apr 1910	Nushagak	San Francisco	14 Sep 1910	S. Christensen
San Francisco	12 Apr 1911	Nushagak	San Francisco	4 Sep 1911	S. Christensen
San Francisco	14 Apr 1912	Nushagak	San Francisco	9 Sep 1912	R. Johnson
San Francisco	11 Apr 1913	Nushagak	San Francisco	9 Sep 1913	R. Johnson
San Francisco	10 Apr 1914	Nushagak	San Francisco	6 Sep 1914	Woldemar Marzan
San Francisco	10 Apr 1915	Nushagak	San Francisco	6 Sep 1915	Woldemar Marzan
San Francisco	8 Apr 1916	Nushagak	San Francisco	22 Sep 1916	Woldemar Marzan
San Francisco	10 Apr 1917	Nushagak	San Francisco	13 Sep 1917	Woldemar Marzan
San Francisco	10 Apr 1918	Nushagak	San Francisco	19 Sep 1918	Woldemar Marzan
San Francisco	15 Apr 1919	Nushagak	San Francisco	8 Sep 1919	Woldemar Marzan
San Francisco	5 Apr 1920	Nushagak	San Francisco	7 Sep 1920	Frank Weidemann
San Francisco	20 Apr 1921	Nushagak	San Francisco	18 Sep 1921	Frank Weidemann
San Francisco	23 Apr 1922	Nushagak	San Francisco	6 Sep 1922	Frank Weidemann
San Francisco	29 Apr 1923	Nushagak	San Francisco	30 Aug 1923	Frank Weidemann

2. Modern Sailings of *Star of India*

No.	Sailed from		Event	Master
1	San Francisco	5-9 Jul 1927	Towed to San Diego by <i>Wapama</i> & U.S.S. <i>Tern</i>	W.A. Brunnick
2	San Diego	4 Jul 1976	Bicentennial Sail - First sail in 50 years	Carl Bowman
3	San Diego	11 Nov 1984	Veteran's Day	Carl Bowman
4	San Diego	25 May 1986	Memorial Day	Carl Bowman
5	San Diego	28 May 1989	Memorial Day - Walter Cronkite aboard	Carl Bowman
6	San Diego	14 Aug 1993	"America's Finest City"	Carl Bowman
7	San Diego	22 Aug 1993	Charlton Heston aboard	Carl Bowman
8	San Diego	10 Aug 1996	Republican Convention, Manned the Yards	Carl Bowman
9	San Diego	11 Aug 1996	Fleet Week Military Guests	Carl Bowman
10	San Diego	18 Aug 1996	Fleet Week	Carl Bowman
11	San Diego	9 Aug 1998	Fleet Week Military Guests	Rich Gobin
12	San Diego	15 Aug 1998	Fleet Week	Rich Gobin
13	San Diego	16 Aug 1998	Fleet Week	Rich Gobin
14	San Diego	13 Jul 1999	Festival of Sail, sailed with 12 tall ships	Rich Gobin
15	San Diego	7 Aug 1999	Fleet Week	Rich Gobin
16	San Diego	8 Aug 1999	Fleet Week	Rich Gobin
17	San Diego	12 Aug 1999	U.S.C.G. Eagle crew exchange	Rich Gobin
18	San Diego	9 Jul 2000	Millennium Sail Cultural Icons	Rich Gobin
19	San Diego	14 Oct 2000	Fleet Week	Rich Gobin
20	San Diego	15 Oct 2000	Fleet Week	Rich Gobin
21	San Diego	13 Oct 2001	Met canoes off of La Jolla	Rich Gobin
22	San Diego	14 Oct 2001	Anchored in Harbor	Rich Gobin

2. Modern Sailings of *Star of India* (cont.)

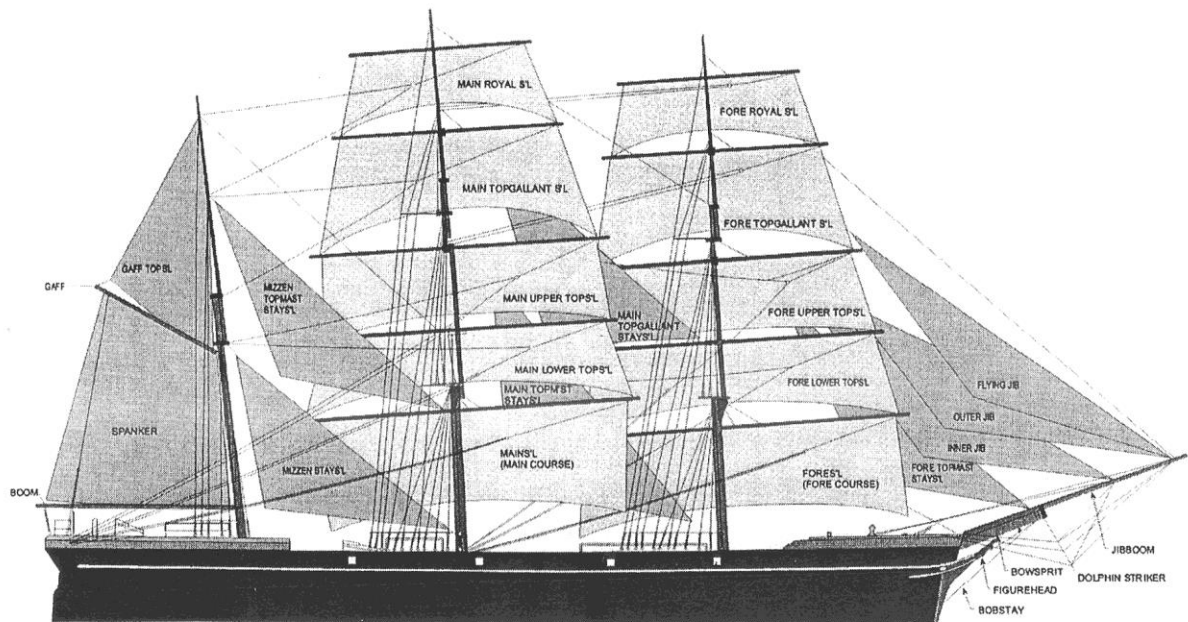
No.	Sailed from		Event	Master
23	San Diego	12 Sept 2002	Festival of Sail, sailed with tall ships	Rich Goben
24	San Diego	5 Oct 2002	Fleet Week - Joined by Navy ships	Rich Goben
25	San Diego	6 Oct 2002	Fleet Week - Five Museum ships in photo	Rich Goben
26	San Diego	15 Nov 2003	Star's 140th Birthday – Many people aboard	Rich Goben
27	San Diego	16 Nov 2003	Star's 140th Birthday - New Zealanders aboard	Rich Goben
28	San Diego	13 Nov 2004		Rich Goben
29	San Diego	14 Nov 2004	Sailed under Coronado Bridge	Rich Goben
30	San Diego	12 Nov 2005		Rich Goben
31	San Diego	13 Nov 2005		Rich Goben
32	San Diego	11 Nov 2006	Sailed with Surprise	Rich Goben
33	San Diego	12 Nov 2006	Sailed with Surprise	Rich Goben
34	San Diego	10 Nov 2007	Sailed with Surprise	Rich Goben
35	San Diego	11 Nov 2007	Sailed with Surprise	Rich Goben
		Nov 2008	Cancelled due to foc'sle head repairs	
		Nov 2009	Cancelled due to foc'sle head repairs	
		Nov 2010	Cancelled due to foc'sle head repairs	
		12 Nov 2011	Cancelled due to weather	
		Nov 2012	Cancelled	
36	San Diego	13 Nov 2011	Sailed with Surprise	Rich Goben
37	San Diego	9 Nov 2013	Star's 150th Birthday	Rich Goben
38	San Diego	10 Nov 2013	Star's 150th Birthday	Rich Goben
39	San Diego	11 Nov 2013	Star's 150th Birthday	Rich Goben

3. Star Ships of the Alaska Packers Fleet

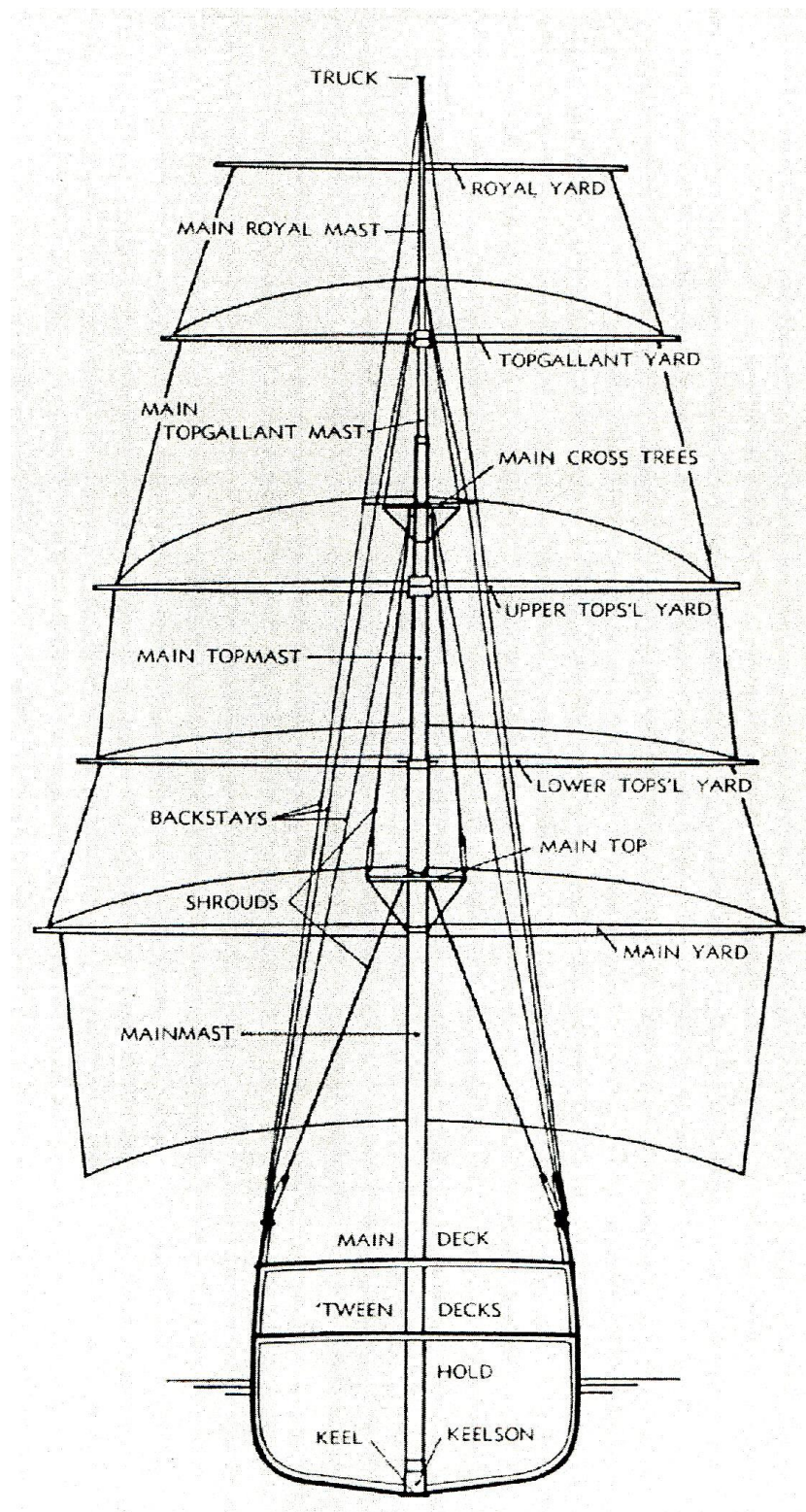
Name Tons/Rig/Steel/Iron	Built	Fate * Formerly owned by: Corry's Irish Star
<i>Star of Alaska</i> (ex. <i>Balclutha</i>) 1682T/Ship/Steel	Glasgow, Scotland 1886	San Francisco Maritime National Historic Park
<i>Star of Bengal</i> 1877T/Ship/Iron	Belfast, Ireland 1874	Wrecked off Coronation Island, Alaska 1908 *
<i>Star of Chile</i> (ex. <i>La Escocesa</i> , ex. <i>Coalinga</i>) 1001T/Ship/Bark/Iron	Dundee, Scotland 1868	Sank as barge off north end Vancouver Island, circ. 1960
<i>Star of England</i> (ex. <i>Blairmore</i>) 2123T/Ship/Bark/Steel	Dumbarton, Scotland 1893	Became B.C. barge <i>Island Star</i> 1935
<i>Star of Falkland</i> (ex. <i>Durbridge</i>) 2163T/Ship/Steel	Glasgow, Scotland 1892	Wrecked off Akun Head, Unimak Pass, Alaska 1928
<i>Star of Finland</i> (ex. <i>Kaiulani</i>) 1699T/Bark/Steel	Bath, Maine 1899	Hull afloat in 1969, Subic Bay, P.I., planned as Wash. DC Maritime Museum
<i>Star of France</i> 1766T/Ship/Iron	Belfast, Ireland 1877	As fish barge <i>Olympic II</i> sank off L.A. Harbor after collision 1940 *
<i>Star of Greenland</i> (ex. <i>Hawaiian Isles</i>) 2179T/Ship/Bark/Steel/4 masts	Glasgow, Scotland 1892	Became Portuguese MS <i>Fos do Duro</i> 1943, traded for many more years
<i>Star of Holland</i> (ex. <i>Zemindar</i> , ex. <i>Otto Gildemeister</i> , ex. <i>Homeward Bound</i>) 2121T/Ship/Bark/Steel	Belfast, Ireland 1885	B.C. sawdust barge, afloat many years, scrapped in 1937
<i>Star of Iceland</i> (ex. <i>Willscott</i>) 2165T/Bark/Steel	Glasgow, Scotland 1896	Towed to Japan and scrapped in 1929 after being abandoned at sea.
<i>Star of India</i> (ex. <i>Euterpe</i>) 1318T/Ship/Bark/Iron	Ramsey, Isle of Man 1863	Maritime Museum of San Diego
<i>Star of Italy</i> 1614T/Ship/Bark/Iron	Belfast, Ireland 1877	Last owned as hulk in Colombia 1940s *
<i>Star of Lapland</i> 3381T/4M Bark/Steel	Bath, Maine 1902	Broken up in Japan 1936
<i>Star of Peru</i> (ex. <i>Himalaya</i>) 1027T/Ship/Bark/Iron	Sunderland, England 1863	Became hulk at New Caledonia 1926 named <i>Bougainville</i>
<i>Star of Poland</i> (ex. <i>Acme</i>) 3288T/4M Bark/Steel	Bath, Maine 1901	Wrecked at Katsumura, Japan 1918
<i>Star of Russia</i> 1981T/Ship/Iron	Belfast, Ireland 1874	Became hulk in New Hebrides 1926 named <i>La Perouse</i> *
<i>Star of Scotland</i> 2598T/Ship/Bark/Steel	Glasgow, Scotland 1887	Sunk by German submarine in South Atlantic as a six-mast schooner
<i>Star of Shetland</i> (ex. <i>Edward Sewall</i>) 3206T/4M Bark/Steel	Bath, Maine 1899	Broken up in Japan 1935-6
<i>Star of Zealand</i> (ex. <i>Astral</i>) 3292T/4M Bark/Steel	Bath, Maine 1900	Broken up in Japan 1935-6

(Source: "Pacific Square-Riggers" by Jim Gibbs, 1969)

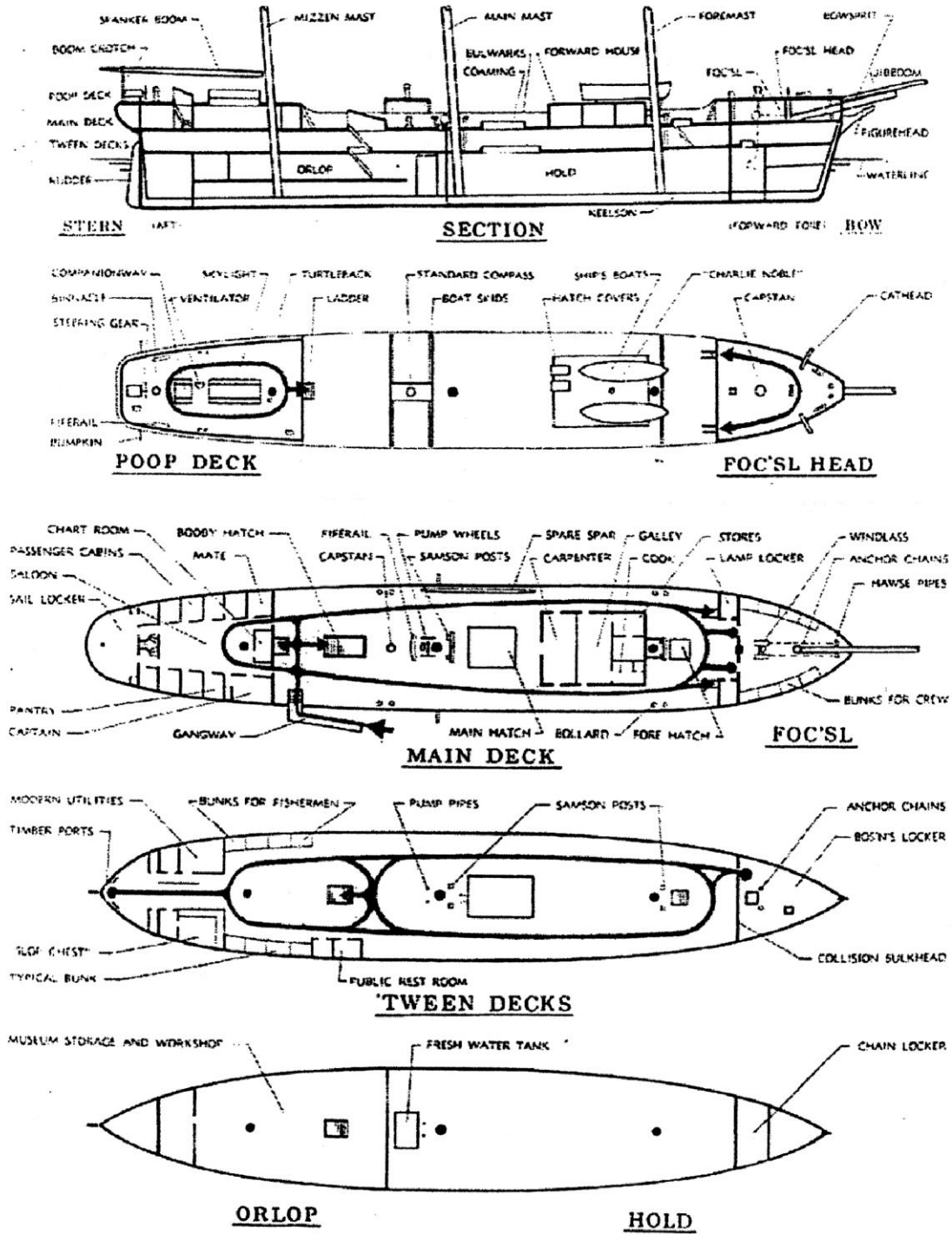
4. Sail Masts and Hull Plans



Beam View



Plan Views



5. History of Wrought Iron Sailing Vessels in the British Isles

The use of Iron in shipbuilding began early with the forging of wrought iron parts such as fasteners, straps and components for the rigging of sailing vessels. It was late in the 18th century that iron workers in the British Isles first began to fabricate ships' hulls of iron, initially using a crude form of malleable iron called puddled iron. These early vessels were primarily narrow horse-drawn canal barges used for transporting cargo or passengers along Britain's waterways. The first such vessel is thought to have been the canal boat *Trial* (length 70 ft., beam 6 ft. 8 in.) built of puddled iron in 1787 for carrying passengers on the river Severn. In 1819 the passenger barge *Vulcan*, similar in size to *Trail* is considered the first vessel constructed of wrought iron. It is generally agreed that the 1821 paddle steamer *Aaron Manby* (120 tons, length 106 ft., beam 18 ft.) was the first wrought iron steam ship to make a sea voyage, traveling from London to Paris, France to begin service as a ferry on the river Seine. As more iron vessels were produced the first wrought iron sailing ship large enough for practical sea voyages was the brig *Ironside* (270 tons, length 100 ft.) launched in Liverpool in 1838.

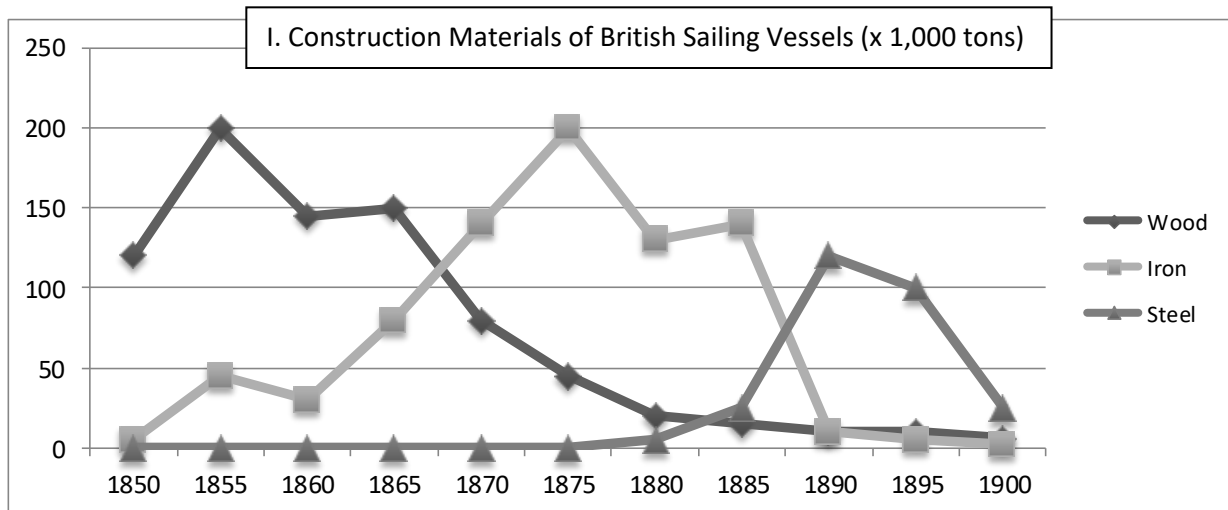
Wrought iron hulls were viewed with suspicion by the tradition-bound shipbuilding trades consequently the technology was slow to be accepted even though this was the time when the British were traveling great distances to secure the types of dense woods suitable for building ships. Advocates for iron ships could point to several well defined benefits over wooden ships; they were shown to be faster to construct, they cost less, were lighter, had greater durability and once launched they needed less maintenance. When riveted together the iron hulls were solid and strong. John Grantham, an early British advocate for iron ships once said, "The iron ship becomes one homogeneous mass; while the wooden ship is composed of a thousand parts, imperfectly united." The superior strength of iron enabled vessels to have longer and narrower shapes. Edward Reid, another supporter of iron ships noted "By 1860 iron vessels were being built with lengths equal to eight or nine times their beam. A wooden ship with a multiple of six or greater would struggle to carry a heavy cargo and experience an arching of the keel caused by sagging of the less buoyant bow and stern." In an comparison of pairs of cargo vessels with the same overall dimensions, one wood and the other iron, the iron vessels with thinner hulls and frames had from 14 to 29 percent greater cargo capacity. In addition, steamships also benefited from iron's greater structural integrity which could withstand the twisting forces and vibration of engines, paddlewheels or propeller shafts, plus iron has vastly superior resistance to fire.

While there was almost universal acceptance of wrought iron hulls for steamships it was mainly in the British Isles that wrought iron also gained acceptance as a material for building sailing vessels. In addition to the reduced availability of wood the increasing use of iron was due to the overall expansion of shipbuilding in Britain and to the advanced state of the country's iron industry. The great volumes of iron being needed for railroads, bridges and other construction created a strong efficient network of iron foundries and rolling mills. However the transition from wood to iron for sailing vessel hulls was slower than for steamships, as noted in the following table.

Iron Vessels Built in Great Britain

<u>All Vessels</u>	<u>1845</u>	<u>1850</u>	<u>1855</u>	<u>1860</u>	<u>1865</u>
Steam	18	71	286	649	858
Sail	18	55	137	255	768
Total	36	126	423	904	1626

Chart I, below, indicates it was 1855 before significant annual tonnages of iron sailing ships were produced. The tonnage of iron sailing ships surpassed wood in 1868 and construction of iron sailing ships continued for the next thirty years however by 1888 the tonnage of steel sailing vessels exceeded iron. The transition from iron to steel was rapid because all the benefits of iron also applied to steel in addition steel was more malleable and easier to bend and shape to the finer lines of modern vessel designs. For the ninety years during which wrought iron was used for shipbuilding in the British Isles there were just twenty years, 1868 to 1888 when it was the dominant shipbuilding material.



In the years prior to *Euterpe's* 1863 launching many iron schooners, ketches, brigs, barks and ships had been launched along the rivers Clyde, Mersey, and Thames as well as at shipyards on the coasts of England as well as Ireland and the Isle of Man. Most of these early iron sailing vessels were modest in size, the majority under 500 tons. Clearly, *Euterpe*, at 1,197 tons, was built early in the iron ship period, but where did she stand among iron sailing ships of her size? To find the answer it was necessary to determine how many large iron sailing vessels had been built in the British Isles by the end of 1863. More specifically, the focus of this paper is on ships meeting the following criteria:

1. Iron sailing vessels of 900 tons or more,
2. Launched in the British Isles, and

3. Listed in *Lloyd's Register of Ships* for the years 1845, 1850, 1855, 1860, 1864 and 1865

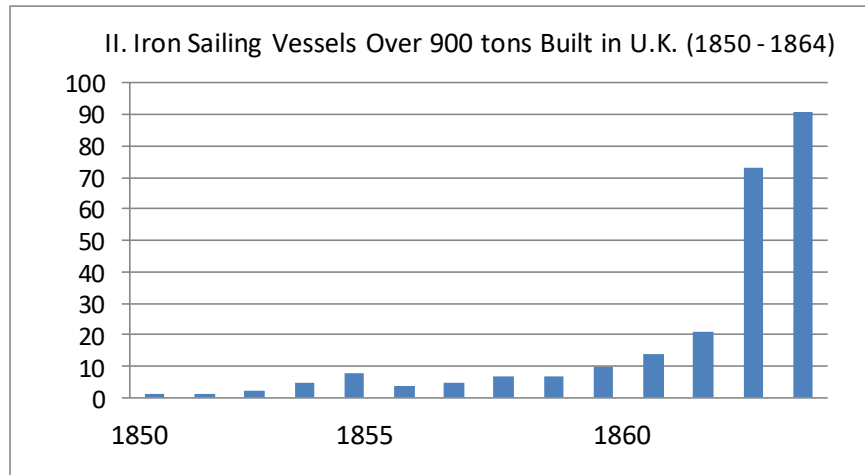
Iron vessels were first listed in *Lloyd's Register* in 1836. Since that time there have been no organized efforts to create an accessible data base from those annual publications. Each volume represents a fiscal year, July 1 thru June 30, and contains information on from 9,000 to 11,000 vessels. Appointed surveyors attempt to obtain information on all vessels being built but this was not a perfect system. The year following *Euterpe's* launching was included with the other five volumes to increase the likelihood that all relevant 1863 launchings were included in the *Register*, however there probably were other large iron sailing vessels built in the British Isles in 1863 or earlier that were not included in *Lloyd's Register*. Thus, the information presented below is likely to be understated due to the fact that some iron sailing vessels launched in the British Isles prior to *Euterpe* were never listed in any volumes of *Lloyd's Register* (see the note regarding *Lloyd's Register* on page 18).

Iron Sailing Vessels Built in Great Britain

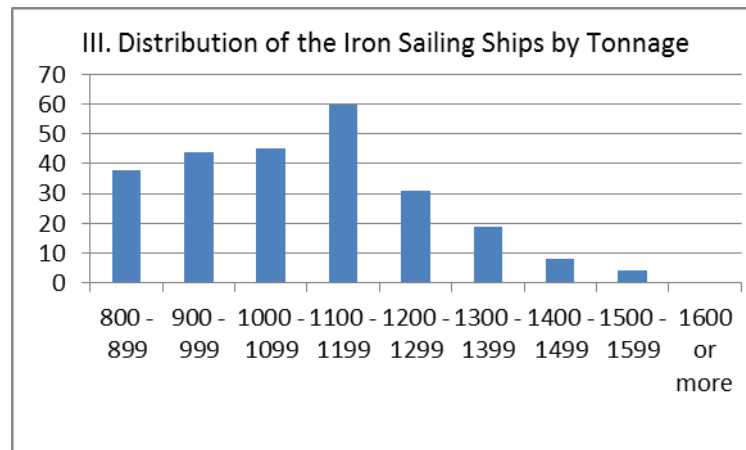
All Sailing Vessels	<u>1845</u>	<u>1850</u>	<u>1855</u>	<u>1860</u>	<u>1864</u>	<u>1865</u>
Under 500 tons	18	53	96	161	248	303
500 to 899 tons	0	2	21	56	138	205
900 to 1250 tons	0	0	14	24	125	194
Over 1250 tons	0	0	6	14	28	66
Total Sailing Vessels	18	55	137	255	539	768

For the period being studied, 1845 thru 1865, the iron sailing vessels were categorized into groups based on net tonnage, *Euterpe* falls into the 900 to 1250 ton group. The lower limit of 900 net tons was set following a review of the data in *Lloyd's Register*, which indicated that sailing vessels of that tonnage or more were likely to be ship-rigged vessels similar in size to *Euterpe*. Factors such as length, beam, draft and the number of watertight bulkheads all influence a vessel's tonnage information. The six editions of *Lloyd's Register* listed 153 iron sailing vessels of 900 net tons or more launched in the British Isles by the end of 1863.

Chart II, on the following page, illustrates the low incidence of large iron sailing vessels built between 1850 and 1859, just 43 vessels. In the next three years (1860 – 1862) 45 more ships were listed, the total for 1863 was 73. Taking into account the iron sailing vessels of similar size launched from 1843 thru 1863 it appears *Euterpe* is among the first 153 large iron sailing vessels to be launched in the British Isles. As noted earlier, this number does not include large British-built iron sailing ships that were not listed in *Lloyd's Register*.



The 260 vessels in the study (including the 92 large iron sailing ships launched in 1864-65) ranged from 900 tons (this study's established lower limit) to 1587 tons, the overall average being 1101 tons. Chart III, indicates 60 of the vessels (24%) are in the range of 1,100 to 1,199 tons, including *Euterpe*. Of the remaining vessels 51% were smaller, ranging from 800 to 1,099 tons and 25% were 1,200 tons or more.



Almost a third (32%) of the large sailing ships in the study had been built along the river Clyde, including shipyards in Glasgow, Port Glasgow, Greenock and Dumbarton. Yards in Liverpool and along the river Mersey accounted for 24% of the ships and another 24% were built along England's northeast coast by shipyards in Newcastle, Hartlepool, Stockton, Sunderland and Chester. Shipyards in London, Bristol, Hull or Ireland and Isle of Man and other locations accounted for the remaining 20 % of the large iron sailing vessels built.

Lloyd's Register

Lloyd's Register of Ships was originally a guide for merchants and insurers reporting on the condition of ships they employed or insured. But the publishers realized that others in the shipping industry needed to know about ships. For instance, port authorities needed to know a ship's tonnage to charge harbor dues, and lawyers

might want to know its owners because of a legal dispute. So *Lloyd's Register* grew in coverage until it became the most respected single source of information on ships of the world. Beginning in 1834 only the first survey report on a vessel was printed by *Lloyd's Register* although the vessel may have been surveyed many times during her life. Not all ships were surveyed during this period but attempts were made to include all British vessels of 50 tons or more in *Lloyd's Register* though little information is given about those vessels not surveyed. In 1838 *Lloyd's Register* began only listing vessels that were surveyed. As well as publishing the Register, Lloyd's set rules and regulations for building and maintaining ships and conducted surveys to ensure they met these standards.

Note: Included among the large sailing ships in the study were eight large ship-rigged vessels built by Alexander Stephen and Sons. In 1904 the Stephen's shipyard launched the Maritime Museum's fine steam yacht *Medea*. In 1863 Stephen's launched *Sea King*, a 1,160 ton ship-rigged vessel of composite construction (iron ribs, beams and stringers with hull planking of teak) with a steam engine and screw propulsion. After her launching *Sea King* voyaged to Funchal, Madeira where she was armed with naval guns, powder, shot and general stores while a number of Confederate officers and sailors rounded out the ship's company. *Sea King's* name was changed to *CSS Shenandoah* and she became one of the famed and feared Civil War raiders that attacked and destroyed U.S. flag merchant vessels and whaling ships. She fired the last shot of the Civil War across the bow of a whaler in May 1865 north of the Aleutian Islands. Although the whaler's master advised Captain Waddell that the war was over he refused to believe it and burned twenty more Yankee whalers before finally leaving the Bering Sea and returning to Liverpool to surrender on 6 November 1865, the last surrender of the war.

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- *Lloyd's Register of Ships*, 1845, 1850, 1855, 1860, 1864, 1865
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- Unpublished paper, McCarthy, Michael. *The Iron Hull – A Brief History of Iron Ship Building*, Washington Maritime Museum, Fremantle, WA

III. *Berkeley*



Chapter III. *Berkeley*

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Chronology

1898	<i>Berkeley</i> was designed and built by Union Iron Works of San Francisco for the Southern Pacific Company. She was launched on 18 October as the first successful propeller-driven ferryboat to operate on the Pacific coast
1898-1958	After initial tests and evaluations, she operated daily between Oakland and San Francisco with occasional side trips to and from Alameda or Sausalito
1906	Evacuated refugees and transported aid and supplies following the San Francisco earthquake and fire (April 18, 1906)
1958	Retired from service and sold to Golden Gate Fishing Company for a planned conversion to a whale reduction vessel
1961-1973	Following two years of negotiations with Golden Gate Fishing Co. <i>Berkeley</i> was bought by businessman Luther Conover who moved her to Sausalito Harbor and converted her to a floating gift shop called "Trade Fair"
1973	Purchased by the Maritime Museum, towed to San Diego and refurbished
Present	Serving as the Maritime Museum's administrative offices and library as well as exhibit space and gift shop

***Berkeley* Overview**

Southern Pacific Company had *Berkeley* built to transport rail passengers from the railroad's western terminus in Oakland across the bay to San Francisco. Southern Pacific contracted with Union Iron Works to design and build a large ferry capable of carrying up to 1,700 passengers and their baggage. The steel-hulled, double-ended, propeller-driven *Berkeley* was completed in less than a year at a cost of \$122,000.

Berkeley's keel was laid January 25, 1898. She was launched on October 18, 1898. Miss Marion Huntington, daughter of the railroad magnate Henry Huntington, pressed the button that sent *Berkeley* down the slipway at the famed Union Iron Works shipyard (see Supplement 1). At the time of her launching she was the largest commuter ferry in the United States. Her overall length was 279 feet. She had a steel hull with a 40-foot moulded beam that extended to 64 feet at the maindeck. A pilothouse at each end of her top deck and a single tall stack made her general appearance typical of the ferries of the day. She was powered by a triple expansion steam engine driving 8-foot bronze screws at each end of her hull. Steam-operated steering gears were located on the main deck beneath each pilothouse and connected to rudders at opposite ends of the boat.

Berkeley was constructed with four decks. The lowest deck is not continuous and one end originally contained a bar, restaurant and men's restroom. The crew was berthed at the opposite end of the ferry on the lowest deck. The main deck is the longest continuous deck and included rows of seating along the outboard bulkheads, the trunk for the engine and smokestack, and the women's restroom. Between the seats and the engine/boiler-room hatches, there were wide lengthwise passageways for carrying baggage carts. At the time of *Berkeley's* construction automobiles were not generally in use and were not taken into consideration in the ship's design. Later, in the 1930s, *Berkeley* did on some occasions carry automobiles across the bay.

The deck above the main deck, known as the saloon deck, provided a majority of passenger seating on three rows of benches running the length of the enclosed deck, one row along each side and a row down the middle, allowing for space forward of amidships for the trunk surrounding the smokestack. Originally, the saloon deck was accessed by one stairway at each end in the middle of the deck. In about 1917, the original access stairways were replaced by two wide stairways located at each end and the open verandas beneath each pilothouse were enclosed. The deck above the saloon deck, described as the hurricane deck, provided access for the captain or crew to the twin pilothouses. The original stairway leading to this deck was located where the women's restroom is today. This deck's use was restricted to captain and crew only. Today, one pilothouse is open to visitors.

One of the more novel features of *Berkeley* was the ventilation in the passenger spaces. Brass pipes were fashioned into columns at the sides and ends of the seat

benches. The lower ends of the pipes were connected with steel air trunks originating in the engine room. At the upper ends an adjustable air register passed heated or ambient air into the passenger area. This piping system has the dual purpose of providing ventilation as well as supporting the arched upper deck. Built in the Victorian era, *Berkeley* had numerous other handsome features including carved wood paneling, plate glass mirrors, perforated seats, elegant stairwells and leaded glass windows.

An efficient and reliable triple-expansion (three cylinder) steam engine powered *Berkeley*. This powerplant was a great improvement over the “walking beam” engines that propelled the stern-wheel or side-wheel ferries on the bay. The engine is very similar to the triple-expansion engines that powered the famous liberty ships of World War II. The two eight-foot propellers were linked directly to the engine. Turning a maximum of 125 rpm, these screws could propel the ferry at speeds up to 12 or 13 knots.

While maneuvering toward a landing engineers could upon orders from the pilothouse shift two levers to reverse the engine's direction to slow the ferry for mooring. One lever, the throttle, interrupted the steam flow into the engine and the other changed the timing, sending steam to the opposite side of the pistons, thus reversing the rotation. This process could be accomplished in less than 10 seconds.

Berkeley's original twin fire tube boilers were coal fired. In a 1901 conversion to bunker C crude oil, four 2,138 gallon fuel tanks were installed in the former coalbunker spaces. These tanks are still in place. In 1924, four Babcock and Wilcox watertube boilers were installed in place of the original boilers. Most turn-of-the-century steam vessels had their boilers placed forward of the engine-room so that the engine-room was closer to the propeller to reduce the length of the propeller shaft. Double-ended ferries like *Berkeley* have a bow and stern like traditional ships although both ends look the same and both ends have propellers. Viewed off the beam, *Berkeley's* tall boiler stack is not centered, but clearly closer to one end, that end was called the bow or the San Francisco end.

Being double-ended, with screws and rudders at each end, *Berkeley* never had to turn around. Once moored the captain would put the wheel amidships and signal a crewman to put a locking pin in the rudder facing the bay and to remove the locking pin from the rudder nearest the slip. The captain would then walk to the opposite pilothouse and be ready to begin the return trip across the bay.

Berkeley officially began service on November 1901. The 3.5 mile transit between the railroad terminus at Oakland and the ferry terminal at San Francisco took about 20 minutes. A round trip between San Francisco and Oakland with loading and unloading took 50 minutes. *Berkeley* also made crossings from Alameda to San Francisco and occasionally to Sausalito. She remained on this basic run from 1901 until 1958. Initially her crew had difficulty handling the ferry while bringing her into the slip. In reference to the numerous broken pilings which needed replacement after *Berkeley*

crashed into them she was known as “the pile driver’s friend.” Eventually, *Berkeley*’s captains and crews became more familiar with her handling characteristics and damaged fewer pilings.

On April 18, 1906 the 8.3 San Francisco earthquake and following fire devastated the city. *Berkeley* joined with other San Francisco ferries, carrying refugees across the bay to safety. On return trips she brought medicine, clothing, food, and firefighting equipment to San Francisco.

Although *Berkeley* had a number of minor scrapes and bumps over her years in service, just two collisions bear brief mention. First, on a cold and foggy December night in 1908, the captain fell off his course when approaching the main slip in Oakland. *Berkeley* crashed solidly into the end of the slip shattering several pilings and shearing away part of the starboard railing and one of the lifeboat davits; at least five passengers were injured by flying wood splinters and the falling lifeboat. One passenger later died from her injuries. The second collision occurred 11 April 1911 when *Bay City* struck *Berkeley* with a glancing blow in midstream. The damage to *Berkeley* was slight compared with *Bay City*’s but according the news account, “just a bit sharper angle and just a little heavier impact, and both probably would have gone to the bottom.” Southern Pacific, owner of both ferries, conducted the investigation and determined Captain Rogers of *Bay City* to be at fault.

On Friday, 13 January 1911, a most unusual incident occurred aboard *Berkeley* as she steamed past the Goat Island lighthouse on her way to San Francisco. An explosion rocked the ship, shattering windows in the pilothouse. At first Captain J.T. Jones thought one of the boilers had exploded but the chief engineer reported all was normal in the engine room. Crewmembers quickly determined that the explosion came from the men’s room on the lower half-deck, in what is now part of the gallery area. One man was killed in the blast and six were injured, one seriously. *Berkeley* continued toward San Francisco, delivering the injured victims and all the other excited and panic-stricken passengers safely.

An explosives expert later theorized that the blast was caused by John O. Norbom, a mining engineer who had apparently come aboard with a vial of nitroglycerin in his overcoat pocket. Mr. Norbom, the lone fatality, was thought to have hung his coat on a hook and turned to use the toilet when the nitro bottle hit the hard tile and exploded. Two facts support this theory. First, the blast occurred several feet above the deck. Second, the blast went off behind Mr. Norbom; his face and the front of his body were found intact. The county coroner’s jury concluded that the explosion was an accident.

Completion of the Oakland Bay Bridge in May 1939 signaled the end of the Southern Pacific Golden Gate Ferry commuter service. *Berkeley* continued her Oakland/San Francisco service for train passengers until the spring of 1958.

The Golden Gate Fishing Company purchased her in January 1959. Plans to turn her into a whale reduction and processing plant failed to materialize and ultimately businessman Luther Conover became her owner in 1961. Conover moved *Berkeley* to Sausalito and opened her as Trade Fair, a floating souvenir and gift shop with maritime-themed articles and miscellaneous items (glassware, ceramics and candles). During this period the experienced square-rigger sailor, movie actor and author Sterling Hayden lived aboard *Berkeley* in one of the pilothouses while working on his biography "Wanderer". Also around this time radio and TV personality Arthur Godfrey is reported to have occasionally broadcast his daytime radio variety show from *Berkeley* when he visited the West Coast.

In November 1972, *Berkeley* was one of the ferries considered for acquisition by the Maritime Museum of San Diego. The ferry was needed to provide space for collections, administrative offices and the library. *Berkeley* appeared to be sound and she was purchased for \$100,000, including towing charges. On June 3, 1973, she arrived in San Diego.

***Berkeley* Today**

Berkeley is now well into her second century, a rare achievement for a steel-hulled, wooden-superstructure vessel. *Berkeley* spent her entire life in seawater. Although originally acquired by the museum as a floating space for exhibits, offices and museum shops, *Berkeley* holds unique historical significance. As the first successful propeller-driven, steel-hulled ferryboat on the Pacific coast, *Berkeley* survives essentially intact from the glory years of passenger carriage.

Some minor changes have been made in converting the ferry to a floating museum space. All passenger benches on the main deck were removed to make room for museum exhibit space, administrative offices, library and shops. The second deck (saloon deck) now includes an oak dance floor in place of some passenger seats. This modification has been helpful in generating income for the museum from events, parties and receptions. The snack bar with its art deco signs was added in the 1930s and still serves at functions today. The remaining passenger benches were restored to natural teakwood, removing their original simulated mahogany look, which was valued for its elegance and style in the 1890s. The curved and perforated seats on the benches are laminated black walnut. The garlands located above the windows are made of pewter. Encircling the saloon deck above the clear glass windows are the leaded glass windows originally crafted by California Art Glass Studio of San Francisco; the colored glass and jewels were produced by Opalescent Glass Works of Kokomo, Indiana. In contrast to stained glass in which colors are baked onto the surface of the glass, opalescent glass is made when colored oxides are mixed into the molten glass before pouring. Artistic Glass of San Marcos, California restored these windows between 1995 and 1998.

The engineering spaces have been cleaned and today they offer visitors a glimpse at 19th century technology. During restoration a hydraulic system was devised and

installed to demonstrate for visitors how the engine operated in either direction. A pneumatic system was also installed for demonstrating many of the engine's auxiliary pumps. The original screws were of cast bronze but during sea trials in 1901 they were replaced by steel. With one screw always in front of the vessel, it was discovered that bronze was too prone to blade damage. Both of *Berkeley's* screws and rudders have been removed and stored.

The historical significance of the triple-expansion engine cannot be overstated. Perfected by John Elder in 1874, this type of engine, more than any other mechanical device, gave competitive advantage to steamships and spelled the demise of sailing ships. The triple-expansion engine was reliable and fuel-efficient, finally enabling steamships to make lengthy runs to distant ports in China, Australia or New Zealand while carrying income-producing cargo instead of loads of fuel, or to make short ferry trips at a lower cost per passenger mile.

Berkeley's hull was constructed of a shell of riveted 3/8-inch-thick steel plates supported by steel frames on 24-inch centers. In 1990, during an inspection of the interior hull substantial corrosion was found warranting immediate action to keep the ship afloat. Because of the high cost and the inability of the museum to operate with its administrative offices while in dry-dock for an extended period, alternative fixes were considered. Following consultation with marine construction and repair specialists it was decided to create a tough water resistant skin inside the hull. After a thorough cleaning and scaling of the bilge spaces a coating of "Rim 7", a hard urethane finish, was applied by spray. Next a closed cell urethane "grow foam" was applied, filling the spaces between each frame. After this thick coating was cured and smoothed, a top coat of "Rim 7" was sprayed on, forming a continuous hard, smooth surface.

Recognizing that the interior hull repairs were a short-term solution for providing watertight integrity, plans were made to tackle the hull's exterior. In March 2003, *Berkeley* entered drydock at Southwest Marine. Using high-pressure water spray and sandblasting about 6,000 tons of marine growth, paint and rust was removed. The hull's holes, weak spots and pits were patched, strengthened and filled, presenting a smooth, clean surface ready for the application of a state-of-the-art ceramic-loaded epoxy coating. The CeRam-Kote coating was applied to a thickness of 40 mils over most of the hull and slightly thicker on the areas where the most serious damage was located. In addition to its rust protection benefits the non-toxic ceramic coating makes it extremely difficult for marine grasses and animals to attach themselves to the hull.

Berkeley's non-metallic coating also inhibits galvanic corrosion. This is the corrosion that occurs when different types of metals (with different electrode potentials) are immersed together in a conductive solution such as saltwater. Ships constructed of several types of metal have been plagued by this problem and over the years it has been dealt with in various ways. For example, plates of base metals such as zinc or aluminum alloy can be attached to a ship's hull near where two different types of metals are used and since these base metals (called anodes) corrode more

easily than iron or steel they corrode and are sacrificed to protect the ship's submerged components. Another method, good for large areas or entire ships, is to pass electrical current (DC) through anode rods made of graphic or mixed metal oxide. The museum uses both of these methods and has found that after the CeRam-Kote was applied *Berkeley* required significantly fewer sacrificial anodes and less electrical power to combat galvanic corrosion.

Touring *Berkeley*

Berkeley can be boarded at the bow (passing through the museum store) or from her port side catwalk (entering into the fishing exhibit). Taking a top-down approach for the tour, begin at the pilothouse. Note that the two pilot houses appear the same. Each has a wheel that controls the rudder at the opposite end. Each has an engine order telegraph with a direct link to the engineroom. These features plus the propellers at each end allowed *Berkeley* to travel back and forth across the bay without having to turn around each time.

Like the pilothouse, the upper or saloon deck generally retains its original appearance. The teak benches and black-walnut veneer seat panels were stained much darker than they are today and the seating ran the full length of this compartment. Originally one stairway at each end provided access to the main deck. This was later changed to the two stairways at each end seen today. The two restrooms and snack bar were also added later. The colored and leaded glass upper windows of the clerestory are original as is the tile decking, which matched the floors in Southern Pacific depots and waiting rooms. California Glass Works of San Francisco fabricated the windows using stain-infused glass manufactured by Opalescent Glass Works of Kokomo, Indiana. Visitors frequently remark on the calming "churchy" feeling to this space. The garlands above the windows are formed from pewter and the paneling is Port Orford cedar. If your tour has been underway for an hour or more you could mention the restrooms are here.

On the main deck you could point out the Model Shop and the nearby collection of ferry models. Continue along the port side to the Fishing and Canning exhibit and the Early Mapping and Exploration section. In the narrow athwartship passageway you can point out the three cylinder heads of the main engine, mentioning the significance of their different diameters. The U. S. Navy ship models, photos and artifacts are located on *Berkeley's* starboard side. Be sure to mention the Navy's historical and continuing importance to San Diego. Supplement 2 of this chapter provides details of these exhibits.

The engine room can be accessed directly from the main deck or, taking a more logical approach since steam was required for the engine to operate, you might prefer to enter the fire room/boiler room via the gallery deck. Depending on the focus of your tour you might stop in the gallery to discuss the current exhibit.

Moving aft in the gallery you can take the ladder through the original coal chute to the fire room/boiler room. Here you could discuss *Berkeley's* conversion from coal to oil-fired boilers and the later change from fire-tube boilers to water-tube boilers. Visitors may be interested in the pipe that carries steam to the engine and the pressure and temperature of the steam as it goes to the engine's steam chest (165 p.s.i. & 425 degrees). Stepping into the engine room you can introduce the docent on duty who will explain and demonstrate the engine. If a docent is not on duty you could explain:

- How speed and direction orders are received and carried out
- The advantages of a compound steam engine
- How steam water is cleaned and reused
- How all the auxiliary equipment including electricity generation is powered by steam
- The snapping sounds of pistol shrimp that can be heard through the hull

Taking the ladder out of the engine room you can lead your visitors out through the museum store to other parts of the museum.

Engine and Auxiliary Machinery

The *Berkeley* engine is a triple-expansion, double-acting, reversible, condensing, reciprocating steam engine built in 1898 by Union Iron Works (Supplement 1) of San Francisco. It has a rated horsepower of 1,450 at 125 rpm and operates on steam at an initial pressure of 165 psi at a temperature of 425°F. The cylinder diameters are 22 inches, 34 inches, and 56 inches respectively, each with a stroke of 36 inches. The steam was originally generated by two double-ended fire tube or "scotch" boilers 19 feet long and 11 feet in diameter. Initially the boilers were coal fired, but in 1901 the fireboxes were converted to burn oil (bunker C crude). In 1924, her fire tube boilers were replaced with four Babcock and Wilcox water tube express-type boilers. The water tube system produced steam faster and more efficiently than the fire tube boilers. Because the water is carried in a series of tubes that are heated by hot gases rather than being held in a large tank, the risk of an accident or explosion releasing a large volume of boiling water into the room is greatly reduced.

Each firebox has four openings for oil burners. An array of sloping watertubes fills the firebox roof. Eight layers of such tubes collect heat and make steam. Bubbles of steam rising up the slope keep water circulating through the tubes and the steam drum above. Forged-steel downcomers carry water down from the steam drum. Each downcomer contains four watertubes with a cover plate on each end. This system allows individual tubes to be replaced when necessary. Adjacent to the catwalk platform are water gauges that show each steam drum's water level. Steam and water together leave the drum at 180 psi and 375°F. It then goes to a set of superheater tubes above the water tubes to pick up additional heat from the furnace gases increasing in temperature to 425°F. If the boiler tubes ran dry they could overheat and burst under the pressure. Boiler tubes being closer to the fire absorb more intense

heat than the superheater tubes, which can run dry and pick up extra heat thus improving the engine's efficiency.

Steam from the throttle valve and a steam chest (a regulating cylinder or chamber) first enters the high-pressure cylinder (HP), the smallest of the three cylinders, and pushes the piston from one end of the cylinder to the other, a distance referred to as the stroke. As the steam "works" to move the piston, it expands and loses a portion of its heat and pressure. Once the stroke is completed, the remaining steam exhausts into the intermediate-pressure (IP) cylinder steam chest. The process of pushing the piston repeats here and the steam expands, losing more heat and pressure. Steam is then exhausted into the large low-pressure (LP) cylinder steam chest, where the process repeats once again. The steam is finally exhausted to the condenser where it is indirectly cooled by seawater and condensed, producing a partial vacuum. The steam ports close at about 40% of the stroke and the steam expands about 2.5 times in each cylinder or 15 times for all three expansions. The double-acting engine operates alternately on each side of the piston.

Three different cylinder sizes allow the steam to yield approximately the same energy in each cylinder so each produces the same force using the same mass of steam even though it is constantly expanding and cooling. The multiple expansions also minimize the temperature gradient thus reducing condensation in and reheating of the cylinders. The top of the engine and the three cylinder heads can be observed from a transverse passageway on *Berkeley's* main deck.

Each cylinder has two eccentrics and eccentric rods to control valve timing, one is set for "ahead" rotation and the other is set for "astern" rotation; switching between eccentric rods reverses the engine. The ends of the eccentric rods are connected by a curved, slotted link, the Stephenson Link, that controls which of the two eccentric rods actuates the valve. The reversing gear shifts the position of the link so that one eccentric is directly beneath the valve actuator while the other eccentric idles off to one side. The valve links for all three cylinders are moved in unison by the power reversing gear located at the engineer's station to the left of the throttle lever that admits steam to the engine.

***Berkeley* Engine Steam Conditions**

Cylinder	Initial Pressure	Initial Temp.	Diameter	Capacity	Expansion Ratio
HP	165 psi	425°F.	22 in.	7.92 ft ³	2.4
IP	53 psi	300°F.	34 in.	18.9 ft ³	2.4
LP	12 psi	244°F.	56 in.	51.3 ft ³	2.4
Exh	6 psi	188°F.			

At maximum turns (125 rpm) the engine was capable of driving *Berkeley* at more than 12 knots. The efficiency of the triple-expansion engine made trans-oceanic

steam freight practical by reducing the fuel required. This both reduced operating costs and increased both freight capacity and revenue potential.

All auxiliary equipment was run by steam: bilge pumps, whistle, fresh water pumps, boiler feed pumps, condensate pumps, seawater cooling pumps, lube oil service pumps, fuel oil heaters and pumps, ventilation blowers, air compressors, fire pumps, steering engine and two electrical generators. At the turn of the twentieth century steam was the proven power source while electricity and internal combustion engines were just coming into their own.

The **Engine Cooling (Circulating) Pump** circulates outside seawater through the condenser cooling tubes. It is driven by a standard single-cylinder engine with only one eccentric since it runs only in one direction. This pump moved about 100 tons of water per hour to cool the steam leaving the main engine. A duplex-cylinder pump located forward serves as backup for this pump.

The **Condensate Pump (Air Pump)** draws the used steam water from the condenser. The steam driving cylinder overhead is small because it works only against atmospheric pressure (15 psia). Two large suction cylinders suck nine tons of water per hour plus any air that got into the system.

The **Hot Well** cleans engine-lubricating oil out of the cooled steam water. The hot well's three separation tanks are filled with loofas (natural cellulose sponges made from the inside of a fibrous squash) which absorb oil from the water. The saturated loofas are squeezed out and the oil can be reused. The water, cleaned of the oil by the loofas, is then pumped back to the boilers. Today loofas are often used as bath sponges.

The **Boiler Feed Pump** works against the boiler pressure and has a large overhead steam driving cylinder and a moderate-sized pumping cylinder below. Flapper valves on each side of the pumping cylinder pass water from the pump but prevent it from flowing backwards from the boilers. The big copper dome to one side is filled with air, which compresses when the pump starts and absorbs the shock in the boiler feed piping as the valves of the pump slam shut. Forward is the duplex backup for this pump.

The **Lubricating Oil Pump** works against main engine steam pressure to pump oil into the steam to lubricate the valves and pistons of the main engine. The **Fresh Water Services Pump** provides fresh water service throughout the ferry. The **Bilge Pump** removes waste water from the ship's bilges.

The **Cabin Heating System** uses steam-heated coils inside a casing containing a large centrifugal blower that drives warm air to cabin heating ducts running throughout the ferry. The blower is driven by a single-valve compound (2-cylinder) steam engine. The **Fuel Pumps** are double-action pumps located in the boiler room that pump fuel oil to the burners.

Thrust Blocks transfer thrust from the shafts and screws to the hull of the ship. The thrust-bearing section of the propeller shaft is machined into three collars, each of which fits into a horseshoe-shaped slot in the bearing housing, which is solidly bolted to the hull. Contact between the shaft collars and the slots in the bearing housing transmits thrust to the hull. The thrust bearings run in oil, as indicated by the brass oil cups. Each part of the bearing is cooled by water passed through pipes and water passages around the bearing.

Main Engine Lubrication occurs when oil is injected directly into the steam. Other bearings and moving parts are lubricated by hand. The main bearings have brass oil cups that deliver oil at a steady drip via woolen wicks. The connecting rods and crossheads have small funnels mounted below tubes that drip oil on the parts as they move. The eccentrics each have an oil cup mounted at a convenient height for hand filling.

Steering Engines were located on the main deck two levels below each pilothouse. The after steering engine originally located below the stern or "Oakland" pilothouse has been removed. The bow or "San Francisco" steering engine is located abaft of the museum store. The steering engine is a steam servo connected by chains to the rudder at the opposite end of the ferry. A vertical shaft connects the wheel in the pilothouse to a piston-valve on the steering engine. The engine is a standard, double-acting, two cylinder engine with normal valves and cranks mounted sideways. The steering engine is controlled by the piston valve. When the wheel is centered the piston valve is closed. When the wheel is turned the piston valve directs either steam or exhaust to the two cylinders causing the engine to rotate and pull the rudder chain in one direction or the other. As the engine rotates a spur gear turns a screw centering the control valve thus stopping the engine and leaving the rudder in its new position.

Specifications

Launched:	18 October 1898
Owner:	Southern Pacific Railroad
Length:	260 feet at waterline; 279 feet 4 inches overall
Beam:	40 feet on the waterline; 64 feet at the main deck
Draft:	9 feet loaded
Tonnage:	1,884
Capacity:	1,700 passengers
Power:	Triple expansion steam engine rated at 1,450 hp
Speed:	~12.25 knots maximum at 125 rpm
Hull:	Steel
Cost:	\$122,000 basic construction cost, not including the conversion from coal to oil and other modifications made between her launching and November 1901, when she entered regular service.

Supplements

1. Union Iron Works

Berkeley's builder became one of the most noted shipyards on the West Coast. Union Iron Works began in 1849 as a smithy founded by brothers Peter and James Donahue. Original equipment consisted of just a pair of hand-operated bellows and a charcoal forge. From these humble beginnings, a full-fledged machine shop appeared. In 1859, the company was paid \$80,000 for the machinery powering *Saginaw*, the first naval ship built on the Pacific coast.

In 1880, the organization owner, Irving M. Scott, visited shipyards throughout the world and subsequently decided to structure the company with steel shipbuilding as the principal operation. The business was incorporated as the Union Iron Works and built on land in the San Francisco Potrero District. The first ship was completed in 1885 and named *Arago*, an all-steel 207-foot collier. From this first ship, Union Iron Works established its reputation as West Coast's premier shipbuilder.

Berkeley was laid down on 25 January 1898 and took shape alongside the battleship *Wisconsin*. Two thousand guests attended *Berkeley's* launch on 18 October 1898 and on November 6th, she was handed over to her owners.

During the years preceding and immediately following the Spanish-American War, Union Iron Works constructed several famous naval ships as well as *Adder*-class submarines. Most notable was the cruiser *Olympia* in 1892, Admiral Dewey's flagship at the Battle of Manila Bay. Additionally, battleships *Oregon*, *Wisconsin*, *Ohio* and *California* were sent down the Union Iron Works slipways.

In 1902 Union Iron Works was absorbed into United States Shipbuilding Corporation and after 1905 the shipyard operated as a part of Bethlehem Steel.

2. Principle Exhibits

Ship Model Construction

Located on the port side of the main deck, aft of the Museum Store, the Model Shop was established in 1976 by Bill Benson, the Museum's first Curator of Models. In 1986, Bob Crawford assumed the duties of Curator of Models in addition to his other Museum responsibilities. Since the position only allowed Bob to spend one day a week in the shop, he transformed the shop into a volunteer-operated workspace. At this time the Model Shop was also established as the unofficial clubhouse of the San Diego Ship Modelers Guild, housing the club's files, library, tool room and mail station.

The Model Shop is manned most weekdays by skilled volunteer modelers who have all gone through the Museum's docent training program. Members of the San Diego Ship Modelers Guild may also work in the shop on weekends. When in the shop the volunteers are available to respond to visitor questions while they work on their individual projects. Occasionally the modelers will repair "shipwrecks" from the museum store and make modifications or repairs to models to be displayed in the Museum collection. Occasionally, the modelers will take on major museum projects, examples being Joe Bompensiero's *U.S.S. Langley* (CV-1) and *Cutty Sark* or Jack Klein's *H.M.S. Challenger*. Bompensiero and Klein also collaborated on the model of Juan Rodriguez Cabrillo's *San Salvador* located in the Early Mapping and Exploration exhibit.

Fishing: Harvesting the Oceans

This exhibit focuses primarily on the history and evolution of fishing by people living in and around San Diego. San Diego's commercial fishing industry was begun around 1860 by Chinese settlers. By about 1920 Italian, Portuguese and Japanese fishermen began to dominate the business, and tuna and albacore were the target as San Diego grew to become "Tuna Capital of the World." At present San Diego's commercial fishing can hardly be called an industry. Except for some headquarters locations, the industry is made up of small boat operators supplying catches for local or regional restaurants and markets plus public charter fishing boats and other specialties. Reasons for the decline in the tuna fishery include changes in ocean currents and temperature patterns, newly established territorial boundary limits, reduced fish populations, and safety and environmental regulations related to protecting dolphins that frequently become trapped in the tuna seiners' nets.

The exhibit includes:

- A fishing log. Fishermen have found that small marine animals naturally grow on or congregate around flotsam which can attract schools of larger fish including tuna. Discovery of a productive fishing log could mean the success of an entire voyage.
- A purse seiner net is presented alongside a small model to illustrate how the system worked. The seiner's net was designed before World War I but not used in

San Diego until the early 1960s. When local fishing boats started using it, pole fishing for tuna came to an end.

- The large photo on the bulkhead shows how the Embarcadero looked when the tuna boats were in port during the late 1940s to early 1960s.
- Fisherman's Shrine is an example of the sacred pictures, sculptures, icons or arrangements of religious articles that many Italian and Portuguese fishing boats carried on board.
- Three models together allow comparisons between a modern purse seiner, a bait boat on which fishing was done with pole (note the racks on the stern where the fisherman stood), and finally a Monterey fishing boat like the Museum's *Mary Ann* and *La Diana* (located just aft of *Berkeley* on the floating dock).
- The Hicks engine in the center powered one of the Monterey fishing boats.
- Information about canneries and the brands and different types of tuna harvested by San Diego's tuna fleet.
- The Marine Resources exhibit illustrates the whaling and the sea otter industry carried on very early in San Diego's history.
- The harvesting and processing of kelp was a significant San Diego industry until 2005. Kelp extracts were used in making cosmetic and medicinal creams as well as food industry thickening agents, toothpaste, and ice cream.
- Display cases contain navigational instruments and tools used in pole fishing for tuna and whaling.
- The small bronze statue is a model of the life-size Tunaman's Memorial, which is located on Shelter Island.
- Mounted along the area's upper bulkhead are half-hull models used in the design and construction of several tuna boats.
- Note the table with three plates on which young visitors can make tracings or rubbings of a tuna fisherman, a tuna boat and a tuna. It is always stocked with paper and crayons.

Early Mapping and Exploration

The chart making and exploration exhibit aboard *Berkeley* spans the history of man's attempts to explore and describe his environment. There is the Western (Christian) view illustrated by the Hereford Mappa Mundi (circa 1300) with its strong

religious emphasis, placing Jerusalem in the center and the Garden of Eden at the top. The Al-Idrisi, in contrast, is based on the Islamic view of the world, emphasizing trade, communication and conquest rather than religion.

Much early exploration was driven by commerce and/or conflict. Islamic powers prevented the West from traveling to and trading with Asia via land, as Marco Polo was said to have done. Access to Asian spice was so important to the West that sea routes to Asian markets were sought as alternatives to the Silk Road. The attempt by Columbus to reach Asia by sailing west was one of many tries.

Spain and Portugal were such strongly competing sea powers that Pope Alexander VI established the Line of Demarcation to divide the world into two parts in order to prevent outright warfare. The division initially granted Spain the territory 100 leagues (300 nautical miles) west of the Azores. Lands to the east of the line were granted to Portugal. The original line was later moved west about 270 leagues putting yet-to-be-discovered Brazil in the Portuguese sector. The treaty of Zaragoza established a similar line in the Pacific. This definition eliminated other European countries and all non-Catholic countries from consideration. Specific voyages of exploration covered by the exhibit include:

- Magellan's voyage (1519-1522) around the world. Only one of five ships and 18 of the original 270 sailors returned to Spain. A western sea route to Asia was proved possible.
- Cabrillo's discovery of San Diego Bay in 1542, and his failure to find a northern route to Asia from Europe as opposed to Magellan's southern one.
- Englishman Sir Edmund Halley's voyage in 1698 to chart tides, winds and magnetic fields "to improve knowledge of the longitude and variations of the compass."
- Between 1764 and 1768 *HMS Dolphin* made voyages of exploration into the Pacific in British attempts to discover the fabled Northwest Passage and to find *Terra Australis*, the land mass thought to exist somewhere in the South Pacific. During these voyages *HMS Dolphin* twice circumnavigated the world.
- Captain James Cook's three voyages (1768-71, 1772-75 and 1776-80) provided new details of the coasts of New Zealand, eastern Australia, and western North America. In the 1770s Cook gathered biological and sociological data in the South Pacific while he searched for the Great Southern Continent that was thought to counterbalance the mass of the northern hemisphere. Cook also pioneered the use of the chronometer and was recognized for his methods for preventing scurvy.
- American Naval officer Charles Wilkes' exploration expedition (1838-42) discovered and mapped Antarctica. The specimens he collected became the foundation of the Smithsonian Institution.

- Matthew Fontaine Maury, unable to serve at sea because of a crippling injury, was placed in charge of a naval depot of charts and instruments. The information he collected from ships' logs, observations and charts and incorporated into charts of winds and ocean currents provided tools for navigators to improve sailing times.
- *H.M.S. Challenger* (1872-76) sailed the world measuring ocean temperature, salinity and topography. The term "oceanography" was coined during efforts to convince the British government to sponsor such a voyage.

United States Navy in San Diego

The U.S. Navy exhibit contains a variety of models of significant warships from the early 19th century through to the present day. The ships represented helped shape much of America's history including the Westward Expansion, the Civil War, World War I, World War II, the Korean War, the Cold War and the Vietnam War. These models show the evolution of propulsion from sail to nuclear. The weapons systems displayed in these models range from round shot and grape to under-sea launched multi-warhead nuclear missiles. Also included in the exhibit is a unique collection of model warships that were made in Japan prior to World War II and were used to teach "ship recognition" to Japanese naval personnel. Models in the Navy exhibit include:

- ***Vincennes***, A *Boston*-class sloop of war, launched in 1826, she was assigned to the Pacific Squadron (1826-1830). She was the first U.S. Navy ship to circumnavigate the world and the first to visit Japan. She also participated in the Wilkes expedition to the South Seas (1838-1842) and the Gulf Blockading Squadron during the Civil War.
- ***Cyane***, a U.S. Sloop of War, was the first U.S. Navy warship to visit San Diego, arriving here on 29 July 1846. Commanded by Capt. Samuel du Pont, *Cyane* brought a detachment of marines and a battalion of volunteers led by John C. Fremont and Kit Carson. They landed unopposed and raised the American flag in what was then Mexican territory. The *Cyane* played a significant role in the war with Mexico and the acquisition of California.
- ***U.S.S. Hartford*** was built and commissioned at the Boston Navy Yard in 1858. Its steam-driven screw gave the ship maneuverability in battle and an efficient sailing rig allowed it to project great power over great distance and for long periods, attributes for what would become the cruiser. This was Admiral David Farragut's flag ship during the Battle of Mobile Bay on 5 August 1864, when she prevailed over the confederate ironclad *Tennessee*. It was from the *Hartford* that Admiral Farragut uttered his famous line, "Damn the torpedoes! Full speed ahead!" In the Civil War era floating or submerged mines were called torpedoes. *Hartford* visited San Diego in 1887.

- **U.S.S. *Bennington*** (PG-4), launched in 1890 and commissioned 1891, carried six 6-inch rifled guns and other guns including Hotchkiss rapid-fire 47 mm guns. On 21 July 1905, while anchored in San Diego harbor and preparing to get underway one of her boilers blew up causing the worst peacetime disaster in the U.S. Navy up to that time. The casualties included 65 killed and 85 injured. Eleven Medals of Honor were awarded for rescue work during the disaster.
- **U.S.S. *Monterey*** (BM-6), built by Union Iron Works, was launched in 1891 and was among the last of the old-style monitors. She departed San Diego in 1899 for service in the Philippines as part of the Asiatic Squadron during the Spanish American War.
- **U.S.S. *Holland*** (SS-1) Although the U.S. Navy's first submarine was *Alligator* (1862), *Holland* on 12 October 1900 became the first commissioned U.S. submarine. *Holland* was powered by an internal combustion engine (gasoline) and had batteries and an electric motor for submerged operations. Her torpedo tube could be reloaded while at sea. She had a deck gun and a conning tower as well as ballast and trim tanks for making depth and attitude changes while submerged.
- **U.S.S. *Patoka*** (AO-9) was commissioned 13 October 1919 as a fleet oiler. In 1924 she began service as a tender for the Navy's rigid airships including *USS Shenandoah*, *USS Los Angeles* and *USS Akron*. Notable for her 177-foot airship mooring mast, she was the tallest ship in the Navy.
- **U.S.S. *San Diego*** (ACR-6), originally named *U.S.S. California*, was built by the Union Iron Works of San Francisco, commissioned 1 August 1907, and renamed in 1914. On 19 July 1918, she was torpedoed by the German submarine *U-156* during operations southeast of Fire Island. Six of her crew died and she was the only major U.S. warship lost during World War I.
- **U.S.S. *Langley*** (CV-1), America's first aircraft carrier, launched on Mare Island in 1912 as the collier (coal carrier) *U.S.S. Jupiter* (AC-3). She was the first U.S. Naval vessel to go through the Panama Canal. In 1920 she was converted into an aircraft carrier to take advantage of advances in naval aviation. *Langley* was homeported in San Diego as the carrier navy was established here.
- **U.S.S. *Pillsbury*** (DD-227) a *Clemson*-class destroyer was commissioned on December 15, 1920. Assigned to the Asiatic Fleet for most of her career, she was operating off Borneo on December 7, 1941. During the first few months of WWII the tired 20-year old *Pillsbury* was awarded two battle stars and was credited with sinking one Japanese destroyer. In a night action on March 2,

1942, Pillsbury was overtaken by two Japanese cruisers and sank with the loss of all hands.

- **U.S.S. Porter** (DD-356) launched in 1935, was the first ship of her class. Assigned to the Pacific in 1937 she was homeported in San Diego but was at sea off Hawaii when Pearl Harbor came under attack. In October 1942, while operating off Guadalcanal during the Battle of the Santa Cruz Islands, the *Porter* was struck by a torpedo, possibly an errant torpedo dropped from a ditching Navy TBF Avenger aircraft. She was heavily damaged and after the crew abandoned ship she was purposely sunk by gunfire from her sister ship *USS Shaw* (DD-373). There was no loss of life.
- **U.S.S. San Diego** (CL-53) a light cruiser of the *Atlanta*-class was commissioned on January 10, 1942. *San Diego* was active in the Pacific throughout WWII; earning 18 battle stars she was one of the most decorated ships of the war. The ship's designation was changed to (CLAA-53) in 1949 after decommissioning.
- **U.S.S. Balao** (SS-285) the first of a very successful class of submarines, she was launched in 1942 and commissioned on February 4, 1943. *Balao* made 10 war patrols in the Pacific, credited for rescuing many airmen and sinking an estimated 40,000 tons of Japanese ships. In 1959 *Balao* had a starring role in the movie "*Operation Petticoat*."
- **U.S.S. Gear** (ARS-34), intended for lend-lease service, was originally launched 24 October 1942 as *H.M.S. Pacific Salvor* (BARS-4); however she was commissioned by the U.S. Navy on 24 September 1943 and performed rescue and salvage work in the Pacific during WWII.
- **U.S.S. Hazlewood**, a *Fletcher*-class destroyer, was commissioned 18 June 1943. On 29 April 1945, she was hit by a kamikaze with the loss of all officers except the engineer and 67 enlisted men. Repaired and retired in 1946, she was recalled in 1951 and was again decommissioned on 19 March 1965.
- **U.S.S. Wasp** (CVS-18), an *Essex*-class carrier, was commissioned on 24 November 1943, replacing *U.S.S. Wasp* (CV-7) which had been torpedoed and lost on 15 September 1942. The new *Wasp* was quickly directed to the Pacific and served with distinction, being awarded eight battle stars. Following WWII the principal mission of the *Essex*-class carriers was to hunt submarines.
- **U.S.S. Shamrock Bay** (CVE-84), a *Casablanca*-class escort carrier, was launched in 1944. Escort carriers were built on merchant ship hulls by the

Kaiser Company of Vancouver, Washington. This company was also, at the time, launching Liberty Ships at a rate of one every 80 hours.

- **U.S.S. *Missouri*** (BB-63), one of four *Iowa*-class battleships, was the last U.S. battleship built. Commissioned on 11 June 1944, the *Missouri* is noteworthy as the ship onboard which the Japanese surrender ceremony was held on 2 September 1945.
- **U.S.S. *Sumner County*** (LST-1148) was launched 22 May 1945 and commissioned June 1945. With a U.S. Coast Guard crew, the *Sumner County* served in Korea and Vietnam wars, and was awarded six battle stars. She was decommissioned 19 March 1965.
- **U.S.S. *Chicago*** (CG-11), the heavy cruiser *U.S.S. Chicago* (CA-136), was commissioned on 10 January 1945 and transited to the Pacific in time to participate in the final months of WWII and in the occupation of Japan. In mid-1947, *Chicago* was decommissioned and placed in the reserve fleet at the Puget Sound Naval Shipyard. In 1958, she began a five-year reconstruction and conversion to become a guided-missile cruiser, and in 1964 she was recommissioned. Between 1966 and 1972 the missile cruiser *Chicago* served five extended deployments in support of the Vietnam War.
- **U.S.S. *Ulysses S. Grant*** (SSBN-631), a *James Madison*-class Polaris missile submarine, was commissioned on 17 July 1964. *U.S. Grant* performed 18 deterrant patrols while operating from Guam as a Polaris missile boat. In 1970 she was converted to a Poseidon Ballistic missile boat and homeported in Holy Loch, Scotland.
- ***Patrol Craft Fast*** (PCF), commonly referred to as Swift Boats, are the aluminum 50-foot long, shallow-draft vessels that were operated by the U.S. Navy's so-called "Brown Water Navy." These boats were employed mainly for counterinsurgency operations during the Vietnam War.
- ***Patrol Boat Riverine*** (PBR) is the U.S. Navy designation for small, rigid fiberglass-hull, water-jet driven patrol boats used in the Vietnam War between 1966 and 1971. About 250 of these heavily armed PBRs were operated by the River Patrol Force, Task Force 116 during the war. They were used to stop and search river traffic and to insert or extract Navy SEAL teams.
- **U.S.S. *La Jolla*** (SSN-701), a *Los Angeles*-class submarine was launched in 1979 and commissioned on 30 September 1981. The first Navy ship to be named for the village of La Jolla, she was the first submarine to successfully test fire a Tomahawk missile while submerged.

Ship Specifications

Ship	Displacement	Length	Beam	Draft	Speed	Crew
<i>Balao</i>	1,526 tons	311'	26'	16'	20 / 8.7	80
<i>Bennington</i>	1,700 tons	244'6"	36'	14'	17.5	197
<i>Chicago</i>	13,600 tons	674' 11"	71'	20' 7"	33	1,142
<i>Cyane</i>	792 tons	132'4"	36'3"	16'6"	13	200
<i>Gear</i>	1,630 tons	213'6"	39'	14'1"	15	120
<i>Hartford</i>	2,900 tons	225'	44'	17'2"	13.5	302
<i>Hazelwood</i>	2,050 tons	376'3"	39'7"	13'	35	273
<i>Holland</i>	64 tons	53' 10"	10' 4"	8' 6"	8 / 5	6
<i>La Jolla</i>	5,774 tons	362'	33'	32'	20	110
<i>Langley</i>	11,500 tons	541'	65'	18'11"	15	468
<i>Missouri</i>	45,000 tons	887'3"	108'2"	28'11"	33	1,921
<i>Monterey</i>	4,084 tons	260'11"	59'	14'	13.6	210
<i>Patoka</i>	16,800 tons	417'10"	60'	26'2"	11	168
<i>Patrol Boat Riverine</i>	N.A.	32'	10' 5"	2'	28.5	4
<i>Patrol Craft Fast</i>	N.A.	50'	13'	5'	25	6
<i>Pillsbury</i>	1,190 tons	314' 4"	30' 8"	9' 3"	35	116
<i>Porter</i>	1,850 tons	381'	36'	10 ft.	35	194
<i>San Diego (ARC-6)</i>	13,680 tons	503'11"	69'7"	24'1"	22	829
<i>San Diego (CL-53)</i>	6, 000 tons	541' 8"	53'	24'	32	796
<i>Shamrock Bay</i>	7,800 tons	512'3"	65'	22'6"	19	860
<i>Sumner County.</i>	3,960 tons	328'	50'	11'2"	11.6	119
<i>Ulysses S. Grant</i>	7,300 tons	425'	33'	32'	20	120
<i>Vincennes</i>	700 tons	127'	32'	16'	18	80
<i>Wasp</i>	27,000 tons	872'	147'6"	28'7"	32.7	3,448

Chapter IV. *Medea*



Chapter IV. *Medea*

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Chronology

1904	Launched 29 August for William Macalister Hall
1904-1911	William Macalister Hall, Torrisdale Castle, Carradale, Argyll, Scotland
1914-1917	John Stephen of Linthouse (<i>Medea's</i> builder), Govan, Glasgow, Scotland
1917-1919	War service in French Navy, based at Cherbourg.
1930-1933	Fred J. Stephen, Invergare, Rhu, Dumbartonshire, Scotland (designer of the yacht in 1904)
1941-1945	War service with British and Norwegian Navies
1969-1970	Captain K.G. Holmberg, Jarnorsen, Sweden
1971-1973	Nelson Paul Whittier, Goudge Island, B.C., Canada
1973-present	The Maritime Museum of San Diego, California

History

The steam yacht Medea, one of three remaining Edwardian yachts in existence, was built for William Macalister Hall of Torrisdale Castle, Scotland, in 1904. When Macalister Hall looked for a shipyard to build his yacht, the prestigious Scottish firm of Alexander and Sons came to mind. Fred J. Stephen, son of the founder Alexander and a naval architect, designed and built Medea in less than two months. She was launched at one of the firm's three ship building facilities at Linthouse on the Clyde River. With steam up and in fully operational condition, Medea was handed over to Macalister Hall. (Note: Photographs of William Macalister Hall and his wife Aymee are in the saloon.)

Her sleek design, precious use of expensive woods, and state of the art technology bespeak the loving care given to her by Stephen at Linthouse. The interior woods of the saloon and smoking cabin on the main deck are quarter-sawn (a log or timber is sawn into quarters along its axis) English oak, and the exterior wood and deck are teak.

Although very small, the galley was equipped with a wood-burning stove and a wooden icebox from which the Macalister Halls and their guests dined on grouse, pheasant, duck, venison, trout, Scottish oat cakes, cheeses, and Springbank Single Malt Scotch Whiskey, which was distilled in Campbeltown, near their home.

The luxurious sleeping accommodations are below the main deck with the guest cabin forward (beneath the saloon) and the family cabin aft (beneath the smoking cabin extending past the open deck). Each has its own stairway. Guest accommodations contain the spacious main cabin, a small single cabin on the port side, and a bathroom (head) on the starboard side. The family quarters are even more spacious and luxurious. There are two large single beds, an expanded hallway with another single bed, and a bathroom (with a bathtub). The guest and family quarters are carpeted throughout. The walls are painted in a soft white with wallmounted sconces and curtains on the portholes. It's not surprising that the Stephen family thought enough of their creation that they eventually became two of the eighteen owners of the yacht.

The engine room, which occupies nearly half the available space, has a double reciprocating steam engine which gives her a cruising speed of a comfortable ten knots. In the first years her boilers were powered by coal; later she was converted to oil.

Macalister Hall, a wealthy sportsman and estate owner, used the yacht in part to reach remote islands around Scotland to hunt grouse (his favorite game), and he and his wife Aymee often took friends on excursions. Under Macalister Hall, the yacht's crew included nine men—captain, mate, engineer, fireman, cook, steward, and three deckhands. Their quarters were in the foc'sle, just forward of the guest cabin. When

not steaming around the Scottish lochs, *Medea*'s home port during this period was at Campbeltown in Kintyre, not far south of Torrisdale Castle, his home. The yacht's normal cruising season was from May to the end of September, when she was laid up for the long Scottish winter.

In late 1911, Macalister Hall sold the yacht to Frederick Todd, who operated *Medea* for only one season. The vessel's third owner, John Stephen, was chairman of the board at Stephen of Linthouse, the yacht's birthplace. World War I came along and, with pleasure yachting suspended for the duration of the war, Stephen sold the vessel to the French Navy in 1917. The French renamed her *Corneille*, after the 17th-century poet, armed her with a 75-mm gun, depth charges, and a tethered observation balloon, and sent her out into the English Channel for anti-submarine patrol and to convoy sailing ships into Normandy ports.

After the war she reverted to private British ownership and her original name of *Medea*. Her new owner, Mr. Graham-White, installed electric power throughout. For a time she was based at Gibraltar, but by 1929 she was back in the hands of her designer, Fred Stephen, in Scotland. Stephen, a passionate yachtsman, employed *Medea* as the commodore's vessel at the Royal Northern Yacht Club at Rhu until his death at the end of 1932, when she passed into other hands.

During World War II, *Medea* first served in the British Royal Navy. She was based first at the Nore and later at Peterhead. She served as a barrage balloon tender and an accommodation vessel in the river Thames. Later in the war, she was loaned to the Norwegian navy, moved to Scotland, and used as a headquarters ship for secret operations against the Germans in Norway.

After the conflict she again returned to private hands in Britain until 1969 when she went to the Baltic under Swedish ownership where she served as a floating art gallery. She was purchased in 1971 by Paul Whittier, a wealthy American. He transported her to British Columbia where she was partially restored in his boatyard.

In July of 1973, her restoration well along, Whittier sailed her with his own crew from British Columbia to San Diego, where the yacht was presented to the Maritime Museum of San Diego. Since then she has been on exhibit at the Museum where Museum donors and guests are privileged to sail on her as a special "thank you" for their contributions.

The age of the steam yacht was roughly between 1870 and 1920, after which changing technology and economic conditions put an end to their construction. In its time, and especially around the turn of the 20th century, the steam yacht was emblematic of wealth and elegance. With her classic lines, sleek clipper bow and counter stern, combined with her teak superstructure and decks, *Medea* is a classic example of this period in maritime history.

Specifications

Launched: 29 August 1904

Owner: William Macalister Hall and others (see Supplement 1)

Length: 109 feet 7 inches at waterline; 134 feet overall

Beam: 17 feet

Draft: 9 feet 4 inches loaded

Tonnage: 111.84 gross, 57.17 net tonnage

Passengers: Berthing accommodations for eight passengers

Power: Compound (two-cylinder) oil-fired steam engine

Speed: 10 knots cruising; 11.5 knots maximum

Hull: Steel with fiberglass coating

Supplement

1. List of Owners

(Extracted from Lloyd's Register of Yachts, 1904-1972. All dates of ownership are approximate. Abbreviations: MP-Member of Parliament, DSO-Distinguished Service Order, CB-Commander of the Order of the Bath. RYS-Royal Yacht Squadron.)

1904-1911	William Macalister Hall, Torrisdale Castle, Carradale, Argyll, Scotland
1912-1913	Frederick G. Todd, Ardery, Troon, Ayrshire, Scotland
1914-1917	John Stephen, Linthouse (<i>Medea's</i> builder), Govan, Glasgow, Scotland
1917-1919	War service in French Navy. Based at Cherbourg.
1919-1920	M. Graham-White, Warsash House, Warsash, Hants, England
1921	H. Dudley Ward, MP, 62 Portland Place, London W1, England
1922	Captain The Right Honorable F.E. Guest, DSO, MP, Templeton, Roehampton, England. (RYS)
1923-1926	A.M. Symington Almada, Lisbon, Portugal (home port - Gibraltar)
1927-1929	B.H. Piercy, 5 Queens Gate, London SW7, England (RYS)
1930-1933	Fred J. Stephen, Invergare, Rhu, Dumbartonshire, Scotland (Designer of the yacht in 1904)
1934	A.A. Paton, CB, Martins Bank Building, Water Street, Liverpool
1935-1941	J.L. Wild, 180 Piccadilly, London
1941-1942	Requisitioned for war service with British Royal Navy
1942-1943	War service with Royal Norwegian Navy in Scotland
1943-1945	War service with British Royal Navy in Scotland
1945-1960	J.L. Wild of Camberlands, Kenley, Surrey, England
1961	The Executors of the Estate of the late J.L. Wild
1962-1964	C.E. Reffitt, 11 Chesterfield Street, London W1, England
1965-1969	Captain N.P.S. Millar, Harlyn Harlyn Ho, Harlyn, Padstow, Cornwall, England
1969-1970	Captain K.G. Holmberg Jarnorsen Sweden
1971-1973	Nelson Paul Whittier, Goudge Island, B.C., Canada
Since 1973	The Maritime Museum Association of San Diego

Chapter V. *Californian*



Chapter V. *Californian*

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Chronologies

Californian

- | | |
|-----------|---|
| 1982 | Nautical Heritage Society founded and planning for <i>Californian</i> begins |
| 1983 | 4 July – Keel laid at Spanish Landing Park, San Diego |
| 1984 | 29 May – <i>Californian</i> is launched at U.S. Coast Guard Air Station, San Diego |
| 1984 | 4 July – <i>Californian's</i> first duty as Tall Ship Ambassador for the State of California is to lead the parade of boats at the opening of the Summer Olympic Games in Los Angeles |
| 1984-2002 | The Nautical Heritage Society maintains a busy schedule with <i>Californian</i> visiting numerous ports along the Pacific and Atlantic Coasts |
| 2002 | The Sheila Potiker Family Foundation of San Diego donates funds for the Museum to purchase <i>Californian</i> |
| 2003 | <i>Californian</i> undergoes extensive restoration and is named Official Tall Ship of the State of California |
| Present | <i>Californian</i> is one of the Museum's most active tall ships, sailing with living history programs, weekend Tall Ship Adventures, visits to other ports, engaging in mock gun battles and making extended coastal cruises each summer |

C.W. Lawrence

- | | |
|------|--|
| 1790 | U.S. Revenue Service created by Congress 4 August |
| 1848 | <i>C.W. Lawrence</i> launched 20 August at Easby's shipyard, Washington, D.C. |
| 1849 | 31 October – <i>Lawrence</i> arrives in San Francisco |
| 1851 | 19 January – 15 February – <i>Lawrence</i> visits San Diego |
| 1851 | 25 February – <i>Lawrence</i> is driven onto the beach south of Point Lobos near the entrance to San Francisco Bay |
| 1915 | U.S. Revenue Service merges with Lifesaving Service to become U.S. Coast Guard |

History

On 12 October 1982, with no appropriate vessel in their possession and only an idea of what they hoped to accomplish, Steve and Julia Christman founded the Nautical Heritage Society as a non-profit organization to educate citizens about the importance of the coastal marine environment to our quality of life by providing “at sea” experience working in the marine environment. The noted naval architect Melbourne Smith was commissioned by the Christmans to develop plans for a suitable sail-training vessel and to manage the process of raising an estimated \$2.5 million to build and outfit the ship.

During the search for a suitable design, the staff of the United States Coast Guard Academy library in New London, Connecticut heard about the project and recalled seeing the log of Revenue Service Cutter *C.W. Lawrence* in the Academy archives; also remembered were plans of a sister vessel to the *Lawrence*. They contacted the Nautical Heritage Society and offered to make the log and plans available at the same time making the case that a revenue cutter would make an ideal sail training vessel. When the Nautical Heritage Society learned about the history of the *Lawrence* they knew they had found the ship they wanted to build--a vessel designed for coastal navigation with deep water capabilities and a historical connection to California.

No plans or drawings of the *Lawrence* existed, only her log books. There were plans for the *Lawrence*’s sister ship *Campbell*, the first of the *Campbell*-class cutters. (*Campbell* was renamed *Joseph Lane* in 1855, and referred to as “Joe Lane” in the service.) These plans were adapted to meet modern Coast Guard regulations and the *Lawrence* was reborn as *Californian*. *Joseph Lane* (ex-*Campbell*) may have shared similar hull lines with the *Lawrence* but it was rigged differently. *Joseph Lane* was rigged as a topsail schooner while the *Lawrence* was rigged as a brig. Because of this difference in rigging *Californian* actually more closely represents the appearance of *Joseph Lane* than the *Lawrence*. Bit by bit, many of the long-forgotten records were discovered. U.S. Customs historians, the U.S. Coast Guard, National Park Service staff and the historians at the Nautical Heritage Society all contributed to the rediscovery of the Revenue Cutter *C.W. Lawrence*.

One of the first steps taken in building *Californian* was to locate and order the lumber that would be used to begin the project. A team was sent to Belize in Central America to find the trees that would be needed for the keel, frames, deck beams and other components that would form the major parts of *Californian*’s structure.

With the unanimous approval of the commissioners of the Port of San Diego a construction site was selected on the beach at Spanish Landing Park across Harbor Drive from the San Diego Lindbergh Field Airport. In June of 1983, before *Californian* was launched, the state legislature by resolution designated *Californian* as the official Tall Ship Ambassador of the State of California by adopting Assembly Concurrent Resolution No. 69.

An ambitious building schedule was begun with laying the keel on 4 July 1983 and launch set for 28 May 1984 (Memorial Day) in order to have the ship in the water and operational in time for the tall ship parade to kick off the 1984 Summer Olympics in Los Angeles.

Wood for the ship arrived from Belize and construction began using traditional wood shipbuilding techniques whenever possible. *C.W. Lawrence* was "staunchly built of white and live oak, yellow pine, cedar, locust, and mahogany and was copper fastened and sheathed." *Californian* would be constructed of:

- **White Oak** mast hoops, gaff and boom jaws
- **Douglas Fir** masts, spars and decks
- **Sugar Maple** shells of the blocks
- **California Redwood** bulkhead paneling in the "Governor's Cabin"
- **Black Locust** gun carriage wheels
- **Longleaf Georgia Pine** frames (Laminated frames made construction easier and nearly doubled the strength of the frames)
- **Chicle Tree** belaying pins
- **Honduras Mahogany** cap rails and hatch covers
- **Jelutong** *Californian's* figurehead Queen Calafia
- **Longleaf Caribbean Pine** hull and ceiling planking (The planks were between 30 and 36 feet long, allowing for fewer joints. The planks are 6 inches wide and 2 1/2 inches thick along most of the hull. At the wales, where more strength is needed, the thickness was increased to 3 1/2 inches)
- **Santa Maria** deck beams and carlings

Melbourne Smith was retained to design and oversee construction of the ship and Jayford Hazell came from Jamaica to serve as master shipwright on the project. An interesting side note is that Mexican Pesos, which were an ideal size, and cheaper than regular metal slugs, held the sheaves inside the blocks in place. Work continued at a steady pace much to the interest of the public who visited the site throughout the year to view the ship's progress. Many local people would spend their lunch hour in the bleachers set up for public viewing. Due to the public response, groups of volunteers called watchkeepers were recruited to be present and provide citizens with information about wooden sailing ship construction and *Californian's* educational mission.

Californian carries a carved figurehead of Queen Calafia, namesake of California, and the ship's transom is ornamented with two California golden grizzly bears on either side of a flowing ribbon in which her name is carved. As early Spanish explorers began to explore northward along the west coast of North America they would follow the coast of Mexico into the 800-mile-long Sea of Cortez. With the Baja California peninsula on one side and the mainland of Mexico on the other it was easy for these explorers to imagine this nameless peninsula as an island not connected to the mainland. The name they chose for this newly discovered "island" came from a

romance novel published in 1508 by the Spanish novelist Garcia Ordenez de Montalvo. The novel was entitled "Las Sergas de Esplandian" (The Exploits of Esplandian). It was based on his translation of the "Amadis of Gaul", a 13th-century French manuscript. In the story, Esplandian, the son of Amadis, has many strange adventures. The novel was extremely popular and passed through many printings. It was familiar to any fairly well-educated Spaniard of the period.

In chapter 157 Montalvo writes, "Know that, on the right hand of the Indies, very near to the Terrestrial Paradise, there is an island called California, which is peopled with black women, without any men among them, for they were accustomed to live in the fashion of Amazons. They were of strong and hardy bodies, of ardent courage and great force. Their island was the strongest in all the world, with its steep cliffs and rocky shores. . . . They lived in caves wrought out of the rock with much labor. They had many ships which they sailed out to other countries to obtain their booty."

"Now at the time when those great men of the Pagans sailed with their great fleet, as history has told you there reigned in this island of California a Queen, very large in person, the most beautiful of all of them, of blooming years, and in her thought desirous of achieving great things, strong of limb and of great courage, more than any of those who had filled her throne before her, Queen Calafia." Catherine Bach (Daisy Duke of TV series "The Dukes of Hazard" 1979 - 1985) was selected and agreed to pose for the ship's figurehead.

The launching of *Californian* had been set for the afternoon of Memorial Day, 28 May 1984. Everything was ready. A crowd of over 10,000 waited expectantly for Gloria Deukmejian, California's first lady, to christen the ship and send her into the bay. The christening took place on schedule but the launch had to be delayed. The slope of the beach was too shallow to allow launching on a traditional slipway so *Californian* had been built on a wheeled launching cradle. As the ship was pushed toward the water the wheels of the launching cradle broke through the crust of hard sand and began sinking into the soft silt beneath causing the ship to heel over at a sickening angle. The cradle was moved up from the shoreline onto more solid ground until a solution could be worked out. It was determined the ship could not be launched off the beach. With the heroic cooperation of numerous government and civic organizations a plan was made to tow the ship on its launching cradle down Harbor Drive to the Coast Guard Air Station where their seaplane ramp would be used for launching the ship. *Californian* was moved that evening and the launching occurred the next day with a minimum of difficulties in front of an even larger crowd. The next month was spent at a floating pier next to the construction site to complete rigging and fitting out the ship.

After leading the 4th of July boat parade celebrating the opening of the 1984 Summer Olympic Games in Los Angeles, *Californian* began her career as Tall Ship Ambassador representing the State of California. As Tall Ship Ambassador, *Californian* represented California in hundreds of special events, inspiring an appreciation for the maritime heritage and coastal resources of the state. She visited

ports in New York, Boston, Maine, Hawaii, Canada and Mexico, representing the state at OP-Sail 86, celebrating the centennial of the Statue of Liberty in New York Harbor. In the year 2000 *Californian* made a Millennium Goodwill Voyage through the Panama Canal to participate in OP-Sail 2000, visiting various ports along the eastern U. S. coast and in the Caribbean before returning home. She also was active in celebrating California's 1999 sesquicentennial, and in the Tall Ships Challenge California 2002. *Californian* delivered eight tons of medical relief supplies to Acapulco to aid victims of the 1985 Mexico City earthquake, made four goodwill voyages to Hawaii (1985, 1986, 1989, and 1992), two voyages to Canada, and two voyages to Isla Guadalupe in Mexican waters.

Californian also found her way into Hollywood productions and a number of documentaries. It is ironic that in the filming of Steven Spielberg's "Amistad" off the coast of Los Angeles in 1997, *Californian* played the title role of the schooner *La Amistad*, which carried slaves from Cuba to the United States, when one of the duties of the Revenue Marine Service at the time was to suppress slavery.

In her eighteen years of operation with the Nautical Heritage Society (1984–2003) *Californian* traveled over 460,000 miles conducting educational and coastal awareness programs for nearly 80,000 schoolchildren from twenty-eight coastal ports throughout California. She has conducted hundreds of five-day and eleven-day at-sea programs for high school and college students, involved thousands of 4th to 8th grade students in sailing and dockside programs and thousands of adults in on-the-water sailing experiences.

Hard times fell upon the Nautical Heritage Society when it failed to gain a state energy conservation grant and was unable to finalize a contract with Operation Sail, Inc. in Washington, D.C. The Society placed *Californian* on the market in 2002.

A New Life with the Maritime Museum

In June 2002, the Maritime Museum received the largest gift in its history when the Sheila Potiker Family Foundation of San Diego contributed funds to purchase *Californian* from the Nautical Heritage Society. When *Californian* arrived at the Maritime Museum, she had logged 18 years of continuous operation and a survey of the vessel made it clear that she needed some alterations, system updates and maintenance to prepare for the next chapter of her life.

Fittings, plumbing, electrical and mechanical systems were overhauled or replaced. In addition to cleaning, her hull and deck seams were re-caulked, and below-deck spaces were redesigned and reworked to maximize use of available space. The hull received a new paint scheme more closely representing the appearance of a Revenue Cutter Service vessel from the era of the original *C.W. Lawrence* and she received a new set of sails (7,000 sq. feet). Changes to the rigging and sail arrangement were

also made to increase the safe handling of the vessel. The restoration of *Californian* was estimated at \$400,000.

In February 2003 the California Coastal Conservancy provided the Maritime Museum of San Diego with a \$300,000 grant to complete restoration of *Californian* and return the ship to a floating classroom for students. Later in February California Assemblywoman Christine Kehoe introduced Assembly Bill No. 965 (AB 965) proposing to designate *Californian* "the Official State Tall Ship". The bill recounted the broad history of *Californian* and its potential to preserve California's maritime heritage and embody "California's role in the great age of sail". Operating as an "educational vessel" and an "historical asset" *Californian* would "promote and encourage an appreciation of the maritime heritage and coastal resources of the State of California." By the end of April, 2003, AB 965 had been unanimously approved by the Assembly and forwarded to the Senate. The Senate approved the amended version of AB 965 on 7 July and returned the bill to the Assembly for final approval. On 23 July 2003, Governor Arnold Schwarzenegger signed Assembly Bill No. 965 replacing Assembly Concurrent Resolution No. 69 of 1983 and declaring that *Californian* was, by law, "the Official State Tall Ship".

In mid-August, 2003, the refurbished *Californian* embarked on a goodwill tour that included stops in Santa Barbara and San Francisco before arriving in Sacramento on 3 September. The first leg of the cruise carried a group of graduate students from Point Loma Nazarene College studying the 1834-35 voyage of Richard Henry Dana as told in his book "Two Years Before the Mast". The group made stops at Dana Point, Ventura, Santa Barbara Island and San Miguel Island before reaching the city of Santa Barbara. On 8 September 2003, *Californian* departed Sacramento for the trip home to San Diego. Paying passengers joined the crew on the homeward voyage that included a tour of the Channel Islands with an overnight stop at Catalina Island before making port in San Diego on 20 September.

The Maritime Museum operates *Californian* as an educational vessel and historic asset to promote and encourage an appreciation of the maritime heritage and coastal resources of the State of California. *Californian* will continue to sail along the California coast to visit other ports and nautical museums so that all Californians can learn about the proud nautical heritage of the state.

The building of *Californian* restored to California's shores the grace, beauty, and indomitable spirit of the single Coast Guard cutter that maintained law and order during the frenzy of the Gold Rush. *Californian* has served as a valuable resource for all Californians. Her voyages have fostered an appreciation for the maritime heritage and coastal resources of the state.

The Maritime Museum plans to continue to use *Californian* extensively to introduce the youth of San Diego to an exciting and varied educational and skills-based curriculum. Some of the planned programming includes supplementary science-based experiences for elementary school children, programs for "at risk" youth and

extensions of the existing overnight living history program. The ship is also available for receptions, charters and day sails.

Californian has nine sails, carries 7,000 square feet of canvas, measures 145 feet in length and weighs 130 tons. With her auxiliary diesel and generator, a modern galley, three heads and 36 bunks in four compartments, *Californian* can comfortably serve up to 50 guests on a half-day sail or 25 guests on extended voyages.

Today *Californian* is armed for ceremonial purposes with four of her original 6-pound guns. The guns were cast for the Nautical Heritage Society by Captain Stan Pietrucki, a skilled craftsman and owner of Pirates Cove Arms. Today *Californian* casts a distinctive and instantly recognizable silhouette and has become one of the country's most well-known tall ships.

The Revenue Marine Service

The war for American independence from Great Britain began the morning of 19 April 1775 at Lexington, Massachusetts with the "shot heard 'round the world" and ended on 14 January 1784 when the Treaty of Paris was ratified by Congress. The new American nation operated under the Articles of Confederation drafted by the Continental Congress in 1777. These articles reflected the wariness by the states of a strong central government and established a "firm league of friendship" between and among the 13 states. Under the Articles each of the states retained their "sovereignty, freedom and independence". It was not until 1789 that America truly became the *United States* of America when the new nation's first Congress convened in New York under the recently ratified Constitution.

After the Revolution, the United States was deep in debt, and its emerging industries were under tremendous pressure from British imports. The American merchant marine, a mainstay of the colonial economy, had been weakened by losses in the war. To secure its political independence, the United States first had to secure its financial independence. One of the acts of the first Congress of the United States was to establish protective tariffs and taxes to generate revenues to repay the heavy debt of the Revolutionary War. Prior to the American Revolution, the colonists balked at what they felt were undue taxes imposed by Great Britain on goods entering North America. One of the ways to avoid taxes was by smuggling. When the war was over, however, many smugglers saw little difference between taxes imposed by King George and by the Congress of the United States, so they continued their illegal trade.

George Washington's former military aide and renowned financier Alexander Hamilton had been appointed as the first Secretary of the Treasury. Hamilton's first interest when he took office was the repayment in full of the \$75 million war debt. He claimed "The debt of the United States ... was the price of liberty." In April of 1790 he sought authorization from Congress to build "so many boats or cutters, not exceeding ten, as may be employed for the protection of revenue."

On 4 August 1790, Congress Enacted the Tariff Act of 1790 establishing a "Revenue Marine" and authorized the building of ten revenue cutters, but did not define their exact specifications. Most were "Baltimore Clipper" two-masted schooners that were "light, fast, easily managed, seaworthy vessels, handy in beating in and out of harbors and through winding river channels". The first ten cutters were constructed and then stationed at strategic locations along the Atlantic sea coast. The service would be variously known as "Revenue Service," "Revenue Marine," and "Revenue Cutter Service," until an Act of Congress on 31 July 1894 officially designated the last name as the only correct one. The term "revenue cutter" dated back to the early 1700s in England, where their revenue patrol vessels were all cutter-rigged, that is, with a single mast and with two or more jibs. The creation of the Revenue Cutter Service on 4 August 1790 is considered the "birth of the United States Coast Guard".

The spirit of the service was based on Hamilton's insistence upon thrift and responsibility to the public. The service was intended to collect money, not spend it. The officers were to be servants of the people. "They (the officers) will always keep in mind that their Countrymen are Freemen & as such are impatient of everything that bears that least mark of a domineering Spirit."

The primary purpose of cutters was to protect the revenue of the new nation by deterring smuggling. That meant sailing out of the ports to which they were assigned and intercepting vessels before they came too close to the shore. It was here, well out of the harbor but within sight of the coast, that smugglers unloaded part of their cargoes into smaller "coaster" vessels or directly onshore to avoid customs duties. The collectors usually had smaller boats that could check vessels as they sailed into port.

These ten cutters, therefore, were not harbor vessels; they were designed to sail out to sea, survive in heavy weather, and sail swiftly so that they might overtake most merchant vessels. They were the nation's first line of defense against attempts to circumvent the new nation's duties, the country's major source of income during this period.

The original duties specifically assigned to the cutters and their crews as legislated by Congress and expounded by Alexander Hamilton included boarding incoming and outgoing vessels and checking their papers (ownership, registration, measurements, manifests, etc.), insuring that all cargoes were properly documented, sealing the cargo holds of incoming vessels, and seizing those vessels in violation of the law.

In 1799 an act of Congress gave authority to the President to maintain as many revenue cutters as should be necessary to provide for the proper collection of import and tonnage duties. The corps gradually grew in size and importance and its vessels became larger and better. In addition to the usual duties, revenue cutters began to enforce other laws as well, such as enforcing quarantine restrictions, enforcing neutrality and embargo acts, and suppressing piracy.

On 22 March 1794 it became illegal for U.S. citizens to engage in the international slave trade and on 2 March 1807 Congress declared the importation of slaves from Africa illegal. Then on 15 May 1820 engaging in the international slave trade was declared an “act of piracy”. Some seizures of note were the first capture under the 1794 law in 1799, the capture of the brig *General Ramirez* carrying 280 African slaves off St. Augustine, Florida on 8 July 1820, and on 25 March 1822 the cutter *Alabama* captured three slave ships. By the time of the Civil War, revenue cutters had captured numerous slavers and freed almost 500 slaves.

The best-known incident of slaver interdiction is the case of the schooner *La Amistad*. On 28 June 1839, 53 slaves recently captured in Africa left Havana, Cuba aboard *La Amistad* bound for a sugar plantation at Puerto Principe, Cuba. Three days later, one of the slaves freed himself and the other slaves. They rose up against their captors and using sugar-cane knives found in the hold they killed all but two of their captors. On 26 August, after almost two difficult months at sea during which time more than a dozen Africans perished, *La Amistad* was spotted by *USS Washington*, a former revenue cutter now a U.S. Navy brig. *Washington* seized *La Amistad* off the coast of Long Island and escorted her to New London, Connecticut where the trial made famous by the 1997 Stephen Spielberg film “Amistad” was held. Ironically in the film the slave ship *La Amistad* was portrayed by *Californian*.

During the Civil War the revenue cutters operated under control of the Navy. On 11 April 1861 the cutter *Harriet Lane*, the service's first operational steam cutter, fired the first shot from any vessel in the Civil War when it sent a volley across the bow of the Confederate vessel *Nashville* entering Charleston harbor during the siege of Fort Sumter.

Legislation to create the Coast Guard was initially introduced in 1913. On 20 January 1915 Congress passed the “Act to Create the Coast Guard” (38 Stat. L., 800) and authorized the merger of the Revenue Cutter Service with the Lifesaving Service. President Woodrow Wilson signed it into law on 28 January 1915 and it went into effect on 30 January 1915. The newly constituted Coast Guard was made, by statute, one of the nation’s armed services. The Coast Guard celebrates 4 August 1790 (the birth of the Revenue Marine Service) as its birthday, making it the nation’s oldest continuously serving sea service.

Revenue Cutter C.W. Lawrence

C.W. Lawrence was one of seven vessels built to replace revenue cutters lost during the war with Mexico (1846–1848). *Lawrence* was a *Campbell*-class brig-rigged Baltimore clipper with raked masts, 96.5 feet in length with a 24-foot beam and displaced 144 tons. She was launched at the William Easby yard, in Foggy Bottom, Washington D.C. on 20 August 1848. She was christened *Cornelius W. Lawrence* in honor of Cornelius Van Wyck Lawrence (28 February 1791 to 20 February 1861) the

11th Collector of Customs at the Port of New York from 1845–1849. He was also a successful merchant, President of the Bank of the State of New York for 20 years, served in the 23rd Congress, House of Representatives (4 March 1833–14 May 1834), and the first elected mayor of New York City (1834–1837) (three terms). *C.W. Lawrence* was accepted for service by the Revenue Marine Service on 11 October 1848. She was pierced for 10 guns and carried two 32-pounders, one long 18-pounder, two 6-pounders, plus carbines, percussion pistols, Colt revolvers, boarding pikes and cutlasses.

With the acquisition of Oregon Territory by treaty with Great Britain in 1846 and signing of the Treaty of Guadalupe Hidalgo on 2 February 1848 ending the war with Mexico, U.S. revenue laws were extended to the new territories, and California was included within a newly designated customs district. News of the discovery of gold in California had reached Washington by spring of 1848 reinforcing the need for revenue cutters to enforce the law on the Pacific Coast. *C.W. Lawrence* set sail for the Pacific on 1 November 1848, under the command of Captain Alexander V. Fraser with a crew of 43 aboard. After an arduous voyage of almost a full year, including five weeks spent attempting to sail around the Horn, she arrived in San Francisco on 31 October 1849 after visiting the ports of Rio de Janeiro, Brazil, Valparaiso, Chile, and the Sandwich Islands (Hawaii).

In late 1850 *Lawrence* was fitted out for a cruise down the coast to San Diego. She cleared the Farallon Islands on the night of 26 December 1850 and headed south along the coast, charting the coastline and the inlets along the way. After passing San Miguel, San Nicolas, and Santa Cruz islands, *Lawrence* hove to off Santa Catalina Island on 2 January 1851 and entered Cat Harbor at the isthmus on the morning of 4 January. Captain Fraser completed his survey of the harbor and sailed out of the harbor on 16 January 1851. *Lawrence* arrived at San Diego Harbor on 19 January 1851, anchoring off the “New Town” where the crew set about “watering, wooding, and coaling.” On 10 February *Lawrence* shifted her anchorage to La Playa on Point Loma opposite North Island prior to her departure on 15 February. Her return voyage to San Francisco took her far out into the Pacific Ocean to the Sandwich Islands (Hawaii) once again. She visited at Hilo from 8 to 24 March and stopped at Honolulu for minor repairs from 26 March to 10 April before arriving back at San Francisco on the evening of 4 May 1851. Upon returning to San Francisco Captain Fraser requested a leave of absence and was relieved by Revenue Captain Douglas Ottinger on 7 June of that same year. From 18 July to 25 August *Lawrence* cruised as far north as Port Orford, Oregon.

On 18 November 1851 *C. W. Lawrence* sailed from San Francisco to Monterey arriving back off San Francisco the evening of 25 November. She anchored near Point Lobos, the southern head of the entrance to San Francisco bay at 7:30 PM. The tide had ebbed and was running with a strong set to the south. The sea was running from the west, almost directly toward the land. After an hour at anchor with waves sweeping across the deck the crew commenced heaving in the anchor to move to a safer position when the cable parted. The ship was driven into shoal water near the

beach and grounded about four miles south of Point Lobos around 9:00 PM. With seas breaking across the deck the crew feared they would all drown but the surf was too high to try leaving the ship and everyone held on as best they could. After a harrowing night it was discovered that everyone had survived without serious injury, but it was determined that the ship could not be salvaged.

The *Lawrence* was hove up onto the beach by means of a hawser carried ashore. She lay in only three-and-one-half feet of water at the low tide that morning and the high tide at 1:05 PM would bring her even higher up on the shore. The launch and a cutter were lowered and valuable items were transported to the beach. Stripping the wreck commenced in earnest on 27 November. Wagons were loaded with ship's papers, navigational instruments, small arms, ammunition, sails, rigging, and "other articles of ship's property" and sent to the military storehouse at the Presidio of San Francisco. On 28 November the cabin and wardroom furniture along with the medicine chest were removed and sent to the Presidio. The last of the rigging, chains, hawsers, etc. were removed to the Presidio on 29 November. In all \$12,000 in goods and equipment were salvaged.

The U.S. Treasury Department ordered the wreck of *Lawrence* sold at auction in early 1852. The hull and many damaged goods were sold for \$2,360.50 indicating how little was left. Another \$40 was tendered for some miscellaneous items bringing the total to \$2,406.50 less the cost of salvage and hauling totaling \$1,127.40 and leaving the government a paltry sum of \$1,279.10 from the wreck of *C.W. Lawrence*. The hull apparently remained on the beach until at least the early months of 1852 as indicated by a survey of the beach dated 1852. Within three years winter storms and heavy waves took their toll on the abandoned ship as the sands and tides swallowed her shattered hulk.

Her memory lived on for a time in the minds of her former crew. They surely would have told their grandchildren about their perilous journey around Cape Horn on the way to California, about their exciting role in the Gold Rush and most of all about the wreck of the *C.W. Lawrence*. As years passed, the stories may have survived in the oral histories of their families, but by the beginning of the twentieth century the revenue cutter *C.W. Lawrence* had been all but lost to history. There were a few records scattered in libraries and dusty archives, newspaper articles, letters, official Customs correspondence and most importantly the salvaged ship's log book. All these clues brought together could reconstruct the lost story of *C.W. Lawrence*.

This section was written by Bob Ross, a Museum volunteer and longtime Californian crew member. Mr. Ross's original article was altered to place Californian history first, followed by the histories of the Revenue Marine Service and C.W. Lawrence.

Specifications

Californian

Launched: 29 May 1984, U.S. Coast Guard Air Station, San Diego
Length: 83 feet 4 inches on waterline; 145 feet length overall
Beam: 24 feet 6 inches
Draft: 9 feet 5 inches loaded
Tonnage: 130 tons
Rig: Topsail schooner (topsail and topgallant)
Power: 9 sails, 7,000 sq. ft. and Caterpillar diesel 140 hp
Armament: Four 6-pound guns

C.W. Lawrence

Launched: 1848, Washington, D.C.
Length: 96 feet on waterline, 160' length overall
Beam: 24 feet
Tonnage: 144 tons
Rig: Brig converted to topsail schooner in the Pacific
Power: 10 sails
Armament: Pierced for 10 guns, carried two 32-pounders, one long 18-pounder, and two 6-pounders; crew armed with a variety of small arms.

Supplements

1. U.S.C.G. History Revenue Cutter *C. W. Lawrence*

The Revenue Cutter *C.W. Lawrence* was built as one of seven replacements for cutters lost during the Mexican War. She was built by the William Easby Yard at Foggy Bottom in Washington, D.C. She was a brig-rigged Baltimore clipper with raked masts. She was 96 feet 6 inches in length and displaced 144 tons. She was "staunchly built of white and live oak, yellow pine, cedar, locust, and mahogany and was copper fastened and sheathed." She was launched at Foggy Bottom on 20 August 1848. Her first commanding officer, who oversaw her construction, was Revenue Captain Alexander Fraser, and he attended her launching. The 30 October 1848 issue of Washington's "Daily National Intelligencer" wrote of her launching: "Scarcely had some of her blocks been knocked away, when she began, at first imperceptibly, to slide down her slippery ways, and Capt. Fraser and his lady, to whom was assigned the honor of christening the vessel, could scarcely, with all his exertion, find time to leap upon her deck before she plunged to the bosom of the Potomac. . . She was launched with all her masts and rigging on board, and with colors flying. . ."

She was christened *C.W. Lawrence*, after the collector of the Port of New York Cornelius van Wyck Lawrence. She spent the next few weeks fitting out and her hull was painted black. The Revenue Marine accepted her for service on 11 October 1848. She was assigned to the west coast, with Captain Fraser's orders being to secure the revenue, enforce U.S. laws on the seas, aid distressed vessels, and to sound and chart the new territory's harbors and inlets.

With a crew of 43 aboard, most of Fraser's officers being political appointees with no sea-going experience, *C.W. Lawrence* set sail for the Pacific on 1 November 1848. After an arduous voyage of over 11 months, including five weeks spent attempting to sail around the Horn, she arrived in San Francisco on 31 October 1849. Trouble was around the corner, however, for the crew learned of the vast fortunes being made by those hunting gold inland and Fraser soon found himself without a crew. Even his officers resigned to join the gold rush. The collector had to charter a small schooner, *Argus*, and purchased another, *Catherine*, to carry out the Revenue patrols while the *Lawrence* remained tied up. For a hectic year, with only a few loyal men, Fraser did his best to secure the revenue, enforce the shipping laws, and prevent mutinies on the merchant craft at anchor in San Francisco Bay when gold fever swept aboard the newly arrived ships. His efforts were summed up in a letter to him from the customs collector, J. Collier: "Few men have had more difficult or responsible duties to perform. You have been in a harbor with from four to five hundred vessels riding at anchor, in the midst of a great excitement, with crews insubordinate and lawless, without the aid of civil tribunals or civil process, and when day and night you have been called upon to render assistance and aid masters of vessels in suppressing mutiny and violence."

In late 1850 the *Lawrence* was fitted out for a cruise down the coast to San Diego once the cutter *Polk* arrived to patrol San Francisco. She cleared the Farallon Islands on the night of 26 December 1850. She cruised the coast, charting the coastline and the inlets as she sailed. She arrived in San Diego on January 19, 1851, and later sailed for the Hawaiian Islands, arriving at Hilo on 7 March 1851. After visiting Honolulu she set sail for San Francisco, arriving there on the evening of 4 May 1851. Fraser requested a leave of absence, which was granted, and Revenue Captain Douglas Ottinger relieved him on 7 June of that same year. Ottinger and some of his crew participated in the *Challenge* affair, when the crew of that vessel attempted to mutiny. The Revenue sailors helped put down the mutiny and Ottinger was later called to testify at the trial of the ringleaders. The *Lawrence's* career, unlike Captain Ottinger's, was over shortly after this. The *Lawrence* ran aground and was lost off Point Lobos within four miles of the southern head of the entrance to San Francisco Bay on the night of 25 November 1851. All hands were saved.

Specifications

Type/Rig/Class:	Brig-rigged Baltimore-style clipper
Builder:	William Easby, Foggy Bottom, Washington, D.C.
Launched:	20 August 1848; commissioned 11 October 1848
Displacement:	144 tons
Length:	96 feet, 6 inches
Beam:	24 feet
Complement:	43 for the voyage around Cape Horn: commanding officer, executive officer, two second lieutenants, two third lieutenants, a surgeon, and 35 crewmen.
Armament:	Pierced for 10 guns, carried 2 x 32-pounders; 1 long 18-pounder; 2 x 6-pounders; carbines, percussion pistols, Colt revolvers, boarding pikes & cutlasses.
Disposition:	Lost off Point Lobos, San Francisco, 25 November 1851

2. Tall Ship Adventures

Today docents have plenty of opportunities to sail aboard *Californian* most Saturdays, Sundays and selected other days on her Tall Ship Adventures (TSA). These four-hour sailing trips either go out past Point Loma and cruise on the ocean or maneuver within the bay in mock gun battles with other tall ships. Two docents are assigned to each voyage to host up to 45 paying passengers, answering questions, keeping an eye on them while the crew is busy and operating a slop-chest of souvenirs, snacks and hot and cold beverages.

Initially, docents must sail with an experienced docent to get checked out on the tasks that need to be accomplished before, during and after the sail. The specific duties vary slightly depending on the day of the sail but include:

Pre-sail

- Verify with ticket office that TSA is scheduled and the expected number of passengers
- Pick up bank and record box from the gift shop
- Load aboard souvenir/literature box, snack box and clothing box
- Check bank vs. accounting sheet
- Check souvenirs vs. inventory sheet
- Load aboard two coolers, each about a third full of ice
- Set up souvenir samples and snacks, and stock coolers with sodas and water
- (In cooler weather) Fill thermos flasks with regular coffee and hot water
- Be on deck for the captain's safety talk

During Sail

- Offer assistance in stowing passenger gear (jackets, lunches & camera bags) below to keep deck and passageways clear
- Make sure one docent is below if any passengers are below
- Encourage passengers to help crew when appropriate
- Watch for and correct any unsafe behavior
- Engage passengers in conversations, answer questions, point out sights on the bay
- Offer to take passenger photos
- Record all souvenir sales as they occur on inventory sheets

Post-sail

- Check below for packs, gear or articles left by passengers
- Repack souvenirs, snacks and literature
- Dump ice water from coolers
- Dump coffee and hot water
- Count bank and complete accounting and inventory sheets

- Separate souvenir sales funds from bank and return souvenir proceeds in box to gift shop
- (If no sail is scheduled for the following day) Place bank funds including snack sales in safe
- (If no sail is scheduled for the following day) Stow all sodas and water and return the souvenir, snack, clothing boxes and coolers to *Berkeley*
- Log your hours at the ticket booth

Chapter VI. “*HMS*” *Surprise*



Chapter VI. “HMS” Surprise

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Note: Since 1789 the letters HMS (His/Her Majesty’s Ship) have been used to indicate that a vessel belongs to the British Royal Navy. In this manual, the HMS is shown in quotation marks to differentiate replicas or fictional vessels from real Royal Navy ships.

Chronologies

HMS Rose

- 1757: A 24-gun, sixth rate ship, HMS Rose was built in Hull, England; served in the French and Indian War, fought along the French coast and in the Caribbean
- 1768: Sent to America to patrol the Northeastern coast
- 1774: Sent to Narragansett Bay, Rhode Island to counter smuggling
- 1776: Played a part in the British invasion of New York
- 1779: Sent to Savannah, Georgia to serve as a river blockade and scuttled

“HMS” Rose/Surprise

- 1970: “HMS” Rose was built in Lunenburg, Nova Scotia
- 1970-1980: Served as a dockside attraction in Newport, Rhode Island
- 1985: Rose Foundation formed to restore and administer the ship
- 1990: Toured the Great Lakes
- 1991: Sailed the East Coast from Maine to Florida
- 1992: U. S. Coast Guard Certified as a Class A sailing school vessel
- 2001: 20th Century Fox buys Rose, converts her to “HMS” Surprise in their film studio in Baja California, Mexico
- 2005: Acquired by the Maritime Museum of San Diego

Note: *Surprise* is a movie prop fashioned from the replica “HMS” Rose. It was used in the movie “Master and Commander: The Far Side of the World”, starring Russell Crowe. *Surprise* was used in on-deck scenes and sailing scenes during the filming of the movie. Though no filming was done below decks, the museum has reconstructed a gun deck for visitor display. The initials HMS designate His (or Her, depending on who was on the throne) Majesty’s Ship, a warship of the Royal Navy. Quotation marks are used to indicate that the Museum’s ship is a replica and not a Royal Navy vessel. Both original and replica *Roses* and *Surprises* are chronicled herein.

History: A Tale of Five Ships

HMS Rose (1757–1779)

The “*HMS Surprise*” at the Maritime Museum of San Diego was constructed in 1970 as a replica of the mid-eighteenth century British Royal Navy frigate *HMS Rose*. The original *HMS Rose* was built in 1757 in Hull, England. At that time ships were divided by “rates”, first rate being the largest with 100 to 110 guns carried on three decks. The *Rose* was a sixth rate, the smallest class of ship that would be commanded by someone holding the rank of Captain. She was part of the *Seaford*-class and carried twenty guns. As a frigate, she would not have participated in major fleet engagements except to relay messages. Frigates normally operated as scout ships for the fleet and to patrol the coasts of any belligerent country and harass their shipping.

HMS Rose was built to fight in the Seven Years War as it was called in Europe, also known as the French & Indian Wars (1754–1763) in America, when the United States was still part of the British Empire. During that conflict, the *Rose* fought along the coast of France and in the Caribbean. In 1768 she was sent to the coast of New England where things were beginning to heat up due to the imposition of new British taxes intended to recover some of the costs of defending North America during the recently concluded war with France. She patrolled the New England coast “impressing” (conscripting) sailors from American merchant vessels and seeking provisions for the British garrison at Boston.

In 1774 the *Rose* under Captain Wallace was sent to Narragansett Bay, Rhode Island to put an end to the lucrative smuggling trade (principally molasses and rum) which had made Newport the fifth wealthiest city in America. These enterprises were illegal, and England had sent several ships to stop it, but the governor sank them. Because the *Rose* was much larger than any American vessel of the time, and her captain was very efficient at his job (though Rhode Islanders considered him to be a brutal pirate), the smuggling soon came to a relative standstill. This damaged the economy of Newport so much that four-fifths of the population fled inland, which led to the founding of Providence as the state capital. Rhode Island’s powerful merchants petitioned their colonial legislature to create a navy to deal with the *Rose* and her captain. By petitioning Congress to form a Continental Navy to rid Narragansett Bay of the *Rose*, the creation of the United States Navy may be directly attributed to the presence of *HMS Rose*. Rhode Island declared her independence from Britain 4 May 1776, two full months before the rest of the colonies.

In July of 1776, *HMS Rose* played a large part in the invasion of New York, shelling the land-based fortification and making forays up the Hudson. Her captain was knighted for his actions in helping to drive General George Washington and his troops from the city.

The original *HMS Rose* finally met her end in 1779 at Savannah, Georgia. At that time, the British occupied the city and the French, who were fighting on the side of the Americans, sent a fleet up the Savannah River to attack the British from the river, while the Americans, aided by other allies, continued the assault from the rear. The British scuttled *Rose* in a narrow part of the river channel, blocking the French fleet from approaching within range. As a result, Savannah remained in British hands until the war's end. After the war, the *Rose* was destroyed to clear the channel. Only a few artifacts brought up in dredging operations have been recovered from the remains of *HMS Rose*.

“HMS” Rose (1970–2001)

The replica *“HMS” Rose* was built in 1970 in Lunenburg, Nova Scotia by Smith & Rhuland. She was the last vessel built by that shipyard. She was designed by Philip C. Bolger of Gloucester, Massachusetts, for Newport, Rhode Island historian John Fitzhugh Millar as part of an ambitious plan to build a fleet of replica ships significant to the American Revolution for the 1976 Bicentennial celebrations. The original construction drawings from 1757 were obtained from the National Maritime Museum in Greenwich, England, and construction began with the Douglas fir keel laid down in June 1969. Local woods (red and white oak, birch, beech, and maple) were used for the ship's frames and planking. The ship was launched in March 1970 and completed in May of the same year. From the start the project was undercapitalized. To save money, the ship was built without the engines that had been planned, and did not participate in OpSail '76, instead spending her first ten years in Newport, Rhode Island as a dockside attraction.

By 1985 she was in serious disrepair and was sold to Kaye Williams, who moved her to Bridgeport, Connecticut. There he formed the private, non-profit *HMS Rose* Foundation to restore and administer the ship. After extensive repair, she was once again in sailing condition. In 1990 she toured the Great Lakes and in 1991 sailed the East Coast from Maine to Florida, while displaying Rhode Island's original draft of the Bill of Rights. In September the *Rose* was certified as America's first Class-A Sailing School Vessel by the U.S. Coast Guard, making her the largest Sailing School Vessel in the United States. She operated in this capacity until 2000.

In 2001, 20th Century Fox movie studios purchased the *Rose* to play the role of *“HMS” Surprise* in the film *Master and Commander: The Far Side of the World*, based on the popular historical fiction series by Patrick O'Brian, which chronicled the adventures of a fictional Royal Navy Captain Jack Aubrey and his friend Stephen Maturin during the Napoleonic Wars (1798–1815).

HMS Surprise (1794–1802)

The historical *HMS Surprise* was the 24 gun corvette *L'Unité*, built from August 1793 to April 1794 by the French at Le Havre. She was originally armed with twenty-four 8-pound long guns. *L'Unité* was captured by the British on 20 April 1796 in the Mediterranean and her name was changed to *HMS Surprise*. French ships were much sought after by the British because of their maneuverability and speed.

Because of their streamlined hull below the waterline, they could outrun most ships. The new *HMS Surprise* was re-armed and classed as a twenty-eight gun, sixth-rate ship, although she actually carried twenty-four 9-pound long guns on the upper deck, eight 4-pound long guns, four 12-pound carronades on the quarterdeck, two 4-pound long guns, and two 12-pound carronades on the forecastle. Her most significant service came on 25 October 1799 when her captain and crew attacked and cut out the French *Hermione* of 32 guns from under the 200 cannons mounted in the batteries around the harbor of Porto Cavallo in the Caribbean. Previously, the *Hermione* had been handed over to the Spanish by her mutinous crew at La Guira on Sept. 22, 1797. Eventually, the real *HMS Surprise* was sold out of the service for scrap in 1802. (Note: *Hermione* herself played an interesting part in the American Revolution and a replica was built by the French.)

“HMS” Surprise in Fiction (1805–1817)

The fictional *Surprise* was the favorite frigate of fictional British Navy Captain Jack Aubrey, whose adventures from 1800 to 1815 are chronicled in a twenty-one volume series of historical novels written by Patrick O'Brian (the twenty-first book was unfinished). In the third book of the series, “*HMS Surprise*”, Jack Aubrey takes command of the *Surprise* for the first time in 1805. It also mentions his service as a midshipman, which would have required the ship to have been in service in the 1780s, years before the real ship existed. Under Jack Aubrey the *Surprise*, with her hull specially strengthened, carried a battery of twenty-eight 9-pound long guns. “*HMS Surprise*” is featured in no less than eleven of the twenty-one books.

“HMS” Surprise Film Star (2001–2005)

The replica “*HMS*”*Rose* was purchased in 2001 by film company 20th Century Fox and was featured in the 2003 film, “*Master and Commander: The Far Side of the World*”, as “*HMS Surprise*”. Changes were made both to the hull and rigging to more closely resemble the original *Surprise*, which had been built much earlier (see above) and was quite different from the *Rose*. In the process of modifying her for her film role, the ship lost her U.S. Coast Guard Sailing School Vessel Certification. Copper was added to her bottom and the figurehead was changed to Pallas Athena (the Greek goddess of wisdom). Some of the modification work was done on the West Coast at Southwest Marine and in Ensenada, Baja California, Mexico. Much of the filming took place at the Fox Baja Studio, up the coast from Ensenada, near Rosarito. The title of the movie is a combination of the first and tenth books of the O'Brian series, but some scenes are drawn from other books in the series. When the filming was finished, the *Surprise* was temporarily stored at Shelter Island. The Maritime Museum of San Diego proposed an arrangement with 20th Century Fox to moor and maintain the ship if the Museum could retain the revenue generated through Museum admissions.

“HMS” Surprise at the Maritime Museum of San Diego (2005 to Present)

In 2005 the Maritime Museum of San Diego acquired *“HMS” Surprise* from 20th Century Fox and the Museum crew and other volunteers began to prepare her to sail again. Rigging was tightened and adjusted, engine maintenance was conducted, and the ship was dry-docked at Southwest Marine (without Coast Guard inspection), in hopes of sailing her with *Star of India* in 2006. However, the Coast Guard determined she would need certification before being operated, so sailing plans were canceled for that year until an underwater hull inspection and new stability letter could be obtained.

In 2007 *Surprise* was hauled out of the water at the Marine Group in Chula Vista using their new 600 ton Travelift, the largest boat lift on the west coast. The mizzen mast had to be removed for the ship to fit in the Travelift. The Coast Guard conducted a satisfactory hull inspection. Hull valves were inspected and repaired or replaced; zincs were replaced; the copper sheathing was removed; the hull was painted. Repairs continued after her return to the museum and she received a conditional U.S. Coast Guard Certification for Sail Training and as an attraction vessel. She has undergone further hauling out and USCG inspections, and when hauled out in 2010, one could see how badly “hogged” she was (the keel sagged at the bow and stern). After so many years of service, she is showing her age. Wooden ships normally don’t last more than 30 to 40 years, and the *Rose/ Surprise* is more than forty years old. Her fragile condition may mean that she again becomes a dockside attraction with occasional sailings in the harbor to participate in mock gun battles.

Tour of *“HMS” Surprise*

The Capstan

The capstan is a large manual winch used for any extremely heavy lifting aboard the ship, which usually means raising the anchor. The anchor that we normally use, a navy stockless type that is sticking out of the starboard hawse pipe, weighs about 1200 pounds. To this we normally attach one shot (90 feet) of chain weighing around 500 pounds. A cable is wrapped around the base of the capstan and the wooden capstan bars are inserted in all of the holes around the top. Then, often with a sailor chanting or playing a fiddle, the hands at the bars would heave the capstan round. The cable is wound up and the anchor is raised. The capstan is also used for raising or lowering upper masts and yards. It is virtually never used for raising sail.

The Quarterdeck

The Quarterdeck was strictly officers’ country and an ordinary seaman did not go back there unless he had a specific job to do, such as manning lines or steering the ship. The “weather”, or windward, side of the quarterdeck was reserved for the

Captain. The other officers kept to the leeward side. The helmsman (often two of them) stood beside the wheel steering by the compass or by the wind in the sails, depending on what the officer of the watch had ordered. The helmsman rarely had to look where he was going as there was a lookout posted in the bow looking forward, one on each side of the waist looking to port and starboard and, during the day, at least one man aloft. In battle the quarterdeck was the Captain's position from which he could most easily see all that was going on and command the ship.

The Great Cabin

The Great Cabin was strictly the domain of the Captain. It was his day cabin, his office, and his meeting room. It was a space that no one entered without the Captain's permission. A Marine guard posted at the door 24 hours a day enforced this rule. The Captain of a ship often had to perform diplomatic functions, and the Great Cabin became the meeting room and dining room for these occasions. A captain generally dined alone but, on occasion, would invite his officers to join him. His sleeping quarters consisted of a small cabin on the starboard side connected to the Great Cabin. The galleries on either side of the cabin would have contained a privy on one side and a bathing tub on the other.

There are two gun ports in the Great Cabin where two of the ship's twenty-four 9-pound guns were mounted, greatly reducing the amount of usable space in the cabin. When the ship cleared for action, the bulkhead that separated the cabin from the rest of the gun deck was disassembled and stowed away along with the furniture, china and any other items not used in combat. The furnishings from the Great Cabin would either be stowed below or placed in one of the ship's boats and set adrift to be collected later. Once cleared for action, all one could see on the gun deck were the guns.

Even so, the unprotected stern with its expanse of great cabin windows was a tempting target for opposing ships. Firing into the stern or directly on the bow is called "raking" which can result in massive damage and carnage as shot travels the length of the ship, unhindered by bulkheads.

Ordinarily, the ship's boats were stowed on the weather deck, vulnerable to enemy shot which would splinter them. Splinters caused by shot penetrating through bulwarks and hull accounted for most of the casualties during battle. By setting the boats adrift the captain's furniture, his china and the boats can be recovered after the fighting.

On the *Rose*, only the Captain lived on the level of the gun deck. The other commissioned officers (lieutenants) and warrant officers of wardroom rank (surgeon, sailing master, purser) lived in the Ward Room on the berthing deck directly below the Great Cabin. The Ward Room consisted of a series of small cabins along the sides of the ship with a long dining table in the middle. Lesser warrant officers (the master gunner, boatswain, carpenter, and sailmaker) lived in the gun room

amidships on the berthing deck, and the midshipmen (officers in training) lived in the midshipman's berth, located wherever there was room.

The Gun Deck

The ship was no more than a seagoing platform for guns. In battle, a vast majority of the men aboard worked on the gun deck and a great deal of shipboard life took place there.

The gun deck has about five feet of headroom (not enough for a man to stand) and was completely open from the bow to the stern post aft. Both sides of the ship were lined with guns, with the tools for the guns hanging above and the mess tables mounted between them. In the bow was the manger where the livestock were housed. Aft of the manger (approximately where the ladder for the bell hatch is located) was the caboose with a huge brick oven for cooking. Another capstan was mounted on the gun deck directly below the one on the weather deck. These and the guns comprised all of the major features of this deck.

All of the common seamen ate at the mess tables slung between the guns. The tables were lowered for eating. The crew was divided into "messes" of six to eight men each, which was the size of a gun crew. They remained together in the same mess for the duration of their time aboard the ship. One member of the mess would be elected as "cook" for a week at a time. He was responsible for reporting to the ship's cook for his mess's food ration, placing the food in a net bag and giving it to the ship's cook to be boiled in cauldrons in the caboose. Each mess group was responsible for the cleanliness of their area.

The Ship's Guns

The *Rose* normally mounted twenty-four 9-pound guns (meaning they fired shot weighing 9 pounds; the gun itself weighed about 2,850 pounds). The number of guns actually varied, and the *Rose* carried thirty-two guns when she took part in the invasion of New York.

The process for loading a gun is as follows: Once a gun was fired it recoiled inboard until it fetched up against its breech ropes, the heavy ropes securing it to the side of the ship. One of the six man gun crew ran the worm down the barrel of the gun to extract any bits of wadding that may have been left inside. Next the swab was dipped in water and was run down the barrel to extinguish any burning embers. Fully recoiled, the end of the barrel was only a foot or two inboard of the gun port making it necessary for the gun crew to lean out of the gun port in order to insert the worm, swab, and rammer. Once the gun was cleaned, the powder was inserted. "Powder monkeys" brought powder in pre-made flannel cartridges to the guns. Powder monkeys were ship's boys between the ages of eight and thirteen who served a number of functions on board and were ideal for carrying powder because they were quick and short enough to run under the low ceiling. The powder was

about half the weight of the ball and was rammed home with the rammer. After loading the shot a piece of wadding was rammed in to keep the shot from rolling out when the ship heeled.

The most common load was round shot, a cast iron ball. Other loads included chain and bar shot used for cutting up rigging, or grapeshot which consisted of nine small balls lashed together to create a shotgun effect when fired. The idea was to disable the enemy ship. Canister shot was a tin can or bag filled with musket balls, and langrage was a sack of old bits of metal. Both were effective as short range, anti-personnel weapons. Swivel guns were mounted on the gunnels (the topmost railing) and used to discourage boarders.

The gun captain, usually a junior or petty officer in charge of the gun crew and aiming the gun, took a small iron skewer called a priming iron and jammed it down the touch hole to break open the powder bag or cartridge. The touch hole was then filled with a fine grain black powder from the powder horn. The gun crew laid into the tackles mounted on the sides of the gun carriage, and ran the gun out of the gun port. The gun captain took the linstock, an angled stick, out of the tub in which it was kept. The linstock held the slow match, a cotton or hemp wick soaked in an oxidizer such as potassium nitrate, which smoldered or glowed when lighted. The glowing slow match was touched to the powder in the touch hole which in turn ignited the powder charge in the barrel and fired the gun. The gun would recoil and the whole process was begun again.

During a battle a gun's crew would simply load and fire as fast as they could. Since the guns of the day were very inaccurate, naval engagements normally took place at close range where rate of fire was of prime importance. Two minutes was considered exceptionally good speed for loading and firing but a gun crew could not maintain such an exhausting rate of fire for very long. The men on the gun deck were more often killed by the splinters thrown off by enemy shot hitting the hull than by the shot itself. On the weather decks the greatest threat was musket fire from the enemy's fighting tops, though the ship's own marines would pose the same threat to any enemy. The deck and "ceiling" (interior side planking) of the gun deck were often painted red to disguise the blood that was spilled there in battle.

Shipboard Life

The complement of the *Rose* consisted of officers, warrant officers, marines, seamen (landsmen, ordinary and able bodied) and boys totaling in war time up to 160 men. On the original *L'Unité/Surprise*, which was larger than the *Rose*, the complement was upwards of 200. Most were seamen and lived on a berthing deck below the gun deck, or, depending on the type and size of the ship, they slept on the gun deck. Every night each man slung his hammock from hooks in the overhead, fourteen to eighteen inches apart. The crowding only became a problem in port where no night watch was kept. At sea at least half the men would be on deck for their watch, which consisted of four hours on and four hours off. The seamen slung

their hammocks in the forward part of the berthing deck with the Marines aft of them. In this way any seaman trying to make his way aft to the Ward Room in officers' country would have to thread his way through the marine's hammocks. In the morning the boatswain's mates would pipe "up hammocks" and the men would roll up their hammocks in a prescribed manner and stow them in netting rigged along the top of the rails or bulwarks. In battle the rolled hammocks afforded the men on deck a little protection from small arms fire.

In addition to their watches, the men did ship's work from sunup to sundown. Besides maintenance, crews were drilled in gunnery and sail handling. Twice a day the boatswain's mates piped "Up spirits" and the men were issued their daily grog ration. At the outset of a voyage, each man was allotted a gallon of small beer per day, but beer does not last for very long and later in the voyage it would be replaced with a daily pint of grog (rum and water).

At least half of the sailors would have been impressed or conscripted by press gangs from individual ships or from the Impress Service which took men off of the streets to man His Majesty's ships. In theory, they were only to press experienced seamen, but ships desperate for men would take anyone. Pressed men were expected to desert if the opportunity presented itself, so they were rarely let off the ship for the duration of their service, often the duration of the war. Despite the harsh life on ship board, it is erroneous to assume that the crew of a ship was in constant misery and always ready to mutiny. Under a fair captain (and most were), the crew would quickly settle into a steady routine and form themselves into an efficient and contented group. The men on shipboard were more likely to be fed and less likely to die of disease than their brothers in the army, and the punishments on shipboard were no worse than in the army or, for that matter, in civilian life.

The Bow

The spar that sticks out from the bow is called the bowsprit; the wooden extension on the bowsprit is the jib boom. On the *Rose*, three headsails or jibs were carried on the jib boom and a sprits'l (small square sail) hung from the bowsprit. This was often considered the most dangerous place aboard ship to work. In a heavy sea, the bowsprit and jib boom could plunge underwater sweeping away anyone who was working out there.

Under the bowsprit is the figurehead, a carving that, in most cases, reflects the name of the ship. (They were not always bare-breasted women!) On ships of the Royal Navy the practice was to make the figurehead as bellicose as possible. Since it was difficult to make a rose look ferocious, the figurehead of *HMS Rose* was the Royal coat of arms emblazoned on the British lion, a symbol of England much as the eagle is of America. Behind the figurehead is an area of the ship known as the beakhead which is enclosed by head rails. It is from this area that the marine toilet derives its name "head", since this was the sailors' latrine. The practice was to put one's feet on the lower rail, sit on the middle one and lean back on the upper. This

was later improved with the addition of outhouse-style seating. The beakhead was an ideal location for this purpose, considering that it was downwind and self-flushing. The greatest drawback was that one could not regulate when it would self flush or thoroughly wash the sailor. Obviously in nasty weather this was not a comfortable spot, which is why marines were posted at the hatchways to ensure that crew did not relieve themselves in the bilge of an already odiferous below decks atmosphere.

The Ship's Bell

Every ship carried a bell that was used for announcing the ship's position when in fog and for heralding the time. The day at sea was divided into four-hour watches stood by the ship's company. One of the ship's boys would turn the half-hour glass by the bell and ring the appropriate number of bells. After the first half-hour of watch, say at 12:30, one bell would be struck; every half hour another bell was added, so 1:00 is two bells, 1:30 three bells, etc. At four o'clock eight bells were struck and the watch below reported for work and the watch on deck could go below. The system repeats every four hours. On the *Rose* today we use the bell only to signal emergency situations. Legend has it that if you ring the bell for no good reason a sailor will die at sea.

Masts and Tops

As a full rigged ship, the *Rose* has three masts (fore, main and mizzen) with square sails on all three. Standing rigging, made up of fixed, tarred lines, support the masts, laterally by shrouds and fore and aft by stays, which, like the sails, take their names from the masts to which they are attached. Each mast is actually made up of a main mast, top mast, topgallant mast, and, on large ships, a royal mast, attached to one another at the cross trees and trestle trees. On warships at the junction of the main and topgallant masts are the fighting tops, platforms from which the marines fired down on an enemy ship. Running rigging consists of the untarred lines that run through blocks or pulleys to work the sails and ship's equipment.

The supplement to this chapter provides more details on life aboard a navy ship in the eighteenth century.

Specifications

HMS Rose

Launched: 1757 at Hull, England

Length: Waterline 110 feet, hull 125 feet, overall 179 feet

Beam: 31 feet

Draft: 13 feet

Displacement: 500 tons

Power: 17 sails, 13,000 square feet

Armament: Pierced for 24 guns, though rated as a 20-gun frigate

"HMS" Rose/Surprise

Launched: March 1970 at Lunenburg, Nova Scotia

Length: Deck 103 feet, hull 135 feet, overall 179 feet 6 inches

Beam: 32 feet

Draft: 13 feet

Displacement: 500 tons

Power: Sails, rigged as a full-rigged ship, and twin diesels

Hull: Wood

Supplement

1. Pacific Exploration and Life on 18th Century Warships

“HMS” Surprise enables the Museum to portray life aboard eighteenth century warships while also describing exploratory voyages into the Pacific by the British, French and Spanish in such vessels. This era, the 1760s and 1770s, is known as the second age of exploration and was greatly influenced by the period known as the Enlightenment, which added a scientific purpose to maritime exploration. Initiated by the Portuguese, the first age of exploration in the 15th to 17th centuries was essentially driven by economic issues (safer trade routes, new sources for trade and, of course, gold) as well as religious objectives. The *Surprise* is an excellent platform to showcase living and working conditions on 18th century warships, including those used for exploration in times of relative peace. In the latter case, two such ships are highlighted: *HMS Dolphin* and the Spanish packet *San Carlos*. An exhibit presented aboard *Surprise* in 2012 and 2013 included models of both ships.

The exhibit posed a challenge for docents as *Surprise* was used to represent both *Dolphin* and *San Carlos* at once. One way that challenge could be met was to meet first at the ship’s bell or on the poop deck to discuss the exhibits visitors were about to see, before going below decks. Although the exhibit has been dismantled, the history of the two vessels remains relevant when considering the types of operations undertaken by vessels similar to *Surprise*.

HMS Dolphin

The *Dolphin* was launched in 1751 as a sixth rate ship, and was the second ship to receive a copper clad bottom for protecting the hull from toredos. She served throughout the Seven Years’ War (1756-1763), at the end of which she was selected as the lead vessel to establish a South Atlantic base to monitor voyages to the Pacific and to explore lands to be claimed and exploited by the Crown. She made two circumnavigations, the first of which was the fastest to that date. In 1767, *Dolphin* took possession of Tahiti after altercations with the natives. Relations improved to the point that sailors were trading iron for sex; the resulting loss of nails threatened the integrity of the ship. *Dolphin* returned to England in May 1768, and continued to serve as a survey ship until 1777, when she was broken up.

Spanish Packet *San Carlos*

The Spanish, with more than 200 years of history in the Pacific, undertook to solidify their claims to overseas territories and establish new ones in the Pacific. Their competitors along the northwestern American coast now included British, French and Russian expeditions. In 1765 Carlos III of Spain dispatched Jose de Galvez as Inspector General to Mexico. Galvez reorganized the entire colonial

structure and in 1769 sent explorers north by sea and by land, beginning the establishment of the California mission system. Ships were necessary both for exploration of the coast and to supply the missions. *San Carlos* was the first of those ships.

Not much is known about *San Carlos*. She was launched in 1757 at Rio Santiago, near San Blas, Mexico, as a troop carrier; she was rigged as a snow brig (2 masts, both with square sails) with a deck length of 79 feet and carried six guns. Her activities, detailed in the exhibit, took her up the coast as far as San Francisco before sailing across the Pacific to Manila. Of primary interest to us is that her initial voyage was personally launched by Galvez on 9 January 1769 from La Paz and blessed by Fra. Junipero Serra. Despite serious setbacks *San Carlos* entered San Diego harbor 110 days later. The packet *San Antonio* had arrived eighteen days earlier, having fared better.

18th Century Ships of the Royal Navy

In the 18th century ships of the Royal Navy armed with more than 20 guns were divided into six rates based on the number of their guns. All rated ships were square-rigged and were commanded by experienced sea officers who held the commissioned rank of Captain and who had additional training in navigation, gunnery and seamanship. When posted to a rated vessel Captains became Post-Captains. Ships in the top four rates were referred to as “men-of-war” or “ships of the line” because when facing an enemy fleet the traditional battle tactic was to form a line parallel with the enemy’s ships and do battle using guns mounted along the ships’ sides. First-rate ships were the largest and carried the most guns. One example is HMS *Victory* (approx. length 230 ft., beam 50 ft., displacement 2,100 tons) with 100 or more heavy guns spread across three gun decks.

First-Rate	100 to 112 guns on 3 decks; ship’s company 840 plus 180 Royal Marines
Second-Rate	90 to 98 guns on 3 decks; ship’s company 740 plus 140 Royal Marines
Third-Rate	60 to 80 guns on 2 decks; ship’s company 720 plus 110 Royal Marines
Fourth-Rate	50 to 60 guns on 2 decks; ship’s company 345 plus 80 Royal Marines
Fifth-Rate	30 to 44 guns on 1 deck; ship’s company 300 plus 40 Royal Marines
Sixth-Rate	20 to 28 guns on 1 deck; ship’s company 190 plus 30 Royal Marines

Third-rate ships were often preferred by senior captains because their sailing characteristics were superior to the heavy-laden triple-deck first-rate and second-rate ships. Sixth-rate ships including HMS *Rose* or *Surprise* were also known as frigates. These ships were usually armed with no more than 28 guns and were considered too small to join the men-of-war in the line of battle formations although certain situations could force the issue. Sixth-rates were more likely to operate independently or in pairs, taking advantage of their speed and maneuverability to raid enemy convoys, escort merchant fleets, take on exploratory expeditions, carry messages or perform other duties.

The two types of guns carried by ships of the line were long guns and carronades. The barrels of long guns were up to 9 feet in length and were mounted on wheeled carriages. The length of the barrels made the guns quite accurate up to a quarter-mile depending on the state of the sea and the training of the gun crew. One long gun could weigh about two tons including the carriage. In battle long guns must be run out (snubbed against the hull) before being fired. The recoil drives the gun back into room where it is swabbed out, loaded with powder, shot and wadding then primed and again run out for firing. The work of manning a long gun is difficult and dangerous work for the six-man gun crew. As fighting ships draw closer together the need for accuracy is less important than destructive power. Carronades have short barrels, weigh much less and are easier to load and fire. The short barrel makes the carronade less accurate but for close-range fighting it delivers the power to smash the enemy. Another benefit of the carronade is that it uses less black powder. The powder charge for a long gun is equal to one-third the weight of the ball (10 lbs. for a 32 lb. ball) where carronade needs a charge equal to one-twelfth the weight of the ball (2.6 lbs. for a 32 lb. ball). Both types of guns were classified by the weight of the ball or shot they fired. The heaviest guns were housed on the lowest deck to increase the stability of the ship by lowering its center of gravity.

A typical 100-gun first-rate ship would carry up to 30 32-pounders on the lowest gun deck, 28 24-pounders on her middle deck and 30 18-pounders on the upper gun deck. With an additional 12 12-pounders on the quarterdeck and forecastle, the ship would be capable of a 1,158 lb. broadside.

Vessels carrying fewer than 20 guns were unrated. These included sloops, brigs, cutters, ketches, yachts and other auxiliary or special use warships such as bomb vessels or fireships. These smaller vessels might be used for close-to-shore operations, harbor raids, cutting-out raids to capture enemy ships or for transporting government officials. The larger of these ships would be commanded by an officer with the rank of Commander. On smaller vessels a Lieutenant would be in command although Masters could also be given command.

Ship's Company or Crew – The officers and men of the crew comprise a rigid structure made up of the following positions:

- **Captain** – Onboard a rated ship the Captain, as noted on the previous page, would have the Admiralty commissioned rank of Captain and the necessary sea officer experience to be posted to the ship. Unrated ships could be commanded by Commanders, Lieutenants, or Masters. Regardless of rank the captain of a vessel holds full responsibility and sole authority over the ship and crew.
- **Lieutenants** – Officers who are deputies or assistants to the ship's captain. A first-rate ship could have as many as six lieutenants ordered according to their Admiralty commission, the First Lieutenant being senior.
- **Midshipmen** – Ranked below Lieutenants, midshipmen were prospective commissioned officers and could be promoted if they showed initiative and passed exams.

- **Masters** – Specialists in navigation and pilotage, masters were licensed by Trinity House, a chartered corporation that oversaw pilotage and buoy maintenance. Masters were qualified to stand deck watches and to command vessel operations except in combat situations. They were assisted by master's mates.
- **Surgeons, Pursers, Chaplains** – In view of the special training and board certification required, these were warrant officer positions and were equivalent in rank to commissioned officers.
- **Boatswains, Gunners, Carpenters** – With less education than masters, surgeons, pursers and chaplains, these warrant officers were not considered to be "wardroom officers" or equivalent to commissioned officers. Instead they were considered to be standing officers of the ship and warranted to the ship for its lifetime.
- **Cooks** – By the 18th century cooks no longer held warrant officer status. The job was usually assigned to an untrained seaman, in many cases one with an injury or disability.
- **Sailors** – There were few requirements for being a crew member; the Royal Navy impressment gangs specialized in taking people off the street and out of pubs to fill out a ship's complement. Along with those poor souls "pressed" into service, a crew typically included foreign nationals, invalids, criminals, escapees, runaways, adventurers and young innocents hoping to serve their country and see the world. While a proportion of the sailors did only what was necessary to keep from being punished, a healthy individual with initiative could "learn the ropes" and with patience and experience advance himself. For a landsman (a total novice regarding life and work on board a ship) the path to advancement began with:
 - **Ordinary Seaman** – A person possessing the skills to be useful on board ship without constant supervision.
 - **Able Seaman** – Experienced and able to perform the basic tasks of sailing a ship. The most senior classification for seamen. Through hard work and perseverance, an able seaman might catch the attention of a bosun, quartermaster, carpenter, gunner or one of their mates and be able to advance.

Daily routine on a warship – By tradition the day began at noon when the date and day of the week were recorded in the ship's log. On a clear day, noon would be determined by the Master (a senior warrant officer trained in navigation) and Midshipmen who by using their quadrants would determine the time at which the angle of the sun reached its highest point above the horizon. Noon was then reported to the Captain, eight bells were struck and the bosun would pipe the crew to dinner, marking the start of a new day. Life on board went on around the clock.

Each day was divided into six watches of four hours each. Time was measured with a 30-minute sandglass, and every half-hour the bell was struck to mark the time since the beginning of the watch (12:30 – 1 bell, 1:00 – 2 bells, 1:30 – 3 bells, and so on). At 12, 4 and 8, the bell received eight strikes and the watch changed.

The crew was divided into starboard and larboard (later port) watch groups. Each watch stood duty four hours on and four hours off around the clock. To rotate the watches so that the watch groups didn't stand the same watch every day the late afternoon watch (4:00 to 8:00) was divided into "dog watches" of two hours each.

The workday began before 4:00 a.m. when the duty Quartermaster woke the mates, midshipmen and lieutenant of the watch coming on duty and the bosun piped "all hands" for the next watch. The cook lit the fire in the galley and began preparation of breakfast. By 5:00 a.m. the watch would begin to sweep, swab, holystone and dry the decks and polish the bright work. Any loose lines would be neatly coiled or flemished. All would be made ship shape to the First Lieutenant's satisfaction. At 7:30 the Bosun would pipe "All hands, up hammocks." By eight bells (8:00) after the hammocks had been stowed the Captain would come on deck, have a look around, and tell the Bosun to pipe the crew to breakfast.

Much of the forenoon period (8:00 to 12:00) would involve the crew in various cleaning or maintenance tasks. The crews might be divided into their regular mess groups for these duties and as noon approached they would assist in preparing their victuals. The Captain might spend time reviewing the Midshipmen's logs or discussing plans with the First Lieutenant. At six bells, if punishment was to be meted out, all hands would be called to witness it. At seven bells the Master and the Midshipmen would prepare for their noon sightings. Dinner for the crew would commence at eight bells followed by the first of the two daily liquor rations.

At three bells (1:30) the crew could begin training exercises such as sail handling, gunnery, firefighting or boarding drills. Based on their performance during these drills they might be given some free time before eight bells signaled the start of the first dog watch (4:00 to 6:00). A brief evening meal was served along with the second ration of alcohol. The second dog watch would start at four bells (6:00) and usually some time before just before sunset all hands would be called to battle stations for an inspection by officers. Depending on the season or latitude, sunset might occur before or after eight bells (8:00). Once released from battle stations the crew could retrieve their hammocks from the netting and turn in until their next watch.

Food and grog rations – The officers could supplement the Royal Navy's regular list of provisions by buying their own foodstuffs and beverages. The meals for the sailors and marines were at best monotonous, partly because there were just nine food items to work with, and rules specified by the Royal Navy Victualing Office prescribed the days when these items could be served and the allowance per person.

- Ship's bread – 1 pound daily
- Salt Beef – 2 pounds each Tuesday and Saturday
- Salt Pork – 1 pound each Sunday and Thursday
- Dried peas – ½ pint each Sunday, Wednesday, Thursday and Friday

- Oatmeal – ½ pint each Monday, Wednesday and Friday
- Sugar – 2 ounces each Monday, Wednesday and Friday
- Butter or olive oil – 2 ounces each Monday, Wednesday and Friday
- Cheese – 4 ounces each Monday, Wednesday and Friday
- Beer – 1 gallon daily

Other food items could be added to these basic provisions based on availability. Cocoa, olive oil, raisins, flour and suet were included in the cook's general provisions to be used at his discretion. When the butter ran out or went bad, olive oil was used. Some fresh provisions including meat would have been served in the first few days at sea but after the first week most provisions aboard were either dried, pickled in brine or buried in salt. Creativity by the cook could prove risky if the crew disapproved.

Breakfast might be Burgoo (oatmeal boiled in water) or Scotch Coffee (ship's biscuits charred black and boiled in water). Butter or cocoa and sugar could improve these offerings, especially if the ship's water had begun to turn rank.

Dinner, served after the noon sighting, was the main meal of the day and something to look forward to except maybe on Mondays, Wednesdays and Fridays when the sailors had to go vegetarian. Those days were known as banyan days after the Banyan people of Western India, a Hindu caste whose religion forbade the eating of animal flesh. On other days the meal was pork with peas or beef with peas. Most likely what made dinner special was anticipation of the day's first ration of beer or grog.

The evening meal occurred during the dog watch at 6:00 along with the second ration of beer or liquor. This meal would be simple, cold beef or pork left over from dinner plus cheese and bread. On Sunday there could be Plum Duff (dough made from flour, pork fat, sugar and raisins put in a canvas bag and boiled for 4 to 5 hours in saltwater) if the cook was feeling charitable.

The daily ration of alcohol was a long-standing tradition in the Royal Navy. Although beer was the most popular beverage with sailors, possibly because of the quantity (a gallon a day), grog is probably more famous. About a month's stock of beer was normally carried aboard, and when this ran out the daily ration would be a pint of grog (a half pint of rum or other spirit mixed with an equal volume or more of water). Sometimes red wine would be obtained, the daily ration being one pint.

Toward the end of the 18th Century the Royal Navy began an experiment requiring crew members on Captain Cook's voyages to take a daily ration of lime juice with their grog to prevent scurvy. The causes of scurvy were unknown, and many hypotheses existed; some thought it to be brought on by dampness, some considered it contagious. It was not known what properties in lime juice prevented and cured scurvy, but limes stored well and the juice was easily administered, and

proved to be the solution to this problem. Early in the 19th Century the Royal Navy began requiring a daily ration of lime juice for all crewmen.

Maintaining a healthy crew – Poor diet, crowded damp living conditions and a dangerous work environment, with the possibility of engaging in hostile actions with the enemy increased the probability of disease, injury or death. In view of these circumstances ships of the line would begin a voyage with a ship's company up to 25 percent larger than the standard complement. Ships of the line carried a surgeon and several surgeon's mates. The quality of medical care on board ship was probably as good as that available to the general population, considering that most people did not have easy access to a doctor. The state of 18th Century medical knowledge, technology, and available drugs limited what doctors could do. The strategy of carrying additional crewmen was a practical method of maintaining battle readiness when operating far away from home waters.

Returning to home port – After a cruise of a year or more a returning ship might be put "in ordinary" or taken out of service. The crew could be transferred to other vessels or paid off and left ashore to their own devices. Officers might go on reduced pay or try to find a position on another ship. Only the carpenter, gunner and boatswain and a small work crew of mates would remain with the ship. This time in ordinary might be short if the ship was being refitted or otherwise modified. In times of peace a ship could be in ordinary for years. It would be the responsibility of the seaman to find another job. If he wanted to go to sea again he had to spend time along the waterfront making personal contacts or signing with a shipping agent to get another ship. Many waterfront boarding houses had business relationships with such agents. Of course the sailor could always be on the lookout for a press gang.

Chapter VII. *Pilot*



Chapter VII. *Pilot*

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Chronology

1914	Launched 7 August from Goularte Boatworks in San Diego.
1916 (approx.)	<i>Pilot's</i> gasoline engine was replaced with a diesel engine.
1924	Railings were installed.
1943	With <i>Pilot</i> drafted into the United States Coast Guard, the pilot house was extended approximately three feet to include space for more pilots and electronics. A more powerful Viking 105 hp diesel engine was added along with four bunks below deck and forward.
1967	New diesel engine was installed (Caterpillar 3408-255 hp).
1996-1998	<i>Pilot</i> was taken out of pilot service and donated to the Maritime Museum. The gift was officially accepted in 1998.
1998-2002	Major restoration begun, <i>Pilot</i> relaunched in 2002.
2002-Present	<i>Pilot</i> operates regularly in support of Education Department programs and since 2009 has offered daily harbor cruises for Museum visitors.

History

Harbor pilots in San Diego Bay go back to the mid-19th century when California was admitted to the Union and passed the Pilot Act of 1850 governing the qualifications and appointment of pilots. In addition to the bay having a narrow entrance and Point Loma hills to the west, it is an estuary bay; it has two rivers flowing into it, the Sweetwater River in the southern portion and until recently the San Diego River from the northeast. From the mid-1870s to the mid-1960s—nearly 100 years—man has made many changes to the bay, with Harbor Island being the last major change. In the early days sailing ships would only come as far as La Playa (now the Navy fuel docks). Later on, as the bay was continually dredged, new areas were opened up to commercial use and deeper draft steamships came into use. Pilots had to be aware of these changes and the effects they had on winds, currents, and the constantly changing sandbar locations.

With a handshake in 1914, Captain Peter Johnson contracted with Manuel Goularte to build a new more reliable power pilot boat in his boatyard on Atlantic Avenue (now Pacific Avenue) at the foot of Hawthorn Street. (The racing sloop Butcher Boy, now part of the Maritime Museum, was also built there.) Amid the shouts of World War I, *Pilot* was launched on 7 August 1914. She was planked with 1-1/8 inch Douglas fir on oak frames, with a length of 52 feet, a beam of 13 feet 9 inches, a draft of 5 feet 9 inches, and a cruising speed of 10 knots. Her engine has been replaced multiple times; the current engine is a rebuilt Caterpillar 3408 255-horsepower diesel. With only a few days off for service and repairs at a time, *Pilot* served harbor pilots for 82 years, from 1914 to 1996.

In 1925, eleven years after her launch, Captain Peter Johnson was climbing a Jacobs' ladder to board the steamer Carfton Hall when the rope ladder gave way dumping him in the sea. The *Pilot* crew struggled to get him back on board. Apparently uninjured, their hopes turned to despair as he was having a heart attack. His death was the first and only fatality on board *Pilot*. His son Hilton was designated his replacement and served through World War II.

The Japanese attack on Pearl Harbor electrified and mobilized the United States and American industrial might. As a result of the increased traffic, many changes took place. During World War II, when *Pilot* was taken over by the Coast Guard the civilian pilots continued as before. They were offered the rank of Lt. Commander, U.S.C.G.; however, Senior Pilot Harry Krog refused because he thought ship captains might resent turning over control of their ships to an outsider of lower rank than themselves. Several picket boats were added as well as more pilots.

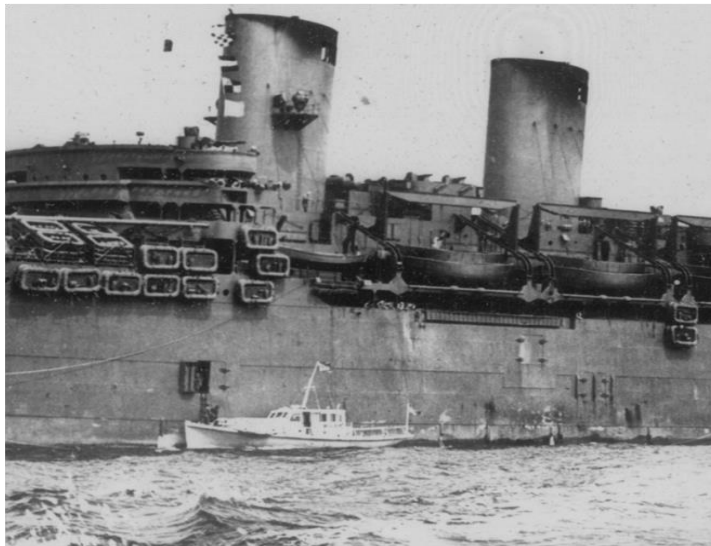
When the Coast Guard took over *Pilot* in mid-1942, she had a rather boxy deckhouse, which was expanded and berthing accommodations were added to house a permanent crew. The forward end of the pilothouse was sloped, a two and half foot extension was added aft and a new, more powerful engine was installed.

During World War II, *Pilot* served as a mother ship for two faster picket boats which ferried pilots to incoming ships. From 1943 to 1945 *Pilot* and her crews were credited with guiding 10 fleet aircraft carriers, 70 light or escort carriers, 5 battleships, 10 heavy cruisers and 10 light cruisers. Capital ships escorted by *Pilot* from 1943-1945 are identified in Supplement 2. Below are photographs of *Pilot* in action.



Secretary of the Navy, James Forrestal, sent a Letter of Commendation to *Pilot's* Captain Harry Krog and the pilots on 2 May 1946. It said in part:

"The *Pilot* has now been returned to you and it will no doubt be a matter of great pride and interest to you to know that the *Pilot* gave valuable and excellent service in the important duties assigned to her. . . In recognition of the service rendered by the *Pilot* you are authorized to place in the most appropriate display location six chevrons, one for each six months' active service with the Coast Guard."



After the Korean War shipping in San Diego fell off. Many times there was a need for only two pilots, and perhaps a third would be called in for relief. In the mid-1990s,

U.S. naval vessels no longer needed pilots as each ship carried their own. The tremendous growth in the cruise ship industry along with technological advances in propulsion has resulted in many more cruise ships using San Diego as a port of call, especially during the fall through spring months. This has increased the need for pilots, 24 hours a day.

In 1996 Ed Silva, *Pilot's* last Sr. Captain, decided to take her out of service and donate her to the Maritime Museum. Her age (she is the oldest wooden pilot boat in the country) and her condition (nearly every rib was reinforced with sisters) led Captain Silva to say, "She's a great old boat, but she has really taken a beating over the years, going into steel hulls every trip."

Pilot, officially acquired by the Maritime Museum in 1998, was placed in a cradle at the east end of the B Street pier for restoration. Over the next three years, she was painstakingly restored to her 1943 configuration, with careful attention paid to retaining her historical details. New laminated frames of Douglas fir were carefully installed one by one to replace rotted frames. Much of the oak stem was rotted and was replaced with Douglas fir, due to the unavailability of appropriately dimensioned oak. About 30 percent of the hull planking had to be replaced, and specially ordered Spanish cedar was used to replace the original cedar planks. The wheel house was extensively rebuilt with Douglas fir recycled from old buildings. The rotted fir deck was replaced with marine grade plywood with epoxy coating and then covered with a weatherproof nonskid coating. The boat was painted in its original colors of white topside with brown trim and bootstrip. Two changes in its appearance were the addition of benches along the stern to accommodate passengers and the width of the pilothouse was reduced by two feet to facilitate wheelchair access.

Pilot was relaunched in April 2002 just 12 years shy of her 100th birthday. Her new home at the museum is a short distance from the site of Goularte Boatworks. Today she carries school children around the Bay for field trips and workshops covering the seafaring sciences including navigation, cartography, magnetism, and the history of San Diego Bay's economy and ecology. She also offers visitors 45-minute tours of the bay several times each day, year round; weather permitting.

Specifications

Launched:	7 August 1914
Owner:	Originally, Capt. Peter Johnson; since 1998, the Maritime Museum of San Diego
Length:	52 feet overall
Beam:	13 feet 9 inches
Draft:	5 feet 9 inches loaded
Tonnage:	19 tons
Passengers:	Since 2002, 32 passengers plus a crew of 3
Power:	Six-cylinder diesel
Speed:	8-10 knots cruise
Hull:	Wood

Supplements

1. *Pilot's* Captains

The following is a partial list of *Pilot* captains:

1900-1925	Peter Johnson
1925-1946	Hilton Johnson
1942-1972	Harry Krog
1943-1975	James Larson
1945-1947	Frank Pannoyer
1951-1953	James Sorenson
1953-1977	Joe Precoda
1959-1975	Mel Gielow
1961-1986	Lloyd Maland
1969-1977	Ken Graham
1977-1996	Ed Silva
1979-1998	P. Berray
1991-1998	Eric Ireland

2. Capital Ships Escorted by *Pilot* between 1943 and 1945

Pilot escorted all naval vessels coming into or going out of San Diego from time she was launched in 1915 until the early 1990s. Logs must have been kept for all these years, but we can only account for the years 1943 (when she was called to active duty) to 1955 and 1984 to 1987. The following is a list of capital ships that *Pilot* escorted from 1943 to 1945. This list does not include destroyers (DD), destroyer escorts (DE), submarines (SS), or a number of large auxiliary ships, including attack transports (AKA), transports (APA), troop ships, etc. Among the vessels that entered San Diego in March 1945 was the troop ship *General Randall*, of which a photograph was taken with *Pilot*. Several ships of the British Navy also entered the Port of San Diego, the largest an escort carrier and the smallest a frigate. Finally, a number of commercial ships, freighters, and coastal passenger liners carried their cargo into San Diego.

Ship Type	Ship Name	Hull Number
Fleet Carriers (CV)	Antietam	36
	Bennington	20
	Bon Homme Richard	31
	Franklin	13
	Hancock	19
	Hornet (ex-Kearsarge)	12
	Ranger	4
	Shangri-la	38
	Ticonderoga	14
	Wasp (ex-Oriskany)	18
Light Carriers (CVL)	Cowpens	25
	San Jacinto	30
	Langley	27
	Cabot	28
Escort Carriers (CVE)	Admiralty Islands	99
	Alta Maha	18
	Attu	102
	Bairoko	113
	Barnes	20
	Bismarck Sea	95
	Block Island	21
	Bougainville	100

Escort Carriers (CVE) (cont.)	Breton	23
	Cape Gloucester	109
	Card	11
	Casa Blanca	55
	Commencement Bay	105
	Copahee	24
	Corregidor	58
	Croatian	25
	Franshaw Bay	70
	Gambier Bay	73
	Hoggatt Bay	75
	Hollandia	97
	Kadashan Bay	76
	Kalinin Bay	68
	Kasaan Bay	69
	Kitkun Bay	71
	Kula Gulf	108
	Kwajalein	98
	Liscome Bay	56
	Long Island	1
	Lunga Point	91
	Makassar Strait	91
	Manila Bay	61
	Marcus Island	77
	Matanikau	101
	Midway	63
	Mission Bay	59
	Munda	104
	Nassau	16
	Natoma Bay	74
	Nehenta Bay	62
	Petrof Bay	80
	Point Cruz	119
	Prince William	31
	Puget Sound	113
	Roi	103
	Rudyard Bay	81
	Saidor	117
	Salerno Bay	110
	Sangamon	26
	Santee	21
	Sargent Bay	83

Escort Carriers (CVE) (Cont.)	Savo Bay	78
	Shamrock Bay	84
	Shipley Bay	85
	Siboney	112
	Sitkah Bay	86
	Solomons	67
	Steamer Bay	87
	Suwannee	27
	Takanis Bay	89
	Thetis Bay	90
	Tripoli	64
	Tulagi	72
	Wake Island	65
	White Plains	66
	Windham Bay	92
Battleships (BB)	Colorado	45
	Maryland	46
	Pennsylvania	38
	Texas	3
	West Virginia	48
Heavy Cruisers (CA)	Baltimore	68
	Canberra	70
	Chester	27
	Indianapolis	35
	Louisville	28
	Minneapolis	36
	New Orleans	32
	Pensacola	24
	San Francisco	38
	Tuscaloosa	37
Light Cruisers (CL)	Astoria	90
	Biloxi	80
	Birmingham	62
	Canberra	70
	Cleveland	55
	Denver	98
	Flint	97
	Mobile	68
	Nashville	43
	Oakland	95

Chapter VIII. *B-39*

Soviet Attack Submarine



Chapter VIII. *B-39* Soviet Attack Submarine

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Chronology

1967	Launched 15 April 1967 at Admiralty Shipyard, Leningrad (now St. Petersburg); operational from 28 Dec 1967
1968	January 11 1968 Assigned to the Soviet Baltic fleet; re-assigned 27 September 1968 to the Soviet Pacific Fleet
1968-1994	Operated throughout the Pacific Ocean from home port Vladivostok
1976	Scientific assignment in Australia under the name "Sirius"
1994	Retired from service 5 July 1994
1996	Sold to a Canadian entrepreneur on 30 th April 1996; towed to Vancouver, British Columbia
2002	Moved to Seattle, Washington
2005	Acquired by the Maritime Museum of San Diego 22 April 2005; towed to San Diego for public display

Note: Earlier versions of this manual reported that *B-39* was launched in 1974 at the Sudomekh shipyard near Leningrad. This information was received from the submarine's previous owners, and appears to have been in error. All other sources of information indicate that the *B-39* was launched in 1967 in Leningrad; this chronology is substantiated by the Russian Web site www.deepstorm.ru, "The Encyclopedia of the Russian Underwater Fleet". While Internet sources can be unreliable, the 1967 build date is indirectly confirmed by dates on equipment in the submarine itself. Though no "build plate" can now be found on the hull (if there ever was one), the majority of the equipment plates are dated 1966, and very little equipment is dated in the years from 1967 to 1981. Note also that a Foxtrot submarine currently on the Medway river in England has also been called *B-39*; deepstorm.ru states that this submarine is in fact the *B-49*.

General Information

B-39 is a Russian Soviet era "Foxtrot" class (NATO designation) or "Project 641" (Soviet Navy designation) diesel-electric attack submarine. She was constructed at the Admiralty shipyard near Leningrad and commissioned in 1967. Foxtrots like *B-39* were among the largest diesel-electric submarines ever built. She was one of a fleet of Soviet attack submarines that shadowed U.S. Navy ships throughout the world's oceans during the Cold War.

B-39 was originally part of the Baltic Fleet operating in the Mediterranean Sea, Indian Ocean and Atlantic Ocean, but was soon reassigned to the Soviet Pacific fleet and based at the Soviet Navy's sprawling base at Vladivostok. She almost certainly spent part of her career stalking many of the U.S. Navy's ships that are now her neighbors on San Diego Bay.

Soviet Foxtrot-class attack submarines were developed from the experience gained during the fierce underwater battles of the Second World War, and are essentially larger and more powerful versions of German World War II U-Boats. Production started in 1958, and *B-39* was built in 1967. The Soviet Union and later the Russian Federation's Navy used Foxtrots on regular patrols until 1994. These submarines played a part in many of the Cold War's most famous episodes including the Cuban Missile Crisis and the Vietnam War.

At 300 feet (92 meters) in length, 24.5 feet (7.5 meters) beam and 18 feet (5.5 meters) draft, the Foxtrot was the Soviet Navy's longest conventional submarine. They would glide smoothly and silently through the water and were so menacingly stealthy that their movements were difficult to follow with even the most modern detection equipment. Searches by the West were made from water, land, and air, almost always without result. They proved to be an excellent surveillance tool during the cold-war years and were extremely reliable. Of the 79 of these submarines operating within the Russian Navy, not one was ever lost in operation.

The vessel was capable of performing underwater operations continuously for four days after which she had to rise to snorkel depth to run her engines, change the air and charge batteries. With a crew of 78, she operated at a depth of 800 feet (250 meters) and was capable of reaching 16.8 knots. *B-39* could reach depths of 985 feet (300 meters) before threatening the integrity of her nickel steel pressure hull. Her submerged cruising range was 400 miles, with a service interval of 90 days. She carried 22 torpedoes, 18 forward and 4 astern. Some torpedos were armed with nuclear warheads. Armaments were removed when *B-39* was decommissioned in 1994.

B-39 carried a crew of 78: 12 officers, 12 under-officer technicians, 53 seamen and a political officer or "Zampolit". The crew was divided into five battle teams: Navigation, Torpedoes, Mechanical, Communication, and Helmsmen. Despite temperatures on board often reaching a staggering 121°F (50°C), working and living conditions were considered to be good. Seamen generally worked 2 four-hour shifts

each 24-hour day, resting for eight hours between shifts. With no laundry service available, uniforms and bedding were disposable and replaced weekly. The men were able to use the shower every three days when the vessel surfaced, at which time the engines heated the sea water. There were two chefs continuously preparing food which the crew described as excellent. They were served four meals a day. Seamen were entitled to one month's shore leave after three years' service, however, after each three-month sail they earned a compulsory rest for 22 days at a naval hotel.

Strong feelings of comradeship existed among the crew; lasting friendships were formed. The crew of *B-39* have expressed the sadness they felt at the end of their service together. None has any regret for the time spent serving on board her.

The 2013 film "Phantom" starring Ed Harris was filmed on *B-39*.

Tour of B-39 by Compartment

B-39, as exhibited by the Maritime Museum, is divided into eight main areas: Topside, Forward Torpedo Room, Forward Battery Compartment, Control Room, After Battery Compartment, Engine Room, Motor Controller Room, and After Torpedo Room. Some areas are separated by round, watertight hatches, 32 inches in diameter, which visitors will have to get through. The sample hatch opening on the dock is set up to prepare visitors before they enter the submarine.

Topside

Before entering the ship the visitor can observe the following features:

- 32-inch round watertight door mockup "test" on the pier
- Freeflooding outer hull contains planes, vents, air flasks, etc.
- 7/8 inch nickel steel inner hull is the pressure boundary—designed for 985 feet
- Bow passive sonar array visible - active array below the waterline
- Vertical fin or sail houses the bridge for surface operations and streamlines mast and periscope supports when submerged

Forward Torpedo Room

Enter via the enlarged torpedo loading hatch and stairs. The torpedo capacity was 18 forward with the option of two-for-one mines in the skids. The torpedo course and depth settings were made via mechanical spindles. They were launched by compressed air. Observe the following:

- Dummy 53-65 torpedo in starboard skid, hydraulic mechanisms to move torpedoes

- Torpedo firing panel on the starboard side; oxygen monitor on the port side
- Emergency vent operators and ballast tank blow valves in overhead

Forward Battery Compartment

Enter the first 32-inch round watertight hatch and observe the following:

- Captain's stateroom on the port side, opposite forward washroom
- Sonar rooms on the starboard side (on the left when moving aft)
- Officer bunkrooms and wardroom, "Zampolit" stateroom aft
- Deck grating by wardroom reveals two decks for battery cells. Each of the boat's four battery wells had 112 cells weighing 1400 pounds apiece

Control Room

Enter through the second 32-inch round watertight hatch and observe:

- Second washroom for use by watchstanders
- Ladder up to the "Action Center" or Conning Tower for periscope depth operations
- Forward periscope with housing cut away for demonstration in the Control Room
- Port side navigation table and gyro
- Starboard side submerged steering station and depth control (planes) station
- Hull opening status panel
- Ballast tank vent and flood valve hydraulic operators open to dive, shut to surface
- Ballast tank air blow valves—to blow water from the tanks after vent valves shut
- Torpedo fire control panel and radar and electronic intercept room aft port side
- Hatch to pump room and refrigerated food storage aft starboard side

After Battery Compartment

Enter through the third 32-inch round watertight hatch and observe the following:

- Classified publications room and radio room forward port side
- "Michmen" (Chiefs and Warrant Officers) bunkrooms and dining area. These technicians were responsible for equipment maintenance
- Two more 112-cell batteries on two decks below walking deck.
- Dry food storage space—Galley for cooking all meals for 78 crew members. Note: No separate crew eating space. They used fold-down tables in the bunking areas
- Vertical trash disposal—aft starboard side

Engine Room

Enter through the rectangular watertight hatch and observe the following:

- Forward engine control space with sound decreasing door—engine controls and gauges.
- Move through the rectangular watertight hatch and observe:
 - Three 6-cylinder 2000 hp Kolomna diesel engines, used on surface and for snorkeling.
 - Direct drive through clutches and reduction gears to three propulsion shafts.
 - Turbochargers on aft end of engines.
 - Diesel-driven high pressure air compressors against after bulkhead.

Motor Controller Room

Enter through the rectangular watertight hatch and observe the following:

- Outboard crew bunks.
- Propulsion motor/generator controller cabinets
- Propulsion shafts have DC machine windings:
 - Raised field voltage makes them generators to charge batteries when diesels are operating.
 - Lowered field voltage allows them to be motors and drive the shafts from batteries when diesels secured and unclutched from shafts.
- Centerline shaft has an additional 180 HP "creep-motor" winding for 2-knot quiet operations.
- After washroom on the starboard side.
- Electric motor driven HP air compressor aft on port side.

After Torpedo Room

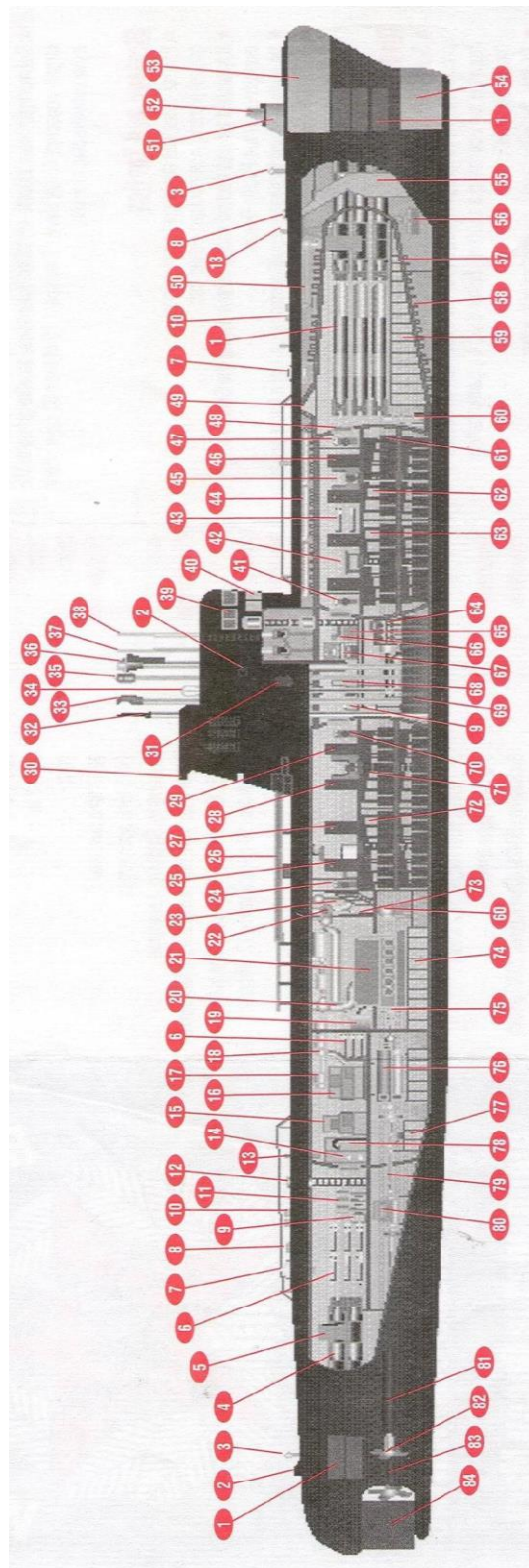
Enter through the fourth 32-inch round watertight hatch. The aft torpedo capacity was four torpedoes/evasion devices in tubes. There was no skid stowage. Occasionally movies could be shown with a sheet hung from torpedo tubes, observe:.

- Principal crew bunking area. Two men were assigned to each bunk. A system of "hot-bunking."
- Escape hatch. A hull patch cut for convenient visitor exit did not actually exist.
- The torpedoes were floated into upper tubes with bow ballasted down.
- Signal ejector aft in overhead for launching flares or countermeasures.

Specifications

Russian Designator:	Project 641
NATO Designator:	Foxtrot Class
Manufacturer's Number:	B-39
Built:	Admiralty Shipyard, Leningrad
Construction:	3/8-inch outer light hull comprising ballast tanks; 7/8 inch in OT28 Nickel Steel pressure hull
Commissioned:	1967
Decommissioned:	1994
Length:	299 feet 6 inches
Displacement:	1952 tons surfaced, 2475 tons submerged
Crew Complement:	56 sailors, 10 midshipman, 12 officers
Maximum Diving Depth:	985 feet
Cruising Speed:	16 knots surfaced, 15 knots submerged, 9 knots snorkeling
Range:	20,000 miles surfaced at 8 knots, 11,000 miles snorkeling, 380 miles submerged at 2 knots.
Endurance:	3-5 days submerged
Propulsion:	
Diesel Engines:	3 x Kolomna 2D42M 2000 hp
Electric Motors:	2 x 1350 hp, 1 x 2700 hp
Auxiliary Motor:	180 hp
Propeller Shafts:	3
Propellers:	6 blades
Torpedo Tubes:	6 forward 4 aft
Armament:	22 type 53 torpedoes with high explosive warheads and a range of 10 miles; 36 mines.
Radar:	Surface search, Snoop Tray I Band
Sonar:	Herkules medium frequency active/passive; Feniks passive search/attack
Electric Warfare:	Stop Light, radar warning; Quad Loop Radio Direction Finder

B-39 Cutaway View



B-39 Detail Descriptions

- | | | |
|-------------------------------------|------------------------------------|-----------------------------------|
| 1. Torpedo Tube Outer Hatch | 29. Radio room | 57. Pressure hull |
| 2. Navigation Light | 30. Diesel exhaust snorkel pipe | 58. Rib on pressure hull |
| 3. Anchor Light | 31. Hatch to Fin | 59. Fresh water tanks |
| 4. Torpedo | 32. Radio and Sat-Nav antennae | 60. Main pump |
| 5. Torpedo Fire Controller | 33. Snoop Tray radar | 61. Batteries |
| 6. Bunk | 34. Quad Loop Directional Finder | 62. Battery Space 1 |
| 7. Emergency Buoy | 35. Stop Light ESM | 63. Battery Space 2 |
| 8. Fair Lead | 36. Snorkel | 64. Generator: Sonar/Nav. Equip. |
| 9. Gyro Compass | 37. Navigation Periscope | 65. Chart Table |
| 10. Bollard | 38. Attack Periscope | 66. Navigation equipment |
| 11. Hydraulic Pump | 39. Bridge window | 67. Weapons Control |
| 12. Escape Hatch | 40. Underwater phone antennae | 68. Radar room |
| 13. Capstan | 41. Main Bat. Controller, Bat. #2 | 69. Compensating Tank |
| 14. Toilet | 42. Ward Room | 70. Main Bat. Controller, Bat. #3 |
| 15. Aux. Electric Motor Controller | 43. Officers cabin (4 berths) | 71. Battery Space 3 |
| 16. Main Electric Motor Controllers | 44. High pressure air storage tank | 72. Battery Space 4 |
| 17. Generator | 45. Sonar room | 73. Engine controller |
| 18. Fan | 46. Captain's cabin | 74. Fuel Tanks |
| 19. Diesel powered air compressor | 47. Main Bat. Controller, Bat. #1 | 75. Clutch |
| 20. Diesel engine exhaust pipe | 48. Hatch | 76. Main Electric Motors |
| 21. Diesel engines | 49. Torpedo Loading Hatch | 77. Oil Tanks |
| 22. Main fan | 50. Bow Plane Control Arm | 78. Shower |
| 23. Machinery Control Room | 51. Underwater phone antennae | 79. Propeller shaft |
| 24. Main Bat. Controller, Bat. #4 | 52. Clarification sonar (passive) | 80. Auxiliary electric motor |
| 25. Galley | 53. Feniks sonar (passive) ant. | 81. Aft Stabilizer |
| 26. Reclining radio antenna | 54. Herkules sonar active or pass | 82. Propeller |
| 27. Dry food storage | 55. Anchor feed and chain locker | 83. Aft diving plane |
| 28. Petty Officer's cabin | 56. Ballast tank kingston valve | 84. Vertical rudder |

Chapter IX. *USS DOLPHIN* (AGSS-555)



Chapter IX *USS DOLPHIN (AGSS-555)*

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Chronology

1968	8 June Launched, commissioned 17 August
1969	Changed bow configuration (removed torpedo tube)
1970	Changed home port to San Diego
1993	Overhauled
2002	21 May - Flooding incident followed by repair and upgrade
2007	15 January - Decommissioned
2008	18 September - Donated to Maritime Museum of San Diego
2009	4 July - Opened for display after visitor safety modifications

Deep Diving Research Submarine

Built at Portsmouth Navy Yard in Kittery, Maine *USS Dolphin* was designed to operate at depths well below other submarines making it a unique research platform. The single most significant technical achievement in the development of *Dolphin* is the pressure hull. It is a constant-diameter cylinder with hemispherical ends and it uses deep interior frames rather than watertight bulkheads to add strength. The entire design of the pressure hull has been kept as simple as possible to facilitate its use in structural experiments and trials. Hull openings have been minimized for structural strength and minimum hull weight, in addition to eliminating possible sources for flooding casualties. The submarine has only one access hatch and no air induction valve or snorkel mast; her one hatch had to be open while her diesels were running.

Employed by both civilian and Navy research agencies, *Dolphin* was equipped with an extensive instrumentation suite supporting missions such as acoustic deep-water and littoral research, near-bottom and ocean surveys, weapons launches, sensor trials, and engineering evaluations. *Dolphin* was built with a 30-inch diameter torpedo tube forward. Following the initial deep dive tests, it was used to launch Mark 48 torpedoes from deep depths in swim out mode. These were the deepest torpedo launches ever conducted. These tests were conducted by the U.S. Navy to verify that the Mark 48 torpedo, an Anti-Submarine Warfare (ASW) and Anti-Surface Warfare (ASuW) weapon, could be successfully launched and operate at depths exceeding the operating capabilities of any other Navy submarine. After these tests the torpedo tube was removed and replaced by a sonar dome section which added 13 feet to its length and 104 tons to its displacement. With the additional space *Dolphin* could accommodate the temporary installation of up to 12 tons of special research and test equipment. The submarine has internal and external mounting points, multiple electronic hull connectors, and up to ten equipment racks for project use. After completing these modifications she was deployed to the Pacific and San Diego became her homeport.

The Navy decided to retire *Dolphin* in 2006, citing the annual \$18 million operations cost, she was deactivated 22 September 2006. On 15 January 2007 she was decommissioned and struck from the Naval Vessel Register. Her 38-year career was the longest in history for a US Navy submarine.

Mission

Dolphin was a phenomenally versatile research vessel used to develop technology for U.S. Navy submarines. The research projects fell into four categories:

- Weapons development
- Electromagnetic spectrum testing
- Sonar and acoustic phenomena
- Propulsion, navigation, communication, and auxiliary equipment testing

Operational Service Summary

Examples of *Dolphin's* work include:

- Launched torpedoes from the deepest depth ever recorded.
- First successful submarine-to-aircraft optical communications.
- Development of a Laser Imaging system of photographic clarity.
- Development of an Extreme Low Frequency (ELF) antenna for *Ohio*-class Fleet Ballistic Submarines (FBM).
- Evaluation of various non-acoustic Anti-Submarine Warfare (ASW) techniques.
- Evaluation of various Low-Probability-of-Interception (LPI) active sonars (ping stealing).
- First submarine launch of a MOBILE Submarine Simulator (MOSS) system. The MOSS Mark70 is a sonar decoy used by submarines of the United States Navy. It is a 10-inch vehicle, without an explosive warhead, but able to generate both an active sonar echo and a passive sound signature recorded to be extremely similar to that of the launching submarine. The purpose of MOSS was to create multiple targets all with the same acoustic signature to confuse the enemy.
- First successful submarine test of BQS-15 sonar system. The AN/BQS-15 is a submerged mine detection and avoidance sonar for SSN-688 *Los Angeles*-class nuclear-powered fast attack submarines. This is a close range, high frequency active sonar which can also be used for ice detection.
- Development of highly accurate (10 cm) towed body position monitoring system.
- Development of a new Obstacle Avoidance Sonar system.
- Development of a highly accurate target management system.
- Evaluation of a possible "fifth force of nature". Occasionally, physicists have postulated the existence of a fifth force in addition to the four known fundamental forces—gravity, electromagnetism, the weak interaction, and the strong interaction. This fifth force is generally believed to have roughly the strength of gravity (i.e. it is much weaker than electromagnetism or the nuclear forces) and to have a range of anywhere from less than a millimeter to cosmological scales.
- First successful submarine-to-aircraft two-way laser communication.
- In the late 1990s, *Dolphin* tested a new sonar system which is being retrofitted into the fleet.

Test/Project Summary

- Deepest torpedo launch ever (Mk-48 swim out)
- Torpedo target platform for Mk-50, Mk-54, and Mk-48 CBASS torpedoes
- Test platform for unmanned vehicle, swimmer delivery, simulator and littoral warfare systems
- Laser (blue-green) communications for strategic and tactical messages between submerged submarines
- Imaging systems for underwater search
- High resolution radar and other imaging technologies
- Advanced antenna systems testing: Extra Low Frequency (ELF)
- Sound path experiments to deep depths
- Thermal, chemical, physical microstructure phenomenon testing
- Doppler, range prediction and transient detection exploration
- Shallow water acoustic applications
- Towed array technology development
- Passive localization techniques
- Wide aperture array technology
- Active adjuncts (like ping stealing)
- Non-linear and LPI active technology
- Bottom track system applications
- Obstacle avoidance and side scan systems
- Hull mounted active and passive arrays (BQR-21, BQS-4, BQS-15)
- Expendable vertical arrays, launched from signal ejector
- Acoustic radio frequency communications technology
- Underwater communications equipment
- Support of air, surface, and littoral acoustic system testing
- Various Ag-Zn and Pb-acid batteries
- Hydrodynamics and vorticity testing
- Hull vibration studies
- Correlation velocity log, navigation, integrated sensor information, and target management systems
- Reverse osmosis desalinization
- Material corrosion testing
- Gravity investigations
- Emergency equipment tests (launched units)
- Non-acoustic anti-submarine warfare experiments
- Multiple search and location operations for sunken assets
- Quiet air conditioning systems

Accidental Flooding Incident

On 21 May 2002 at about 1130 PDT, *Dolphin* was cruising on the surface about 100 miles off the coast of San Diego charging batteries, an operation that required the boat's only access hatch to be open to provide air to the diesel engines. The wind was high and ocean swells were in the 10 to 11-foot range. When a gasket on the sail door failed the boat began taking seawater into the sail and down the access hatch into the boat. Before the hatch could be secured, 70 to 85 tons of seawater entered the ship, an amount perilously close to the boat's reserve buoyancy. The flooding also shorted electrical panels, starting fires.

The seawater poured down through the control room directly below into the pump room. Not knowing if the pump room's electrical equipment had been secured, Chief Machinist's Mate (SS) John D. Wise Jr., climbed down into the flooded space to assess the situation. With less than a foot of breathable space in the compartment he dove down and aligned the seawater discharge valves to begin pumping out the seawater. He remained in the pump room for more than 90 minutes in order to keep the submersible pump from becoming clogged. His courageous efforts prevented the loss of the ship and crew.

Within about 90 minutes the sail door had been secured and a substantial amount of the seawater had been discharged overboard leaving the boat in stable condition but inoperable due to seawater and fire damage to electrical circuits. Commander Stephen Kelety, *Dolphin's* commanding officer, ordered the crew of 41 and two civilian Navy employees to abandon ship. A call for assistance had been made earlier and the Oceanographic Research ship *McGaw* was standing-by with a small boat to pick up the crew. All crewmembers were safely transferred with only a few minor injuries. Two crewmen who were washed overboard during the transfer operation were recovered by a U.S. Coast Guard helicopter and transported to San Diego. *McGaw* brought the remainder of the crew to San Diego.

The frigate USS *Thach* (FFG-43) also responded to the emergency but the seas were too rough for towing operations and she remained on station overnight. Submarine Support Vessel MV *Kellie Chouest* got underway from San Diego early on 22 May to begin the recovery effort. *Dolphin* was towed back to San Diego the next day. Following a review of the incident Chief Wise was awarded the Navy and Marine Corps Medal for his action.

After the flooding incident *Dolphin* underwent three and a half years of repairs and upgrades at a cost of \$50 million. She completed sea-trials during the summer of 2005 and returned to her duties.

Specifications

Dimensions

- Length: 165 feet (since 1969 modification), originally 151 feet
- Draft: 15 feet, 9 inches
- Beam: 18 feet
- Displacement: 965 tons (since 1969 modification), originally 861 tons
- Ballast tanks: two radial aft; two axial forward
- Hull: Single hull, one hatch, no internal water tight bulkheads
- Diving depth: 3000+ feet, still classified

Propulsion

- Two GM V71 12-cylinder diesel engines with 250 KW DC generators
- Two 425 HP electric motors (series or parallel operation 125v, 250v or 500v)
- Two 126-cell batteries (variously utilized silver-zinc or lead-acid)
- Speed: 7.5 knots surface; 10 knots submerged
- Endurance: 15 days
- The submarine has no snorkel mast; her one hatch must be open while her diesel engines are running.

Armament

- Originally built with a 30-inch torpedo tube forward. Used for launch of Mk-48 torpedoes from deep depth in swim out mode. The torpedeo tube was removed in late 1969 when the sonar dome section was installed.

Crew and Capacity

- Crew: Total 46, normal underway complement 3 officers, 21 enlisted, 5 scientists
- Payload: 12 tons equipment on 12 external mounting pads and other foundations plus multiple variable equipment on racks in space forward of the Control Room.
- Crew quarters: 31 bunks
- Galley: From a Boeing 707 with seating for six at a tme
- Limited water production (reverse osmosis desalinization)

Ship Control

- Only stern planes, no bow or sail planes
- Used "sally ship" method to change angle (moving crew members fore and aft)
- Traveled under tow for some transits
- Enlisted watch standers were qualified as Officer of the Deck (OOD) at sea and duty officer in port

Chapter X. The Floating Dock



Chapter X. The Floating Dock

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Floating Dock

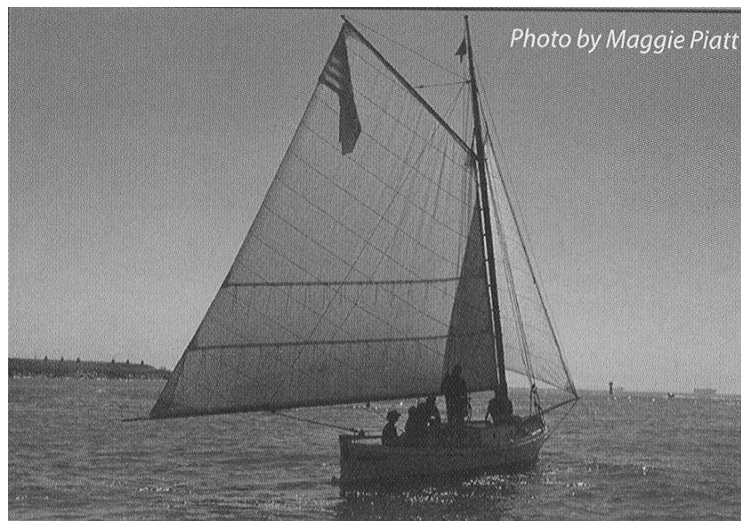
Moored aft of *Berkeley* is the 255 foot long and 38 foot wide Floating Dock SF7 which is being used as a mooring dock, an exhibit platform and a storage and work space. The Floating Dock was built in 1929 by the Moore Dry Dock Company in San Francisco for use as a railroad barge. The ferryboat *Coronado* was built there shortly afterwards. The barge was originally used to transport up to three lines of rail cars across the bay or in the ocean to other ports. Eventually, it ended up in San Diego's South Bay at the Marine Group Boat Works where it finally became an abandoned vessel. Marine Group donated the barge to the Museum in 2008. Some 100 tons of machinery and equipment was removed or salvaged from her spaces and a three inch layer of cement laid on the main deck.

Today the Floating Dock provides a mooring site for *Californian*, *San Salvador* and from time to time various other vessels in the Museum's collection. Often you will find actively sailed local charter vessels, visiting tall ships, research ships, antique ocean vessels or replicas not owned or operated by the Museum moored there. The former America Cup sloops *Stars & Stripes* and *Abracadabra*, and the gaff schooner *America* are frequently tied up alongside. The *America* is a replica of the original 1851 schooner that sailed to England and won the Royal Yacht Squadron Cup in the famous annual yacht race around the Isle of Wight. The trophy, called the Squadron 100 Guinea Cup, was renamed *America's Cup* and given to the New York Yacht Club in perpetuity to honor that most famous racing yacht.

The Floating Dock's main deck provides convenient space for a patio bar, muzzle-loaded long gun demonstrations and several outdoor exhibits which are described on the following pages. Below the main deck, the usable space running the interior length of the vessel has 12 feet of headroom which now contains carpentry and machine shops, storage space and other Museum facilities.

A. *Butcher Boy* - 1902 West Coast Work Boat

In the early years of the 20th century, there was a growing demand in West Coast harbors for work boats of a rugged type that could perform a variety of tasks. One of the general types that found favor in San Diego was the double-ended salmon boat. Sometimes referred to as day boats, they were snug craft indeed. Generally speaking, a craft of this type was about twenty-five feet long, flush-decked and with three small hatches. The smallest hatch, farthest aft, was where the helmsman sat. Amidships was the fish hatch, and forward was a hatch either for fish or, for those boats that sailed with more than one man, a pair of bunks. Many of these boats were sailed by one man who had to handle the tiller, the sheets and other lines all at once. It required no small skill at seamanship to do so.



Other jobs lay at hand besides fishing. In those far off days many windjammers—American, British, German and others—beat around Cape Horn from the eastern seaboard or Europe and sailed up to West Coast ports. By the time the men on board reached a port like San Diego, they had probably been many weeks at sea, subsisting on weevilly bread and salted horsemeat. Some fresh meat, in place of the standard seagoing fare, would be of great interest to them.

Hence, the employment of the so-called meat boat in San Diego Bay and other harbors. Meat boats took fresh meat to the square-riggers that hauled in and anchored out. *Butcher Boy* was one of the names commonly given to such boats, and there were more than one of that title at San Diego in various periods,

Charles S. Hardy, known locally as "Boss" Hardy, operated the Bay City Market among other interests. Hardy decided that his market must have its own meat boat to get meat to the potential customers riding on their anchor chains off Spanish Bight or Dutch Flats. This was in 1886; a year earlier, when he had opened his market, Hardy had gone a-peddling to the square-riggers in a Whitehall boat. So it

came about that Hardy's first *Butcher Boy*, about which little is known, was built and served the Cape Horn fleet when they visited San Diego for some 15 years.

By 1901 Hardy, in need of a new meat boat, approached Manuel Goularte, a native of the Portuguese Azores who ran a boatyard on the San Diego waterfront. The boat that rose in the Goularte yard between January and April 1902 was 29 feet, 11 inches long; 8 feet, 6 inches in beam; and had a draft of 2 feet, 7 inches. She carried 604 square feet of sail in her big mains'l and jib. The spars of the new *Butcher Boy* measured as follows: mast, 35 feet, 9 inches; boom, 30 feet, 9 inches; gaff, 13 feet, 6 inches; bowsprit, 10 feet, 1 inch. She was framed in oak, planked with cedar, and copper-fastened throughout. She carried a long bowsprit, a low overhanging boom, a small cabin forward on her flush deck, a main fish-hold (or fish box) amidships, and at the stern a small hatch or cockpit, on the edge of which the helmsman sat. Her mast was spruce, stepped seven feet from the bow.

Butcher Boy carried 2,000 pounds of lead outside on her shallow keel. The lead ran her entire length and projected two inches abaft the forward edge of the rudder. Her flush deck plus her cabin made her an exceedingly comfortable boat. Years later, the two hatches were joined to form a roomy cockpit, and the cabin was enlarged and extended aft. This arrangement gave her a four-berth capacity below by running two of them out under the cockpit seats.

Meat-boat work was more a matter of delivery than soliciting orders. The Cape Horn captains were all acquainted with "Boss" Hardy by this time and placed orders at the Bay City Market almost while their anchor chains were still roaring out the hawse pipes. *Butcher Boy* took aboard meat on the waterfront (Hardy's Market was at Fifth and Broadway), then set her sails and sped forth on her errands. It is easy to picture the lean-faced crew of a "lime-juicer" just in from Callao or Valparaiso, lining the bulwarks as *Butcher Boy* came alongside, necks craning, eyes searching, mouths watering for the fresh meat about to be slung aboard.

Around 1905, Hardy decided to sell *Butcher Boy*. His reason for doing so was doubtless purely economic, and very probably had something to do with the fact that steam-powered boats were rapidly taking over all sorts of harbor work. Her second owner was Kent Hamilton, a well-known San Diego yachtsman. The sloop now entered upon her long career as a private yacht. Hamilton partly rebuilt *Butcher Boy*, although his modifications were minor. Hamilton became Commodore of the San Diego Yacht Club and he and *Butcher Boy* vied for the Lipton Cup Trophy in these waters. *Butcher Boy* took part in a famous match against the yacht *Detroit* off the Hotel Del Coronado in 1905. This match, for which *Detroit* was shipped to San Diego, was handily won by the visiting vessel, which was larger, faster, and built from the keel up for racing. *Butcher Boy* put up a sturdy battle, however, and dogged *Detroit's* heels most of the way. Although not designed for racing, she had shown promise.

Butcher Boy finally passed from Hamilton's hands into those of several other San Diego yachtsmen, including newsman, and later a key *Star of India* supporter, Jerry MacMullen, who purchased the boat in 1917 when he was twenty and owned her until 1930. He never tired of singing her praises. It was in 1930 that *Butcher Boy* left her San Diego birthplace and home for 41 years and took up moorings in Los Angeles. She was purchased in 1935 by Grant Allen, who later on confessed that he and a buddy planned to sail her to the South Pacific and live the romantic life as portrayed in various Hollywood films. They voyaged as far as the Isthmus at Catalina Island where better sense prevailed, and they returned to San Pedro. In September of that year Allen resold her making enough profit to resume his education at U.C. Berkeley.

After Allen had her for that glorious summer, *Butcher Boy* was owned successively by three other Los Angeles area yachtsmen. In 1940 she was acquired by Roland "Rollie" Kalayjian, a jolly sailor of Armenian descent, who decided to make some changes to her. Rollie rebuilt parts of the boat, raising the freeboard and making other modifications. The boat was originally equipped with a centerboard; this was now long gone, and in its place Rollie installed a rocker fore-and-aft keel from the forefoot to the sternpost. He also added between 600 and 800 pounds of lead ballast. *Butcher Boy* still had her original cast-iron ballast blocks in place between her floor timbers; the blocks appeared custom-made for the boat and were fitted with lifting rings. Rollie said they fit very snugly into place, further evidence of the careful workmanship that went into her construction. On the chain-plate bolts, Rollie found old slot-machine tokens doing duty as washers. In the argot of *Butcher Boy's* youth, these were dubbed Chinese coins and gave rise to a long-circulated, but unfortunately false, story that she actually had Chinese money embedded in her innards.

During the period 1940-48, while the boat was in Rollie's hands, he kept her at San Pedro. She participated each May in a race from that port to Coronado, and she was kept in trim with mid-winter regattas at San Miguel Island. Rollie sold the boat to one Al Upton, who moved her back to Los Angeles waters until 1952, and then sold her to another party at which point the history of the boat becomes murky for some sixteen years. It is known that she remained under private ownership in the Los Angeles area, presumably at San Pedro.

In 1971 veteran San Diego yachtsman Joe Jessop heard that she was still in existence somewhere in Los Angeles and he began a personal search. He finally heard that *Butcher Boy*—or what seemed to be *Butcher Boy*—was at Playa del Rey, lying quietly in the basin. He and Ken Reynard (the man who supervised restoration of the bark *Star of India*) took a jaunt north from San Diego to see whether this really was the fabled *Butcher Boy*. At first sight, they were dubious. She was a double ender, all right, but she just didn't look 70 years old. Closer inspection, and comparison with various documents revealed that, yes indeed, this was the famous *Butcher Boy*. She now sported a trunk cabin with "all the discomforts of modern conveniences," according to Reynard. "There were three cramped bunks, a head

that only a dwarf could use, a four-cylinder Gray Sea Scout engine that was not easily reached, and other annoyances.” As a final touch, there was a Princess telephone, “about as useful as radar on a dugout canoe,” grouched Reynard. The boat's owner at this time was a faraway bank. Funding for *Butcher Boy*'s purchase for the Maritime Museum was raised by the Star of India Auxiliary. Jessop and Reynard arranged an inspection haul-out, and after further negotiation Reynard obtained control of the boat from the bank and decided to sail her to San Diego where a proper haul-out could be done. After a 41-year hiatus *Butcher Boy* was on her way to her ancestral home via Catalina. She carried with her two pounds of bacon—performing again a service she had not done for sixty-five years. Jessop and Reynard also packed a few other necessities along with a hand-me-down set of sails and a Sea Scout engine, and they were off on their journey.

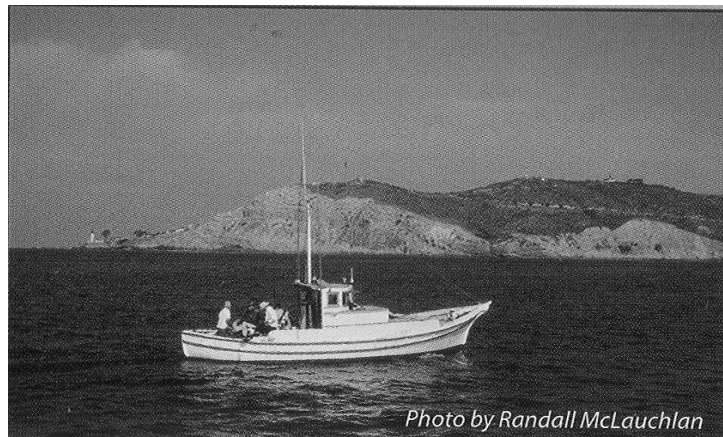
The next day around 1:45 p.m. they were off Point Loma, having averaged about 6.7 knots under sail, in only a moderate but fair wind. “Her legendary speed was real!” commented Reynard. Reynard brought her safely in, to the stares of the curious and admiring, and ever since that day she's been part of the small-craft collection of the Maritime Museum and is on display.

Butcher Boy represents the last flourish of the west coast salmon boat, a development that began in the 1860s. She is among the last few harbor work boats in existence dating from the turn of the century. Work boat, racing yacht, and pleasure craft, she symbolizes a parade of colorful moments in West Coast maritime lore.

B. Monterey Fishing Boats *Mary Ann* and *La Diana*

The classic Monterey-style boats *Mary Ann* and *La Diana*, built in 1930 in San Francisco, represent a modification of a hull form indigenous to Italy and brought to California by Italian immigrants, gradually replacing the Chinese and Japanese junks of the local fishing fleet. With their owners, *Mary Ann* and *La Diana* fished together in San Diego waters for over sixty years.

For many decades the San Diego waterfront was home to one of the greatest fishing fleets in the country. With boatbuilding and boat repair, offshore and deep sea fishing, canneries and restaurant businesses, this industry was one which brought many different peoples to our



region—Asians, Italians, Portuguese, Hispanic—contributing to the cultural diversity we see today.

In the 1960s and 1970s the big tuna boats, sometimes rafted two deep, tied up along the embarcadero, with people gathering to watch the fishermen loading and unloading their boats, mending their nets, and chatting about the latest catch. The embarcadero was alive with people, teeming with activities related to fishing. In the 1970s things started to change, as regulations and disputes began to take their toll. The industry began to disappear, and by the late 1980s had all but ceased to exist. That area of the waterfront has been given over to Hornblower Cruises and anchorages for private vessels and the historic ships of the Maritime Museum.

Part of the Maritime Museum's mission focuses on our local San Diego history. With the acquisition in 2003 of the two Monterey fishing boats *Mary Ann* and *La Diana*, we took the opportunity to tell the story of the San Diego fishing industry in a way that offers tangible, real objects that will intrigue people of all ages and connect them with the past. The Monterey boats are appealing artifacts because they are some of the few remaining examples of boats once plentiful. These types of vessels were crucial to the early history of fishing in San Diego, as well as to the salmon and sardine fisheries of Northern California.

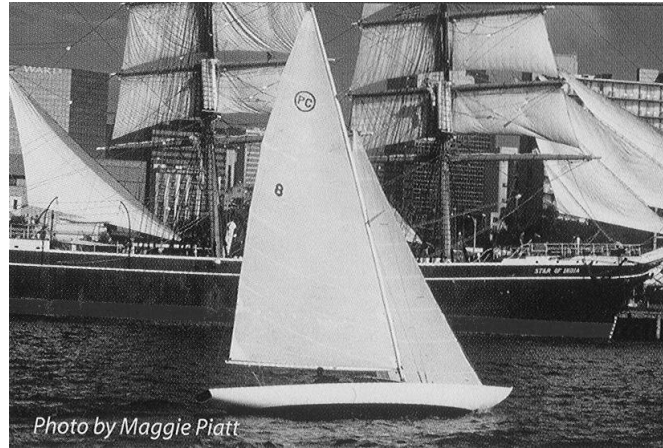
Mary Ann and *La Diana* are also of interest because of the role they played for two fishing friends, Tony Giacalone and Joe De Santi. Born to fishing families that lived a few doors apart in San Diego's Little Italy neighborhood, Tony and Joe fished together, each in his own boat, in a working friendship that outlasted all of the great bait boats and multimillion-dollar seiners that sailed from San Diego. They wished to keep their boats together as reminders of their generation of fishermen. They are tangible, visible artifacts of our waterfront's illustrious past, and serve as a connection for our children and grandchildren to our great maritime heritage.

C. *Wings* - Pacific Coast Racing Sloop

The concept behind the Kettenburg Pacific Class, one-design, wooden racing yacht was developed by George Kettenburg Jr. in answer to a request from his close friends Joe and George Jessop. Known as the PC, she was built to compete successfully in Southern California waters. This vessel was the first successful wooden racing yacht built for these waters. PCs were developed by the Kettenburg Boatworks in the 1920s and were produced until the early 1950s. Eighty-three hull numbers were assigned and the PC fleet has been a very successful and active presence at many yacht clubs along the West Coast, with the heart of the fleet based at the San Diego Yacht Club.

PC Hull #8, *Wings*, was built at the Kettenburg Boatworks on Shelter Island in 1931, and is believed to be the oldest PC in existence. She was originally built for

Ed Depew, a San Diego builder who soon sold her to jeweler George Carter Jessop. *Wings* competed well into the 1940s. After many years sailing and racing, she came to be owned by Paul Hartley, a former San Diego City Councilman and acting Mayor.



The Hartley family donated *Wings* to the San Diego Maritime Museum in 1983, but she remained in storage at the Kettenburg boatyard until the yard was sold. The yacht was then moved to a storage yard on Hancock Street. In 2001 *Wings* was offered to local PC skipper, Richard S. "Rish" Pavelec, to restore and race or sell her. He proposed to restore this wonderful piece of San Diego maritime history and donate it to the Museum. As the responsible member volunteer, he directed the restoration and the associated fund raising. With the generous help of the Museum, Koehler Kraft Boatyard, the Ellen Browning Scripps Foundation and others the restoration was completed in 2003. A relauching occurred on 6 April 2003. *Wings* is on display and is occasionally sailed for special Museum events.

D. *Rascal* - Starlet Class Racing Sloop

In the late 1920s San Diego's active sailing community was based at San Diego Yacht Club. On Sundays families taking the trolley out toward Roseville (today's La Playa area) might see yacht club members out on the water sailing six-meters, R-boats, Stars and other racing sloops. In those days the yacht club's commodore was Joe Jessop, an avid and skilled sailor who often traveled east to New York to compete in races. Recognizing the value of involving youngsters in the fundamentals of sailing, Mr. Jessop founded San Diego Yacht Club's junior boating program. Initially, a variety of small boats were used to teach sailing skills. The popular racing sloops of the time were judged to be too big for young sailors to handle. Fellow yacht club member and sailor George Kettenburg, Jr. had already designed and built a number of racing sloops at his boatyard and he thought a smaller version of the popular 22-foot Star class keelboat would be a good performing boat that young sailors would be able to handle.

Designed in 1927, the Starlet class of 16-foot keelboats became very popular in San Diego. It is estimated that Kettenburg Boat and Engine Company built about 40 Starlets during the 1930s. When the larger Star class boats were later chosen for use in the Olympics, many of the San Diegans who first honed their racing skills on Starlets found they were among the best sailors in



the world, bringing home gold, silver and bronze medals to prove it. Starlets remained popular locally and were actively raced well into the 1950s. *Rascal* is thought to be the last remaining boat of the Starlet class.

E. "Napoleon" Cannons - Federal Civil War Cannons

"El Justin" and "Big John" are the two field artillery pieces presently located at the western end of the Floating Dock. Occasionally the Museum has put these cannons to work by the practice of firing a noonday gun or by returning *Californian's* two-gun salutes to *Star of India* with two loud answering shots. The cannons are Civil War-era Model 1857 Federal "Napoleon" Cannons. The 12-pound "Napoleon" was the most popular smoothbore cannon used during the Civil war. The Model 1857 was of lighter weight than the previous 12-pounder guns. They could be transported by a six-horse draft, yet offered the heavier projectile payload of the larger bore weapons. The term "smoothbore" refers to weapons that are not rifled, meaning the ball is blown out of the barrel and may have an erratic flight because of the ball's irregularities. In contrast, a rifled gun barrel contains spiral grooves that cause the ball to twist as it exits the barrel, eliminating the influence of the ball's irregularities, making it fly on a straight course, affected only by gravity or wind in flight. At the time of the Civil War, metallurgy and other supporting technologies had just recently become capable of large scale production of rifled field artillery. However, many smoothbore weapons were still in use and in production, even at the end of the war.

The name "Napoleon" refers to Emperor Louis Napoleon III of France, where this type of cannon was designed and produced, starting in 1850. They were first introduced to the United States in 1857. These cannons were widely admired because of their safety, reliability, and killing power, especially at close range. They represent the last cast-bronze gun used by an American army. The federal version of the Napoleon can be recognized by the flared front end of the barrel, called the muzzle-swell, although a few Confederate versions of the gun also had the muzzle-swell design.



The Museum's two cannons arrived in San Diego on 19 September 1886, transported from San Francisco by the wooden side-wheeler *S.S. Orizaba*. History of the travels and wartime uses of these guns, from their initial acceptance by the U.S. Army until their arrival in San Diego, are unknown and untraceable so far as unit assignment or involvement in Civil War battles is concerned. It is believed the guns were loaded aboard *S.S. Orizaba* at the Benicia Arsenal along San Francisco Bay. Upon arrival in San Diego, the cannons were delivered to the U.S. Army Barracks at the foot of Market Street (now Martin Luther King Boulevard near present-day Seaport Village) and served as "Sunrise and Sunset" salute guns. In 1898, they were moved to Fort Rosecrans, specifically to the end of Ballast Point, to guard the newly laid electrically-controlled mine field that protected the channel entrance during the Spanish-American war. Later, the cannons were used for ceremonial and decorative functions at Fort Rosecrans. Over the years the National Park Service, U.S. Army Reserve and U.S. Navy had possession of the guns, and in that time the barrels became separated from the original carriages. Uncovered in 1980 by the U.S. Navy, they were restored by the San Diego Cannoneers club and U.S. Navy Submarine Base and Seabee personnel, utilizing original carriage parts donated by the San Diego Historical Society.

These cannons fired a 12-pound solid-iron shot using a 2½ pound charge of black powder and had an effective range of 1,686 yards (0.96 miles). They also fired air-bursting shells (case or canister shot) at shorter ranges, in which hundreds of smaller shot would scatter from a case or canister with devastating effect on opposing personnel. The bore of the cannons is 63.6 inches deep and 4.62 inches in diameter.

“Big John” weighs 1,217 lbs. and was cast by Cyrus Alger & Co., Boston, Foundry No. 1144, and was accepted on July 19, 1862 by Thomas J. Rodman as U.S. Ordnance No. 106. “El Justin” weighs 1,213 lbs., casting was by Revere Copper Co., Boston, Foundry No. 290, and was accepted on 26 August 1863, also by Thomas J. Rodman, as U.S. Ordnance No. 289.

Chapter XI. Swift Boat *PCF 816*



Chapter XI. Swift Boat *PCF 816*

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Chronology

- 1962 March - South Vietnam launched "Operation Sunrise" to eliminate communist Viet Cong guerrilla activity in the country. The U.S. provided money, weapons and field advisors. For the first time the U.S. advisors were authorized to fight alongside the South Vietnamese troops.
- June - The U.N. International Control Commission on Indo-China reported that North Vietnam was supporting and supplying the Viet Cong, in violation of the 1954 Geneva agreement on Vietnam.
- 1963 November - The conflict escalated as long serving President Diem was killed in a coup. The U.S. military presence of political and military advisors, trainers and instructors approached 16,000.
- 1964 August - After North Vietnamese PT boats attacked a U.S. destroyer in international waters Congress passed the Tonkin Gulf Resolution, which authorized President Johnson to "take all necessary measures to repel any armed attack against forces of the U.S. and to prevent further aggression."
- September - After the second such seaborne attack U.S aircraft began regular bombing of North Vietnamese bases
- December - President Johnson announced a vast increase in U.S. aid to South Vietnam "to restrain the mounting infiltration of men and equipment by the Hanoi regime in support of the Viet Cong."
- 1965 January - U.S. planes bombed North Vietnamese targets in retaliation for Viet Cong attacks on U.S. ground forces in South Vietnam.
- February - The first contingent of Republic of Korea (ROK) troops arrived in Saigon to support South Vietnam.
- February - Surveillance aircraft detected a North Vietnamese trawler trying to

land supplies in South Vietnam. The incident revealed a need for heavily-armed, close in-shore, coastal surveillance vessels.

March - A U.S. Navy staff study generated a number of recommendations regarding the type of coastal surveillance patrol craft needed to counter North Vietnamese incursions into South Vietnam.

March - 3,500 U.S. Marines from the 9th Marine Expeditionary Brigade landed at Da Nang, in the northern part of South Vietnam.

August – Two new boats, identified as Patrol Craft Fast (PCF), were delivered to the Navy in San Diego for sea trials. Crew training was initiated at the U.S. Navy Amphibious Base in Coronado. The new boats soon became known as Swift Boats.

1965 October - Just eight months after the need was defined, two PCFs arrived in An Thoi, South Vietnam. Within hours of their arrival PCF 3 and PCF 4 put to sea on a patrol in which 9 Viet Cong were killed in action (KIA).

December - On Christmas Eve six more Swift Boats (PCFs 5, 6, & 9 to 12) were delivered to An Thoi.

1966 - A total of 171 PCFs were produced in three slightly different models; about 110
1969 served in Vietnam. The other vessels were used to train crews and some were sold or given to other nations.

1968 *PCF 816*, a Mark II vessel, was launched and dedicated to crew training operations. The Mark II and Mark III boats were slightly longer, their decks were raised and the cabins were located farther aft than on the Mark I boats.

1969 PCFs began operating in the rivers, canals and waterways in the Mekong Delta as part of the Brown Water Navy. Crew training was moved to the Naval Inshore Operations Training Center (NIOTC) at Vallejo, California on San Francisco Bay. *PCF 816* was deployed north to the new base.

- 1970 In a policy known as Vietnamization the U.S. began substituting Vietnamese troops for U.S. forces. By year-end the last American Swift Boats had been turned over to the South Vietnamese Navy.
- 1971 The Navy donated two Swift Boats to the Mediterranean island nation of Malta to form the Malta Maritime Squadron, a security, safety and law enforcement force. One of the donated boats was *PCF 816*.
- 1973 After the cease fire agreement was signed and the U.S. withdrew from South Vietnam about 1,100 vessels, including most of the Brown Water Navy craft, were turned over to the South Vietnamese forces.
- 2011 Malta retired their two Swift Boats from service and donated *PCF 816* to the Swift Boat Sailors Association with the understanding that it would be restored and preserved, with maintenance and operation to be undertaken by the Maritime Museum of San Diego.
- 2012 *PCF 816* arrived in San Diego on 29 August, not far from where she began service in 1968, some 44 years earlier.

History

The United States involvement with what would become the Vietnam War started when the U.S. began providing advice, assistance in training and surveillance to the government of South Vietnam. U.S. assistance increased in response to North Vietnam's expanded delivery of men and materials to the South Vietnamese communist Viet Cong rebels. The tenor of the U.S. relationship changed in August of 1964 when three North Vietnamese torpedo patrol boats attacked the destroyer *USS Maddox* (DD 731) in international waters in the Gulf of Tonkin, more than 30 miles off the coast of North Vietnam. That attack and another incident several days later marked the start of an intense escalation of the war. As the U.S. was drawn further into the conflict the variety of surveillance craft included maritime patrol aircraft, destroyer escorts, mine sweepers & U.S. Coast Guard cutters.

In February of 1965 a North Vietnamese fishing trawler thought to be carrying arms and material for the Viet Cong was detected attempting to land in Vung Ro Bay, South Vietnam. Although the landing was thwarted the incident and the timid South Vietnamese response to it caused the U.S. to take two actions. First, a major arms interdiction program, Operation Market Time, was launched with the objective of capturing or destroying any contraband which might contribute to the enemy's war effort. Second, the U.S. Navy began to look for a type of small fast craft capable of conducting coastal and near shore patrols for overtaking, boarding and searching junks and steel-hulled fishing boats that operate along the coast of Vietnam.

PCF Construction and Layout

The Navy's need for the new type of patrol vessel was clearly defined in a 1965 Naval Advisory Staff study titled *Naval Craft Requirements in a Counter Insurgency Environment*, which noted that water-based counterinsurgency operations would require patrol craft that should incorporate the following characteristics:

- Light sturdy construction, reliable and quiet operation
- Non-wooden hull, with screw and rudder protection against groundings
- Self-sufficient for 400 to 500 mile patrols
- Operational speed of 20 to 25 knots
- Small high-resolution radar range 4 to 6 miles
- Reliable long-range communications equipment compatible with Army and Air Force

- Armament for limited offense
- Sparse berthing, minimal messing
- Depth meter, accurate from 0 to 50 feet
- Small, powerful searchlight

The new craft's specific mission would be to disrupt the flow of manpower (North Vietnamese Army & Viet Cong and supplies from North Vietnam to South Vietnam. Patrols would focus on traffic along the coast of the South China Sea as well as point-to-point traffic between the many small inlets and bays scattered along coastal waters within South Vietnamese territory. The patrols would be prepared to board and inspect steel hulled trawlers, junks and smaller coastal craft. The study was positively received, and the Navy began to search for vessels that could meet the requirements. The Navy soon found Sewart Seacraft, Inc. of Berwick, Louisiana, a builder of water taxis for servicing oil rig operations in the Gulf of Mexico. While the boats they produced appeared highly suitable, the Navy asked the company to prepare drawings for necessary modifications including gun mounts, ammo lockers, bunks, and a small galley. Following the competitive bidding process the Navy selected Sewart Seacraft.

In August of 1965 the Navy took delivery of the first two PCFs in San Diego and began sea trials. At this time San Diego became the logical location to conduct crew training as well. The Swift Boats had welded aluminum hulls about 50 feet long with a 13 foot beam, and draft of about five feet. They were powered by a pair of General Motors V12 marine diesel engines rated at 480 hp each, with a design range from 320 nautical miles at 21 knots to about 750 nautical miles at 10 knots. Because of the speed and agility of the boats they quickly became known as "Swift Boats."

The hull and superstructure were of all-welded 1/4 inch aluminum alloy construction. All deck plating, bulkheads, and other structural members including sheets, plates and extrusions were aluminum alloy. Four magnesium anodes were located on the stern below the water line to provide the means for reducing electrolytic corrosion.

The craft's general layout:

The **forepeak** was used as a gun platform, chain locker and storage area.

The **crew quarters** contained berthing for four personnel, storage area for personal equipment and a head (seldom used).

The **pilothouse** was equipped with the necessary controls to operate the boat via throttles & helm (replicated at the after port conning station on the fantail), start the engines, control the AC generator and other electrical equipment including navigational lights, search light, & siren and electronic

equipment such as radios, radar & fathometer. Radio equipment included line of site (VHF) tactical communications and over the horizon (HF) command & control communications. Radio equipment evolved over time and tended to be split between the pilot house and the cabin.

The **cabin** contained berthing for two personnel; galley area with a griddle, ice box/freezer, sink, small arms locker, storage cabinets including a chart drawer, fire extinguishers and a mix of radio equipment shared with the pilothouse.

The **stowage compartment** provided ammunition storage, the forward fuel tank and the two engine control units. The remaining space was utilized for general storage. Access to the compartment was through the bilge hatch located in the deckhouse. Three access hatches were provided in the deckhouse, one for the forward fuel tank and two for the ammunition boxes.

The **engine-room** housed the two engines, a diesel generator, two 24 volt battery sets, storage access for service manuals and tools, engine and generator exhaust systems, a lube oil tank, piping necessary for the bilge system, engine and generator seawater cooling systems and fuel system. Access to the engine room was through two hinged hatches on the main deck just aft of the deckhouse.

The **lazarette** housed the two aft fuel tanks, fresh water tank, steering gear, rudder tillers and two five-gallon lube oil tanks. Access to the lazarette was through a hatch located on the aft port corner of the after deck. Two soft-patch hatches on the aft deck were provided for access to the fuel tanks.

The nominal US crew for a PCF totaled six: an Officer in Charge (OIC), Quartermaster, Radar Man, Gunners Mate, Engine Man & Bosun's Mate. Beginning in 1966, the crew was occasionally augmented with a Vietnamese Navy Petty Officer (VNNPO). The VNNPO was particularly helpful in reading various documents such as personal ID cards & cargo manifests, as well as sensing when the occupants of a particular craft didn't "seem to fit", such as military-age males claiming to be fishermen even though their hands did not show the wear and tear of fishing.

The original water taxi design had been modified with two 50 caliber M2 Browning machine guns in a turret above the pilot house, and an over-and-under 50 caliber machine gun/81 mm mortar combination mounted on the rear deck. The 81 mm mortar located below the 50 caliber machine gun on the after gun mount could be fired either in the traditional drop fire mode or in a trigger fire mode. In the drop fire mode, the mortar round hits the firing pin at the bottom of the tube and is immediately fired out of the tube. This is the high angle mortar fire typically associated with mortars. It is used for firing illumination rounds or at targets on a "reverse slope" or with little overhead protection. In the trigger fire mode, the mortar round is preloaded in the tube (with the firing pin withdrawn) and then, consistent with the rules of engagement, trigger fired when the target is properly positioned for

engagement. This firing is typically flat trajectory and very accurate to about one thousand yards. It gives the fifty-foot Swift Boat the equivalent of a three-inch naval gun.

The over-and-under 50 caliber machine gun/81 mm arrangement had been developed by the U.S. Coast Guard for use on their cutters. PCFs occasionally operated with Coast Guard 82-foot (WPB) cutters during coastal patrols. Both craft (the PCF & the WPB) carried this weapon. While the weapon provided a powerful punch for these small craft, it also carried the dangers inherent in using a mortar in other than a drop fire mode. Ten of the 50 Swift Boat sailors killed in Vietnam and two of the six WPB Coast Guard killed in Vietnam were due to mortar accidents. Such accidents may have been caused by double loading the mortar (and then pulling the trigger) or by faulty safety devices (such as bore riding safety pins).

The Navy's original order for 20 boats was followed by orders for 38 and then 50 more of the Mark I boats. With experience it was determined that the Mark I boats did not ride well at speed in heavy seas or rough weather. The Swift Boats frequently had their pilothouse windows blown out by heavy seas. In a little over a year three of the boats were destroyed by the heavy surf in the mouth of the Cua Viet River just south of the Demilitarized Zone (DMV). Ten PCFs (all Mark I boats) were lost between 1966 and 1971. Of these ten, four were lost in combat and seven were lost due to heavy seas or weather. Thirty Mark II boats (including PCF 816) were ordered, 3 of which served in Vietnam. Relative to the Mark I, the bow and corresponding decking on the Mark II was raised, the deck house was placed further aft from the bow and the forward windshields were slanted to provide better protection against destructive seas coming over the bow. This could be due to either pounding seas from ahead or following seas that worked to lift the stern up and plunge the boat's bow down, in the extreme causing the boat to "pitch pole" (flip over), as was the case in the loss of PCF 77. Aft, on the port and starboard sides of the cabin, the large sliding windows were replaced with smaller round portholes, reducing the vulnerability to damage from beam seas, as would be the case in a broaching situation. Beginning in 1969, 33 Mark III boats were produced, 5 of which served in Vietnam. The Mk IIIs were slightly larger than the Mk IIs. In all, 171 PCFs were constructed in three slightly different versions (Marks I, II & III).

Of the 171 PCFs built, about 110 served in Vietnam or at either of the two training bases in California; the remaining PCFs were sold or given to nations friendly to the United States. The original training base for Swift Boats was located at the US Navy Amphibious Base in Coronado, California, a San Diego Bay location well suited for coastal and offshore training.

In 1965, in addition to running coastal patrol operations, the U.S. Navy was tasked with patrolling the Mekong Delta, the vast network of rivers, canals and inland waterways that covers a quarter of the geography and holds half of the population of South Vietnam. At first this job was done primarily with South Vietnamese river craft which had been inherited from the French during their war against the Viet Minh (the communist-led Vietnamese alliance). The U.S. Navy's first riverine boat built for the Vietnam War was the 50-foot steel hull ASPB (Assault

Support Patrol Boat) better known as the "Alpha Boat." This was followed by the fiberglass PBR (Patrol Boat River) with water-jet propulsion which was designed to penetrate the country's vast inland waterways. The riverine force was known as the Brown Water Navy. Training for the Brown Water Navy boats and crews was located at the Naval Inshore Operation Training Center (NIOTC) in Vallejo, California, along the north shore of San Francisco Bay. The rivers and narrow, shallow waterways (known as sloughs) around Vallejo provided a good training environment for the NIOTC units.

In 1969, Vietnam Swift Boat operations were expanded to include riverine patrols and crew training was moved north to NIOTC for the remainder of the Vietnam War. The PCF training boats, *PCF 816* among them, moved operations to San Francisco Bay and frequently transited from the bay to open waters either north or south along the Pacific coastline. The only Swift Boat lost while stationed at NIOTC was *PCF 8*, which sank during a storm off Bodega Bay, north of San Francisco, in December 1969. No crewmen were lost.

The most frequent training area for the NIOTC units was along the marshland on the northern shore of San Francisco Bay. Swift Boat crews with orders to the rivers & canals of Vietnam trained in these tidal marshlands. This area, now designated as the Napa-Sonoma Marshes State Wildlife Refuge Area, was also used by U.S. Naval Reserve PBRs until 1995, when Mare Island Naval Shipyard was closed. During those years when the Swifts and PBRs were training, motorists on Highway 37 west of Mare Island would often see the boats making their way through sloughs that bisect the north shore of San Pablo Bay. U.S. Naval Riverine Training is still authorized in the waters along the state wildlife refuge area, and portions of the History Channel TV series *Gunboats of Vietnam* were filmed there.

Vietnam Service

In March 1965 the first of the fiberglass PBR water-jet powered riverine boats was delivered to Vietnam. In October of that year the first two Swift Boats arrived at An Thoi, in the Gulf of Thailand, ready to take part in Operation Market Time. Six more Swift Boats were off-loaded in An Thoi on Christmas Eve. The buildup of PCFs continued until a total of 84 Swift Boats was reached in November 1966. As new boats were completed in Louisiana, navy planners assigned them to PCF Divisions located along the coast of Vietnam. Initially these divisions were referred to as PCF Divisions and served as component organizations under Boat Squadron ONE. On 1 January 1967, Boat Squadron ONE was re-designated Coastal Squadron ONE and the component divisions were re-designated as Coastal Divisions, as summarized below:

Before January 1, 1967		Starting January 1, 1967
PCF Division	Location	Coastal Division
101	An Thoi	11
102	Da Nang*	12
103	Cat Lo	13
104	Cam Rahn Bay	14
105	Qui Nhon	15

**Coastal Division 12 Detachment Chu Lai was designated Coastal Division 16 in May 1967. Coastal Division 16 was disestablished in September 1967; PCFs in Chu Lai reverted to Coastal Division 12 Detachment Chu Lai. This detachment was officially closed on 25 October 1969.*

On 29 February & 1 March 1968, during the Tet offensive, North Vietnam attempted the simultaneous infiltration of four steel hulled trawlers into South Vietnam. Interdiction efforts by coastal surveillance forces resulted in two trawlers destroyed, one trawler scuttled at sea and the last trawler retreating seaward. By this time it was becoming evident to the logistics planners in North Vietnam that attempts to infiltrate along the coast via trawler were not working. Accordingly, their logistic strategy shifted to sending men and supplies down through the interior, mainly via the Ho Chi Minh Trail.

In September of 1968, the newly arrived Commander Naval Forces Vietnam, Vice Admiral Elmo Zumwalt, recognized this shift in strategy and devised Operation Southeast Asia Land, Ocean, River Delta Strategy (SEALORDS) to counter the North Vietnam plan. Recognizing that the men and material coming out of the south end of the Ho Chi Minh Trail would have to be transported by watercraft into South Vietnam, Admiral Zumwalt sent the PBRs up into the narrow rivers and canals of the Mekong Delta and used the PCFs, no longer critically needed in coastal waters, to support the PBRs on the major rivers and waterways. Once on the rivers, in addition to backfilling for the PBRs, PCFs moved further and further upriver to confront the enemy.

When Operation SEALORDS kicked off in October of 1968 the PCF Table of Equipment (TOE) was officially modified to add an M60 machine gun; this weapon was typically manned by a gunner in the peak tank, just in front of the forward superstructure. "Swifties" were known to augment their official TOE weapons as needed without necessarily going through official channels.

Task Group 194.0, the tactical organization executing Operation SEALORDS, received a Presidential Unit Citation for the period 18 October 1968 to 5 December 1968. This award noted in part that the participants (including PCFs) were "...eminently successful in their campaign to interdict enemy supply routes and base

areas...". The successful disruption of VC supply and communication lines continued for two years. By 1971, all aspects of SEALORDS operation had been turned over to the South Vietnamese Navy.

Swift Boats generally operated alone on open water and coastal missions, but when assigned missions in the Mekong Delta waterways they frequently worked in pairs. Each boat had an officer in charge, one of whom would also be placed in overall charge of the mission. Later in the war the Swift Boat missions often included patrolling the waterways, searching water traffic for weapons and munitions, transporting Vietnamese marine units and inserting Navy SEAL teams. The SEAL missions generally employed teams of three to five Swift Boats.

In response to the Swift Boats the Viet Cong set up ambushes, built obstructions in the canals to create choke points, and began to place mines in the waterways. For the Swift Boats, returning back down river was always more dangerous than going up river. The up-river passage often alerted the enemy to a patrol and their eventual return down-river provided an opportunity for the Viet Cong. The ambushes were typically short-lived affairs, set up at a river bend or in a narrow canal that restricted the maneuverability of the boats. The enemy could employ a wide variety of portable weapons in their attacks including recoilless rifles, B-40 rockets, 50 caliber machine guns and AK-47s, often fired from behind earthen bunkered positions.

When attacked the Swift Boats would accelerate out of the hot zone, turn and then return as a group, firing as many of their 50 caliber machine guns as they could bring to bear as they powered past the ambush point, then returning back across as many times as needed to reduce the ambushers. Though most cruising and patrolling was done at 8 to 10 knots, the boats could reach top speed of 32 knots. Engagements were brief and violent, with the ambushers often slipping away into the undergrowth when the boats located the source of attack and began to concentrate their return fire. Thick brush and vegetation in the delta provided excellent cover for the escaping ambushers. Casualties among the Swift Boat crews were high. Casualties suffered among the Viet Cong were difficult to assess, as they would take their dead and wounded away from a firefight. Discovering newly dug graves was one of the few ways to confirm Viet Cong losses.

The first Swift Boat to be lost during the war was *PCF 4*, lost to a mine in 1966. Three others (*PCF 14*, *76* & *77*) were lost in rough seas, trying to re-enter the treacherous mouth of the Cua Viet River. *PCF 41*, caught in an ambush, was hit by fire from a 57 mm recoilless rifle. The boat's controls were destroyed and the coxswain, Bosun's Mate Second Class Godley, was killed instantly. With no controls the boat ran aground at full speed. The crew remained aboard manning their weapons; when they ran out of ammunition they abandoned the vessel. The surviving crew was picked up and later in the day a rescue/salvage team returned to recover BM-2 Godley's body and a starlight scope (a classified secret night vision scope). An attempt to recover the boat failed when she sank but some time later she was raised and salvaged.

PCF 43 was lost to a rocket attack in 1969. At the time she was carrying a SEAL team and a large supply of ammunition. The boat burned and melted, killing or wounding all aboard. Several other Swift Boats had been lost to river mines, but were salvaged and either repaired or used for spare parts. (See Supplements 1 and 2 in this chapter for details of lost and missing crewmen and boats.)

As the U.S. began to withdraw from the war the Swift Boat duties were taken over by the South Vietnam Navy. The last U.S. Navy PCF was turned over to the SVN in December 1970, although the USN provided some advisory services after that date. In the years 1965 to 1970 approximately 3,500 men served aboard Swift Boats in Vietnam as crew or support personnel. Fifty Swift Boat sailors made the ultimate sacrifice for their country, and more than 350 were wounded.

Malta Service

On April 5, 1971 the U.S. Navy donated two Swift Boats to the Republic of Malta's newly formed Maritime Squadron. These two Mark II vessels, *P23* and *P24*, had started their service in California as training vessels (*PCF 813* and *PCF 816*). The Swift Boats were quickly put to work performing routine security patrols in cooperation with Italian and various African authorities to search for and interdict contraband and illegal aliens moving from the northern coast of Africa through Malta to the coasts of southern Europe. The many coastal waterways surrounding the tri-island nation and the volume of Mediterranean traffic make security, vessel assist and rescue at sea operations a high priority for Malta.

The relationship between the Malta Maritime Squadron and the Swift Boat Sailors Association (SBSA) goes back at least to 2003, when Major Ivan Consigilo and former Swift Boat skipper Bob Shirley established a ham radio connection enabling sailors from both countries to share stories of their experiences. These lines of communication remained open and in 2008 Major Consigilo told San Diego-based author and former Swift Boat skipper Virg Irwin that the two Malta Swift Boats were to be retired from service. The Major proposed donating one of the boats to SBSA for restoration and preservation. Maritime Museum President and CEO Dr. Ray Ashley had for several years promoted the history of Swift Boats and their close association with San Diego. Now, informed of the proposal, Dr. Ashley offered to support the SBSA effort to restore the boat and to exhibit and operate the boat as living history, giving museum visitors the opportunity to experience the sound and speed of these vessels. One planned museum exhibit will pay tribute to the seven Malta Maritime Squadron sailors and firemen who died on September 7, 1984 aboard *P23* as a result of a violent explosion. In 2010, a group of SBSA members traveled to Malta and presented the restoration plan and the Museum's commitment to the Malta Maritime Squadron. The Republic of Malta awarded the patrol boat, *P24*, to the SBSA and the Maritime Museum of San Diego.

Swift Boats Today

In late August 2012, after four decades of coast guard duty in the Republic of Malta, Swift Boat P24 (originally U.S. Navy *PCF 816*) was returned to San Diego Bay to become part of the Maritime Museum of San Diego. Though the second Maltese boat was badly damaged in the 1984 accident, P23 was restored and will remain in Malta serving as a memorial to the men who died in the country's worst peacetime tragedy.

Currently there are two Swift Boats preserved in static displays in the United States. These two Swift Boats, like *PCF 816*, were also originally stationed in California to train PCF crews. *PCF 1* is located at the Navy Museum at Washington Navy Yard in Washington, D.C. *PCF 104* is at the Vietnam Unit Memorial Monument at Naval Amphibious Base, Coronado, California, the original home of PCF training.

PCF 2 was donated to Tidewater Community College in Norfolk, Virginia and serves as a research vessel. Re-named *Matthew Maury*, the former Swift Boat is used in collecting oceanographic data throughout Chesapeake Bay and the Hampton Roads area.

Specifications

A. Mark I (PCFs 1 thru 104)

Length:	50 ft. 1.5 in.
Beam:	13 ft. 6.5 in.
Draft:	Hull - 3 ft. 10 in. Overall - 5 ft. 10 in.
Height from Water Line:	Main deck at pilothouse - 3 ft. 8 in. Top of 50 caliber gun tub - 11 ft. 6 in. Top of the radar mast - 16 ft. 9 in.
Speed:	28 knots, 32 knots design maximum
Paint Scheme:	Original: haze gray overall - factory applied color Vietnam: deck gray with varying amounts of black added, white mortar box lid and a large white star in a blue circle on the pilot house roof. Riverine: dull green with black camouflage patterns - authorized in May 1970
Weight:	36,913 lbs. empty - 47,047 lbs. with full war load of fuel and ammunition
Displacement:	42,500 lbs.
Engines:	Two General Motors 12V71N Detroit marine diesels; port model #7122-3000, starboard model #7122-7000, each equipped with two 4-71 blowers and rated at 480 horsepower, when using the N70 type injectors, SM-118 Hydraulic Marine Gear Clutch with 1.15:1 reduction gears driving two counter-rotating screws.
Electrical:	24 volt batteries provided the main source of electrical power for main engine starting, general purpose lighting, search lights, navigational lights, radar and the URC-58 radio (alternate mode). There were two 24 volt battery banks, each charged by an alternator. The port bank was a standby 24 volt supply, while the starboard bank was used for general boat power. In an emergency, these banks could be configured in parallel mode, to ensure operation of vital equipment. 120 volt 60 cycle AC single phase electricity was used for operation of the URC-58 radio, signal light, refrigeration equipment, cooking outlet and griddle.
Electronics:	Surface search radar, maximum range scale of 24 miles. Fathometer - dual range (240 foot maximum depth). Various radios for boat to base, boat to shore, boat to boat, or boat to air communications and a survival/emergency radio. An amplified loud-hailer system with a range of approximately 1800 yards

Armament: Twin 50-caliber Browning machine guns, with heavy barrels, on a ring mount. Capable of firing at 450-550 RPM and equipped with ammo cans for 500-600 rounds per gun, referred to as "mount 5 1." The maximum range of this gun was in excess of 7,000 yards, effectiveness was poor in excess of 2,000 yards and accuracy was excellent at 1,000 yards or less. Typically 20,000 to 25,000 rounds of 50 caliber ammunition were carried onboard the PCF.

81mm Mark 2/Mod 0, trigger fired mortar with a 50 caliber, semi-automatic capable, fixed with a Browning machine gun on top, referred to as "mount 5 2" or the "over and under weapon." Range of the 81mm mortar was 3,940 yards at elevated fire and 1000 yards at direct fire. Trigger fired capacity was 10 rounds per minute, drop fired 18 rounds per minute.

Typical 81mm ammunition load carried on board in the stern-mounted ready service locker and two main cabin floor lockers included: high explosive w/ point detonate fuse, white phosphorus w/point detonate fuse, flechette (scatter shot), illumination w/time fuse, proximity (variable time) fuse.

Various crew member weapons, could include: M-60 machine guns, M-79 grenade launchers, M-14, M-16 rifles, 12 gauge Ithaca riot guns, 38 caliber or 45 caliber pistols, various types of hand grenades, Very pistols (flare guns), and C-4 explosive.

Turning radius: 75 yards when cruising at 20 knots

Stopping distance: 2 1/4 boats lengths (112') in 9 seconds, from maximum speed

Fuel: 800 gallons, diesel or JP-5 (aviation fuel) in an emergency, in three fuel tanks (2 aft, 1 amidships)
There were no fuel transfer pumps. PCFs 1 -16 engines could draw fuel from their own tank or the centerline tank. PCFs 17 and higher could draw fuel from any tank.

B. Mark II (PCFs 137-139, 813, 814 & 816)

Length:	51 foot 3.75 inches
Beam:	13 foot 7 inches
Full load draft:	5 foot 10 inches
Construction:	Bow height was raised by one foot and the pilothouse was moved aft by approximately three feet from the Mark I construction plans design
Weight:	34,934 lbs. empty - 45,093.8 lbs. with full war load of fuel and ammunition
Displacement :	43,035 lbs.
Engines:	Two General Motors 12V71 N Detroit marine diesels; port model #7122-3000, starboard model #7122-7000, each equipped with two 4-71 blowers and rated at 480 horsepower, when using the N70 type injectors, SM-118 Hydraulic Marine Gear Clutch with 1.15:1 reduction gears driving two counter-rotating screws.
Fuel:	828 gallons, diesel or JP-5 (aviation fuel) in an emergency, in three fuel tanks (2 aft, 1 amidships)

C. Mark III (PCFs 691 to 695)

Length:	Slightly longer than Marks I & II
Beam:	Slightly wider than Marks I & II
Full load draft:	Slightly deeper than Marks I & II

Supplements

1 - Swift Boats Lost

Date	PCF	Cause	Remarks
14 Feb 1966	4	Command detonated mine	4 Crew killed in action (KIA); 2 Crew wounded in action (WIA)
22 May 1966	41	Shore Fire & Mine	Came under heavy shore fire killing helmsmen & wounding radioman. Craft abandoned. Remainder of crew (with wounded) floated down river, receiving painful stings from jellyfish-like critters. PCF 41 evaluated as not salvageable.
15 Nov 1966	77	Flipped	Entrance to Cua Viet. Bow down/stern up flip. Two crew members & one passenger lost; possibly trapped in upside-down main cabin by deck plates and ammunition from main magazines.
6 Nov 1967	76	Capsized	Entrance to Hue. Crew saved.
30 Nov 1967	14	Swamped, capsized, sunk	Entrance to Cua Viet. Trying to rescue local fishermen. Crew of PCF 14 survived. Third PCF lost in the vicinity of Cua Viet November 66 to November 67 due to heavy seas. Cua Viet Detachment of Coastal Division 12 in Da Nang closed on 30 November 1967.
15/16 Jun 1968	19	Sunk by aircraft	Sunk at near the Demilitarized Zone (DMZ). Initially attributed to friendly fire from USAF aircraft. More likely, fire from USSR Hind helo north of the DMZ. Four USN & one Vietnamese Navy Petty Officer KIA. See Jim Steffes' book "Swift Boat Down."
12 Apr 1969	43	Recoilless Rifle, B 40 Rocket Fire	Initial enemy fire beached the PCF and resulted in fires that detonated a substantial amount of cargo explosives. Officer in charge KIA; remainder of crew not injured; 3 other Navy personnel KIA and 33 WIA.
18 Dec 1969	8	Surf	PCF 1 & 8 ran aground while conducting stateside training in the surf off Bodega Bay, CA. PCF 1 was saved; PCF 8 was lost. Crew of PCF 8 survived; one crew member hospitalized.
2 Nov 1970	9	Tropical Storm Nora	As Vietnamese Navy (VNN) PCF 3904
2 Nov 1970	20	Tropical Storm Nora	As VNN PCF 3907
1971	70	Typhoon	As VNN PCF 3905

Of 11 Swift Boats lost, 4 were due to combat, 7 were due to heavy seas or weather.

2 - Swift Boat Crew Lost or Missing in Action

Date	Rate	Name	Home Town	PCF ⁵¹	Remarks
1966					
4 Feb	SN	David J. Boyle	Woodland, CA	4	First Swift KIAs in Vietnam. Command detonated mine.
4 Feb	BM2	Thomas E. Hill	Knoxville, TN	4	First Swift KIAs in Vietnam. Command detonated mine.
4 Feb	EN2	Joaquin C. Rodriguez	Jackson Heights, NY	4	First Swift KIAs in Vietnam. Command detonated mine.
4 Feb	GMG2	Dayton L. Rudsill	Greensburg, KS	4	First Swift KIAs in Vietnam. Command detonated mine.
22 May	BM2	Raleigh Lee Godley	Lawson, MO	41	Operation LEXINGTON III. KIA 57mm recoilless rifle. Mine explosion. Craft abandoned. Not salvageable.
18 Oct	EN2	Gale J. Hays	Falling Rock, WV	9	Mortar accident.
18 Oct	QM3	Eugene L. Self	Carteret, NJ	9	Mortar accident.
18 Oct	BM2	Hubert Tuck, Jr.	Lenoir City, TN	9	Mortar accident.
25 Oct	GMGSN	Alvin L. Levan	Catawissa, PA	87	Suffered an apparent seizure; fell overboard; remains not recovered. MIA.
29 Oct	BM1	Kemper S. Billings	Burlington, NC	56	Swept overboard and drowned; remains recovered.
15 Nov	BM3	Harry G. Brock	Odessa, TX	77	PCF lost in heavy seas near mouth of Hue River attempting to rescue PCF 22 crewmember swept overboard (subsequently recovered by PCF 22). Drowned; remains recovered.
15 Nov	RM3	Bruce A. Timmons	Fort Lauderdale, FL	77	Remains not recovered. MIA.
15 Nov	MRC	Willy S. Baker	Buffalo, TN	77	After PCF 77 was sunk, passenger Chief Baker (a Navy Diver) was seen on the surface. He reentered the sunken boat trying to save crewmembers. Drowned; remains recovered.
1967					
11 Mar	SN	Gary W. Friedmann	Lebanon, PA	39	Mortar accident. Blown over the side. Remains recovered two days later.
29 Mar	SN	Dennis R. Puckett	Independence, MO	63	Fell overboard; struck by screws of PCF 63; lacerations of head & chest; died enroute to First Air Cavalry Aid Station.
19 Nov	LTJG	William H. Murphy	Madison, WI	NA	Died when riding in a First Air Cavalry helo that was shot down near Qui Nhon. Never assigned to a boat.
6 Dec	BM1	Bobby Don Carver	Richmond, CA	79	KIA by shore fire during Psychological Warfare Operations (PSYOPS) at the Co Lay; previously (15 Jul 67) Mt 52 gunner who trigger fired 81mm WP mortar round through pilot house window of North Vietnamese trawler (Skunk Alpha) off Cape Batangaan.
23 Dec	EN2	Carl R. Goodfellow	Waterproof, LA	88	KIA in sapper attack on Qui Nhon Swift Base; Crew Member PCF 88.

⁵¹ PCF "Cell" is shaded if the PCF was lost in the course of the event that led to the fatality.

Date	Rate	Name	Home Town	PCF ⁵¹	Remarks
1968					
PCF 19 was sunk on 16 June 1968 in the vicinity of the Demilitarized Zone (DMZ) by an aircraft. Attack initially classified as friendly fire from a USAF jet based in Da Nang; subsequent investigation (see Jim Steffes "Swift Boat Down") indicates attack may have come from a USSR provided helo (perhaps HIND) based just north of the DMZ. Of the 4 US Crewmembers KIA, two were initially MIA. Some of Tony Chandler's remains were identified in 2001 & buried with full military honors in Georgia. Vietnamese Navy Petty Officer Bui Quang Thi, Da Nang, was also KIA in the sinking of PCF 19. His remains were recovered.					
16 Jun	GMG2	Billy S. Armstrong	West Helena, AR	19	Remains recovered.
16 Jun	QM2	Frank Bowman	Waterborough, SC	19	Remains not recovered; MIA.
16 Jun	BM2	Anthony G. Chandler	Warner Robbins, GA	19	Initially remains not recovered; designated MIA. In 1993 a joint US Vietnamese recovery team interviewed a Vietnamese fisherman in Quang Tri Province, Vietnam. The fisherman produced an 8.5 cm bone fragment that he had discovered & buried. In 2001, fragment identified through DNA as from Tony Chandler (possible left upper arm bone). Tony was buried near Warner Robins, GA, with full military honors on 16 June 2001, 33 years after the sinking of PCF 19; an event that the US Government still has not explained. The closure from this burial ceremony was comforting to Tony's family & shipmates. We still have a special place in our hearts for our MIA shipmates, including Frank Bowman.
16 Jun	EN2	Edward C. Cruz	Inarajan, Guam	19	Remains recovered.
4 Sep	RD3	Gerald D. Pochel	Otis, OR	96	Small arms fire.
7 Sep	BM2	John McDermott	Pittsburg, KS	98	Mortar explosion.
3 Nov	BM3	Richard C Simon	Ellsworth, WI	50	Sniper Fire.
6 Nov	EN2	David L. Merrill	South Bend, IN	70	2 recoilless rifle hits. USMC rider knocked overboard. Marine's remains not recovered.
8 Nov	BM3	Peter P. Blasko, Jr.	Southern Pines, NC	89	Double loaded mortar.
8 Nov	BM3	Stephen T. Volz	Lakewood, CA	89	Double loaded mortar.
8 Nov	LTJG	Richard C. Wallace	Norfolk, VA	89	Double loaded mortar.
6 Dec	BM2	Steve R. Luke	Provo, UT	36	Small arms fire.
17 Dec	EN2	John R. Hartkemeyer	Hamilton, OH	51	B-40 hit; rocket alley.
1969					
5 Jan	BM3	Gerald R Horrell	North Hollywood, CA	21	Probe Song Ong Doc
12 Apr	LTJG	Donald G. Droz	Rich Hill, MO	43	KIA by shore fire. PCF 43 grounded on river bank with diesel engines on full throttle. PCF subsequently burned; destroyed when cargo explosives detonated. Remainder of crew survived. Overall Casualties: US Navy – 3 KIA & 33 WIA; Vietnamese Marines -2 KIA & 13 WIA/MIA.
12 Apr	QM3	Thomas E. Holloway	New Castle, IN	51	Silver Lance 2; B-40 rocket.
5 May	BM3	Richard L.	Mansfield, OH	9	Third tour volunteer. Killed leading a

Date	Rate	Name	Home Town	PCF ⁵¹	Remarks
		Baumberger, Jr.			landing party ashore.
15 May	EN3	Dewey R. Decker	Ionia, MI	51	VC attack in Song Bay Hap
15 May	GMG3	Richard W. Stindl	Beloit, WI	51	VC attack in Song Bay Hap.
19 May	BM3	Robert Alan Thompson	Downey, CA	59	Small arms fire; died of wounds.
22 Jun	RD2	Kenneth P. West	Butte, MT	NA	Nha Be Detachment; Coastal Division 15. Drowned; remains recovered.
2 Jul	EN3	Albert M. Fransen, Jr.	Las Vegas, NV	87	Mortar Accident; possible bore riding safety pin problem. Blown over the side. Remains not recovered. MIA.
2 Jul	GMG3	Glen Cameron Keene, Jr.	Fairhope, AL	87	Mortar accident; possible bore riding safety pin problem. Remains recovered.
12 Aug	GMG3	Stephen J. Penta	Revere, MA	57	Claymore mine.
26 Sep	LTJG	Robert L. Crosby	South Hamilton, MA	NA	Maintenance Officer, Coastal Division 12 in Da Nang; office on a YFNB-2 (Large Covered Lighter (non-self-propelled)). While aboard PCF 13 (tied alongside the barge), was shot on 24 September by an accidental discharge from the 50 cal machine gun. Died 26 September at Third Field Hospital in Saigon.
2 Oct	QM2	Richard Laverne Wissler	Willow Street, PA	27	Explosive device.
7 Oct	LTJG	Kenneth D. Norton	Lady Lake, FL	61	Operation Sea Tiger. At helm,killed in a hail of automatic, semi-automatic & 57mm RR fire.
4 Dec	RD3	Martin S. Doherty	New York, NY	42	Bow Gunner on PCF 42 conducting operations on Song Dam Doi, northwest of Sea Float. KIA by B-40 rocket direct hit.
1970					
17 Feb	RD3	Craig W. Haines	Keyser, WV	22	Drowned; remains recovered.
17 May	RD3	Frederick D. Snyder	Moab, UT	64	B-40 rocket hit, wounded 16 May 1970; died of wounds 17 May 1970.
6 Jul	QM2	Lanny H. Buroff	Chicago, IL	40	PCF 40 moored alongside USS KRISHNA (ARL 38) (Auxiliary Repair Landing-craft ship) at Sea Float. Underwater mine damaged KRISHNA & PCF 40, killing QM2 Lanny Buroff. The last Swift Boat combat death in Vietnam.
25 Oct	QM1	Joseph P. Jurgella	Stevens Point, WI.	59	Heart attack. Last Swift Boat death in Vietnam.
U.S. Navy Swift Boat Shipmates Missing in Action *					
Date			PCF		Name
25 October 1966			PCF 87		GMGSN Alvin L. Levon
15 November 1966			PCF 77		RM3 Bruce A. Timmons
16 June 1968			PCF 19		QM2 Frank Bowman
2 July 1969			PCF 87		EN3 Albert M. Fransen, Jr.
Armed Forces of Malta Missing in Action					
7 September 1984			C 23 (PCF 813)		Bombardier Francis Berg
7 September 1984			C 23 (PCF 813)		Private Anthony Farrugia

**In the United States, National Prisoner of War/Missing in Action (POW/MIA) Recognition Day is observed on the 3rd Friday in September.*

3 - Malta Maritime Squadron Service

With the Vietnamization program in place and the drawdown of U.S. forces underway, the last of the Swift Boats deployed in Vietnam were turned over to the South Vietnam Navy in December of 1970. There was no longer a need for PCF crew training in California and the craft employed in that training became surplus. The U.S. offered the island nation of Malta two Mark II crew training boats. In February of 1971 PCF 813 and PCF 816 were shipped to Malta and on 5 April of that year the boats were formally turned over to that country to become patrol boats in the newly formed Malta Maritime Squadron. The boats were later designated P23 and P24, respectively, and were assigned to coast guard duty.

Various Designations for PCF 813 & 816

Date	PCF 813	PCF 816	Remarks
1968	#50NS6823	#50NS6824	Building yard designation (the 23 rd & 24 th fifty foot boats built for the Navy in 1968)
1968 – July 1969	PCF 813	PCF 816	Training at Coronado
July 1969 - 1970	PCF 813	PCF 816	Training at Mare Island
6 February 1971	C-6823	C-6824	On arrival at Valetta's Grand Harbor aboard USS WOOD COUNTY (LST 1178)
5 April 1971	C-23	C-24	Upon official hand-off to Malta ceremony
Later	P23	P24	In the service of the Armed Forces of Malta
2012	N.A.	PCF 816	Upon return to San Diego

Victory Day and the Magnificent Seven

September 8th is celebrated as Victory Day in Malta. This celebration observes:

- The Victory of the Great Siege of Malta by the Knights of St. John against the Turks in 1565
- Rebellion against the French troops in Malta which ended in September 1800.
- Surrender of Italy, an Axis ally of Germany, in 1943 during World War II; Germany would subsequently occupy Italy and continue to fight Allied troops advancing north through Italy but the attacks on Malta were essentially over.

On 7 September 1984, Armed Forces of Malta (AFM) Patrol Boat P23 was carrying a large amount of confiscated illegal fireworks to an intended dumping spot in the Mediterranean. The fireworks somehow exploded, blowing a gaping hole in the boat's starboard bow and foredeck, killing five MMS sailors and two Maltese policemen. The sole survivor was crewman Private Emmanuel Monstein.

Today, PCF 816 serves as a memorial to the 50 Americans and 7 Maltese who died in the service of their country aboard Swift Boats. Their names are posted in the memorial section of the PCF 816 boarding area on board *Berkeley*.

Malta Maritime Squadron Sailors Lost	
Title	Name
Remains Recovered	
Bombardier	Joseph Pace
Gunner	William Simpson
Private	Anthony Vella
Remains Not Recovered	
Bombardier	Francis Berg
Private	Anthony Farrugia
Armed Forces of Malta Policemen	
Title	Name
Remains Recovered	
Police Sergeant	Savior Muscat
Police Constable	Joseph Hare

4 - The Vietnam War

The area including present day Vietnam had been a French possession for many generations. Following the end of WWII this region, then known as French Indochina, was the scene of a growing movement seeking independence from France. A leader of this movement was Ho Chi Minh, an inspiring figure who as a student in France had helped found the French Communist Party in the 1920s and who later led an effective resistance movement against the Japanese during WWII. In 1950, President Truman sent some military personnel to support the French effort to control Vietnam under the leadership of the French-appointed Emperor Bao Dai. At this time Ho Chi Minh was recognized as Vietnam's leader by the communist-bloc countries.

In May 1954, the battle of Dien Bien Phu ended after almost two months of heavy fighting as the Vietnamese insurgents overran and expelled the French forces. Over the eight years of the French Indochina War some 52,000 French soldiers were killed. Making the defeat official the French signed an armistice known as the Geneva Accords, surrendering North Vietnam to the communists. Vietnam was now divided into two countries along the 17th parallel, the communist north led by Ho Chi Minh and a pro-capitalist south under Ngo Dinh Diem. With the division official, it is estimated that almost a million anti-communists fled to the south. Later in the year President Eisenhower authorized a crash program to train the South Vietnamese Army.

For the next few years what would be known as the Vietnam War was a cold war era conflict that spread across Vietnam and much of Laos and Cambodia until the fall of Saigon on 30 April 1975. This so-called proxy war was fought between North Vietnam, supported by the Soviet Union, China and other communist allies, and the government of South Vietnam, which was supported by the United States and neighboring South Pacific or Asian anti-communist countries. The National Liberation Front, also called Viet Cong, was a lightly armed South Vietnamese communist group directed by the North, who fought a guerrilla war against anti-communist forces in the region. The North Vietnamese Army (People's Army of Vietnam or NVA) engaged in a more conventional war, at times committing large units into battle. As the war grew, the Viet Cong share of the fighting decreased as the role of the NVA grew. The South Vietnamese with U.S. and other allied forces relied on air superiority and firepower to conduct search and destroy operations involving ground forces, artillery, and airstrikes. In the course of the war, the U.S. conducted a large-scale strategic bombing campaign against North Vietnam.

The U.S. government viewed American involvement in the war as more than a way to prevent a Communist takeover of South Vietnam. This was part of a wider containment strategy, with the stated aim of stopping the spread of communism. According to the U.S. domino theory, if one state became communist, other states in the region would follow. Thus, U.S. policy was based on the

assumption that accommodation to the spread of communist rule across all of Vietnam was unacceptable. The North Vietnamese government and the Viet Cong were fighting to reunify Vietnam under communist rule. They viewed the conflict as a colonial war, fought initially against forces from France before U.S. involvement, and against South Vietnam, which it regarded as a U.S. puppet state.

Although small groups of American military advisors had been deployed in the region since 1950, as the table on the following page indicates U.S. involvement escalated in the early 1960s as troop levels tripled in 1961 and increased eight-fold in 1964. Note also that U.S. involvement escalated further following an incident in the Gulf of Tonkin. On 2 August 1964, while on an intelligence-gathering patrol in the Tonkin Gulf, about 30 miles off the coast of North Vietnam the destroyer USS Maddox (DD-731) was engaged by three North Vietnam Navy torpedo boats. The result of the ensuing battle, which severely damaged the torpedo boats, and a reported second confrontation two days later (since considered questionable) pushed the U.S. Congress to pass the Gulf of Tonkin Resolution giving U.S. President Johnson authority to assist any Southeast Asian country whose government was considered to be jeopardized by "communist aggression". The resolution served as Johnson's legal justification for deploying U.S. conventional forces and beginning open warfare against North Vietnam.

U.S. combat units were deployed beginning in 1965. Operations crossed international borders as areas of Laos and Cambodia were heavily bombed by U.S. forces. American involvement in the war peaked in 1968; this was also the year that the communists launched the Tet Offensive. Although the Tet Offensive failed in its goal of overthrowing the South Vietnamese government, it became the turning point in the war, as it showed that South Vietnam was unable to fend for itself against the North despite many years of massive U.S. military aid. Additionally, American public support for the war effort had declined significantly and a majority of citizens were opposed to additional effort. The U.S. ground forces were gradually withdrawn as part of a policy known as Vietnamization, which aimed to transfer the task of fighting the communists to the South Vietnamese themselves. In the U.S. and other parts of the Western world, an aggressive anti-Vietnam War movement had developed and merged into the larger, more general counter-culture movement of the time. From college campuses to the general public, support had swung overwhelmingly against the war to the extent that troops returning home, even those with serious injuries, were faced with hostile, angry crowds.

Despite the Paris Peace Accords, which was signed by all parties in January 1973, the fighting continued. Direct U.S. military involvement ended on 15 August 1973 as a result of the Case–Church Amendment passed by the U.S. Congress. The capture of Saigon by the North Vietnamese Army in April 1975 marked the end of the war, and North and South Vietnam were reunified under communist rule the following year.

Allied Troop Levels in Vietnam 1959 to 1973

Year	American	South Vietnam	Allied Forces*
1959	760	243,000	--
1960	900	243,000	--
1961	3,205	243,000	--
1962	11,300	243,000	--
1963	16,300	243,000	--
1964	23,300	514,000	448
1965	184,300	642,500	22,390
1966	385,300	735,900	32,560
1967	485,600	798,700	59,400
1968	536,100	820,000	69,940
1969	475,200	897,000	68,850
1970	334,600	968,000	67,330
1971	156,800	1,046,250	53,850
1972	24,200	1,048,000	37,060
1973	50	1,110,000	--

*Allied Forces were drawn from the Republic of Korea, Australia, New Zealand, the Philippines and Thailand

Source: U.S. Department of Defense Manpower Data Center

Chapter XII. *San Salvador*



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Chronology

San Salvador & Juan Rodriguez Cabrillo

- About 1499 Juan Rodriguez Cabrillo was born in Palma de Mice Gilio (later called Palma del Rio), a village located near Cordoba in southern Spain.
- 1514 At about age 15, he joined the expedition of Pedrarias Dávila (Pedro Arias de Ávila) and sailed from Seville to the New World as a crossbowman (*ballestero*). Although 15 seems young to us, he would have been considered a man on that expedition.
- 1515 - 1517 Within several years he arrived in Cuba, from where he may have joined in short expeditions to the Mexican coast, helping to establish Spanish bases or handling supplies. He may also have helped with ship repair in Cuba's busy Puerto de Carenas (now Havana). He then joined the expedition of Pánfilo de Narváez, which was dispatched to the Mexican coast by the governor of Cuba to arrest Hernán Cortés for disobeying orders.
- 1519 - 1521 Narváez landed his army on the Yucatan coast and soon clashed with the forces of his rival Cortés. Thereafter, Cabrillo switched sides and joined the army of Cortés in his sweep across Mexico through Aztec territory. He helped with construction of the barges used to transport Cortés's invading force across Lake Texcoco to the Aztec capital, Tenochtitlán (now Mexico City).
- 1524 - 1532 After the conquest of Mexico, Cabrillo went south as a trusted lieutenant to Pedro de Alvarado when he conquered the Province of Guatemala. For his services, Cabrillo was awarded vast land holdings there. In 1532 he returned to Seville, Spain, to marry the sister of his best friend and bring her back to Guatemala. Records from 1532 reveal his use of the name Juan Rodríguez Cabrillo for the first time. Before that, documents record his name simply as Juan Rodríguez.
- 1533 At the port of Acajutla, Guatemala (now part of El Salvador) Cabrillo built the galleon *Santiago*, a vessel he intended to use for shipping Spanish trade goods to markets in Peru. He had set up this business venture with his father-in-law; however, Alvarado commandeered the galleon for his own use.

1536 By age 37, Cabrillo was a successful land owner, thanks in part to Alvarado's patronage. At Alvarado's request, Cabrillo established a shipyard on the coast of Guatemala near the town of Ixtapa. This became the site for building and repairing vessels to be used in Alvarado's proposed plans to explore the Pacific Ocean and establish a trade route to Asia.

1539 *San Salvador*, which Cabrillo built as his own vessel, was the largest of the six or seven ships that he built at the shipyard. It was about the same size as his first vessel *Santiago* and was likewise designed to carry trade goods as well as sailors, soldiers, and arms. Experts often call such ships 'merchant galleons' to distinguish them from later galleons that were usually larger, sleeker, and designed more for speed and military uses than for carrying cargo.

1540 Sent by Alvarado to locate a departure point for expeditions to the northern and western Pacific, Cabrillo located a bay and lagoon about 600 miles north of Acapulco which he named La Navidad (now Barre de Navidad, a few miles north of present-day Manzanillo).

1542 Appointed as captain-general of a fleet of three vessels, Cabrillo departed La Navidad on June 27. The primary goal of this voyage of exploration was to reach Asia by sailing northwest along the coast of Alta California.

On September 28, he entered and explored what he described as a well-protected harbor, which he named San Miguel (present-day San Diego). In early October, continuing north, Cabrillo explored the Channel Islands and the central coast of Alta California north to a river (now Russian River) a few miles beyond Cabo de Pinos (now Point Reyes) before strong winter storms forced their return south.

Mid-November found them exploring Baya de los Pinos (now Monterey Bay) before returning to the Channel Islands to rest, make repairs and prepare for another push north in the spring as weather improved.

1543

On January 3, Cabrillo died, due probably to gangrene that developed from an injury he sustained 10 days earlier during an encounter with natives in the Channel Islands, perhaps from an accidental fall. Just before his death he turned command of the little fleet over to pilot Bartolomé Ferrer, who pledged to make another attempt to complete the expedition.

On 22 February repairs had been made and, taking advantage of a strong south-southeast wind, the fleet again headed north. As the storm became more severe, their highest recorded latitude indicates they may have reached as far north as (present day) Cape Mendocino before the wind shifted sharply to the north. With huge waves washing over the deck, Ferrer gave up and the fleet turned south.

On 14 April the *San Salvador* expedition returned to La Navidad. Later in the year the three vessels were dispatched to Peru. There is no further record of the three ships after this date.

Historical Overview

The story of Cabrillo and his galleon *San Salvador* took place during the age of European exploration that began with the Portuguese sailing southward around Africa to reach India and the Spice Islands, and the Spanish sailing westward with the same goal—to tap into the riches of Asia. Columbus's 1492 voyage never reached Asia; instead, it found the islands and continents of the Americas, unknown to Europeans before then. After Columbus, dozens of Spanish voyages continued to explore the area and colonize islands such as Hispaniola (now Haiti and the Dominican Republic) and Cuba.

By 1520, Spanish settlement, administration, and trade were well established in the islands, even though explorers and settlers still didn't know how those lands fit into the geography of the world or how far away Asia might still be. In 1513 Vasco Núñez de Balboa came upon another vast ocean—the Pacific—on the other side of Panama, but it took a Spanish voyage around the world in 1519–22, led by the Portuguese Ferdinand Magellan, to show just how vast that ocean was. At this same time, Hernán Cortés was launching an invasion of Mexico. With the crucial help of local allies, Cortés defeated the Aztec Empire by 1524 and established Spanish rule in what was dubbed New Spain. Thereafter, exploration of the western coasts of North America aimed to figure out how the continent might connect to Asia and how to get there and back. Juan Rodríguez Cabrillo was a key figure in that effort and a classic example of the sort of men who triumphed during the first fifty years after Columbus. Cabrillo began his military career as a simple crossbowman, but his exploits in the conquest of Guatemala gained him wealth, noble (*hidalgo*) status, and appointment as captain-general of the small fleet that explored the California coast in 1542. In that role, Cabrillo became the symbolic founder of San Diego.

Military men such as Cabrillo were conquerors (*conquistadores*) of the new lands across the sea, and they signed on hoping to gain personal wealth, fame, and privileges from the Spanish crown. Instead, many went to their graves, outnumbered and cut down in battle or killed by tropical diseases in the steamy environments on the coasts and inland forests. Those who survived were used to hardship and toughened by their experiences. The crown was glad to have their services in gaining new territories and spreading the knowledge of Christianity to new peoples, but it is not surprising that the goals of the *conquistadores* often clashed with official rules about how to behave and how to treat the new peoples they encountered. Many *conquistadores* were ruthless in victory as well as in battle, illegally enslaving indigenous peoples, exploiting their labor, and violently opposing priests and royal officials who tried to enforce legal and humane standards. As an added horror, diseases that were common and not very deadly in the Old World of Europe, Africa, and Asia had a devastating effect on New World peoples who had never experienced those diseases. No one at the time knew why, but the combination of conquest, exploitation, and unfamiliar diseases resulted in a huge decline of the

indigenous populations, which did not begin to recover until more than a century after the conquest. As colonial society developed, some African slaves were imported to supplement the labor supplies, but the peak of the Atlantic slave trade would not come until more than two centuries later.

Juan Rodríguez Cabrillo

Today many monuments, streets, commercial enterprises and public institutions bear the name of Juan Rodríguez Cabrillo, but until recently, we knew very little about his origins, and all the documents we had identified him only as Juan Rodríguez. Then, in 2015, a document came to light recording his testimony as a witness in an official investigation in Spain in 1532. During his swearing in as a witness, he identified himself as Juan Rodríguez Cabrillo and said that he was a native of Palma de Micer Gilio, a small town near Córdoba, Spain, that is now called Palma del Río. You can learn about how the mystery of his birthplace was finally solved by reading the news story included in a supplement to this chapter.

So, what do we know about his career? Juan Rodríguez arrived in what Europeans called the New World in 1514 at the age of fifteen. Classified as a crossbowman, in 1519–1521 he joined the expedition of Hernán Cortés that marched inland from the Mexican coast to conquer the Aztec Empire. Cabrillo helped to build the boats that crossed Lake Texcoco to invade the Aztec's island capital of Tenochtitlán (now Mexico City). After the conquest, Pedro de Alvarado took Juan Rodríguez with him to conquer Guatemala. To reward his services, in 1524 Alvarado gave Juan Rodríguez extensive estates. He became a wealthy rancher and in 1529 received permission to extract gold from streams on his land. In 1532 he sailed to Spain and while there testified in the investigation that would later prove his Spanish identity. During his time in Spain, Cabrillo married Beatriz Sánchez de Ortega, who returned with him to Guatemala in 1533. They settled on Cabrillo's vast and productive estates, and he and his wife had two sons by 1536, the first named Juan Rodríguez Cabrillo. The senior Cabrillo became involved in a variety of commercial and domestic affairs in Guatemala. Among other ventures, Cabrillo built a 200-tonelada galleon named *Santiago* in the Guatemalan port of Acajutla in 1534, which Pedro de Alvarado promptly requisitioned for his own use.

Alvarado, then governor of Guatemala, enlisted Cabrillo's help to assemble a fleet of thirteen ships. Records suggest that between 1536 and 1540 Cabrillo's shipyard built six or seven vessels, of which *San Salvador* was the largest, and six other vessels were extensively refitted. The work required skilled shipwrights, woodworkers, and talented foremen to produce and refit so many vessels at once. That was possible because Alvarado and the viceroy, Don Antonio de Mendoza, had royal permission to reassign shipwrights and other workers from all over New Spain. Estimates of the size of Cabrillo's workforce range as high as 400, including some slaves, all of whom were forced to work at a rapid pace. When *San Salvador*

was finished, Cabrillo embarked on a profitable trading voyage to Peru, which gave him and his crew valuable experience in long-range sailing.

The ships that Cabrillo and others built at Alvarado's request were intended to seek routes to the Spice Islands (Moluccas), Japan (Cipango), and China (Cathay or Catayo). One possible route was to sail due west toward Manila, although Magellan's voyage had shown how very wide the Pacific Ocean was with no known opportunities to obtain fresh water or food supplies. However, because maps of the time often showed Asia not too far from the coast of northwestern America, many thought it would be quicker to sail toward the north and northwest, following the curve of what is now California and Oregon and eventually reaching Asia. To test both possibilities, one group of three vessels would sail west across the Pacific. Another three vessels would sail up the northwestern coast in search of a shorter route to the riches of Asia.

Alvarado wanted a more suitable base for his expeditions away from busy Acapulco, and he commissioned Cabrillo to sail north to locate a site. Cabrillo found an appropriate bay eventually called La Navidad, located near present-day Manzanillo. When Alvarado was called away to quell a native uprising, he left Cabrillo in charge of preparations for the voyages. Unfortunately, Alvarado was killed during the uprising, and Viceroy Mendoza took charge of the fleet. Following two failed attempts to sail up the northwest coast, Mendoza named Cabrillo as captain-general for the third such expedition.

San Salvador and Cabrillo's Voyage

In California, images of the galleon *San Salvador* appear almost as often as the name Cabrillo, even appearing on official San Diego County and City government letterheads and seals, but they are based on what little we know about other ships of the period. From descriptions and drawings of the era, we believe she was a full-rigged galleon with square sails on the mainmast, foremast, and bowsprit, and a lateen mizzen, with a low foc'sle (fore-castle), a beakhead under the bowsprit, and a high aft-castle and taffrail. She had two fully planked decks and reportedly measured about 200 *toneladas* in the reckoning of the day. She was about 75 feet in length on the main deck, with a 25-foot beam.

Manning ratios of the time suggest that *San Salvador* may have carried 20–30 sailors and the same number of soldiers—in other words, about 40–60 persons—probably including some slaves. The sailors would mostly have been adult seamen (*marineros*), plus younger apprentices (*grumetes*), and even a few boys (*pages*). Officers, bureaucrats, and a clergyman or two added to the total. The sea officers would have included Cabrillo as captain general (*capitán general*), plus the ship's master (*maestre*) and his subordinates; the ship's pilot (*piloto*); a carpenter (*carpintero*) and caulker (*calafate*); and perhaps a few other craftsmen and a

medical officer (barber-surgeon, *cirujano*). Cabrillo would be the ultimate commander of the soldiers on board, aided by a lieutenant (*alférez*). If Cabrillo brought along a few trusted colleagues, they would have helped to keep the soldiers in line. The bureaucrats would have included a representative of the crown with his servant or slave, and the official scribe (*escribano*), who kept a record of the voyage. Altogether, there may have been between 75 and 90 people on board, but this is guesswork. We don't have a list of who was on board, so we have to rely on what we know about other ships of the period, along with official rules about manning Spanish ships for exploration.

We also do not know what the sailors and soldiers earned on *San Salvador*. However, *marineros* on Spain's Atlantic fleets seem to have earned about 26.5 silver *reales* per month in the mid-sixteenth century, *grumetes* earned 17.6, and *pages* earned 13.2. Depending on the price of food, the crown may have paid twice as much to feed a sailor than to pay his wages. The basic pay for a soldier could be considerably more than an adult sailor earned, but soldiers typically had to pay for their own rations, weapons, and medical care if they were hospitalized on land. Complicating matters, sailors who had particular skills and soldiers who had proven their worth could earn bonuses that were larger than their base pay.

Ships built on New Spain's west coast were the product of what shipwrights had learned in Europe. Although indigenous laborers soon learned the techniques of European shipbuilding, large vessels such as *San Salvador* would not have borrowed much from local traditions. There are no plans available for the original *San Salvador*, and such plans may never have existed. Instead, Cabrillo and other experienced shipbuilders would have known the traditional proportions of the ship they wanted to build—for example, the relationship between the maximum breadth of the ship (beam or *manga*), and the length of the keel (*quilla*) and the first planked deck (*eslora*). They would then assemble the timbers for the keel, shape and attach the ribs and other structural elements to it, and close in the hull with planking. As soon as the keel was laid and the master rib was attached, experienced shipbuilders had a very good sense of what the finished vessel would look like. There was a variety of suitable woods for ships' timbers and spars available in nearby forests, and fibers for rope and rigging could also be obtained locally. Similarly, there were forges to make iron nails, spikes, and ship fittings for the project. However, materials such as sails, guns, tools, and ready-made rigging and fittings were imported from Spain to the Caribbean and carried overland to Pacific ports by local workers and African slaves.

Cabrillo's 1542 fleet consisted of three vessels: *San Salvador*, also known as the *capitana* (flag ship) or *Juan Rodríguez*; *La Victoria*, a smaller ship with two masts; and *San Miguel*, a 30 ft. pinnace or long boat known as a *bergantín* or *fragata*, with a partially covered foredeck and a sail and benches for thirteen pairs of oars. *San Miguel* might also be towed, but it was too big to be brought aboard *San Salvador*. Armament for the vessels probably would have been light. The soldiers' weapons

included crossbows, lances, swords, and possibly a few matchlock harquebuses. *San Salvador* and *Victoria* each carried several carriage-mounted wrought-iron guns (*bombardetas*) and rail-mounted swivel guns (*versos*). Both types were breech-loading weapons that could be quickly reloaded with a removable prepared charge (*serviola*). Another rail-mounted swivel gun may also have been carried aboard *San Miguel* to protect shore parties.

Cabrillo's small fleet departed La Navidad on June 27, 1542 and headed north. It was a difficult voyage along an inhospitable and uncharted coast, going against the prevailing winds and currents. They frequently hove to at night to avoid running aground or encountering other hazards, and they sought anchorages to avoid rough weather. Often they encountered local natives, took soundings, and recorded descriptions and locations of potential harbors.

They entered the bay we call San Diego on September 28, probably landing at what is now Ballast Point—the West's Plymouth Rock. An ancient Kumeyaay petroglyph of what might be a galleon has been located and documented in the desert east of San Diego, which suggests that local residents had observed the ships sailing along the coast. Natives they encountered at first fled in fear. When they returned later, they explained their fear by indicating that bearded men like Cabrillo's were not far inland, and that they had killed many natives. To make the encounter more terrifying, some of the Spaniards were riding horses, which the Indians presumably had never seen before. After six days in San Diego Bay, during which the Spaniards and natives exchanged small gifts, Cabrillo's ships continued their journey.

They made many landings and met with larger populations of natives as they progressed north, who continued to tell stories about warlike Spaniards traveling inland. Cabrillo surmised that the inland Spaniards were part of the land army of Francisco Vázquez de Coronado—perhaps the contingent of Hernando de Alarcón, which had been sent to explore the Colorado River. Continuing north along the coast, Cabrillo landed on and described several of the Channel Islands before sailing as far north as what is now the Russian River area of Sonoma County. As stormy weather impeded their progress, Cabrillo decided to return to the Channel Islands for the winter, where he hoped to rest his crew and make some repairs before again pushing north. It was on one of those islands, likely *San Salvador*/*La Capitana* (now *Santa Catalina*), that he died. The exact circumstances surrounding his death are not clear. He seems to have suffered a shattered shinbone or a broken arm during a hostile encounter with natives, perhaps from an accidental fall. In any case, the injury became infected and resulted in gangrene. Cabrillo died on January 3, 1543, at the age of 44. His burial place remains unknown.

The pilot, Bartolomé Ferrer, then took command of the expedition, promising to fulfill Cabrillo's dying orders to complete the mission. In February *San Salvador* and her consorts took advantage of strong south-southeast winds to make good progress up the coast. After reaching nearly to what is now the Oregon border, winter storms out

of the north again drove the small fleet south. Battered and exhausted, the vessels returned to La Navidad on April 14, 1543, ending the 10 month voyage. The governor took over *San Salvador* and her consorts, along with three vessels from the Alarcón (Sea of Cortés) expedition. After a period of refitting, the six ships embarked on a trading voyage to Peru late in 1543. Few of the men and none of the ships were heard from again, and that is where the record ended. Sixty years passed before another attempt was made to explore the coast of Alta California.

The Replica *San Salvador*

The purpose in building *San Salvador* was to create an iconic educational tool similar to the East Coast's *Mayflower* and other colonial-era ships, to serve as a symbol of West Coast history. The Museum aimed to produce a vessel that is historically accurate in appearance while complying with U.S. Coast Guard requirements for carrying paying passengers. The replica incorporates modern safety features and navigational equipment, auxiliary engines, and electrical, plumbing, and freshwater systems. The Museum now sails *San Salvador* as an aid in teaching a host of subjects that stand at the intersection of California history and social studies. As a modern representative of that history, *San Salvador* operates as a passenger-carrying vessel as well as a learning center. Visitors have access to the upper and main decks, which house period elements, and to the hold, which contains bunks but can be used for exhibits.

On the whole, construction of the vessel did not try to replicate the methods used in 1540. Instead, modern engineering drawings were prepared and followed in conformance with U.S. Coast Guard requirements, however many traditional shipbuilding techniques were used as well such double sawn oak frames, trunnels (wooden pegs), caulking and tarring of the seams between hull planks and decking. Some of the more conspicuous metal fittings were hand-forged at the build site.

No image of *San Salvador* is known to exist, although the galleon was reported to have been included in a painting of Alvarado's fleet that was carried to Spain in about 1540. Moreover, there are only a few specific historical references to the size and appearance of the original vessel. The first task in the *San Salvador* replica project was to obtain a consensus of opinion by an international panel of historians and marine archeologists about what the ship would have looked like, based on the limited historical references available and on the kinds of vessels being built and used by Spain in the middle of the sixteenth century. Once the research team assembled by the Museum had settled on the most likely size and appearance of the original vessel, a detailed set of construction plans was developed. From the basic concept drawings circulated to the consulting panel to the final design and engineering specifications, all of the *San Salvador* plans and drawings were prepared *pro-bono* by San Diego-based naval architect Douglas Sharp, of Sharp Design. From the beginning Mr. Sharp maintained an active consulting role in every facet of the construction process. On May 30, 2014, Spain's ambassador to the

United States, Ramón Gil-Casares, officially knighted Mr. Sharp with the Order of Isabella the Catholic. The order recognizes those in the Americas who have made important contributions to the promotion of Spanish culture and heritage.

The San Diego Port District approved use of the West Spanish Landing parking lot and access roads near the airport for a shipbuilding site. A workshop and lofting area was located under the Harbor Drive overpass. The shipway, project offices, tool and material storage sheds, forge, information center, gift shop, and Kumeyaay (Native American) demonstration village were located on the existing parking lot and along the walkway facing the bay. The work began with laying the shipway to support the vessel and setting up the work yard. Next came lofting—that is, scaling up the naval architect's drawings to full-size and creating templates or patterns for building the frames and parts of the stem and stern that attach to the vessel's keel. On April 15, 2011, the two sections of *San Salvador's* keel were joined together in a public celebration marking the official beginning of the shipbuilding process.

There was a brief delay in construction when the proposed method for fabricating laminated frames out of white oak failed, and a new method of building frames and a new source of wood had to be found. Within two months Cross Sawmill in Iron City, Georgia, began delivering sufficient quantities of Southern Live Oak for fabricating the frames, and work began. By the end of 2011, the sternpost, transom, and stem (except for the beakhead) and deadwood were attached to the keel, and nearly half of the massive double-sawn oak frames were in place on the keel. Visits to *San Salvador* Village started to increase as the vessel took shape in sight of traffic passing along Harbor Drive.

While Cabrillo had convenient access to a variety of suitable tropical hardwoods as well as coastal fir trees from his location in Guatemala, this was not the case in arid San Diego. Woods used in the *San Salvador* construction came from around the world and included:

Angelique (a.k.a. Guiana Teak) – *San Salvador's* keel is fabricated from two long pieces of this wood. Angelique is a dense, hard, straight-grained wood that comes from French Guiana.

Apitong (a.k.a. Yaang Yuung) – Harvested in Southeast Asia and the Philippines as well as India and Brazil, this wood was used to plank the transom. It is dense with a tough, coarse grain; shrinkage is uniform in both directions. It stands up to abrasive wear and resists rot, fungus, and termites.

Black Locust (a.k.a. False Acacia) – Dried dowels made of this wood were used as trunnels (treenails, trenails or pegs) to take the place of metal nails and spikes to fasten wooden pieces together. This wood is found in the southeastern U.S. It is extremely hard, durable, and resistant to rot. A trunnel driven into a hole drilled through several pieces of wood will expand with moisture and hold the pieces securely together just as a screw or nail could but without introducing corrosion that can weaken joints.

Douglas Fir (a.k.a. Oregon Pine or Douglas Spruce) – Shipped from Washington, this straight-grained wood weathers well and resists rot. It was used as deck beams; decking on the main, poop, and quarterdecks; masts and spars; planking above the wales; and as bilge stringers.

Hackmatack (a.k.a. Tamarack Larch or American Larch) – A deciduous conifer tree native to eastern Canada, the wood is tough and durable but also flexible in thin strips. A plant favored by Bonsai enthusiasts, it has also been used by the Algonquin People for snowshoes and other products where toughness with some flexibility is required. To shipwrights, however, hackmatack means “knees.” A knee means the ninety-degree curve in grain that occurs where the tree’s trunk and branch (or root) meet. The knee provides a natural right-angle that can be used to support the ship’s many wooden joints. *San Salvador* has approximately 100 knees that support beams, stiffen joints, and restrict their lateral movement.

Purpleheart (a.k.a. Amaranth or Violet Wood) – Used in one set of frames and in parts of *San Salvador*’s stern, engine bedding, capstan, mast steps, and other major structural components. Grown in northern Brazil and parts of Central America, this wood is quite dense and very hard; a sharp carbide blade is required to cut it. The wood is prized by craftsmen for woodturning, cabinetry, flooring, and furniture. Exposure to the dust generated by cutting, routing, and sanding can cause irritation and nausea, due possibly to compounds in the wood.

Sapele (a.k.a. Sapelli or Aboudikro) – Employed in structural parts of the stem and stern as well as planking and wales. Native to tropical Africa, primarily Nigeria and Congo, this hardwood has a grain similar to mahogany. It is commonly used by makers of guitars, and other musical instruments, including Taylor and Gibson guitars.

Southern Live Oak (known to hybridize with Encino Oak or Bay Live Oak) – Used for *San Salvador*’s frames and other massive structural parts, this wood comes primarily from 200-year-old trees harvested in southeast Georgia. Southern Live Oak is a slow-growing, extremely dense wood (over 75 lbs. per cu. ft.) with a long history of use as a shipbuilding material. This type of oak was the principal material used in building the frames and planking of the original six frigates of the U.S. Navy in 1795.

White Ash (a.k.a. Biltmore Ash) – Abundant in eastern North America, this hard, durable wood was used for blocks, belaying pins, and other implements on *San Salvador*. It is commonly used for baseball bats.

White Oak (a.k.a. Post Oak or Chestnut Oak) – Native to eastern North America, cleats and hatches were fabricated from this wood, as were various other pieces on or above the deck. It is rot resistant.

Yellow Cedar (a.k.a. Tree of Life, Arbor Vitae, or False White Cedar) – A strong yet lightweight and rot-resistant wood native to northeastern North America, Yellow Cedar was used for the ship’s upper frames and top timbers. This wood is honored by the Ojibwe People as “Grandmother Cedar,” a gift to humanity for a variety of uses in crafts, construction, and medicine. In

shipbuilding, the use of lighter woods well above the waterline can improve the stability of a vessel.

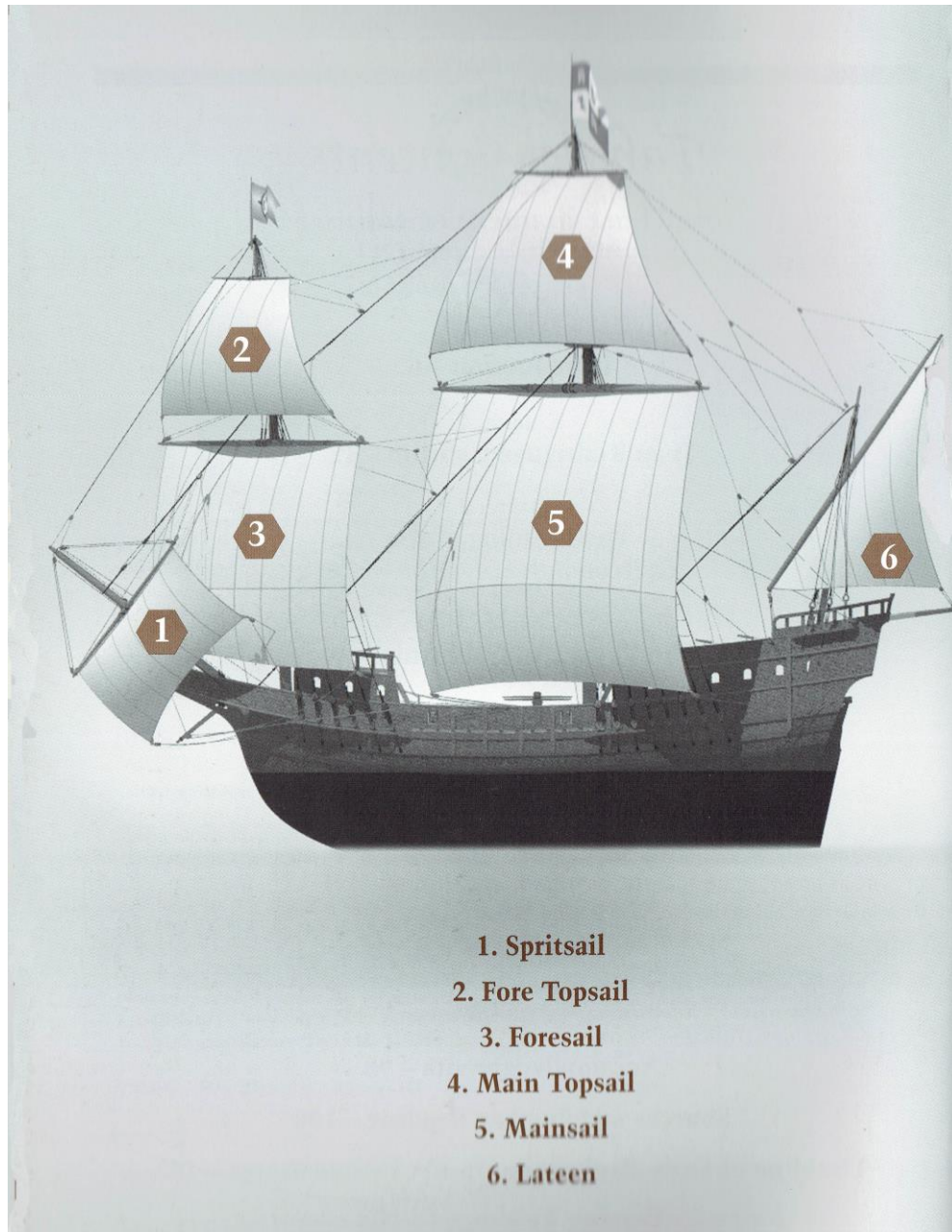
By the end of 2012, portions of the 88-ton lead ballast had been installed both below and above the keel. The lead accounts for about half the weight of *San Salvador* when launched. All of the double-sawn oak frames and four watertight bulkheads were also completed and two diesel engines were installed. By the close of 2013 planking of the main, quarter, and poop decks had been completed and planking of the hull was underway. By 2015, construction was estimated to be approximately 80 percent complete, and *San Salvador* was launched on July 29, 2015.

The five-year construction period generated strong public interest and satisfied the Museum's initial educational goals. Once launched, *San Salvador* was moved to the Museum, where her topmasts were run up and major construction and rigging were completed. Work on the interior compartments continued in 2016, even as sea trials were carried out.

In recent years, the Maritime Museum of San Diego has been involved in the building and restoration of several replica vessels from the age of sail. The Museum currently owns two such replica ships: *Californian* and "*HMS Surprise*, formerly *HMS Rose*". Since both of those vessels have required substantial maintenance, the Museum staff already possessed most of the skills necessary to build *San Salvador*. The services of an experienced naval architect, two experienced master shipwrights, and a project director were engaged to manage her construction. Museum staff and more than 450 volunteers worked with a small team of specialists in the various traditional shipbuilding trades—some local and some from out of the area—to form the build crew. The ship presents the appearance of the sixteenth century galleon while including modern features to support day cruises and extended voyages. *San Salvador* meets U. S. Coast Guard requirements and is equipped to navigate with precision. Best of all, the Museum's *San Salvador* is much stronger and more durable than Cabrillo's original galleon.

Cost for the construction of *San Salvador* was approximately \$6,800,000 in public and private funds, plus \$6,000,000 in donations of skilled labor, materials, site use, and professional services. In addition to the steady flow of the Museum's operational funds, the ship was built with contributions from an impressive roster of private and public donors. The California Coastal Conservancy provided major funding, as did many private foundations, including the Ellen B. Scripps Foundation, the Hervey Family Foundation, Price Charities, and many others. Hundreds of individual donors contributed funds at all levels. In addition, there have been many donations of in-kind goods or services. For example, Goodrich, Inc. (now United Technologies, Inc.) donated 88 tons of lead and cast it into specified shapes for use as ballast. Finally, as with the rest of the Museum's collection and vessels, the Maritime Museum has drawn heavily on the incomparable and highly skilled contributions of our many member volunteers. From April 2011 through June 2016,

454 volunteers contributed at least 128,109 hours (64 man-years!) to the construction of *San Salvador*.



Specifications

San Salvador (original)

Length on deck	Approximately 75 ft.
Beam	Approximately 25 ft.
Displacement	Approximately 200 <i>tonneladas</i> (one tonnelada is somewhat more than a ton)
Description	Spanish galleon

San Salvador (reproduction)

Sparred Length	114' 8" Tip of bowsprit to tip of boomkin
Length on Deck	75' 6" Main deck
Length overall	93' 7" Beakhead to aft end of poop
Beam	25' 1" Maximum hull
Draft	10' Fully loaded, maximum draft
Displacement	206 long tons, full load waterline
Gross Reg. Tonnage	92.8 tons
Rig	3 Masts (square sails on fore & main masts, lateen rig on mizzen mast, spritsail on bowsprit)
Sail Area	4,160 sq. ft. (main mast 2,276 sq. ft., fore mast 1,284 sq. ft., mizzen mast 314 sq. ft., spritsail 286 sq. ft.)
Rig Height	82' 3" Main topmast cap
Auxiliary Power	2 Marine diesel engines (John Deere, 280 hp each)
Crew	U.S. Coast Guard requires at least 10 crew, more may be aboard especially for long voyages
Passengers	There are a total of 36 berths on board for crew and passengers. Day sails may include up to 40 passengers

Supplement

A. Ships of Juan Cabrillo's Era

The three basic types of ocean-going vessels used by the Spanish and Portuguese in the 15th and 16th centuries are:

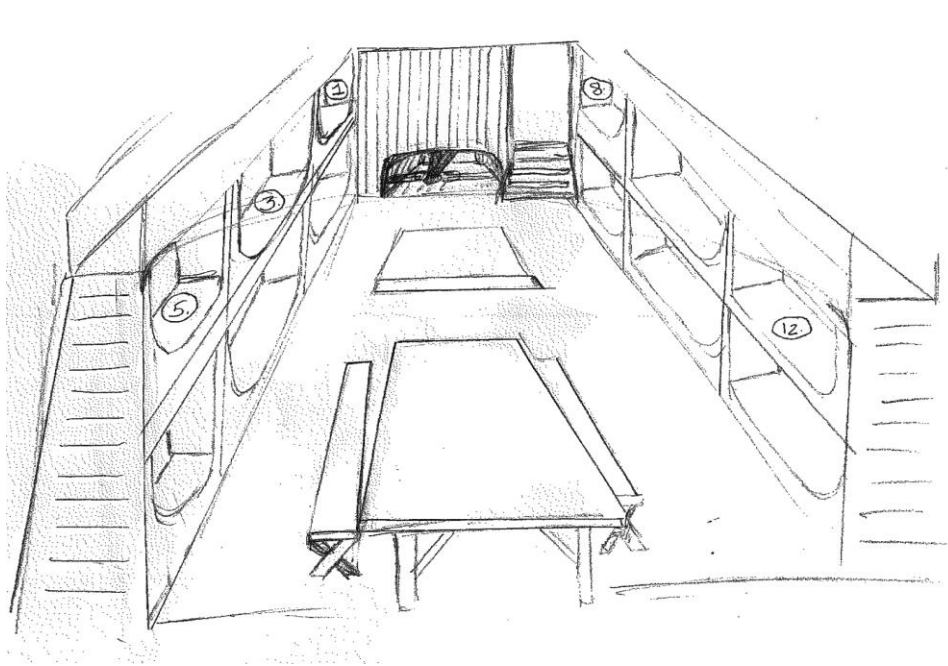
Caravel – Small vessels from 50 to 160 tons with up to 3 masts carrying triangular lateen sails. The caravel was probably developed in the mid-15th century in the time of Prince Henry the Navigator of Portugal. With broad rounded bows and sterns and at most a low or very modest forecastle and slightly more prominent aft-castle, caravels were the workhorses early in the age of discovery when the Portuguese explored the coast of Africa and the Spanish crossed the Atlantic and entered the Pacific. *Niña* and *Pinta* of Columbus' fleet were caravels, although one or both of them could have been rigged with square sails to take advantage of the Atlantic's trade winds.

Carrack, Carraca or Nao – These names identify the vessel that is thought to have been the forerunner of the galleon. Carracks tended to have high forecastles and aft-castles, but retained the rounded bows and sterns of the caravel. In general, carracks were larger with more beam than caravels and more likely to have 3 or 4 masts, carrying square sails on the forward masts and lateen rigs aft. Columbus' lead vessel *Santa Maria* was a carrack; although only 4 feet longer than *Pinta* she was also 4 feet broader, with more than double the displacement. Another famous carrack was Magellan's *Victoria*, the first vessel to circumnavigate the globe and the only survivor of the five vessels in that 1519 to 1522 Spanish expedition. Cabrillo's *La Victoria* was a carrack of 100 tons, about 60 feet in length with a flush deck and 2 masts carrying square sails.

Galleon – Sometimes called "galliot," these vessels could be 500 tons or more in volume. They generally had 3 or 4 masts, the fore and main masts carrying 1 or 2 square sails, while the mizzen and second or bonaventure mizzen, if used, carried lateen sails. These vessels had a squared stern and an elongated "beak" at the bow, which was a little more pointed than the round caravel and carrack bows. Galleons had several decks and by the mid-1500s the length-to-beam ratio of 4:1 gave the hulls a longer, narrower appearance and a relatively lower profile than earlier vessels which had the high forecastles and aftercastles. The word galleon is thought to have evolved from galley, the large oared craft used among the Mediterranean cultures of the 12th and 13th centuries, but galleons of Cabrillo's time relied on sails only.

B. Living and Working on Board *San Salvador*

During the voyages of exploration by the Spanish in the Pacific from 1525 to 1565, the ships had little space below the main deck for men to work or sleep, given that it was stuffed with cargo and supplies. Instead, most of the designated berthing areas were on the main deck: the enclosed space at the aft end for the officers and gentlemen, the *tolda* area above and behind the enclosed space for the captain, and the rest of the main deck for the sailors and soldiers—wherever they could find room.



On Spanish ships of the sixteenth century, the planked decks were called *cubiertas* (later called *puentes*). At the aft end of the main deck, there was an enclosed chamber for berthing the crown's representative, ships' officers, and any high-status passengers aboard. The area was lined with bedboxes or open bunks built against the inner planks of the enclosed area. For privacy, there were curtains that could be pulled shut. Each bedbox had a sleeping mat. A mattress would not have been feasible, because mattress stuffing (straw, feathers, etc.) would get wet and rot.

The bedboxes were used not only for sleeping but also for storing necessities and personal items reflecting each person's status and job title. Normally, an individual would have one set of clothes that he wore every day, though the principal officers and high-status passengers presumably had more items of clothing available. They would also have had a heavy water-resistant cloak that could double as a blanket. If the cloak had a hood, it could also serve as a pillow or night cap.

A gentleman or crown official on board was likely to have a bag made of sheepskin or canvas to store his belongings. His sword and dagger or side knife would also be stored in the bedbox. These items were allowed because of his status and could also be useful in case he was called upon to help keep order or aid in quelling a mutiny. He might also store a limited number of other personal possessions below deck in chests or boxes. Any armor he owned would be placed in sheepskin bags to protect from dampness and would be stowed in a readily accessible space in the hold.

Likely bedbox assignments on *San Salvador*

1. *Procurador* (Spanish crown's representative on board—a lawyer and gentleman)
2. Storage area for use by the *Procurador*; his servant would sleep on a mat on the deck nearby
3. *Escribano* (Scribe; responsible for keeping all legal records on board); his bedbox would contain a laptop writing desk, paper, quills, containers for ink and sand, sealing wax, and books
4. Unassigned
5. *Barbero/Cirujano* (Barber/Surgeon), essentially the ship's medical officer; his bedbox would contain tools of his trade, such as a bone saw and various medicines
6. Unassigned
7. *Maestre* (Master of the ship), responsible for the physical ship and everything on board.
8. *Piloto* (Ship's pilot and navigator); his bedbox might contain an astrolabe, quadrant, charts, sand-glass (*ampolleta*), sundial, cross-staff (*ballestilla*), and a logbook for recording the ship's movements.
9. *Alférez* – Officer for the soldiers; larger contingents of soldiers would have a *sargento* (sergeant) as well. As mentioned above, Cabrillo would have held ultimate military command.
10. Arms locker: quarter pike, boarding ax, capelin helmet, celeda helmet
11. *Contramaestre* (Boatswain), and the *Guardián* (Boatswain's Mate), sharing the bunk on different watches; they were responsible for overseeing the sailors
12. *Despensero* (Dispenser, responsible for keeping track of the food supplies and distributing them to all on board; selected by the *Maestre* and answerable to him)

Captain's Cabin (*Tolda*)

The captain resided in the tolda, located aft of the whipstaff and above the main deck. The tolda included the captain's cabin and its roof. The tolda was strictly for the captain, although he could invite high-status passengers to join him. On *San*

Salvador, the *tolda* is only a half deck; the helmsman's viewing port and the tiller flat intrude into the captain's space but are not considered part of it. On a period ship with a full-sized *tolda*, the captain's quarters would be furnished with a table and chairs, and a bed. His personal belongings would include a breast plate and weapons.

Sailors and Soldiers Sleeping Quarters

The main deck had to accommodate most of the people on board. The sailors and soldiers off duty slept on the open deck on sleeping mats that they rolled up when not in use. There were probably livestock in pens as well. Crowding and exposure to the weather created hardships for all. Bedding down on the foc'sle (*castillo*) was difficult, because it was full of rigging and equipment and could easily become soaked, since it was so far forward above the ship's bow. The lower deck or hold was crowded with cargo and supplies, although crew could lay a sleeping mat on top of barrels in the hold; this space would get larger as the voyage progressed (as supplies were used up and barrels were disassembled) and could provide protection from the weather. Apart from the officers and important passengers, the people on board had to find places to sleep wherever they could.

Fortunately, not everyone slept at the same time, as the sailors were assigned to different "watches" during each 24-hour period. Sailors on watch followed orders from the pilot and captain, tending the sails, looking for potential hazards, taking turns at the whipstaff, and doing whatever tasks they were ordered to do. Often at night, especially when close to the coast, they would be ordered to "heave to" (adjust the sails and whipstaff so as to maintain their position), rather than take a chance on running into some hazard along the uncharted coastline. Soldiers on watch followed orders from their officers.

It is likely that the ordinary sailors and soldiers had little more clothing than what they wore every day. They may have had a small canvas bag containing personal items, or they may have had a small sea chest. Each sailor and soldier was required to purchase at least one weapon, a shield, and a helmet, as they were sailing into unknown territory with unknown dangers. The sailors had to have their rigging knife on them at all times, but more serious weapons were all kept under lock and key.

Steering *San Salvador*

Sailing ships are steered by two means: adjusting the balance and set of the sails and altering the flow of water past the stern with some kind of blade. Until the twelfth century, European ships used a steering oar pivoting from one or both sides of the stern. The development of a rudder attached to, and pivoting directly on, the sternpost was one of the great inventions of maritime history.



Early rudders were controlled by a horizontal lever called a tiller, which attached to the rudder and projected through or over the transom at the stern of the ship. However, as ships grew larger with greater freeboard above the water line, the tiller became increasingly surrounded by superstructure, and it became impossible to see anything from the steering position. The distance from the tiller to where the captain stood was too far for efficient voice communication. The whipstaff was developed to solve those problems. To improve visibility, a vertical lever (the whipstaff or pinzote [pin ZO tay]), linked to the tiller at one end, raised the steering position at the other end to a height where the helmsman could at least hear and respond to commands and see a portion of the sails. This arrangement was awkward at best and restricted a few degrees of rudder angle, but it was an improvement over the tiller.

In heavy weather the whipstaff could be augmented by “relieving tackles” running from the end of the tiller and attached to each side of the ship. This allowed the helmsman to apply more force to the tiller and to achieve a greater angle on the rudder, but at the expense of immediate control. The helmsman stood in an enclosed space underneath the poop deck and steered the ship by pushing the whipstaff from side to side. Pushing the whipstaff to port turned the ship to port; pushing it to starboard turned the ship to starboard. Because the helmsman’s forward visibility was limited, he peered through a small hatch to communicate with the officer setting the course and guiding the ship.

When the original *San Salvador* was built, the whipstaff was the only proven method for steering large multideck European sailing ships, and that is why our *San Salvador* uses a whipstaff. As vessels became larger the whipstaff was replaced by leading the relieving tackles up to a wheel situated on the deck. The ship’s wheel, improved control, visibility and ease of communication, a significant innovation that appeared around 1700, some 160 years after *San Salvador* sailed!

Navigational Equipment

During the sixteenth century, ships’ pilots used equipment that was very simple in nature but limited in accuracy. The ship’s latitude (the distance of a ship’s position north or south of the Equator) could be estimated but longitude (position along an east-west axis) could not be determined, thus the ship’s position had only one dimension. A pilot needed to keep track of the ship’s current latitude, the latitude of its proposed destination, and the approximate distance between the two. With this information and a good portolan chart, ships sailing in known waters could simply sail to the latitude of the destination and continue along that line of latitude until they arrived. In unknown waters, calculating the latitude was even more important. In the Northern Hemisphere, ships’ pilots could begin to calculate the latitude of their current position by observing the North Star at night or the sun at noon. There were several instruments that could assist them (see below).

Once they determined the angle of the sun from the horizon, for example, they could consult published tables that told them the changing position, or declination, of the

sun at noon for every day of the year. With all this information they could calculate their current latitude. But it wasn't easy to get a good reading at sea even in the smoothest of seas, and the instruments weren't very accurate. Nonetheless, the methods used in Cabrillo's time worked well enough to pilot ships all over the world, and Spanish navigational manuals were translated into a number of languages within a few years of their publication. (Longitude could not be determined with precision until the late eighteenth-century invention of the marine chronometer by John Harrison.)

The **Quadrant** allowed ships' pilots to read the position of the sun at noon or the North Star (Pole Star) at night in relation to the horizon in the Northern Hemisphere. They tipped the quadrant until they could sight the celestial object through two peepholes, while letting a plumb bob hang down vertically. They could then read the angle off a scale inscribed on the curved edge of the quadrant. Errors could be up to $\frac{1}{2}$ degree or 30 miles, due to the loose hanging weight and the movement of the ship.



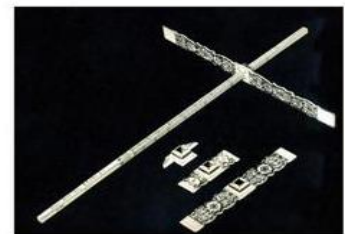
Instrument Quadrant.tif

The **Astrolabe** had been used for centuries by astronomers and astrologers for sighting celestial bodies. The astrolabe was hung by the loop at its top, and the moveable alidade (sighting rule) attached to the apparatus was turned so that the celestial body could be sighted through the two peepholes, and the altitude was then read off the scale inscribed on the ring. As with the quadrant, the movement of the ship made it difficult to get a good reading. Though the heavy weight of the astrolabe (often about 10 lbs.) and the fixed alidade were more stable than the quadrant, the astrolabe was still very difficult to use on a moving ship.



Instrument Astrolabe.tif

The **Cross-staff** was a long wooden rod with degrees of angle inscribed on it. The pilot, or whoever was doing the observation, slid a moveable crosspiece along the rod until one end aligned with the horizon and the other end aligned with the celestial body. The observer then read the angle at the point where the crosspiece met the rod. As there was no swinging weight to worry about (unlike the quadrant), and the cross-staff was much lighter than the astrolabe, many mariners considered it superior to those instruments.



Instrument Cross-Staff.tif

The **Compass** allowed mariners to determine their direction on the open sea, even when they couldn't see the sun or the stars. In the center was a 'compass rose' with 32 points indicating directions. The compass was mounted in a wooden box or bowl, and some were small enough to fit in a pocket. The moveable needle in the center of the compass needed frequent re-magnetizing with a lodestone. Due to variations

in earth's magnetic strength (deviation) magnetic compasses can be influenced by these fields as well as by the heavy iron sword worn by the helmsman. The causes of deviation were mostly unknown in the 16th century. In addition, since magnetic north is different from the rotational North Pole (geographic north), and up to 15 degrees of compass error were not uncommon.

A **Sounding Lead** (a heavy lead weight attached to a line) used to measure depth was tossed overboard and allowed to sink to the ocean floor. The length of the line told the pilot the depth of the water, so he could know if it was safe for the ship to continue without running aground. A sticky substance such as tar or wax might be smeared on the bottom of the sounding lead, so that it would collect a sample of whatever was on the bottom where it landed. Depending on what stuck to the weight—sand, pebbles, and so on—the pilot could judge whether it would hold an anchor. In known waters, the type of sand or gravel on the bottom could even tell the pilot if the ship was near a known port or river estuary.

Estimates of the ship's speed were approximate at best. A check of the size of the bow wave could provide an estimate of speed. The pilot might simply have someone toss a chip of wood into the water at the bow and then estimate how quickly it passed by as the ship moved forward. A **chip log**, a reel of light string with a wood float at the end could be used to see how many feet of cord would run out in 30 seconds might have been employed.

Charts that showed coastlines and harbors of previously unknown areas were highly prized. A master chart that recorded all the new information gathered by Spanish expeditions was kept in Seville. A copy from 1527 (the *Padrón Real*), now in the Vatican Library, was surprisingly accurate about the coastlines of the world explored by 1525. By contrast, many of the famous maps published in the sixteenth century are hopelessly inaccurate by modern standards.

Portolans were late medieval charts drawn and painted on sheepskin, showing known coastlines and ports and with an extensive array of directional lines coming from various compass roses. As noted above, in known waters, pilots could use a compass and a good portolan to get from one port to another, simply by following the appropriate compass direction. Engraved printed charts superseded portolans in the sixteenth century and made their information more widely available.

Rutters were written sailing directions for various routes from place to place were as highly prized as accurate charts, especially for previously unknown destinations. They included information about local phenomena (such as sources of fresh water), winds, currents, and other conditions, as well as information about routes and ports. Such information was considered so important that Spanish pilots were ordered to destroy their rutters if they were in danger of being captured by an enemy.

The sailor's last resort for determining location at sea was an educated guess. When weather conditions made it impossible to take celestial measurements, pilots had to estimate their current position in order to plot their future course based on their last known position and the record of their changes in direction and speed since then. **Dead reckoning** used by an experienced pilot could provide a reasonable estimate of his ship's position but he would need to proceed with care until the weather cleared.

Seaborne Weapons

San Salvador carried guns and other weaponry to defend the expedition from potential threats posed by both the indigenous peoples encountered on the voyage and also from sophisticated maritime powers like the Portuguese and Chinese on the far side of the Pacific, should they get that far. Nonetheless, Cabrillo and his companions were specifically instructed to develop peaceful relations with indigenous populations through non-violent interactions. As a further precaution, they were also advised to avoid any contact with unknown vessels.

San Salvador's armament can be estimated from what is known about contemporary expeditions, together with the results of archaeological excavations of similar vessels and details provided by historical narratives, illustrations, and examples of the guns themselves in historical museums. Using such evidence, we know that *San Salvador* carried several carriage-mounted wrought-iron guns (*bombardetas*) and rail-mounted swivel guns (*versos*).

Bombardetas were the biggest guns on *San Salvador*. They were about seven feet long, weighed about 1,500 pounds, and were capable of firing shot that weighed about five pounds. There may have been four *bombardetas* with 36 balls each (144 balls total) on *San Salvador*. The *bombardetas* were breech loading and mounted on simple two-wheeled carriages. *San Salvador* had gun ports, so it is likely that the *bombardetas* would have been lashed alongside those openings.

In 1542, using artillery aboard ships was still a fairly new concept. It is unlikely that a *bombardeta* would be considered a ship killer, because it could not have penetrated a ship's hull at anything farther than point blank range (less than 100 yards). The main component of *San Salvador's* defensive and offensive firepower was the *verso* (swivel gun), designed to be mounted to the rail.



Galleons like *San Salvador* undoubtedly carried a number of *versos*. They had smooth barrels and were designed primarily as anti-personnel weapons. *Versos* could be mounted on the rails in the waist (*combés*) of the main deck, or on more elevated parts of the ship such as the half-deck.

Like *bombardetas*, *versos* were breech loading and could fire a series of projectiles in swift succession by using prepared charges in their own canisters (*serviolas*).

They were noted not only for being devastating against the crew of other vessels, but also for having the potential to explode and maim or kill their own gunners.

Food, Fresh or Preserved

Cabrillo estimated that his voyage would last approximately two years, and he had to calculate how much food to bring to feed all the men sailing on the three vessels. In preparation for the voyage, he had tons of ship's biscuit, salted fish, pork and beef, and cheese, along with dried beans, garbanzos, peas, rice, and olive oil brought on board in heavy barrels and stored in the hold of the ship. Onions, garlic, water, and wine rounded out the provisions for the journey. In addition, there were probably livestock on board in pens—sheep, pigs, and chickens—which would be slaughtered and eaten during the voyage. Officers and passengers might supplement the basic fare by bringing small quantities of food with them, typically pickled vegetables and dried fruit such as quince, figs, and raisins. Cabrillo intended to supplement the preserved food on board by having the crew catch fish in the rich fishing grounds off Baja California and sending parties ashore for game, native fruits and vegetables, and fresh water to replenish their supplies.

Standard rations on Spanish ships included a regular schedule of meat days (19 per month), fish days (9 per month), and cheese days (3 per month), along with a daily mixture (*menestra*) of dried legumes and rice. Food was cooked on a *fogón*, an iron firebox open on one side, with several inches of sand in the bottom for a wood fire to be built. It was available on a first-come, first-served basis during the daylight hours. A servant or a page would cook the food for his employer or ship's officer. Groups of ordinary sailors and soldiers would likely have pooled their rations and cooked them together, perhaps organized according to the watch schedule, or simply among a group of friends.

When the seas were too rough to build a cooking fire, hard cheese and ships' biscuit became the common fare. Food was eaten from wooden plates while sitting on a blanket or piece of coarse cloth laid on the deck.

The daily ration would provide adequate nutrition and upwards of 3,000 calories per day, if the rations were distributed according to Spanish regulations. The real deficiency was liquid. One liter of wine and one liter of water were issued daily to each person, but that was inadequate, as the water had to serve for cooking the dried, salted rations, as well as for



drinking. Even counting the wine, the daily ration provided less than the 3 liters of liquid needed by an average sized, hard-working adult male. Unfortunately, water took up valuable storage space on the ship. The result was that everyone on board was perpetually dehydrated, and undoubtedly constipated as well.

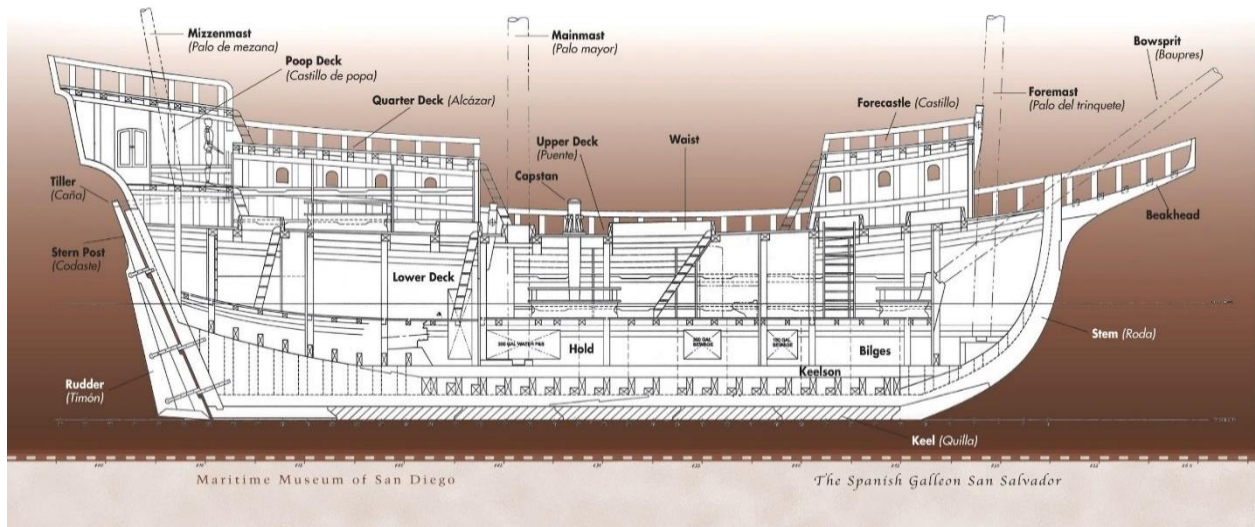
Ship's biscuit (*bizcocho*) was the dietary staple. It was a thick cracker of flour-and-water, baked to a rock-hard consistency that was supposed to stay edible for years at sea. Ship's biscuit was nearly impossible to eat in its dry state, but soaking it in a little water created a porridge-like mush that could be flavored with pieces of meat or fish, garlic, onions, oil, and a dash of vinegar. Weevils often infested the storage containers for the biscuit and created a pattern of perforations that made the *bizcocho* easier to break up into chunks, but that didn't improve the flavor.

Livestock, especially chicken, pigs, goats, sheep, or even cattle to be slaughtered during the voyage were not uncommon aboard ships in Cabrillo's time, and we assume they were on *San Salvador* as well. The livestock would be housed in pens on the open main deck, where the men worked, prepared and ate their meals, and slept or relaxed when they could. The large pens took up valuable deck space, and the livestock needed to be fed and cleaned up after as well. Some voyages even carried horses. Cabrillo's son, who was a young child in 1542, later recalled that his father had at least one horse on the voyage. Since *San Salvador* made landfall many times, a horse would have been useful.

Cargo Hold

Cargo and supplies were stored in the hold of the ship or on the lower deck. Food and water would be stored where they were easily accessible to the *despensero*, as he had to distribute the rations. Frequently used supplies, guns, armor covered in sheepskins, and wood for the *fogón* were also stored where they could be reached easily. Valuables and delicate cargo were kept under lock and key in trunks. In case of running aground, fire, or other mishaps, the valuables could be more easily removed. Officers, gentlemen, and any merchants on board were also allocated some storage space in the hold. As Cabrillo was an experienced merchant in his own right, it is doubtful that there were other merchants on his 1542 voyage.

Heavy cargo and items less likely to be affected by water damage were stored in the hold in wooden boxes, barrels, or sea chests that were stacked and secured as well as possible with netting to prevent shifting at sea. Beneath the floor (*plan*) at the bottom of the ship near the keel, there would be ballast in the form of rocks or iron bars to help stabilize the ship; sand seems to have been used as ballast on some ships as well. Not surprisingly, the lowest level or bilge of the ship accumulated seawater from leaks and other liquids such as human waste. Even though the ship's pump was used to clear the bilge and pump its contents overboard, the putrid stench emanating from the bilge was enough to knock a man unconscious if he got too close.



C. Goal of the Spanish Voyages

The original objective of all Spanish voyages westward from Europe was to establish maritime trade with China, including Japan, India and the Spice Islands. However, by 1521 it became evident that the American continents extended so far to the North and to the South as to deny practical access to the Pacific and that the Pacific itself was so vast that crossing it from any starting point in Europe was unrealistic. However, the Spanish conquest of portions of the Americas with all its riches gave them more convenient access to China and the wherewithal to effect trade. The problem then became how to get across the North Pacific from America to China and return.

Initially, Cabrillo's assignment was to prepare several small fleets for what would become three expeditions. Hernando de Alarcón was to sail to the mouth of the Buen Guia (Colorado River) to make contact with the land army of Francisco Vasquez de Coronado and possibly to establish a settlement in the region. Ruy López de Villalobos was assigned to lead an expedition directly west from Navidad across the Pacific. The assignment to explore the northwest Alta California coast went initially to Juan de Alvarado (nephew of the governor); when he formed other plans, Diego López de Zúñiga was assigned to the task. However, when Zúñiga was dispatched inland to deal with an Indian crisis Francisco de Bolanos took his place. Bolanos' fleet became stranded along the California peninsula and was rescued and brought back to Navidad by Villalobos before he began his voyage across the Pacific. At this point Cabrillo was ordered to command an attempt to explore the northern coast of California. Cabrillo was also urged to look for evidence of a western access to the fabled Northwest Passage, the waterway that was thought to lead back to the Atlantic Ocean. All four of these expeditions departed from Navidad or slightly north of there; three departed in the fall of 1542, Cabrillo in June 1542.

San Diego Bay is the first place within the present-day borders of the United States to be sighted and explored by Cabrillo as he voyaged north along the Pacific coast. San Diego is thus considered the place where California began. Today the local iconography is replete with imagery of Cabrillo and *San Salvador*. The voyage itself is memorialized by Cabrillo National Monument, the second most visited National Monument in the United States. Cabrillo's voyage acquired significance with the rise of California as a wealthy, populous, and culturally influential state and society, beginning with the Gold Rush and growing dramatically until California became the world's sixth largest economy. As with most societies, identity tends to coalesce from an origin point or origin tale. The Cabrillo story returned to prominence at the close of the 19th century with promotion of Cabrillo as a central figure and heroic icon by Portuguese immigrants anxious to establish a connection with their new home. Over time Cabrillo's voyage was accepted by Californians as a milestone in California's history and an early part of the opening of the west at a time when much of the Atlantic coast still lay undiscovered.

D. California: A Bountiful Land

Though it was the intent of Juan Rodríguez Cabrillo's voyage on the *San Salvador* to discover a new route to Asia, his lasting legacy was to be the first European to map the coast of California and make a record of these densely populated lands. He was peacefully received by diverse individual tribes who were well adapted to a wide array of ecological settings. These people originated from six different language families and spoke a multitude of separate languages (map from Heizer and Elsasser 1980:5). It would be realized much later that this bountiful land was occupied by the most diverse population of indigenous people in the American continents. This could only be the case if California was one of the earliest places to be occupied when people first entered the New World.



This voyage only came into direct contact with people living along the coast who were well adapted to coastal estuaries and tidelands, or marine mammal hunting and fishing. The people who occupied San Diego Bay and coast were the Kumayaay who gathered plants, fish and shellfish from coastal estuaries during the summer and then moved to the mountains and deserts for the rest of the year on their seasonal rounds. This was distinctly different from the seafaring Tongva who occupied the present day Los Angeles/Orange County coast and the southern Channel Islands, as well as the Chumash who occupied the Santa Barbara/Ventura coast and northern Channel Islands. Both the Tongva and Chumash were organized as complex Chiefdom communities and intensely harvested marine resources, such as seals, dolphins, sea otters, fish and shellfish. As the voyage explored north of Point Conception they encountered the exposed central coast, known for its strong southeasterly winds, ocean currents and winter storms that were unsuited for the Chumash and Tongva plank canoes.

As *San Salvador* sailed north Cabrillo sighted a prominent crowned-shaped volcanic plug which reminded him of a turban, so he named it "El Morro". What is now Morro Bay was the home of Obispeno Chumash villages who exploited the rich resources of the estuary and Morro Creek as it empties into Estero Bay.

Cabrillo is thought to have travelled as far north as the Russian River before turning back to record Monterey Bay. This well-sheltered bay was home to the Costanoan people who occupied the area south from San Francisco Bay to Point Sur and used balsa canoes to gather plants, fish and shellfish from the coastal tide lands, river mouth estuaries and the coastal plain. Resources in the form of salmon, shellfish, waterfowl, plant seeds, acorns, deer, elk, antelope, and rabbit were abundant. Rich environments such as Monterey Bay would have supported large villages politically organized by chiefs who oversaw the distribution of surpluses.

Article by: Dr. Jim Cassidy, Associate State Archaeologist, California State Parks

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E. Cabrillo's Impact on Native Americans

Many of the native cultures that Cabrillo encountered had a history in the region extending back thousands of years. Most of Cabrillo's interactions occurred in the coastal region extending from present day San Diego to Point Conception, with Kumeyaay, Gabrielino, Chumash and Tongva tribal areas distributed from South to North, respectively and these peoples had a highly sophisticated understanding of the available resources which supported their populations, and their trade and communication extended hundreds of miles beyond their cultural boundaries. While the Gabrielino have disappeared, descendants of the Kumeyaay, Chumash and Tongva remain. Everything the Kumeyaay needed for their lives came from the land: food, clothing, shelter, medicine and tools. Their primary food, acorns, were shelled, ground, leached with stream water and then cooked in baskets.

Creation stories about the land and its resources served as their spiritual guides. Stories of first contact are rare; without anyone conversant in both languages to record what must have been a complex process it is difficult to know what effect the first contact might have had on the Native American's world view. Written records suggest several minor misunderstandings may have resulted in brief scrimmages with members of Cabrillo's party. However, because the Spanish expedition did not stay long in any one place and did not consider the newly discovered territories to be very promising, the Kumeyaay and other native people were left pretty much alone. Contacts were few and scattered until European settlement began more than 225 years later, in 1769, with establishment of the Spanish missions.

F. Evidence Found on Cabrillo's Birthplace

Mystery of Cabrillo's Birthplace May Have Been Solved by Historian

For centuries, Portugal and Spain have vied for the honor of claiming explorer Juan Rodriguez Cabrillo as their own. The conquistador has been a shadowy figure and historians have hunted in vain for documentation of his birthplace. Now a Canadian researcher may have solved the mystery. Ancient documents unearthed by Wendy Kramer indicate that Cabrillo — whose 1542 landing in San Diego was Europe's first foray into California — was Spanish. "This," Cabrillo National Monument historian Robert Munson said, "could be the smoking gun."

Last month, Kramer logged into the online General Archive of the Indies. Examining digitized documents from a 1532 lawsuit involving the theft of New World gold from a Spanish vessel, Kramer was stunned by the testimony of one witness. He was identified as Juan Rodriguez Cabrillo, *natural de* (native of) Palma de Micergilio, a town in the province of Cordoba, Spain. "Look who was on the boat!" Kramer remembers exclaiming.

Her find, Munson said, is a major historical breakthrough. "Right now, all the circumstantial evidence points in the right direction," he said. Yet Idalmiro Manuel da Rosa — president of San Diego's Cabrillo Festival, an annual event that celebrates the navigator as well as the local Portuguese American community — finds the news disturbing. "I've requested that the documents be sent to us so we can turn them over to the Portuguese government," da Rosa said. "We definitely want to get to the bottom of this."

Kramer's research is rooted in the Archives of the Indies, a storehouse of records from Spain's colonial era. Other historians now are scanning the 483-year-old documents — and finding them persuasive. Munson, for example, noted that Cabrillo testified to his Spanish roots while under a sacred oath. "These people lived in an era when invoking the name of God is putting your immortal soul in danger," he said. "There would be no reason for Cabrillo to perjure himself on this."

Kramer, 59, admits that her specialty — colonial Guatemalan history — is not the sexiest topic. "Most of my friends' eyes glaze over," she said. Yet she's been entranced by the topic since the 1970s when, as a college student, she traveled to Central America and became swept up in the tales of 16th century Spanish adventurers creating a new society there. Still fascinated by the first generation of conquistadors in Guatemala decades later, she set out to write brief biographies of each, working alphabetically. Last month, arriving at the letter C, she was investigating Gabriel de Cabrera. The archives' online index led Kramer to three cases involving the lawyer, who had been transporting two chests of gold to Spain — taxes owed to the crown, as well as private individuals' funds. He and this

treasure boarded a ship in San Juan de Ulúa — present-day Veracruz — and sailed for Cadiz by way of Cuba. When the vessel landed in Havana, Cabrera's journey was interrupted. "Some of the gold that he was taking to the crown was stolen while he was on the boat," Kramer said. "These guys get hauled off to jail and authorities start putting together this big case." The trial dragged on through hearings in Havana, Tenerife, Cadiz and Seville. Among the witnesses testifying were passengers from the voyage — including Juan Rodriguez Cabrillo, born in Palma de Micergilio.

But were that man and the famed explorer one and the same? In separate documents, Juan Rodriguez de Palma is linked to personal details — conquering the Aztecs with Hernan Cortés and marrying a Spanish woman — that conform with what historians already know about the explorer. Moreover, his presence in Spain in 1532 is well documented.

"It is pretty clear," said Harry Kelsey, a Huntington Library research scholar and biographer of Cabrillo, "that the man who made this statement is the same Juan Rodriguez Cabrillo." Cabrillo made landfall on what is now Point Loma on Sept. 28, 1542. He was 43 or 44 — his exact birth date in 1499 is unknown — and had little more than three months to live. After a brief stay in San Diego Bay, his expedition sailed north and charted the California coast beyond San Francisco. Sailing south, his flotilla stopped in the Channel Islands, where Cabrillo suffered a broken bone. He died weeks later.

At the National Monument marking the explorer's arrival in what now is California, there is a statue of him perched high above the Pacific. It was commissioned by Portugal in 1939. "The Portuguese government has proof that he was Portuguese," Da Rosa said. "And in Portugal, there is a town, Cabril, and it is assumed he was born near there."

Still, historians have been unable to reach a consensus on Cabrillo's nationality or birthplace. Kramer said her discovery of Cabrillo's 1532 testimony was a fluke: "It was buried in a document that had nothing to do with him," the researcher said. Yet the find has added credibility because it is in the 16th century equivalent of a court reporter's official transcript. Kramer has found three documents with Cabrillo's testimony; in two, he identified himself as a native of Palma de Micergilio. In the third case, he called himself Juan Rodriguez de Palma. "You Cabrillo-in-Spain deniers will say it's not the same guy," Kramer said. "But this is him."

Source: San Diego Union-Tribune, September 17, 2015

G. Using the New *San Salvador*

Design of *San Salvador* is based on extensive research drawing upon archival sources, shipbuilding treatises, historic artwork, pictographs, votive models, and findings from archeological excavations of contemporary vessels all sharing their timeframe and technology with *San Salvador*. Historic accounts suggest the expedition may have included about 200 men, up to 125 of them aboard *San Salvador*; the others were aboard the two escort vessels. These numbers seem high to present day historians and others familiar with the manning ratios of 16th century Spanish Pacific expeditions. A total of 170 men with 80 aboard *San Salvador* seems more likely based on the size of the three vessels in Cabrillo's fleet.

San Salvador joins the museum fleet as a fully functional representation of a 16th century sailing ship. *San Salvador* is open daily for visitors and she will function as an educational platform for the museum's school programs, conducting day sails and longer voyages and providing sail training for our volunteers. She will spend most of her time at the museum with occasional voyages to other California ports; in so doing she will trace parts of the route sailed by Cabrillo.

During construction, the museum docents, education department staff and Cabrillo National Monument staff members offered site visits and educational tours for area school children free of charge. The museum's web site also provided educational content as well as live interactive exchanges between schools throughout the nation with construction personnel, historians, and educators at the site. As *San Salvador* joins the Museum fleet she will integrate with the rest of our educational programs offering a variety of educational experiences to students of different ages.

The museum's mission is to serve as the community memory of our seafaring experience by collecting, preserving, and presenting our rich maritime heritage and historic connections with the Pacific world. The vessels have increasingly presented a clear chronological organization scheme in fulfilling this mission with specific ships representing important eras and waypoints in a Pacific history spanning five centuries. The starting point for all this is *San Salvador*. Exploration-era vessels seem to evoke a fascination that has made them among the most popular tourist attractions wherever they have been situated. *Mayflower* and the Jamestown replicas may be said to have created the heritage tourism industry on the East Coast. Fifty years after the founding of the replica Jamestown settlement, the three small ships *Susan Constant*, *Godspeed*, and *Discovery* welcomed more than 1,000,000 visitors, making them the most visited historical ships in America.

Because heritage tourism is just now coming into its own in California, the direct and indirect benefits of *San Salvador* to the museum and to the regional economy are of similar potential. *San Salvador* functions as a potent public symbol on many levels: as a symbol of our community, an inspiration, an educational platform, a window to the past, a provider of unique experiences, and as an aesthetic construct. Perhaps

her greatest importance lies in what she represents to us in the subliminal realm, as the only object within our collective regional history to be designed, built, and committed to confronting the unknown.

H. Comparing *San Salvador* to other Museum Vessels

Differences between *San Salvador* and other Maritime Museum of San Diego Sailing Ships

By: David Clark, Sail Crew, Maritime Museum of San Diego

San Salvador represents a mid-sixteenth-century Spanish galleon from an era two to three centuries earlier than the other ships of the Maritime Museum of San Diego (MMSD), which are late-eighteenth-century to mid-nineteenth-century designs. Differences can be seen in many details of the rigging and hull of *San Salvador*, including a distinctive projecting beak at the bow and a high stern castle and forecastle. Unlike ships of later eras, *San Salvador's* standing rigging is fiber rope, rather than steel wire.

The bowsprit (the large spar that projects forward of the bow) anchors the stays that provide support for the fore mast. Note that the bowsprit is not on the centerline of the ship but is offset to the starboard side of the stem. Only in the mid-to-late-seventeenth century were bowsprits moved to the centerline.

Other MMSD sailing ships have rigging underneath the bowsprit to counter the upward pull of the fore mast stays. Bobstays, dolphin strikers and martingale stays were innovations introduced in the seventeenth century for this purpose. *San Salvador's* bowsprit has only gammoning, a very heavy rope lashing, to secure it to the stem of the ship.

San Salvador carries a spritsail – a square sail on the bowsprit – to provide balance to the turning effect of the lateen sail and high stern castle at the stern. This is unlike the more modern ships in the MMSD collection, which have fore-and-aft-rigged staysails and jibs at the bow. These were introduced in the seventeenth century.

Notice the fore and main masts. The tops – the platforms at the head of the lower parts of the masts – are round, rather than squared off on the aft side, as began to be seen in the early eighteenth century.

The fore and main yards are not fixed at the head of their masts but can be lowered to the deck with a system of halyards and lines called tyes for furling sails and maintenance. The tyes and halyards are connected by ram's head blocks (a type of very large wooden block) that leads to knights, the large wooden posts with sheaves in them, on deck. The fore knight is in the forecastle and its halyards lead through a scuttle in the deck above.

The yards are attached to the masts with parrels, wooden roller bearings that allow the yards to move up and down the masts and to brace around to catch the wind while still being held securely against the masts. The parrels can be tightened or

loosened as needed to allow the yards to move slightly away from the masts so they may be braced farther around. This allows the ship to sail closer to the wind.

Martnets, a system of small lines that attach to the leech (vertical edge) of the fore and main sails, are used to bring the sail up and under the yard when furling. In the mid-seventeenth century, these were replaced with a simpler system of leechlines and buntlines to gather the sail to the yard.

Unlike more modern ships, the original *San Salvador* had no footropes, the ropes that were hung under the yards for sailors to stand on while working aloft. These were not introduced until the mid-seventeenth century. *San Salvador's* sails are furled by using the martnets to control the outboard sections of the sail. The inboard sections are then reached by standing on the shrouds, or by bringing the yard down to the deck to furl. In the sixteenth century, sailors also crawled or even walked out along the yards to work on the sails, a dangerous practice that is not used today on *San Salvador*.

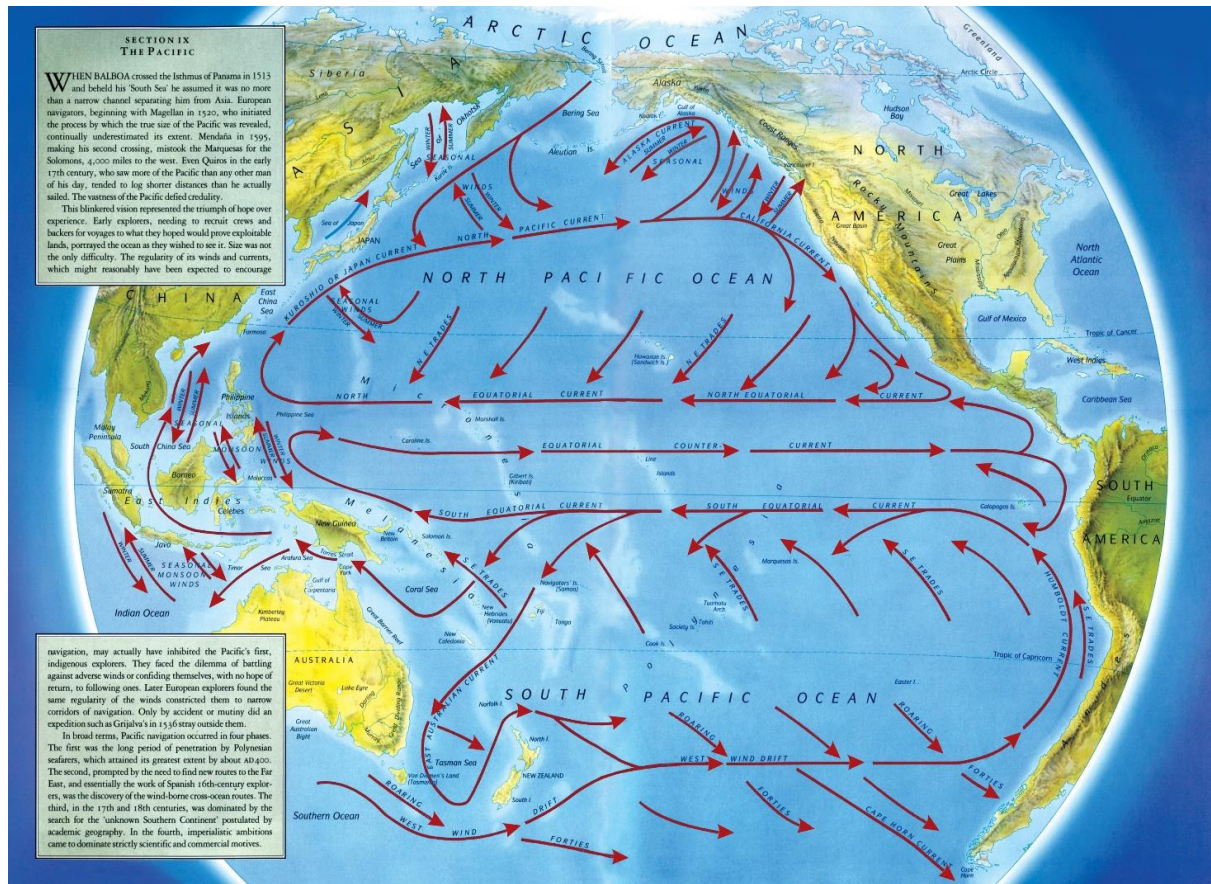
The mizzen mast carries a long lateen yard and a sail, a Mediterranean design that was the precursor to the spanker sail seen on more modern ships such as “HMS” *Surprise* and *Star of India*.

San Salvador does not have a ship's wheel, which is an innovation from a later era. The ship's rudder is connected to a large tiller, which is controlled by a vertical spar called a whipstaff. The helmsman stands in an enclosed space underneath the poop deck and steers the ship by pushing the whipstaff from side to side. Visibility is very limited, so the helmsman communicates via a small hatch with the officer on the quarter deck who is guiding the ship.

Note: The estimated dates cited for the introduction of various innovations have been drawn from:

- Anderson, R.C., *The Rigging of Ships in the Days of the Spritsail Topmast, 1600-1720*, Salem, 1927
- Harland, J., *Seamanship in the Age of Sail*, London, 1984

I. Solving the Mystery of the Winds



Sixteenth-century sailors were limited by their navigational tools and by the sailing abilities of their ships:

- The compass let them sail in a straight line on a determined course.
- The sand glass let them estimate how fast they were travelling.
- The quadrant, astrolabe, or cross-staff, plus navigational tables, let them calculate their latitude (plus or minus 30 miles).

All long-distance voyages depended on finding the right prevailing winds and setting your sails to take the best advantage of them. You could rarely, if ever, make a long trip by simply pointing your ship towards your destination.

- By 1540 the Spaniards had learned that the Atlantic Ocean had predictable winds that blew from east to west just above the equator. That enabled them to follow a predictable route westward across the Atlantic.
- They also knew that at about 40 degrees latitude north or south, strong prevailing winds blew across the Atlantic from west to east. That enabled them to follow a predictable route eastward back to Spain.

- Early on, Spanish mariners realized that the Pacific Ocean had east-to-west winds along the equator like the Atlantic. That enabled several voyages to reach Asia in the 1520s and early 1530s, but they couldn't find the proper winds to make the return voyage to America.

- It was not until 1565 that a Spanish voyage proved that the Pacific – three times the size of the Atlantic – had the same west-to-east winds at North latitude 40 degrees that existed in the Atlantic. The return route from Asia was pioneered by Andrés de Urdaneta, who had sailed to Asia from New Spain in his youth and had studied the problem of the return route for several decades thereafter.

Juan Rodríguez Cabrillo did not know it, but he had been assigned an impossible task – that of sailing west across the Northern Pacific.

- His route north along the California coast ran into both winds and currents that blew from north to south along the California coast.
- The fact that he got as far as he did (the Oregon/California border) before giving up indicates that he was a first-rate navigator.

Despite fighting contrary winds and currents on the way north, all of Cabrillo's ships and most of the crew made it back to Mexico. Ironically, his encounter with the powerful winds and currents flowing southward laid the groundwork for Urdaneta's pioneering voyage in 1565.

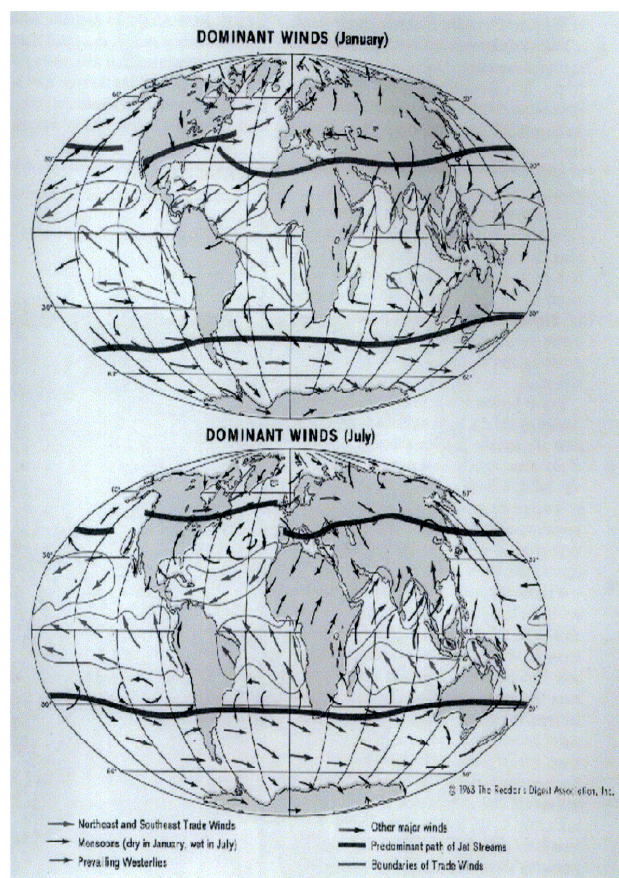
Chapter XIII. Appendices



A. The Winds and Sailing

Ancient watermen (traders, fishermen, warriors, explorers, etc.) learned about winds and currents through first hand experience, however this mostly local knowledge was seldom passed on to others outside of the family or village. Charts and logs were treated as trade secrets well into the 19th century. Enter U.S. Naval officer Matthew Fontaine Maury who in 1839 became unfit for sea duty due to injuries received in a stagecoach accident. Resigned to sailing a desk Maury began a systematic collection and study of ships' logs, charts and records. Along the way he became Superintendent of the Naval Observatory and head of the Depot of Charts and Instruments. In 1855 he published "Physical Geography of the Sea", a comprehensive study of oceanography. He followed this with many detailed charts and reports on prevailing winds and currents around the world, in sufficient detail to outline optimum shipping lanes.

Maury's data noted a low-pressure belt located roughly between 10 degrees south and 10 degrees north of the equator. Within this belt, called the equatorial belt of calms or the "doldrums", the air is hot and sultry. At about 30 degrees from the equator in both hemispheres are high-pressure belts of calms or light variable winds sometimes referred to as the "horse latitudes." Surface air moving toward the low-pressure equatorial belt causes the prevailing winds of the lower latitudes. These are the trade winds that sailors generally could count on with slight variations by season. In the northern hemisphere, the northerly wind blowing toward the equator is deflected by the rotation of the earth to become northeasterly and is known as the northeast trade wind. In the southern hemisphere, the southerly wind, which is similarly deflected, becomes southeasterly and is known as the southeast trade wind.



On the polar side of the horse latitudes in either hemisphere, the atmospheric pressure diminishes toward low-pressure centers in middle and high latitudes. The winds set in motion toward the earth's poles by these pressure systems are deflected toward the east by the earth's rotation. Because winds are known by the direction from which they blow, the winds in middle latitudes are known as westerlies. These westerlies are greatly affected by traveling cyclonic disturbances (circling a low pressure area) and anticyclonic disturbances (blowing out from a high

pressure area) that cause their actual direction to change greatly from day to day and create stormy conditions. The colder regions at the earth's poles tend to be high-pressure centers, particularly in the Southern Hemisphere, and winds spreading out from these areas are deflected to become the polar easterlies.

Sailing

Today sailing is largely a recreational rather than a commercial activity. The commercial businesses related to sailing are limited to charters, cruising and eco/green exploration, plus boat construction, maintenance, support and services for recreational and competitive sailing. Over time the materials for constructing sailboats and sails have changed from reeds, logs, skins, bark, flax and hemp to fiberglass, aluminum, Kevlar, Dacron, carbon fiber and titanium, however the basics of sailing remain the same. Although modern designs and materials make it possible to sail at multiples of the wind speed, sailing remains dependent on wind and water conditions and there are limits on how closely any boat can sail toward the direction of the wind. In general, even under in the most favorable sea conditions sailboats cannot sail closer than about 45 degrees of the direction of the wind (an arc of 90 degrees). Square-rigged ships, barks, brigs etc. would do very well to sail within 75 degrees of the true wind direction (150 degree arc).

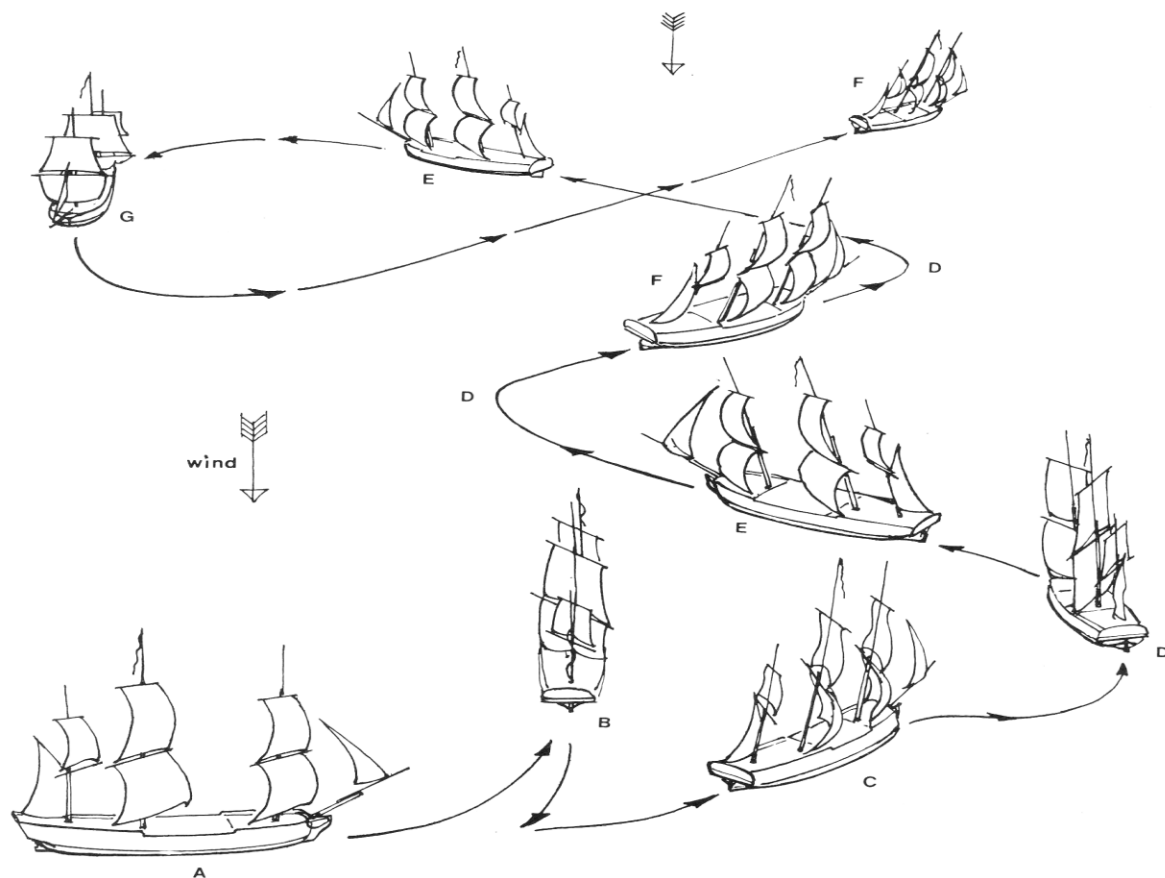
Many people believe that the wind pushing against the sails is what makes a ship move. This is only partially true. The real power of the sail is the partial vacuum produced when a difference in pressure forms as wind passes along both sides of the curved surface of the sail. This vacuum is explained by a law of physics known as Bernoulli's Principle. Because the air flowing on the side away from the wind (leeward) moves faster than the air flowing on the side facing the wind (windward), a vacuum develops on the leeward side of the sail. When force of the higher pressure on one side of the sail is transferred to the boat's hull, the shape of the hull converts a portion of the pressure into forward motion. This is very similar to what an airplane wing does to provide lift.

Originally, sails were flat pieces of material formed into triangular or rectangular shapes. Lines attached to the corners were used to adjust the shape of the sail to obtain the most favorable difference in pressure between the windward and leeward sides of the sail. Sailmakers today design, cut and assemble sails with built-in curves to make them more efficient in using the wind. This is true of both square and triangular sails.

Because sailing ships are limited in how closely they can sail toward the wind, wind direction is always a significant factor in choosing a course. If, for example, the harbor entrance bears 270 degrees (due west) from a boat's current position and the wind is also coming from the west, the boat's skipper cannot head directly for the harbor. Instead, he can steer no closer than 225 or 315 degrees; when the

harbor finally bears at least 90 degrees from the boat's heading he should be able to "tack" (change course through the wind) and sail into the harbor.

On most of today's sailing vessels with lateral sails (in line with the hull) changing course so that the wind comes across to the opposite side of the boat is a very simple process and is done by either tacking or jibing. To "tack" is to change course when heading windward with the bow of the boat passing through the direction of the wind. To "jibe" (or gybe) is to change course so the wind is directed to the opposite side of the boat while heading downwind. Not so on a square-rigged vessel; the following shows the various points of sail for a square-rigger.

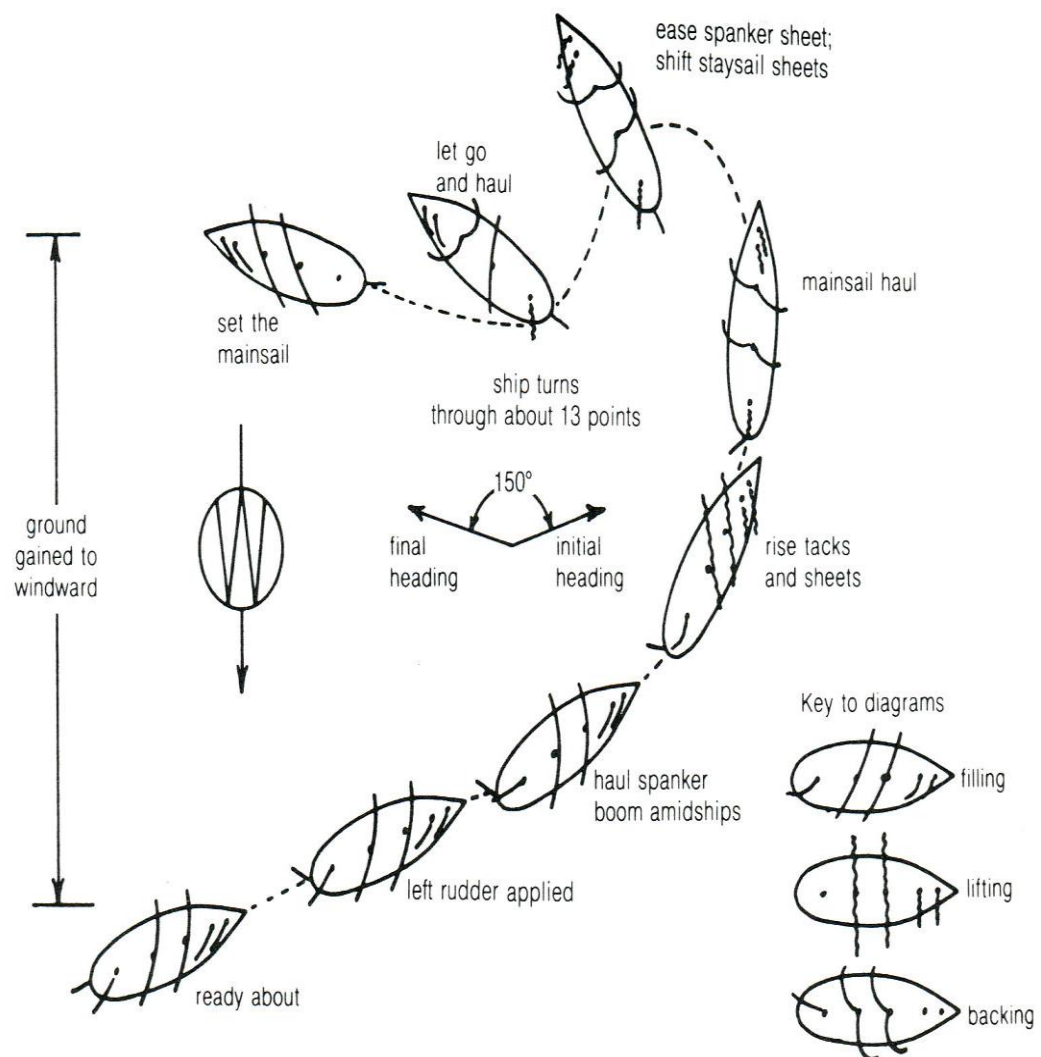


Working to Windward

- A. Making headway on port tack (wind coming from the port side of the vessel)
- B. Ship in irons, making a sternboard all aback (going backwards)
- C. Making a half-board or pilot's luff (pinching up by using momentum)
- D. Tacking or coming about
- E. Sailing close-hauled on the starboard tack
- F. Sailing close-hauled on the port tack
- G. Wearing (changing course with the wind coming from astern)

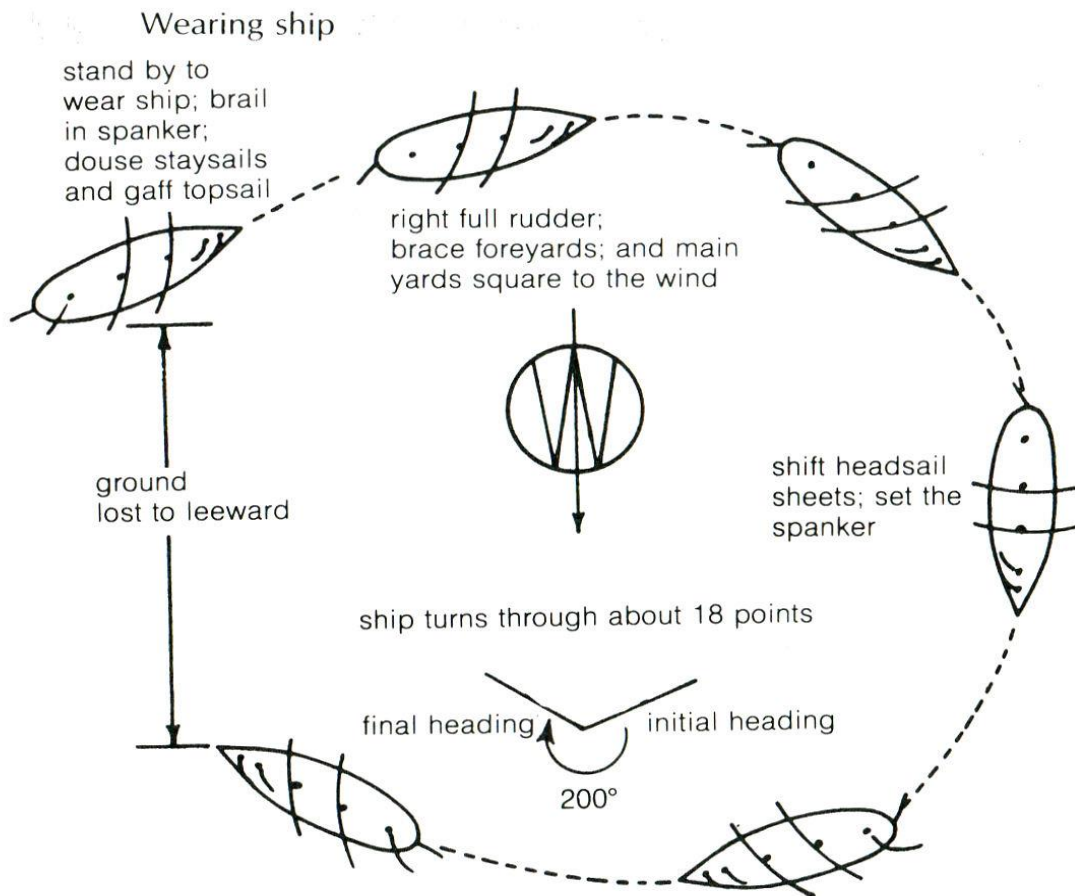
Tacking a Square-rigger through the Wind

The fastest and most efficient way for a square-rigger to change course is to tack, bringing the bow across the wind. (1) Sailing on a port tack, the vessel (a bark) is brought close to the wind direction to build speed. (2) The helm is put over hard to port, the spanker sail is hauled to windward to pivot the ship. (3) The main yards are braced around their sails and the jibs fluttered for a moment while the wind strikes the front of the foresails, driving the ship to port. (4) The ship rapidly loses momentum, but as she comes around, the jibs and the mainsail fill. (5) As the vessel gains way again, the foreyards are braced around to the new course. (6) With the ship picking up speed, all sails are trimmed for the starboard tack. In a light air, a choppy sea or with land downwind wearing might be preferable to tacking.



Wearing a Square-rigger around the Wind

Wearing ship, altering course by bringing the vessel's stern across the wind, is a maneuver used primarily in heavy weather. (1) Under reduced sail, the bark is readied for a run downwind. (2) The spanker is furled, the rudder is put over to starboard while the main and fore yards are squared into the wind. (3) The ship falls off to leeward until the wind aft fills the main and fore sails. (4) With the wind directly astern, the main sails blanket the fore sails, freeing them to be hauled around for the starboard tack. (5) The forward sails fill and the main yards are braced around farther to take the wind over the starboard side. (6) Having reversed direction, the ship is trimmed for the new course and the spanker is reset.



A Brief Look at Sails

Throughout history a great variety of methods and materials have been used to harness the wind for travel on water. The museum's sailing vessels can be categorized as having two basic types of sails—fore-and-aft or transverse. Fore-and-aft sails are rigged to be in line with the keel of the vessel. In contrast, transverse sails (or square sails) are carried on yards, which are mounted athwartships, always 45 or more degrees away from being in line with the keel. Although the sails' shapes and the manner in which they are rigged and utilized differ considerably you will note they share many terms. Each type of sail has, as noted in the following illustrations, a head, foot, tack, leech, and clew. Some sails are hanked to stays, others are attached to yards or booms at the head or foot or both edges. Note that the spanker and gaff-rigged sails are also secured on the luff edge. The upper three yards on *Star of India's* main and fore masts must be raised to position for sailing; the lower two yards are fixed in their vertical positions. Refer to the Glossary of Nautical Terms (Appendix F) to learn the definitions of terms that are presented in the following figures.

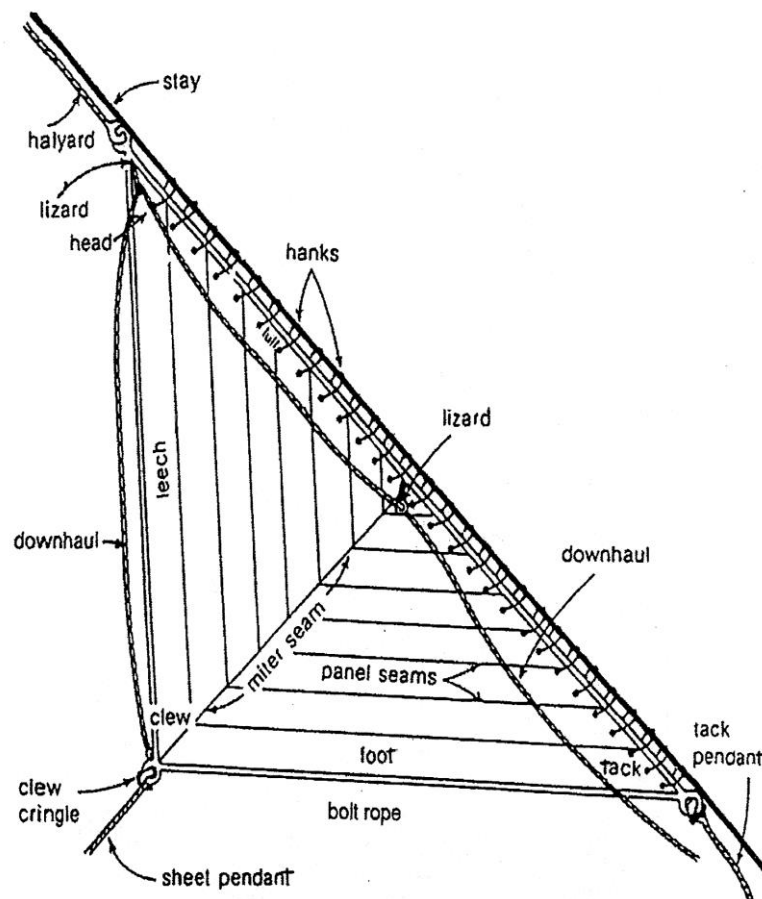


Figure 1 Staysail/Jib Set & Rigging

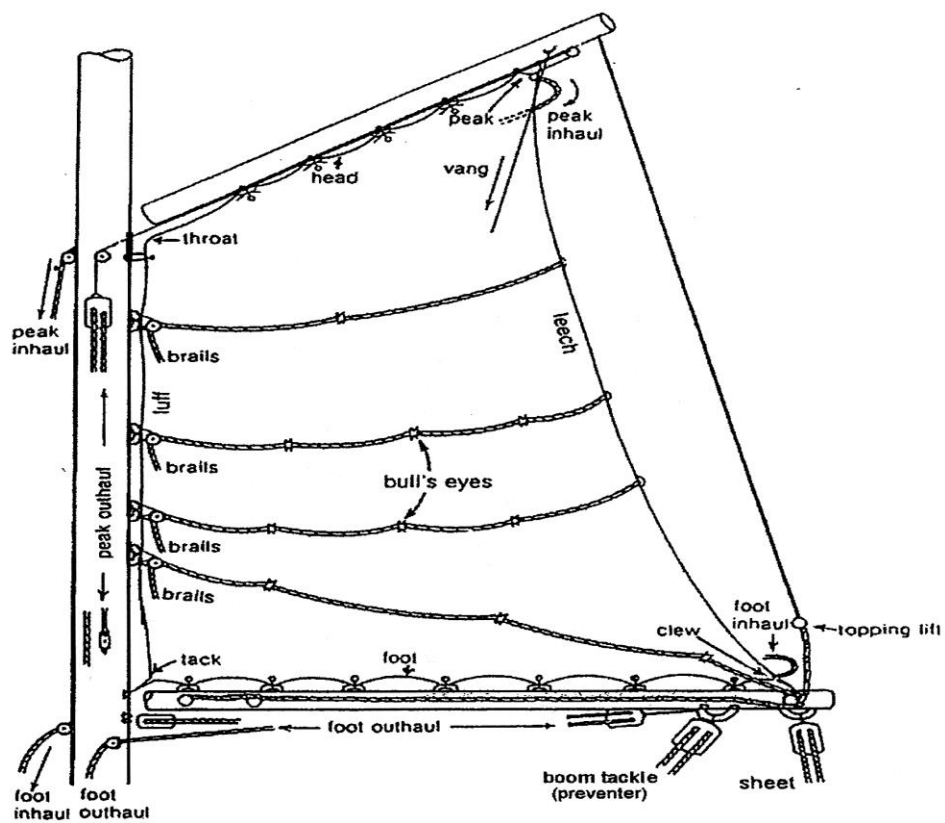


Figure 2 Spanker Set & Rigging

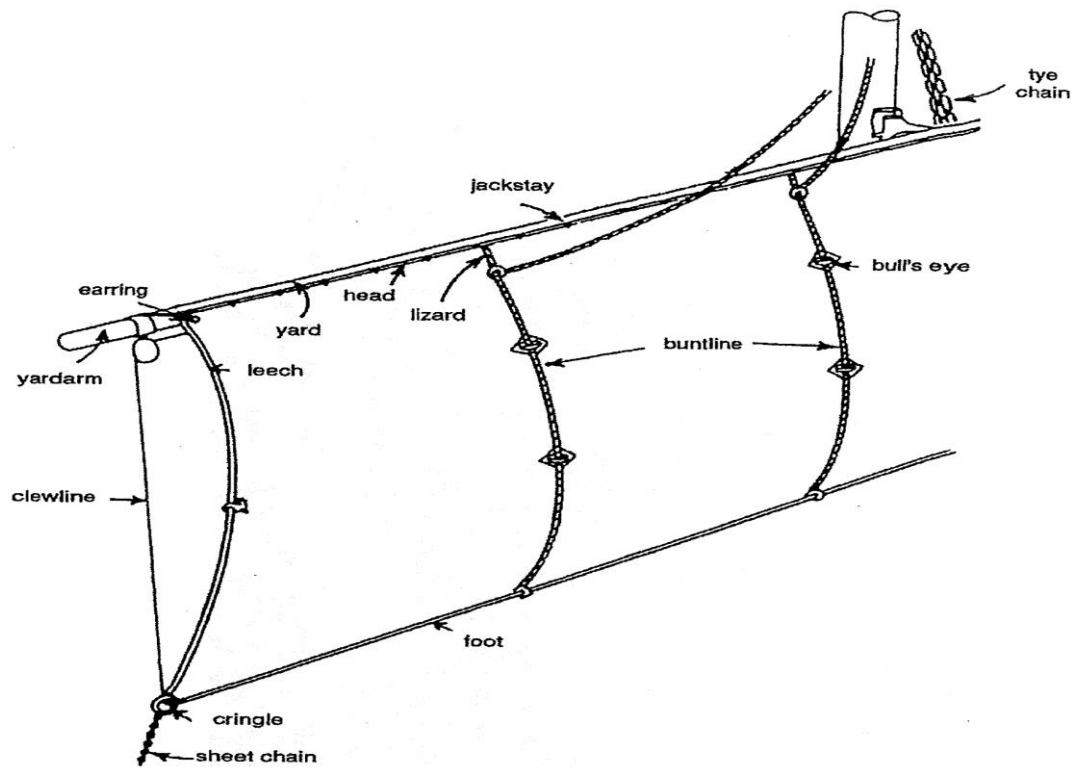


Figure 3 Typical Square Sail Set

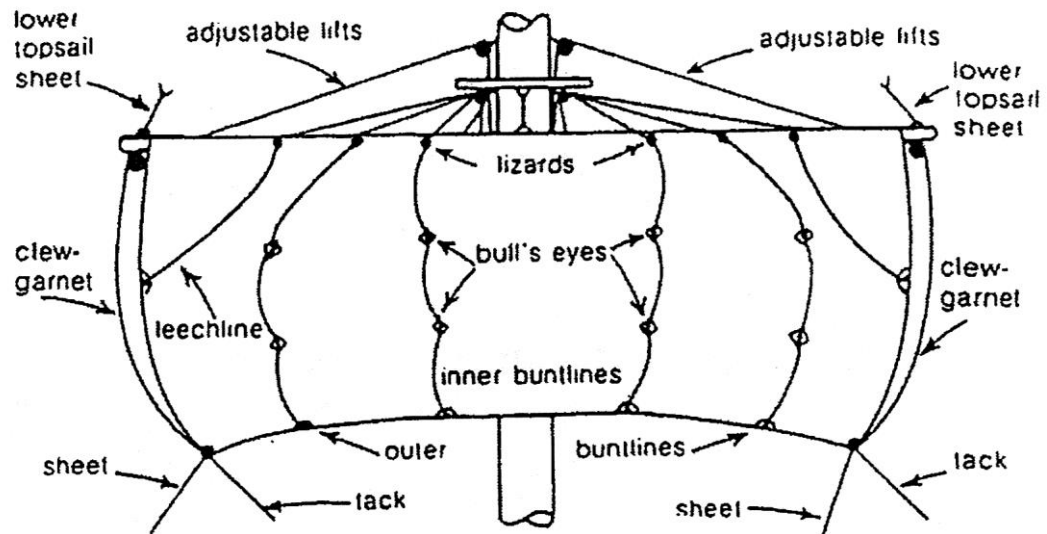


Figure 4 Foresail Set

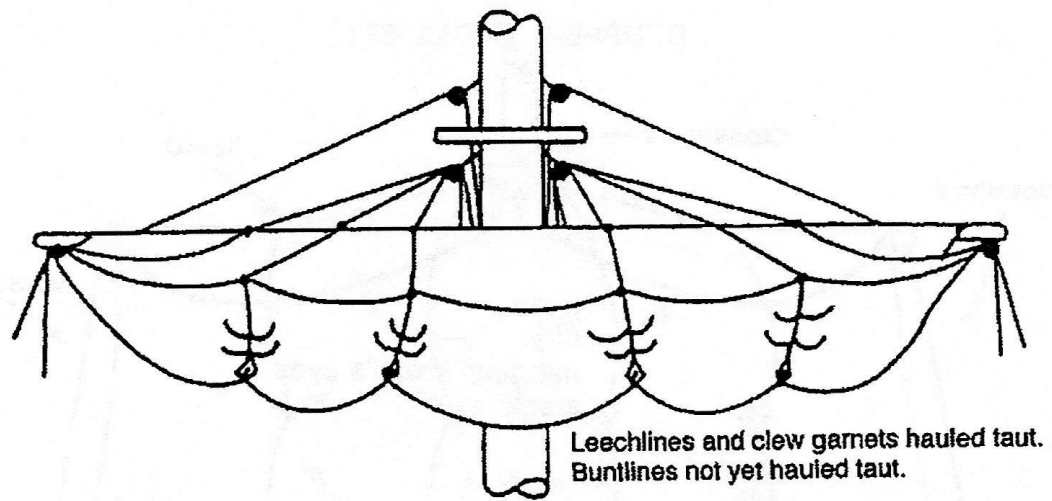


Figure 5 Foresail in its Gear

B. Navigation

Navigation and navigational instruments are displayed in various places within the Museum. This information is relevant for all of these exhibits.

Early sailors used coastal navigation sailing along the shore by observing nearby landmarks. They were aided with the growth of chart making, first in the form of the portolano or rutter, and later as navigational charts. A portolano or rutter is a set of sailing directions, describing coasts, ports, anchorages, rocks and shoals, etc. A navigational chart is essentially a portolano drawn to scale. With some information on speed and direction a sailor could move out of sight of land for short periods using dead reckoning. Other clues available out of sight of land were waves, currents, clouds, birds, etc. Islander navigators used this type of information. Obvious position indicators are the sun, moon and stars. Ancient people knew that the sun and moon move north and south during the year and that Polaris, the North Star, was close to the North Pole. They had even developed methods for estimating the true pole position from the position of nearby stars. Navigational developments stem from improved information on celestial body positions and instruments used to observe them. The earliest navigational instruments were sailors' eyes and brains. They could steer a daytime course using the sun's position and the approximate time of day. They could steer a nighttime course using the North Star.

The ancients knew the world was spherical and they recognized that the angle of Polaris above the horizon, as corrected by the rule, was equal to the observer's latitude. They also knew that the Sun's noontime position moves north in summer and south in winter by a certain amount each day. By comparing the Sun's highest altitude on any day with the tabulated altitude for that day they could calculate latitude. The first nautical instruments for measuring the altitude of celestial bodies were the seaman's quadrant and the nautical astrolabe. The quadrant was a quarter-circle plate held up by a cord at one corner and graduated in degrees with the pivot hole as the center. The cord continued down to a plumb bob. The plate carried two sighting vanes, usually with small peepholes in them. The sailor turned toward the star and tilted the plate to sight the star through the peepholes. The angle between the star and the vertical, was indicated by the plumb line against the graduations. The nautical astrolabe, a heavier device, was a simple version of the astronomer's astrolabe. It was a metal ring graduated in degrees that bore a rotating arm with sighting vanes. The sailor turned toward the star, held the ring up, and rotated the sighting arm until he saw the star through the peepholes. The altitude of the star was indicated by the position of the arm against the graduations. Quadrants and astrolabes required a vertical reference and were used for land-based measurements but were not very accurate on ships because of pitching and rolling.

The magnetic compass was first used in primitive form about 1100AD. An early version was simply a magnetized needle slipped into a straw floating in a basin of

water. It pointed north and south, or near enough to be believed. The bare needle developed probably between 1200 and 1400AD into the mariner's compass, in which the needle is mounted beneath a compass card showing the "points of the compass," mounted on a pivot pin floating in liquid (oil or alcohol). The liquid floated the card to reduce friction at the pivot and steadied its motion. The compass was mounted on gimbals rings so it stayed level and enclosed in a box on which was drawn a line (lubber line) aligned with the centerline of the ship. The angle between the lubber line and the compass card north showed the direction of the ship.

The cross-staff was an improvement over the quadrant and astrolabe, which required a vertical reference, hard to come by in a pitching ship. The horizon provided a better reference at sea. First described in 1342, the cross-staff measured the angle between the horizon and celestial bodies. It consisted of a staff, no longer than a man's arm, that bore a movable crossbar from whose equal ends protruded two sighting vanes. The mariner looked toward the sun, held the near end of the staff against his nose, and moved the crossbar in and out, raising and lowering the far end of the staff, until the sun was aligned with the upper sighting vane and the horizon was aligned with the lower sighting vane. The angle was indicated by the markings where the crossbar edge crossed the staff. The staff could not be longer than a sailor's reach so the instrument was provided with three or four crossbars of different sizes to extend the range of measurable angles. The staff, rectangular in section, had different scales on each of its sides for use with different crossbars. Use of the cross-staff required looking toward the sun and injured the eye in time. Even without injury, the instrument required simultaneous observation in the directions of the sun and the horizon, a difficult task.

The back-staff, developed in Elizabethan times and described by John Davis, was an instrument that measured the altitude of the sun using a projection of its shadow. It consisted of a staff on which were mounted two graduated arcs, a smaller one above the staff and a larger one below, each with a sliding sighting vane. The two arcs, though of different sizes, had a common center, and at that center point was a third vane with a slit used to sight the horizon. The smaller upper arc was positioned on the staff so that the shadow of its vane would fall exactly at the horizon slit. With his back to the sun, looking through a peephole in the sighting vane on the larger, lower arc, the mariner would slide that sighting vane up and down the arc until he could see the horizon through the peephole and the horizon slit while also keeping the shadow from the upper shadow vane aligned with the horizon. The sum of the angles read from the two arcs gave the altitude of the sun. The back-staff could only be used to sight the sun, since stars give too little light to cast a shadow. The sailor had to hold very steady to compensate for the pitch and roll of the ship.



In 1731, John Hadley developed the reflecting octant to measure the angle between any two celestial objects. This instrument could measure the altitude of stars and was much better than the back-staff for measuring the altitude of the sun. The octant and the later sextant work as follows: A glass horizon mirror has its right half silvered but its left half clear. A star mirror is on a rotating pivot graduated in degrees and fractions. The instrument is held vertically with the center up. Across the base is a sighting line, with the horizon mirror at the far side and the telescope at the near side. An arm is pivoted at the center of the arc, carrying the star mirror at its pivot point, and extending out to the arc, which is graduated in degrees and fractions. A star is selected below which the horizon is visible. Looking through the telescope toward the horizon mirror the horizon is visible through the clear half. The star mirror is rotated by moving the arm until the star image in the silvered half of the mirror is even with the horizon. The angle is indicated on the scale by the arm's index. The mirror only has to rotate half of the measured angle so an octant (one-eighth of a circle) can measure an angle of 90° . For observing the sun, movable colored safety filters were fitted near the star mirror to dim the light of the sun. Later on it was found convenient to be able to observe stars a little behind the observer, so that the arc was extended to one-sixth of a circle, giving the name sextant to the improved instrument. The sextant can measure up to 120 degrees. Since a nautical mile is defined as one minute of arc of a great circle on the Earth's surface, angles of latitude translate directly to nautical miles from the pole, hence the saying, "A minute is a mile."

The "nocturnal" enabled navigators to tell time at night by using the position of the stars of the Little Dipper and Polaris. It was first described in print by Michel Coignet in 1581. The nocturnal has a supporting outer dial, a rotating inner dial, and the arm that is shaped to match the pattern of the Little Dipper. The outer dial is marked with the months and dates of the year, the inner dial by the hours of the night. To use it, the index of the inner dial is set to the date on the outer dial, the instrument is held up northwards, with its top up, and the arm is turned to match the Little Dipper. The index on the arm then reads the time on the inner dial.

The methods described so far determined latitude only. The observations did not tell anything about longitude. Since the earth rotates once per day, the difference in longitude between two places is equal to the difference in time of noon between those two places. Longitude, therefore, requires knowing local noon time relative to the time at Greenwich. Because of the uncertainty in longitude, the typical way to make a landfall was to sail south or north until the latitude of the destination was reached, then sail east or west along the correct latitude until the destination was found. This was called Latitude Sailing. On shore, with observatory instruments, it was possible to set a clock to local noon time and observe some astronomical event, far from earth, that could be similarly observed and timed elsewhere on earth. The difference in the time between two observations of the same event gave the difference in longitude between the two places. You could not do that at sea. Pendulum clocks could not keep time in a pitching and rolling ship and the astronomical event would likely not occur when the sailor needed to know his position. Astronomical "clocks" were considered: movement of the moons of Jupiter, or the movement of the Moon. Jupiter's moons could not be reliably

observed from a ship at sea. Earth's moon moves across the stars at about half a degree per hour, but not uniformly. Navigation using Lunar tables required the following: 1) precise positions of stars usable for navigation, 2) formulas to predict the motion of the Moon for several years in advance, 3) an instrument to measure the angle between the moon and a navigational star, and 4) a clock that would run sufficiently accurately from noon when the sun could be observed, through the night. Much effort went towards making this lunar distance method practical, resulting in a great star catalog, the octant and sextant, and pretty good formulas for predicting the motion of the moon. In 1722, the first great catalog of the positions of many stars was published, based on work at the Greenwich observatory.

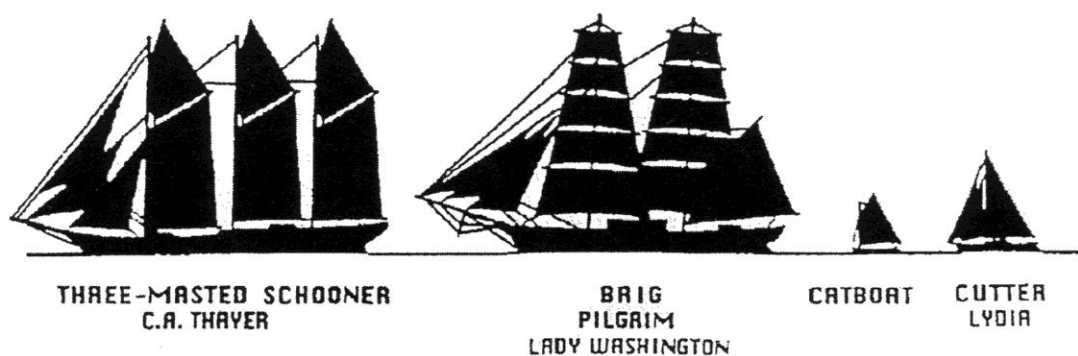
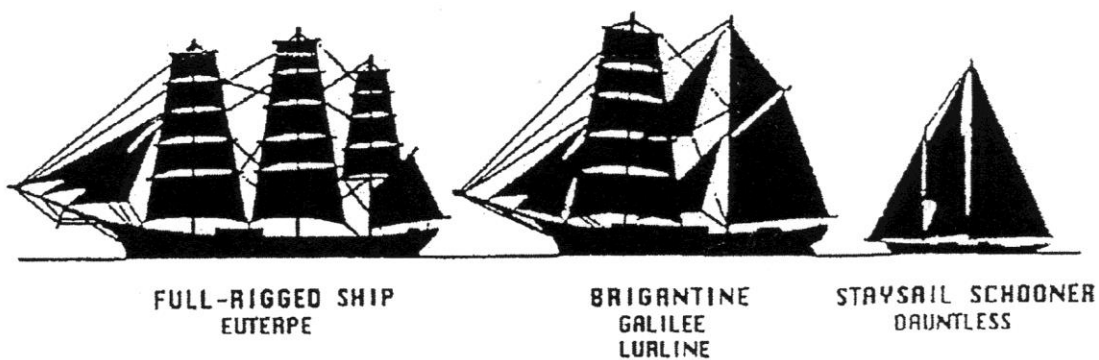
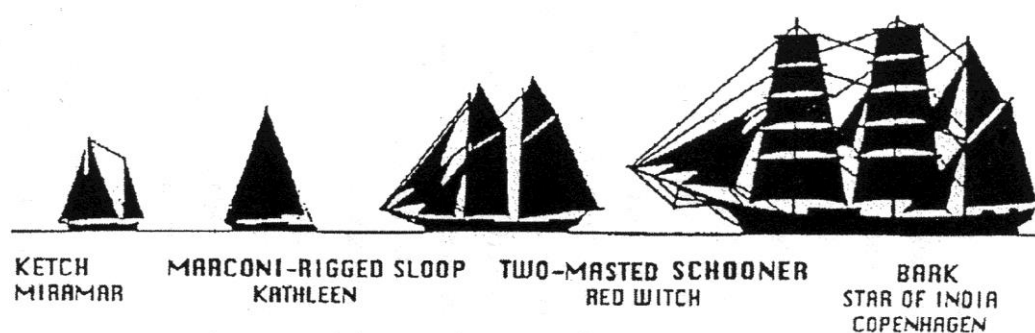
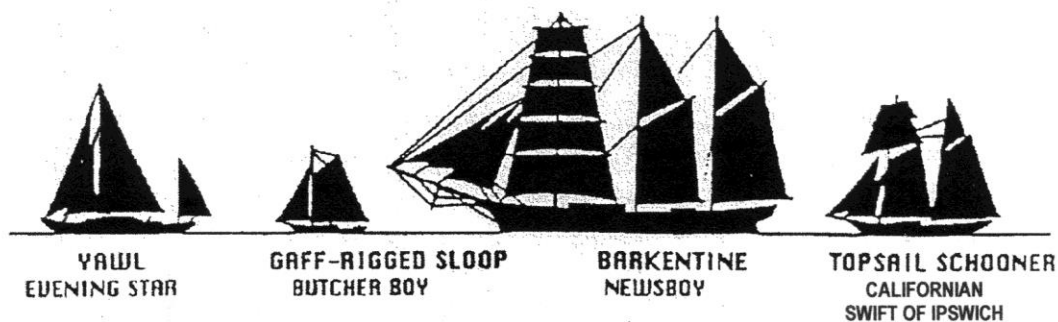
Navigation using lunar distance worked in skilled hands with skilled minds, but it was too difficult for most people. A mechanical clock was needed to give time directly, since an error of four seconds in time would result in an error of one nautical mile in longitudinal distance at the equator. Parliament offered a prize of 20,000 pounds for an accurate method of determining longitude at sea. The task of creating a clock that could be carried aboard a ship and of sufficient accuracy for navigation was undertaken by John Harrison. After many years of patient work, and several different types of clock, Harrison's chronometer demonstrated its accuracy and usefulness in Captain Cook's second and third circumnavigations of the world from 1772 to 1779. The chronometer is a portable clock compensated for temperature, winding state, position, motion, etc.

Between navigational fixes the ship's position is determined by tracking the speed and direction since the last fix. Speed is determined by a log. The early log was a chip of wood tossed into the water at the bow and the seconds counted until it reached the stern. It was not very accurate. The classic log is a quarter-circle board, weighted at its curved edge so that it floats vertically in the water with one corner up. At each corner is a hole for part of a rope bridle so arranged that the bridle tries to pull the log through the water in its upright position. The log strongly resists movement through the water. The log is attached to a long, light line that is wound onto a spool that can be held by its axle. The log line is marked with a series of knots and fabric flags at 47 foot 3 inch intervals. A 28-second sandglass is used as a time reference. The log is thrown overboard and the line unwinds from the spool. The "knots" that run out in 28 seconds is the speed of the ship. A sharp jerk on the log line pulls a plug out of a socket so the log tips horizontal and can be hauled in easily. Between each pair of knots are five white markers. Estimating distance between knots enables the speed to be measured to 1/10 knot.

A traverse board was used to keep track of distance traveled. Speed, direction, and time was recorded on the traverse board each bell (half hour) of the watch. The traverse board has two parts, a compass rose above and squares indicating speed below, with holes in each section for wooden marker pins. Each pair of marker pins is linked by a light line. At each half hour of the watch one end of a pair of pins is placed in a hole indicating direction and the other is placed in a hole indicating speed. At the end of the watch, the officer of the watch adds up the northing or westerly components of each speed to calculate the total distance and direction traveled.

When cheap mechanisms became available the patent log was adopted. This was strung over the stern when the vessel cleared port, and was not pulled out until reaching the next port. It consisted of a rotator, like a very sharply pitched propeller, running on the end of a braided line. As the ship traveled, the rotator turned, turning the line. The line was connected to an odometer mechanism, which recorded the distance traveled since leaving the last port.

C. Ship Silhouettes



D. Plimsoll Load Line Mark

Merchant sailors around the world can thank Samuel Plimsoll (1824–1898) for reducing their likelihood of ending up in Davy Jones' locker due to overloaded or otherwise unseaworthy ships. Bristol-born Plimsoll gained his knowledge of the dangers that sailors face when he worked in the coal shipping trade. Initially, he heard of the dangers sailors experienced. Later, as he studied British merchant maritime records he learned that well over 1,000 sailors were lost at sea each year in the waters surrounding Great Britain because of overloaded or unseaworthy ships.

Beginning in 1860 Plimsoll began proposing remedies to improve the conditions of life at sea without any tangible success. Sensing the futility of his lone voice Plimsoll sought and won a seat in the House of Commons and carried the fight for safety forward from Parliament. Focusing first on the problem of overloaded ships Plimsoll advocated replacement of "Lloyd's Rule" which was the standard for determining a cargo ship's maximum load line. This rule of thumb calculation was based on measurement of the depth of a ship's hold to determine the minimum freeboard (freeboard being the distance between the ship's waterline and its main deck). The calculation was: depth of hold (in feet) x 3 inches = minimum freeboard.

Lloyd's Rule was inadequate for several reasons. First, it was only required for ships that were insured by Lloyds of London. Second, ship owners were not required to place a visible mark of the load line on a ship's hull. And most importantly, the wide variety of ships (wooden or iron, sail or steam, paddle or screw) ruled out the possibility of one simple calculation being applicable to all cargo ships. Plimsoll's goal was to require all British merchant ships have a load line determined by the hold's depth and volume and the overall characteristics of the ship including the superstructure, and to display the load line on each side so that it would be underwater if the ship were overloaded. Further, because water density varies with both temperature and salinity a ship's buoyancy and its maximum load line could change based on where it is sailing. Although the first mark was a simple circle with a bisecting line, Plimsoll wanted these differences in water conditions taken into consideration, as in the sample above.



TF = Tropical Fresh Water
F = Fresh Water

T = Tropical Sea Water

S = Summer Temperate Seawater

W = Winter Temperate Seawater

In 1876, the United Kingdom Merchant Shipping Act made the load line mark compulsory, although the positioning of the mark was not fixed by law until 1894. In 1906, laws were passed requiring foreign ships visiting British ports to be marked with a load line. Finally, well after Samuel Plimsoll passed on to greener pastures,

the 1930 Load Line Convention obtained an international agreement for universal application of load line regulations.

Samuel Plimsoll also advocated for legal rights for sailors. Before Plimsoll got involved a seaman would be jailed directly if he refused to go to sea once he signed his voyage contract. How widespread was this problem? Consider, an inspector of prisons who in 1860 reported that nine out of twelve prisoners in the jails of southwest England were sailors, imprisoned for twelve weeks for refusing to sail in ships they considered to be unseaworthy or without adequate crew. A case in point was the ship *Harkaway* of 898 tons. In 1866, four successive crews received twelve week jail sentences for refusing to go to sea on this ship on the grounds that even at anchor in a calm harbor the ship took on more than 40 inches of water per day. The fifth crew seems to have validated the complaint when they put to sea aboard *Harkaway* and were never heard from again! British maritime rules passed in 1871 permitted sailors to refuse to go to sea if they determined the ship was unseaworthy.

E. *Chalupa*

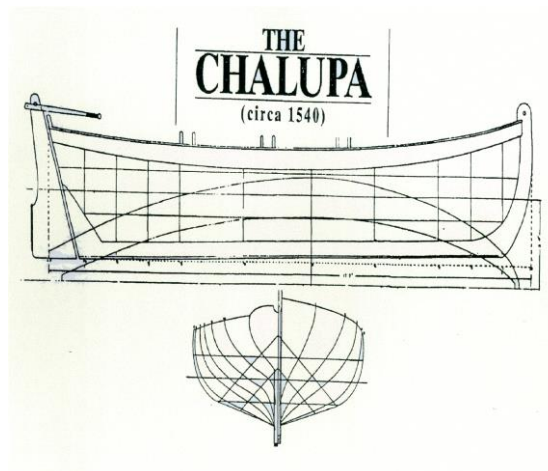
The original *Chalupa* was built in Guatemala at the time of the building of the *San Salvador*, about 1540. She was constructed of woods indigenous to that area, such as white oak, white cedar, and mahogany. With the help of naval architect Melbourne Smith, special plans for construction of the *Chalupa* replica were developed, based on limited information about Cabrillo and his ships, and shipbuilding in that era. Smith conducted research into Cabrillo's voyages and had studied Central and South American boat building techniques and materials for years before consulting on this replica project.

The *Chalupa* measures 17½ feet in length and has a 6-foot beam. An open boat with a very bluff bow and full stern, she was designed to hold both supplies and men. The boat is unusually full at the ends, which suggests an ability to carry sizable loads. Since the *Chalupa* was a good-sized vessel herself in relation to the *San Salvador*, Cabrillo carried only one boat of that type on his flagship.



While you could comfortably fit five fully-armed men into the *Chalupa*, three additional men would not overload the sturdy craft. With this in mind, a single boat could carry a significant landing party, either for defensive purposes, or for the exploration of foreign shores, where the Indians might be hostile.

The *Chalupa* was heavily built, as is evidenced by the thick, weighty keel (3 inches x 5 inches x 16 feet). The stem of the *Chalupa* is also of massive dimensions, which would have been valuable in rough seas and during hard landings on uncharted shores such as those at San Diego in 1542. Three men rowed and one handled the tiller, and it is possible that a small sail, probably a single spritsail stepped forward of amidships, was hoisted in favorable wind conditions.



F. Glossary of Nautical Terms

In the interest of brevity, certain common nautical terms have been omitted from this glossary. If a desired definition is not listed here, consult references in the Museum library or go on-line.

aback	The position of the sails when the wind presses them toward the mast.
abaft	Behind, toward the stern.
abeam	To the side of a vessel, at or near a right angle to the line of the keel or the beam.
aft	In, near or toward the stern of a vessel.
afterguard	The master and officers; in a general sense, all those quartered amidships and in the after part of the ship.
alee	On the lee side of a ship; to leeward; downwind.
aloft	On or to a higher part of a vessel, such as the rigging, generally with reference to the deck. Overhead.
amidships	In or toward the part of a ship midway between the bow and stern.
anchor	A heavy forging or casting shaped to grip the sea bottom and, by means of chain, cable, or rope, hold a vessel in a desired position regardless of wind and current. Traditional anchors have a shank with a large shackle or ring at one end, and two arms with palms at the other. The anchors at the bow of the ship are known as bowers. The anchor on the main deck forward on Star of India is a kedge anchor. From the Greek agkura.
apparent wind	The direction of the wind relative to the moving ship.
astrolabe, nautical	A device used to measure the angular altitude of a celestial body above the horizon. It consists of a metal ring, graduated in degrees, that is held up by a shackle. It has a rotating arm with sighting vanes. Similar to the astronomical astrolabe, it was adapted for navigation in 1484 by Martin Behaim. See the "Navigation" section (Appendix B).
athwartships	At right angles to the fore-and-aft line of a vessel.
avast	Verbal order to stop or cease an action.
aweigh	Refers to the anchor being just off the bottom.
back-staff	A 16th century device used to measure the angular altitude of the sun above the horizon. It improved upon the cross-staff because the observer faced away from the sun. See the "Navigation" section (Appendix B).

backsplice	Splice used to finish the end of a rope by tucking the strands back into themselves.
backstay	A supporting rope or wire aft of a mast; part of the standing rigging.
baggywrinkle	Chafing gear on stays and shrouds made of old rope yarn.
ballast	Heavy material (pig iron, cobble stones, rocks, cement blocks etc.) placed low in a vessel to maintain proper stability.
bare poles	Said of a ship that is underway with no sails set.
bark, barque	A vessel with three or more masts, with all except the aftmost mast square rigged and the aftmost mast fore-and-aft rigged. The Star of India is a bark.
barkentine, barquentine	A vessel with three or more masts which is square-rigged on the foremast and fore-and-aft rigged on all other masts.
barometer	An instrument for measuring atmospheric pressure; also referred to as a "glass". Used to predict weather.
batten down the hatches	To secure the hatches by means of gratings and tarpaulins, which are kept in place with battens and wedges.
battens	Strips of iron that fit into brackets welded to the sides of a hatch coaming and secure the hatch-covering tarpaulins. Also long slender wooden or plastic strips placed in sails to support and hold their form. From French baton, a stick.
beakhead	A protruding section at the bow of a ship, usually found on ships built before the 19 th century.
beam	1) The width of a ship. 2) A transverse structural member of a ship's framing.
beating	The process of sailing against the wind by sailing in a zigzag course.
becket	The eye at the base of a block for making fast the standing end of a fall.
becket block	A block with an eye at one end for the standing end of a fall.
belay	1) To secure a line with turns around a belaying pin. 2) To stop or cease.
belaying pin	A short bar of iron, brass or wood to which lines of the running rigging are made fast or belayed. From the Old English belecgam.
bend	1) A knot which ties the ends of two ropes together. 2) To bend a line or sail is to make it fast to a yard, gaff, mast, boom, or stay.

berth	The shelf-like space allotted to a passenger or member of the crew as a sleeping space. The place assigned to a vessel in port when anchored or lying alongside a pier, quay or wharf where it can load or discharge.
best bower	The anchor on the starboard bow of a ship.
bibbs	Timber bolted to the hounds of a mast to support the trestle-trees.
bight	1) A curved or slack part of a rope between the ends. Some knots can be tied without using the ends of the rope, and are said to be tied "in the bight". 2) A handful of sail when furling.
bilge	The lowest internal space of a ship; the foul water that may collect there.
bilge pump	A pump used aboard ship to remove accumulations of water in the vessel's hold and other compartments and discharge it overboard.
binnacle	A case, box, or stand containing a ship's compass and some form of illumination.
bitt, bits	A single or double post of metal or wood fixed on the deck of a ship for securing mooring or other lines.
bitter end	The inboard end of a cable, rope or line.
blacking down	Tarring the rigging.
block	One or more pulleys mounted in a casing or shell fitted with a hook, eye or strap by which it may be attached. Used to make hauling lines, yards or sheets etc. easier.
board the tack	Secure a special tackle called a tack jigger to the weather clew of the foresail or mainsail, and haul it down to the rail.
boarding-house master	A man who keeps a boarding-house for sailors and sells their services to ships' masters, a crimp.
boat	A small, open craft propelled by oars, sails or some form of engine. This term is also applied to larger vessels built to navigate rivers and inland waters, and sometimes to seagoing vessels. Old Norse <i>beit</i> .
boat hook	A metal hook with a straight prong fixed to a long pole. Used to push or pull a vessel from any place, or to hold on to another object.
boat skid	A rack for holding small boats.
boatyard	A shore-side facility where vessels of varying sizes are built, repaired, maintained or stored.
bobstay	A rope, chain or iron rod that extends from the bowsprit to the stem, which counteracts

	the lifting strain of the foremast stay on the bowsprit. See also martingale and dolphin striker.
boiler, marine	A generating unit used aboard ship to provide steam for propulsion by reciprocating engines or turbines, or for auxiliary purposes such as heating, or for both.
bollard	Single or double metal or wood posts secured to a wharf or pier and used for mooring vessels by means of lines extending from the vessel and fastened to the post(s).
bolt rope	Rope or wire sewn to the edges of sails to strengthen them.
booby hatch	A small hatch used for obtaining access inside a vessel without removing the main hatch covers; a hood-like cover over a small hatch. On the Star of India, the hatch between the foremast and the foc'sle.
boom	A projecting spar or pole used to extend the foot of sails, for mooring boats, handling cargo, or bearing a ship away from a pier or quay wall. Possibly from Old Norse bathum, meaning beam, or Dutch, boom, tree.
boom crotch, boom crutch	1) A structural fitting for resting the main boom of a fore-and-aft rigged craft when at anchor or in port. 2) A stanchion to support the lowered end of a cargo boom at sea.
boot topping	To clean the upper part of a ship's bottom and coat it with a protective layer of antifouling compound.
bosun	Originally "boatswain"; the senior crew man of the deck department, whose duties include the opening and battening down of hatches and cargo ports, maintenance of the hull and rigging, small boats, cargo handling, etc.
bosun's chair	A chair used for working aloft, made from a board with four holes, one at each corner. Two pieces of line formed into loops are passed through the holes and spliced on the underside. The platform thus formed is hoisted aloft to send a man up where foothold is not obtainable.
bosun's locker	A compartment in which are kept tools and other equipment for repairing and making up rigging or cargo gear.
bow	The forward part or head of a vessel. Possibly from the Old Icelandic word bogr, meaning shoulder.
bower anchors	Anchors carried at the bow of a vessel.
bowline	(Pronounced bowlin) 1) A line used to haul the windward leech of a square sail forward, to keep the leech taut when sailing close to the wind. 2) A knot that makes a fixed loop which neither slips nor jams in the end of a line.
bowsprit	A large spar projecting forward from the stem of a vessel, often supporting a jibboom for headsails.

bowsprit shrouds	Stays for lateral support of the bowsprit running from the bowsprit to the side of a ship.
box keelson	A heavy interior support for the keel consisting of riveted plates and angles forming a hollow box or girder of rectangular section.
boxhauling	A method of turning a ship by allowing the wind to push the ship back, and the bow to leeward, until the ship turns completely around.
brace sharp	To bring the yards of a square rigged ship to their greatest possible angle away from square.
brace square	To bring the yards of a square rigged ship to a 90-degree angle to the ship's centerline.
brace up	To bring the yards nearer to a fore-and-aft direction by hauling on the lee braces.
braces	Lines by which the horizontal motion of yards is controlled. From French bras, arm, or possibly the Greek brachion, arm.
brails	Lines used to furl a gaff-rigged sail, such as the spanker. To "brail up" is to haul on the brails, which gather the sail into the mast for furling.
brass bounder	An apprentice in a sailing ship, so called because of his brass-buttoned uniform; a midshipman.
break of the poop	The forward end of a ship's after superstructure; the bulkhead at the forward end of the poop deck.
breast line	A mooring line leading at an angle of about 90 degrees from the fore-and-aft line of the vessel to the wharf or to another vessel.
breastwork	The rails and stanchions on the foremost end of the poop.
bridge	An elevated platform above the main deck from which the ship is conned.
brig	A two-masted square-rigged vessel.
brigantine	A two masted vessel with a square rig on the foremast and a fore-and-aft rig on the mainmast.
bulkhead	Any vertical partition, whether fore and aft or athwartships which separates different compartments or spaces from one another.
bull's eye	A circular piece of hardwood, hollowed in the center, which is set into a strop and used as a fairlead for the buntlines on the face of a sail.
bulwark	The extension of a vessel's side above the weather deck to keep out the sea.
bumkin, bumpkin	A short outrigger projecting from each side of the bow and used for extending the

	foretack or weather clew of a square foresail. A spar extending from the stern of a sail boat to which the backstay is attached.
bunk	A raised recess or compartment, usually enclosed on three sides, which serves as a sleeping berth on a vessel.
bunt	The middle section of a square sail where it is cut full.
bunt-leechlines	Lines attached to the leech and foot of a square sail, used to furl the sail by hauling it up to the yard.
buntlines	Lines attached to the foot of a square sail, used to furl the sail by hauling it up to the yard.
by the wind	As near as possible to the direction from which the wind is blowing.
cabin	An apartment or small room in a vessel for the use of officers or passengers.
cable's length	A traditional unit of nautical measure, varying from country to country. In the U.S. Navy, one cable length is 120 fathoms or 720 feet.
camel	A float placed between the ship and the dock for fending off from the dock.
cap	A block of wood used to join together the head of one mast and the lower part of the mast above.
capstan	A vertically revolving winch used for raising anchor, hoisting yards, lifting heavy items, or warping the ship. Capstan bars fitted into the pigeonholes are pushed by the crew to turn the capstan drum.
capstan bar	A heavy length of wood that is fitted into a pigeonhole of a capstan for turning the capstan drum.
captain	The officer in charge of a ship. Old French chevetagne, chieftain; Latin caput, meaning head or leader
Captain's Railroad	Local slang for two small rail tracks which run alongside the keel of Star of India. They were installed during the restoration period to make it easier to keep the bilge clean, free from rust and painted. Small wheeled cars run on the tracks, enabling crew members to go back and forth easily with their tools and equipment.
cargo	Freight carried by a ship. Spanish cargar, to load.
carpenter shop	On board ship, an area where the ship's carpenter works and keeps the tools and materials of his trade).
carry away	When any part of the vessel's gear or rigging breaks or gives way.

cast off	To let a line go or, to undo the mooring lines in preparation of departing.
cat an anchor	Hoist the anchor to the cathead and make it fast.
cat fall	The line hauled upon when the cat block is secured to the anchor in hoisting it to the cathead.
cat-harpings, catharpins	Short lines just below the top that pull the shrouds toward the mast in order to tighten the shrouds and allow the yards to be braced sharp.
catboat	A centerboard sailing vessel characterized by its single sail and small length-to-breadth ratio. The hull is decked and the cockpit large. Freeboard forward is exceptionally high and breadth is usually just short of half the waterline length.
catenary	A dip in a line or chain caused by the weight of the line itself.
cathead	A projecting piece of timber or iron near the bow of a ship to which the anchor is hoisted and secured.
caulk	To make a vessel watertight by forcing oakum between the planks and then covering these seams with pitch.
ceiling	Interior planking on the frames of a wooden vessel, to the sides and underfoot. Contrast with overhead.
celestial navigation	The art of determining the location or position of a ship at sea by the observation and measurement of celestial bodies (sun, moon and stars).
centerboard	A movable fin or sliding keel made of wood or metal, fitting into a fore-and- aft slot in a keelless sailboat. Its purpose is to increase the area of lateral resistance in the water when the sailing vessel is working to windward, and to prevent excessive leeway.
chafing gear	Cloth or other material put on lines and rigging to prevent damage caused by rubbing.
chain	The term usually applied to that part of the anchor cable made up of chain. There are two types of chain, the stud-link and the open-link.
chain locker	Compartment for the stowage of anchor chain.
chain plate	One of the strips of plating secured to the side of a ship to which the lower deadeye or the lower end of a shroud or stay is fastened.
chain sheets	Chain fastened to the clews of a sail that the sheet is attached to.
chain stopper	A short length of wire or rope secured to the deck near the hawse pipe which is equipped with a slip hook and a turnbuckle, used for securing the anchor chain.
channels	Projections over a ship's side at upper deck level abaft each mast of a sailing vessel to which the shrouds are set up clear of the gunwale. Also used as a platform for a

seaman heaving the lead.

Charlie Noble	Slang for the galley stove-pipe.
chart	A maritime map intended primarily for the use of mariners to assist navigation. French <i>carte</i> , which can be traced to the Greek, <i>khartes</i> , map.
chart room	An area where nautical charts, barometers, chronometers and other navigational devices and equipment are stored for access by the navigator. Also called the chart house.
cheek block	A block attached on one of its cheeks to a mast, yard, or other surface.
cheeks	The sides of a block.
chip log	A wooden quadrant about five inches in radius with lead placed in the circular edge which causes it to float upright. It is made fast to a log line by a three part bridle. Used for estimating a ship's speed.
chronometer	A highly accurate sea-going clock fitted with gimbals to neutralize the motion of the vessel. Used for navigation purposes.
cleat	A "T" shaped fitting bolted to a dock or deck on which lines can be fastened.
clerestory	An upper part of a building or vessel pierced with windows to let light into the interior. On its upper (passenger) deck the Berkeley has a clerestory with opalescent glass windows.
clew	One of two lower corners of a square sail, or the aft lower corner of a fore-and-aft sail.
clew down	To haul on the clewlines and ease the halyard while holding the sheets in order to settle a yard into its fixed lifts.
clew garnet	The clewline of a lower (course) square sail.
clew iron	See spectacle iron.
clewline	One of the lines by which the clews of a square sail are hauled up to the yard. They lead from the clews to the yard arm and then down on deck.
clew up	To haul the clew of a square sail up to the yard by hauling on the clewlines.
clipper bow	Bow in which the stem forms a concave curve which projects outboard above the waterline.
clipper ship	A type of fast, square-rigged vessel, usually a bark or full-rigged ship, employed chiefly in the tea trade from 1843 until the opening of the Suez Canal in 1869. They were the fastest sailing vessels the world had ever seen--long and lean, with sharp bows, raked

masts and a great spread of sail.

close-hauled	A vessel is close-hauled when it sails as nearly as possible in the direction from which the wind is blowing. See also full and by, and by the wind.
coaming	A raised edge around a hatchway to prevent water from running below.
cockbilled	Having one end cocked up; with respect to yards, to tilt them by one lift to an angle with the deck.
cockpit	A well or sunken space in the afterdeck of a small boat for the use of the helmsman and crew.
collision bulkhead	The foremost transverse watertight bulkhead extending from the bottom to the freeboard or bulkhead deck of a vessel.
companionway	1) Steps leading from a companion hatchway to a cabin or saloon below deck. 2) A metal or wooden hood with doors built over a small hatchway on a weather deck to cover and make weather-tight an entrance to the deck below.
compass	An instrument used for determining geographical direction. The magnetic compass uses a magnetized needle which turns freely on a pivot, and points to magnetic north. Recent innovations that do not rely on the earth's magnetic field include the gyrocompass and the astrocompass.
compensating spheres	Balls of soft iron or magnetic material on either side of a compass which neutralize the effect of the metals in a ship on the compass needle.
compound engine	A development from the single-cylinder reciprocating marine engine in which the steam, after leaving the first cylinder, was passed through a second low-pressure cylinder of larger diameter before being drawn off to a condenser to be changed back to boiler feed water. This second use of the steam results in higher engine efficiency.
condenser	A device in which exhaust steam is received from the main engines, turbines or auxiliary machinery and converted into water, which is thereby regained for further use in the boiler feed system.
copper-fastened	Said of a wooden vessel whose planking below the loadline is fastened with copper or bronze instead of iron or steel bolts.
cordage	A general term for line of all sizes and materials, such as rope, twine, etc.
counter stern	A form of stern in which the upper works extend abaft the rudderpost, forming a continuation of the lines of the hull. Also called an overhanging stern.
courses	Square sails bent to the lowest yards on each mast of a square-rigged vessel. A ship is said to be "under her courses" when she has no sails set but her foresail, mainsail and mizzen.
crane-line	A footrope leading from the shrouds to a mast.

crew	The personnel who man a vessel.
crimp	A person who traps or forces men into ships as sailors; a boardinghouse master, or his runner or thug.
cringle	A ring at the edge of a sail containing a thimble used for making lines fast.
cross-staff	An early device used to measure the angular altitude of a celestial body above the horizon. It was first described in writing by Levi ben Gerson (1238-1344), a Jew of Provence. Its invention is ascribed to Jacob ben Makir of the same period. See "Navigation" section (Appendix B).
crossheads	The fixtures at the rudder head connecting with the hand steering gear.
crossjack	(Pronounced crojack) The lowest yard on a ship rigged vessel's mizzenmast, used to spread the foot of a mizzen topsail.
crosstrees	Wood or metal spreaders with slots at each end over which shrouds are led to support an upper mast.
crown	That part of an anchor where the shank and the arms join.
cutter	A single-masted fore-and-aft rigged vessel with more than one headsail.
cutwater	The forward edge of the stem of a ship.
davit	A name given to small derricks of various designs used for hoisting boats, anchors, and ladders, for handling stores, and so on.
deadeye	A stout disk, usually of hardwood, and strapped with rope or iron through which holes (usually three) are pierced for the reception of lanyards. They are used to connect shrouds and chainplates.
dead man	A large bulge in a tightly furled sail resulting from poor furling.
dead reckoning	Determining the position of a ship by laying off on a chart the courses steered and distances run from the last fixed position, without reference to external observations. Due allowance is made for currents, tidal streams, and leeway. See the "Navigation" section (Appendix B).
deck	A platform in a vessel serving usually as a structural element and forming the floor or roof of its compartments. Middle Dutch <i>dec</i> , roof.
deck log	A full nautical record of a ship's voyage, written up at the end of each watch by the officer of the watch.
deckhouse	A superstructure built on an upper or weather deck of a vessel, which does not extend over its full breadth.

derrick	A form of crane consisting of a boom and mast with a whip and tackle connected to a deck winch, for raising items. The boom is capable of being topped up by means of lifts.
ditty bag	A small bag for personal items and tools.
docent	1) A teacher or lecturer at some universities who is not a regular faculty member. 2) A lecturer or tour guide in a museum or cathedral. (German dozent, university lecturer; from Latin, docens, teaching)
dock	The water space between piers, or a basin provided with suitable installations for loading or unloading close to the sea where vessels can lie afloat. Seamen frequently use the term to refer to a wharf or pier, although this is not strictly correct usage.
dog rail	A rail on the foc'sle head to which the headsail downhauls are belayed.
dog watch	A two-hour watch between four and eight PM. These watches permit a shift in the order of the watch every twenty-four hours, so that the same men will not have the same watch every night. See also watch.
doldrums	A belt of calm and light airs lying between the trade winds of the Northern and Southern Hemispheres. See "The Prevailing Winds" section (Appendix A).
dolphin striker	A short spar extending below the cap of the bowsprit used for holding down the jibboom by means of stays. Also called a martingale.
donkey engine	A small reciprocating steam engine found in large sailing vessels, and used for several subsidiary purposes such as working the windlass, hoisting sails, pumping water and handling cargo.
double ender	A vessel built with a stern which has nearly the same lines as the bow to part the waves of a following sea.
double purchase	A purchase using two double sheaved blocks which provides a four-to-one mechanical advantage.
doubling	That portion of the mast where an upper mast overlaps the lower.
douse	To dump the wind out of a sail by hauling the sail up to the yard.
downhaul	A line for hauling down a jib or a staysail or an upper topsail yard.
draft	The depth of a vessel below the waterline, measured vertically to the lowest part of the hull.
drawing	A sail is said to be drawing when it is catching the wind.
drumhead	The top of a capstan.

dunnage	Loose wood carried on a ship.
earring	A line secured to a grommet or eye in the boltrope of the upper corner of a square sail for hauling it outboard on the yard when bending or reefing sail.
earring tackle	A small tackle consisting of two small blocks that is attached temporarily to the upper corner of a sail, used to draw the sail tight on the yard.
ease	To pay out slowly and with care or to reduce strain on the line.
easy up	Command to slack a line under tension while still keeping control of the line.
eight bells	An expression of time at sea, indicating the end of a four-hour duty watch. See also watch.
ensign	The flag carried by a vessel as insignia of her nationality. Usually hoisted on a pole or staff over the taffrail, or in sailing vessels, at the peak of the gaff.
eye of the wind	1) The exact direction from which the wind blows. 2) Dead to windward.
eye splice	A fixed loop made in the end of a rope by turning the end back and interweaving the strands through the standing portion of the line.
fairlead	A strip of wood or metal with holes in it for running rigging to pass through. A ring which guides a line in the required direction.
fake	To lay out a line on the deck in such a way that the line will run clear without fouling.
fall	The entire length of rope in a tackle. The end secured to the block is called the standing part, the opposite end the working part. In hoisting machinery, the part of the rope to which power is applied.
false deck	A deck not a part of a vessel's basic structure which has been installed for a special use.
fanning	Bracing the weather yardarms slightly aft for each successively higher yard.
fathom	A nautical measure equal to six feet; used for measuring cordage, anchor chains, lead lines, and depth of the sea. Old English <i>fæthm</i> , length of the outstretched arms.
fathometer	Also called a sounding machine; a navigational instrument used on board ship for measuring the depth of the sea.
fid	1) A round pin of wood tapered to a point, used to open strands of cordage for splicing. 2) The stout pin used to support the heel of a topmast on the trestletrees.
fiddle block	A block with long cheeks, with one sheave over the other, the lower one being a smaller diameter than the upper one.

fiddle racks	Guardrails used on tables aboard ship to keep crockery and silverware from sliding off during rough weather.
fife rail	A rail at the base of a mast with holes for belaying pins, to which running rigging lines are secured. See also pin rail.
figurehead	An ornamental or decorative figure such as a statue or bust which is placed on the projecting part of the head of a ship, immediately under the bowsprit.
first mate	The second in command aboard a merchant vessel. The officer who executes the captain's orders.
fish tackle	A large tackle consisting of triple sheaved blocks leading from the fore topmast head used to haul the anchor up onto the deck.
fix	A term denoting the determination of a ship's position by observations of celestial or terrestrial objects.
Flemish coil	A line coiled spirally from the center and laid flat on the deck.
Flemish horse	A short footrope at the end of a yard.
flukes	Triangular pieces of metal at the end of anchor arms.
flush decked	Having an unbroken weather deck fore and aft, where no wells or deck houses extend across a vessel.
flying jib	The head sail whose tack is fast to the jibboom or flying jibboom.
foc'sle	A superstructure erected over the bow, or a space below the bow. The inside space is generally used for crew accommodation. A contraction of the two words "fore" and "castle", originally a raised platform for archers or musketeers. (Stern castles also existed on medieval war vessels.)
foc'sle head	1) A small deck above the foc'sle. 2) The foremost part of the weather deck of a vessel.
foot	The bottom of a triangular or a square sail.
footrope	A piece of wire or rope hanging in a bight beneath a yard, supported by stirrups, upon which crew members stand when loosing, furling, or reefing sail.
fore	In, near or toward the stem of a vessel. Also used to describe parts associated with the foremast.
fore-and-aft sail	A sail, either triangular or gaff rigged, that runs lengthwise on a ship.
forebrace	A line attached to the fore-yardarm to change the position of the yard.

forefoot	The intersection of the curved portion of the stem with the keel, or the end of a vessel's stem which is stepped on the keel; may be called the "grip" on a wooden vessel.
foremast	The mast before the mainmast, the first mast abaft the bow (except in a ketch).
foresail	The lowest square sail on the foremast.
forestay	A stay leading from the fore masthead to the bow to keep the mast from falling back and used to set a staysail.
foretop	The platform at the head of the foremast.
foreyard	The lowest yard on the foremast.
forward	At or in the direction of the bow.
forward house	A structure on deck in the forward part of a vessel. A term sometimes used to describe the foc'sle.
founder	Of a ship, to sink.
frames	The ribs of a ship, set at right angles to the keel.
frapping	To take several turns round the middle of a lashing and draw the parts tight together.
freeboard	The vertical distance measured on a vessel's side amidships from the load water line to the lowest deck level where water can enter the ship.
freighter	A vessel engaged in the transportation of freight (cargo).
full and by	1) A vessel is sailing full and by when all sails are drawing full and the course steered is as close to the wind as possible. 2) The name of the Maritime Museum's bi-monthly newsletter.) See also close-hauled, and by the wind.
full-rigged	As applied to a ship, denotes a vessel with a bowsprit and three or more masts carrying square sails.
furling	To take in a sail and secure it to the yard or mast. By hauling on the clew lines, buntlines, leech lines or brails, a sail is brought close to its yard, stay or mast, where it is secured snugly until it is required to be spread again.
futtock shroud	A short iron rod which supports the top and topmast rigging. Its function is to hold down the rim of the top to the lower mast and so resist the upward pull of the topmast shrouds.
gaff	A spar that stands or hoists on the after side of a mast and supports and extends the top of a fore-and-aft quadrilateral sail.

gaff-topsail	A fore-and-aft sail set between a mast and a gaff.
galley	The kitchen or cookhouse of a vessel.
gangway	1) A narrow, portable platform used as a passage by persons entering or leaving a vessel moored alongside a quay or pier. 2) An opening in the side of a ship by which it is entered. 3) A raised walkway from the quarterdeck to the foc'sle.
gantline	A single line rove through a block and used to hoist items aloft.
garboard strake	The length of plank or plating next to the keel of a vessel.
gaskets	Lengths of small rope or canvas straps used to secure a sail to a yard, boom or gaff when furled.
gauges	Instruments or devices used for checking, measuring, marking or testing according to some standard or system.
gimbal	A device consisting of rings or hoops pivoted one within the other, and arranged to maintain an object suspended in their center in horizontal plane regardless of motion outside it.
glass	See barometer.
glass, long glass	A telescope.
grip	See forefoot.
gross tonnage	A measure of the overall size of a vessel; related to, but not equal to, the total internal volume.
gudgeons	Metal brackets attached to the sternpost that receive corresponding pintles attached to the rudder allowing the rudder to pivot.
gunwale	The upper edge of a vessel's side. Pronounced, and sometimes spelled, "gunnel".
guy	1) A line or whip supporting or steadying a spar in a horizontal or inclined plane, such as a bowsprit, davit, or cargo boom. 2) A slack line extending between two masts and carrying a block or tackle. 3) A line used to steady an object when it is being hoisted or lowered. Middle English, gye, and Old French, guie, both meaning guide.
gybe	1) To cross a boomed fore-and-aft sail from one tack to another by bringing the leech of the sail through the wind. This is one of the maneuvers required to wear ship. 2) In recent usage, to wear ship (bring the stern through the wind). See also wear ship.

halyard, halliard	A line used for hoisting or lowering yards, spars, or sails on their respective masts or stays. Old French, haler, and Old Saxon, halar, both meaning to haul.
hand-over-hand	To haul rapidly on a line by passing your hands alternately one before the other, keeping the line in motion.
handsomely	To haul on a line in a slow and careful manner; moderately.
handy-billy	1) A small tackle with two blocks; a small, handy purchase used for various purposes about the decks; also called a watch tackle. 2) A lift pump worked by a hand lever pivoted to a portable standard.
hanks	Small open-ended metal hoops by which the luff of a jib or staysail is bent to the stays.
hard laid	Rope which has been laid up (twisted) tightly.
harden-up	To haul on a line to tighten it as much as possible.
harness cask	A cask in which salt is soaked out of salt beef preparatory to cooking.
hatch	An opening in a vessel's deck affording access into the compartment below.
hatch cover	Timber section placed over a cargo hatch. This is covered with a tarpaulin, lashed down, or fastened down with wooden battens and wedges. ("Batten down the hatches.")
haul	To pull on a line.
hawsehole	An opening, usually cylindrical, in the bow of a vessel into which a hawsepipe is fitted. There are two of these, one on either side of the stem.
hawsepipe	A cylindrical or elliptical pipe made of metal situated near the stem of a vessel through which the anchor cable runs.
hawser	A large rope or cable used for mooring or towing a vessel.
head	1) The upper side of a square sail or a quadrilateral fore-and-aft sail. 2) The upper corner of a triangular fore-and-aft sail, where the halyard is made fast. 3) The upper end of any object, such as a mast, spar, frame, or rudder. 4) The location or compartment with toilet facilities, which originally was the open space at the beakhead of a ship.
heading	The direction in which a vessel's bow points while underway. It is the angle between the meridian and the ship's keel.
headrope	That portion of the boltrope of a square sail along the head of the sail.

headsails	All fore and aft sails forward of the foremast, as in the jibs.
heave	To haul on a line or throw a line.
heave around	To haul on a line with the aid of machinery such as a capstan.
heave to	To bring a vessel to a near standstill by making one set of sails work against another.
heaving line	A light line weighted at one end used for throwing between ships or to the dock. Used to assist in passing heavy mooring lines to the dock.
heel	1) Generally, the opposite of the head, e.g. the lower end of a mast. 2) To lay over from the pressure of the wind on the sails.
helm	The helm proper is the tiller or wheel, but the term is often used to describe the rudder and the gear used for turning it. The word "helm" can denote the whole of the steering apparatus.
helmsman	A person who steers a vessel.
hemp	Cordage made from the fiber of the hemp plant.
hitch	A knot that secures a rope to another object.
hockle	A twist or kink in a line.
hog	The condition of a ship in which the bow and stern have drooped over time due to the lesser buoyancy at the bow and stern than amidships. A vessel that is supported amidships on a wave crest and whose bow and stern are poised over the trough on either side of the wave is said to be subject to a hogging stress.
hold	Space below deck of a vessel, designated for the stowage of cargo.
holiday	An area unintentionally left uncovered when painting or tarring.
hood	A canvas cover set up over a hatch or companionway to protect from the sun or rain.
horns	1) The jaws of booms. 2) The ends of the crosstrees.
horse latitudes	Zones of high atmospheric pressure on the northern or southern limit of the trade winds, where calms and variable winds prevail.
hounds	Shoulder attached to either side of a mast to support the trestletrees.
house flag	A distinguishing flag of a shipping firm. At sea, it is flown at the main truck.

hove to	See heave to.
hull	The body of a vessel exclusive of masts, yards, sails, rigging, machinery, etc.
idlers	Those members of the crew whose time at sea is not divided into watches, who normally work during the day, and who are off duty at night. Typical "idlers" are the cook, bosun, carpenter, sailmaker and storekeeper.
in irons	A sailing vessel is "in irons" when it loses headway and stalls while coming about with the wind directly ahead.
in its gear	A sail is "in its gear" when it has been taken in and is being held by its buntlines, clewlines, and leechlines.
in its lifts	A yard is "in its lifts" when the halyard has been eased and the yard hauled down so that the entire weight is supported by the fixed lifts.
in stays	A sailing vessel is "in stays" when its bow is into the wind while coming about.
inboard	Toward the center of a vessel from the sides.
inhaul	A line used to haul the peak or foot of the spanker into the mast.
Irish pennant	Loose line or twine hanging from the rigging.
jackstay	A metal rod attached across the top of a yard by eyebolts. A square sail is bent onto the jackstay, which also acts as a hand hold for the crew aloft.
Jacob's ladder	A rope ladder having wooden steps, used to climb the side of a ship's hull.
jib	A triangular sail set on the forestays; its tack is made fast to the jibboom.
jibboom	A wooden spar attached to the top of and extending out beyond the bowsprit to which the forestays and the tack of the jib are attached; used to fly one or more headsails (jibs).
jibboom guy (outer, inner)	A wire rope leading from the jibboom to either side of the bow giving lateral support to the jibboom.
jibe	See gybe.
jigger	A light tackle consisting of two blocks used as a general-purpose tackle.
jury rig	Implies a substitute or temporary item.
kedg anchor	A small anchor that is set at a distance from a ship, then used to warp or pull the ship toward the anchor when the wind or tide are unfavorable.

keel	The main centerline structural member running fore and aft along the bottom of a vessel; the backbone or spine of a ship.
keelson	A fore-and-aft center line girder extending from stem to sternpost and located above or between the floor plates. It is usually bolted to the keel in order to stiffen and strengthen the framework of a vessel.
ketch	A two-masted vessel with a fore-and-aft rig in which the mizzen is stepped forward of the rudderpost instead of abaft it, as in the case of a yawl. It differs from the two-masted schooner in that the larger mast and sail stand foremost, whereas in the schooner the reverse is true.
king spoke	The spoke on the ship's wheel which is uppermost when the helm is amidships.
knees	Supports or plates, usually of a triangular shape, provided for the purpose of rigidly connecting intersecting structural members, such as frames and deck beams.
knightheads	Strong vertical posts to the side of the stem that reinforce the bowsprit.
knock down	To roll a ship over with the masts and sails in the water but not fully capsized.
knot	1) A unit of speed, measured in nautical miles per hour. 2) Any deliberate complication in cordage.
ladder	A metal, wooden or rope stairway on board a vessel.
laid	Refers to the direction of the twist of the strands in twisted rope. Right laid rope has strands that twist clockwise away from the observer. Left laid rope is very uncommon.
lamp locker	A small area, usually located in the forepart of a vessel on the upper deck, where lanterns and navigation lights are stored.
lanyard	1) A line rove through the deadeyes, used to tension the shrouds. 2) A line that is attached to tools or equipment to keep them from falling to the deck or overboard. 3) An ornamental braid around the neck of a sailor from which a personal possession is suspended.
lay	The twist of a stranded rope. See laid.
lay aloft	The command for the crew to climb into the rigging.
lay to the waist	Command given when crew is to go to the area on the main deck amidships between bow and stern.
lazarette	A small storeroom below the weather deck, most commonly in the stern.
lead	(Pronounced led) A device for obtaining soundings, usually consisting of a cone-shaped metallic weight (e.g. lead) to which a marked line is attached.

leading part	The part of a tackle that is hauled upon.
lee	The part or side which is sheltered from the wind.
leech	The side of a square sail, or the after edge of a fore-and-aft sail.
leech line	A line made fast at about the middle of the leech of a sail, and passing up through a block on a yard to pull the leech up to the yard. Usually used for lifting a sail when reefing or furling. (See also brails, buntlines.)
leeward	On the downwind side of a ship.
leeway	The sideways drift of a vessel to leeward of the desired course.
let fall	The command to push a sail off the forward side of a yard into its gear.
let fly	The command to free a line immediately.
let go and haul	The order given to brace around the yards of the foremast while tacking a square-rigged ship.
life ring	A circular float used to support a person in the water. Made of cork, foam or some similarly buoyant substance. It has grab lines fastened to its outside edges, and may have a long line attached by which it may be hauled in.
life vest	A flotation device worn on the body, made to support a person in the water. Also called a life preserver, PFD (Personal Flotation Device), or life jacket.
lifting	See luffing.
lifts	1) Fixed lines extending from the yards to the mastheads used to support the yard in its lowered position. 2) Moveable lines used to cockbill the yards.
lime juicer, limey	Nickname for a British ship or sailor. The term is derived from the requirement, under British law, that rations of lime juice be served periodically to crew members to prevent scurvy. See scurvy.
line handler	A crewman who handles mooring lines.
line-throwing gun	A lifesaving gun designed to shoot a projectile with a line attached to it from a beach to a stranded vessel (or vice versa). Also used in high-line and/or breeches buoy operations for transporting stores or personnel from one ship to another. Also called a Lyle Gun after its inventor David A. Lyle, working at the Naval Armory in Benicia, California in 1869.
lines	Ropes used for various purposes aboard ship, such as clewlines, buntlines, leechlines, and for holding a vessel to a wharf. Lines have purposes and are so named. Rope, by

itself, is a general term.

lizard	A short length of line with a thimble at one end through which a line can be rove to act as a fairlead.
log	1) A journal or tabulated summary of all the activities aboard a vessel; also called the logbook. 2) A device used to measure speed for use in determining distance run. See chip log.
log windlass	An early form of windlass in which the "log" or barrel was turned by wooden bars or handspikes inserted into holes, or by a ratchet mechanism connected to brake handles that were pumped up and down by crew members. The Euterpe had such a windlass: a black metal box just forward of the ship's bell on the foc'sle housed a pedestal which supported the brake handles. See also capstan.
long splice	A method of splicing two lines end-to-end in such a way that the final splice is no thicker than the original line.
loose	To cast loose the gaskets of a furled sail to put the sail in its gear.
luff	1) The forward edge of a fore-and-aft sail. 2) To bring a vessel's head closer to the wind by putting the helm down.
luffing	The shaking or slatting of a sail when the sheet is too slack or the vessel is too close to the wind.
lumber ports	See timber ports.
lying to	Said of a vessel when it is lying close to the wind under reduced canvas, with sails adjusted so that they counteract each other. See heave to.
macrame	A coarse lace or decorative fringe made by knotting threads or cords in a geometrical pattern.
magnetic compass	See compass.
main deck	The principal deck of a multi-decked vessel; usually the uppermost deck running continuously from bow to stern, sometimes called the weather deck or spar deck.
main hatch	See hatch. On the Star of India, the main hatch is the large one abaft the deck house and forward of the mainmast which provides access to the 'tween deck and hold.
mainmast	The tallest mast of a vessel, usually the second mast from the bow. The foremost mast in ketches and yawls.
mainsail	(Pronounced mains'l) In a square-rigged vessel, the square sail set from the main yard. Also called the Main Course. In fore-and-aft-rigged vessels, this term applies to the largest sail set from the mainmast.

mainsail haul	(Pronounced mains'I haul) 1) When tacking, an order to swing the main yards around to the new tack. 2) The name, as pronounced, of the Maritime Museum's quarterly, scholarly journal.
mainsheet	The line attached to the clew of the mainsail used to control the sail aft of the mast.
mainstay	A stay extending from the top of the mainmast, forward to the foot of the foremast.
mainyard	The lowest yard on the mainmast to which the mainsail is attached.
make fast	To secure or attach a line, sail, spar, etc.
Marconi rigged	Said of a vessel in which the mainmast is set with a jib-headed sail rather than having a gaff spar.
marl	To bind tightly with marline.
marline	Small two-strand line used for a variety of purposes.
marlinespike, marlingspike, marlinspike	A steel spike pointed at one end; used to haul on cordage, open and close shackles, and separate the strands of rope when splicing.
marry	Twist two or more lines together so that the friction between them will prevent the lines from running free.
martingale stay	A line or chain extending from the jibboom to the lower end of the dolphin striker to counteract the strain of the head stays.
mast	A straight piece of timber or a hollow cylinder of metal set up vertically, or nearly so, in a vessel to support yards, booms, derricks or gaffs, sails, and running rigging.
Mate	The officer, second in command, who assists the Captain in operating a vessel.
mercury barometer	A barometer which consists of a long tube containing a column of mercury, with a vacuum at the top of the column and a mercury reservoir in which the lower end of the tube is immersed. The height of the mercury column measures the atmospheric pressure. See barometer.
midship	The middle of the ship between the bow and the stern or between port and starboard.
miss stays	To be unsuccessful in an attempt to tack; to fail to come about from one tack to another.
mitre seam	The center seam where two sections of a triangular sail are sewn together.
mizzen	An adjective applied to the yards, sails, rigging, and gear belonging to the mizzenmast.

mizzen gaff topsail	A triangular fore-and-aft sail set between a gaff and the mizzenmast above the spanker.
mizzen staysail	The triangular fore-and-aft sail bent on to the stay leading from the base of the mainmast to the head of the mizzen lower mast.
mizzen topmast	The section of the mast located directly above the mizzenmast.
mizzenmast	1) On a three-masted vessel, the aftermost mast. 2) The after mast of a ketch or yawl.
monitor	A low freeboard, shallow draft vessel mounting one or two large guns, usually for coastal bombardment purposes.
monkey's fist	A knot enclosing a weight used on the end of a heaving line.
mooring line	A chain, cable, rope or hawser by which a vessel is secured to a dock or mooring.
mouse	1) A lashing across the mouth of a hook to keep the load from coming out. 2) A large flared section on a stay to act as a stop for an eye.
Napoleon cannon	Cannon developed in France in 1850 as a result of a requirement of Napoleon III. It is a field artillery piece of medium weight or 12-pound caliber with a 4.62 inch diameter bore capable of using both shot and shell.
nautical mile	The standard unit of measure for marine navigation. A nautical mile was historically defined as the length of one minute of arc along a meridian or the equator. Modern measurements of the irregularities of the earth's shape have required refinements of this definition. The internationally accepted standard nautical mile is currently 1852 meters exactly, or 6076.12 feet.
nock	The point immediately above the lower mast where the luff of the gaff topsail is attached.
nocturnal	An early instrument, first described in 1581 by Michel Coignet, for determining time at night using Polaris and stars of the Little Dipper.
oakum	Loosely twisted fiber which may be impregnated with tar or a tar derivative, and used in caulking seams and packing joints.
octant	A reflecting navigational instrument for measuring the angular altitude of heavenly bodies above the horizon. Invented by John Hadley in 1731, the octant has an arc of 1/8th of a circle and can measure angles to 90 degrees. See sextant.
off the wind	Sailing with the wind coming from broad off the bow.
officer	Certificated member of a vessel's staff who assists the Captain in the navigation and operation of a vessel. See mate.

oiler	1) In naval parlance, an oil tanker. 2) An unlicensed member of a vessel's engine room staff who oils and greases bearings and moving parts of machinery.
on the quarter	The wind coming from the quarter, between the stern and the beam.
on the wind	Sailing as close to the direction of the wind as possible; close hauled.
orlop	A partial deck below the lower deck. Origin: Dutch overloop, a covering; Middle English ouerlop.
outer jib	The jib bent on the outer topmast stay, forward of the inner jib.
outhaul	A line by which a sail is hauled outboard along a spar.
overhaul	1) To increase the distance between the blocks of a purchase by easing the running line through the block. 2) Slacking the buntlines and leechlines.
overhead	The underside of the deck above. Contrast with ceiling.
paddle wheel	A large wheel with numerous paddle blades used to propel a ship. Generally superseded by the screw propeller.
padeye	Steel ring attached to the deck or bulkhead to which gear is rigged.
painter	A length of small line used for securing a boat alongside a pier.
pantry	On board a vessel, a small room used for storing food, china, silverware and linens, and from which food is served.
parcel	To wind strips of tarred canvas round a rope after it has been wormed and before serving.
parrel, parral	A rope, chain or metal collar by which a running yard or gaff is kept against a mast, but which allows vertical motion.
partners	The framework that supports the mast at the deck opening.
passage	A journey by water from one place to another.
patent log	A rotator towed by a ship as a means of measuring speed. Though the idea was conceived as early as 1683, it was more than a century before the effects of friction were reduced to an acceptable degree. See the "Navigation" section (Appendix B).
pawl	1) A metal dog at the bottom of the barrel of a capstan which prevents the capstan from turning back. 2) A metal plate which prevents an object from moving.

pay out	To let out chain or ease off on a line.
peak	The upper outer corner of a spanker, or upper corner of a gaff topsail.
pendant	A length of rope or wire attached to a spar or the clew of a sail, used for attaching tackles.
pigeonholes	Holes in the head of the capstan into which the capstan bars are fitted.
pilot	A qualified coastal navigator, usually with expert local knowledge in the piloting of vessels, who is taken on board at a particular place for the purpose of conducting a vessel into or from a port or through a channel or river.
pilot house	The enclosed space on the navigating bridge from which a vessel is usually controlled when underway.
pin rail	A rail placed at the side of a vessel for holding belaying pins to which running rigging lines are secured. See also fife rail.
pintle	A metal pin attached to the leading edge of a rudder that drops into a gudgeon on a vessel's stern for hanging a rudder.
Plimsoll mark, Plimsoll line	The minimum freeboard mark painted on a vessel's sides. Named for Samuel Plimsoll, who promoted merchant shipping acts passed by the British parliament in 1874-76 which brought the question of maximum load lines to a definite solution. See the "Plimsoll Load Line Mark" section (Appendix D) or Chapter II, Star of India, page 9.
point	For navigation, the compass rose is divided into 32 points, making one point equal to 11.25 degrees.
poop, poop deck	1) The aftermost part of a ship, the stern. 2) The aftermost, highest deck of a ship. Middle English, poupe; Latin, puppis, stern or rear of a ship.
pooped	A term applied when a wave breaks over the stern of a vessel.
port	The left side of a vessel when facing toward the bow.
port tack	Sailing with the wind coming from the port side of the vessel.
porthole	An opening provided in the sides or superstructure of a vessel to give light and ventilation.
portolano or rutter	A form of sailing directions used in the Mediterranean between the 12th and 15th centuries. It described coasts, ports, anchorages, rocks, shoals, etc.
prevailing westerlies	The average or normal winds in the middle latitudes of the Atlantic, Pacific and Indian Oceans, where these winds blow consistently from west to east.

preventer	A tackle rigged to back up any rigging.
propeller	A propulsive device consisting of a boss or hub carrying radial blades from two to eight in number. These blades are curved to provide a driving surface for the vessel. Often called a screw.
pump wheels	The flywheels, turned by cranks, which operate the pumps to clear any water from the bilges (bottom of the ship).
purchase	A general term for any mechanical arrangement which uses a combination of blocks to multiply the applied force.
quadrant	An early instrument used by navigators for measuring the angular altitude of celestial bodies above the horizon. The quadrant was used by Portuguese navigators during their voyages along the West African coast during the second half of the 15th century. See the "Navigation" section (Appendix B).
quarter	A direction referring to the quadrant of the ship between the beam and the stern.
quarter deck	The after part of the upper deck or the portion of the upper deck extending aft from the mainmast to the stern.
quarter-block	A block set under a yard close to the mast that the clews and sheets are rove through.
rake	The aftward inclination from the perpendicular of a mast, funnel or sternpost; the overhang of a vessel forward.
ratlines	(Pronounced ratlins) Rope or wire rungs fastened across the shrouds horizontally to form a ladder for seamen to use when climbing aloft.
ready about	The order to prepare to tack the ship.
recovery sling	A collar with hoisting lines attached, used to recover from the water a person who has fallen overboard. There is a sling of this type aboard the Medea, where a boat davit would be used to do the hoisting.
reef	One of the horizontal portions of a sail which may be rolled or folded up to reduce the area exposed to the wind. To reef is to reduce the area of the sail and secure it by tying reef points.
reeve	To pass a line through a block or fairlead.
regatta	A group of races of sail, power or rowing craft; a water carnival. Corruption of the Italian word rigattare, to wrangle; Spanish regatear, to hassle.
registry	An organization which documents and certifies vessels as meeting the maritime standards of the nation in which the vessel is registered.
revolution counter	An apparatus by which the direction and number of revolutions per minute of an engine

are indicated.

rig	1) The distinctive manner in which the masts and sails of a vessel are disposed. 2) To rig a sailing vessel is to equip it with spars and sails and the associated standing and running rigging.
rigging	A general term for all lines, chains and other gear used for supporting and operating masts, yards, booms, gaffs, and sails.
rigging screws	1) Devices for adjusting the length of shrouds, stays and guys. 2) Clamps for forcing the parts of a wire rope together for splicing purposes.
rise tacks and sheets	The command to clew up the foresail and mainsail into their gear.
roach	1) The curve in the foot of a square sail. 2) An arc of extra sailcloth on the leech of a fore-and-aft sail, aft of a line drawn from the head to the clew.
roaring forties	Strong westerly winds occurring between 40 and 50 degrees South latitude.
roband	Small line used to attach the head of a square sail to the jackstay or the luff of a fore-and-aft sail to the hanks.
rocker keel	A sharply curved rounded keel frequently used in fishing vessels and small craft.
rope	A strong thick cord of strands of fibers or wire, twisted or braided together.
royal	A small square sail, usually the uppermost in sailing vessels, which is carried next above the topgallant sail.
rudder	A device used for steering and maneuvering a vessel. It commonly consists of a flat plane of wood or metal hinged at the forward end to the stern or rudderpost.
rudder amidships	When used as part of a helm order, signifies that the helmsman is to center the rudder so that the vessel turns neither to starboard nor to port.
rudder angle indicator	An electrical or mechanical appliance to indicate at a steering station the angle the rudder makes with the keel of the vessel.
running lights	A general term used to describe the various lights carried from sunset to sunrise by various classes of vessels.
running rigging	Lines hauled on to control spars and sails and perform other functions aboard a sailing vessel.
rutter	See portolano.
sail	1) Cloth, skin, or other strong material which is spread to use the force of the wind to

cause a vessel to move through the water.

2) On a submarine, the housing on the outer hull that surrounds the conning tower; also called the "fin".

sail locker	Storage area for extra sails.
salmon boat	An open, carvel-built, double-ended boat fitted with a centerboard, and partially decked at each end. It usually has a long, low floor, rounded bilge and shallow keel, with little or no rake to the stem and sternpost.
saloon	A ship's dining hall; a large cabin for social use.
salt horse	Slang term for salt beef, which in former days was a staple in the seaman's diet.
salvage ship	A vessel fitted with special equipment for retrieving stranded or sunken vessels and their gear.
Samson post	1) A strong pillar fixed to a ship's deck to act as a support for a tackle or other equipment. Samson posts may contain sheaves, where a line may be rove through and hauled horizontally by many hands, rather than straight down. 2) In small craft, a single bitt placed amidships just forward of the mast, to which the anchor cable is made fast. 3) A short heavily-built mast placed midway between the centerline and bulwarks of a vessel from which a derrick is supported and stayed. It is used to handle light cargo and other similar weights.
sand glass	Another name for an hour glass. It may be calibrated for 28 seconds, or 30 minutes, or some other period of time.
scallops	Slack sections of the luff of a fore-and-aft sail caused by insufficient tension on the halyard.
scandalize	To cockbill the yards at various angles to honor the death of a crewmember.
scurvy	A disease caused by lack of vitamin C, which is needed for the production of collagen. Symptoms include lethargy, opening of old wounds and loss of teeth, and eventual death if untreated. Until it was realized that scurvy could be prevented and cured by an appropriate diet, it was a principal cause of death among sailors on long voyages.
schooner	A vessel with two or more masts all of which have fore-and-aft rigged sails, and the mainmast at least as tall as the foremast.
scupper	A drain set in the decks, waterways, or bulwarks of a vessel to carry off accumulations of water.
scuttlebutt	1) A cask (butt) that has been scuttled by cutting a hole in the side, used for fresh water; later a drinking fountain or faucet. 2) Sailor's slang for rumors.
sea chest	1) A chest which serves a seaman as a trunk.

2) The portion of an intake between a vessel's side and the sea valve.

seaboard

- 1) The country bordering a seacoast.
- 2) The side of a ship toward the sea.

seamanship

A general term for the art by which vessels of all classes and sizes are handled in all conditions of weather.

seize

To bind one line to another with small stuff, or the end of a line to its own standing part to form an eye.

seizing

A lashing or binding that holds two or more lines together.

serve

To wind small stuff around a line in order to prevent chafing.

service

Small stuff wound tightly around a line to prevent chafing.

serving mallet

A wooden hand mallet used to pass service round a line.

sextant

An instrument for measuring angles which is principally employed to measure the angular altitude of heavenly bodies above the horizon, but is also useful in determining the horizontal angles between landmarks to fix position. The sextant has an arc of 1/6th of a circle and can measure angles to 120 degrees. It was developed from the octant in 1757 to increase the angle of measure.

shackle

A bow-shaped, D-shaped, saddle-shaped, or U-shaped metal fitting with a pin across the throat, used as a connection between lengths of chain or rope to attach other fittings.

shackle spike

See marlinespike.

shear pole

A horizontal rod fitted at the base of the shrouds just above the deadeyes to keep the shrouds aligned while they are being set up.

sheave

(Pronounced shiv) A grooved wheel in a block, mast or yard, over which a rope or cable passes.

sheet

A rope or chain fastened to the clew of a sail, and used to extend it or to change its orientation.

sheet home

To haul on a sheet to pull the clew of a square sail down to the yard below.

shellback

A person who has crossed the equator by sea; more broadly, any old sailor.

ship

A general term for seagoing vessels of any kind. A masted vessel larger than a boat and suitable for navigation on the high seas.

ship rigged

A vessel with three or more masts, all with square sails.

ship's bell	A bell traditionally made of brass or bronze with the ship's name engraved on it. It is used for striking the bells which mark the passage of time, or as a fog signal when no other form of audible warning is carried on board.
ship's log	A nautical record compiled from entries taken from the rough log book. It is kept by the chief officer and signed by the Captain.
ship's wheel	A spoked wheel with handles around the perimeter, used to steer the ship by means of its connection to the steering gear and rudder.
shipentine	A four masted bark.
short splice	A method of splicing two lines end-to-end where the resulting splice is thicker than the rope, and will not run freely through blocks.
shot of chain	A length of chain cable between two joining shackles, usually 15 fathoms or 90 feet.
shrouds	Standing rigging of strong wires or ropes extending from each side of a masthead to the sides of a vessel to support the mast laterally.
sidewheeler	A descriptive term for a vessel having a paddle wheel on each side.
sight	An instrumental observation of the sun or other heavenly body for determining the position of a vessel at sea.
signal flags	Special flags used in, or adapted for, signaling between two ships, ship and shore, or entities on shore.
sister hooks	Flat hooks that when joined together form an eye. Used to shackle blocks to an eye.
skid	1) A beam or girder, normally running athwartships, on which a boat is stowed on deck. 2) A framework of planks or timbers fitted to the outside of a vessel abreast of the hatches to prevent injury to the ship's side when cargo is loaded or unloaded. 3) A carriage for storing or moving torpedos on board submarines.
skiff	A flat-bottomed, shallow-draft open boat of simple construction with a sharp bow and square stern.
skylight	A wood or metal structure built over a weather deck opening to afford light and ventilation to the space below.
sloop	A single-masted vessel carrying a mainsail and one headsail.
slop chest	A compartment containing clothing and other necessities provided for the use of a vessel's crew, which may be sold to them during a voyage; a ship's store. Originally, a sea chest from which the Captain sold "slops", or clothing, to his crew.
small bower	The anchor on the port bow of a ship.

small stuff	Small cordage used for whipping and serving.
snatch block	A block with a single sheave which has a hinged opening above the sheave to allow the bight of a rope to be dropped in.
snow brig	A two-masted vessel carrying square sails on both masts with a fore-and-aft sail set on a small mast known as a snowmast. The snowmast is a spar set on the deck about a foot behind the mainmast and attached at the top to the mainmast.
snub a line	To stop a running line by passing it round a pin, cleat, or bollard.
spanker	A triangular or quadrilateral gaff sail set on the after side of the mizzenmast of a square-rigged ship, brig, or bark.
spanker boom	A spar to hold the foot of the spanker.
spar	Generally, a long, round piece of timber or metal used for masts, yards, booms, gaffs, bowsprits and similar items.
spectacle iron	Two or three thimbles cast in a single mold so that two or three lines (sheet, tack, clew line) may be made fast to lead in different directions; used at the clews of square sails.
spider band	A metal band with cleats fitted around a mast for securing running rigging.
spill	To take the wind out of a sail.
splice	To join two lines end-to-end, or make an eye in the end of a line, by interweaving the parts of the line.
sponsons	Projections from the sides of a vessel for protection, stability, or the mounting of equipment.
spreader	An extension projecting horizontally at the crosstrees to spread the backstays.
spring line	A line leading from the forward part of a vessel aft to a pier, dock, or other vessel, or from the after part forward, to keep her from moving ahead or astern.
spritsail	1) A square sail mounted on a yard below the bowsprit. 2) A quadrilateral sail extended by a spar reaching diagonally from a mast to the upper after corner of the sail.
square-rigged	Said of masts or vessels carrying sails extended by yards slung athwartships and trimmed with braces.
stack	1) A metal trunk through which combustion gases are led to the open air. Also called a funnel, smoke pipe, or smokestack. 2) An inclusive term used to describe all of the sails on a particular mast aboard a sailing vessel.

stacked	When the yards are positioned one right above the other.
stanchions	Vertical posts of wood or metal used between decks for support, to support deck railings, or to spread awnings on deck.
standing part	That part of a line or tackle which is made fast, not the part that is hauled upon.
standing rigging	Rigging which acts chiefly to support the masts, i.e. shrouds, stays, backstays, bobstay, bowsprit shrouds, jibboom guys and lifts. When once in position such rigging is not moved except when it requires renewal or adjustment.
starboard	The right side of a ship when facing toward the bow.
starboard tack	Sailing with the wind coming from the starboard side of the vessel.
stateroom	A private compartment aboard ship with sleeping accommodation.
stay	A supporting rope or wire forward of a mast; part of the standing rigging.
staysail	A triangular or quadrilateral fore-and-aft sail set on a stay.
steam steering gear	A steering apparatus in which a steam engine supplies the necessary power for moving the rudder.
steering gear	The wheel, wheel ropes, steering engine (if present), helm, and rudder, and associated fittings used to steer a vessel.
stem	The upright post or bar at the bow of a vessel.
stepped in	Said of a mast when its heel has been secured to the keelson.
stern	The after part of a vessel.
stiffening	Weights, ballast or cargo kept in a ship when the vessel is unloaded, or nearly so, in order to increase or maintain her stability.
stirrups	Short pieces of rope or wire suspended from a yard which support the footropes.
stopper	A short length of rope, wire, or chain used to check the running of a rope or cable, or to secure it while it is being belayed.
stores	Articles accumulated for some specific use, and drawn as needed.
strake	A line of planks or plates abutting each other and extending the whole length of a vessel's hull.

strike	To take down.
stringers	Fore-and-aft strength members of a vessel's structure.
strong back	Large timber mounted in the middle of the cargo hatch that supports the hatch covers.
strop	1) An eye spliced into a line for use round the cheeks of a block. 2) A line with an eye at each end used for lifting.
studding sail	(Pronounced stuns'l) Light, usually quadrilateral sails set from studding sail booms, which are portable extensions of yards.
superstructure	Any structure extending above the upper or main deck as a continuation of the main framing.
swallow	The opening in a block between the block and sheave through which the line is rove.
sway	A method of hauling on a line that is under strain by pulling the line toward you, then down while another crewman hauls in the slack that was created.
sweat	See sway.
swifter	The foremost shroud of the lower masts.
swivel block	Any type of block that has a swivel for a base.
tabling	A hem along a sail's border to which the boltrope is sewn.
tack	1) To bring a sailing vessel around to a new course by bringing the wind across the bow. 2) The direction of a vessel's head with regard to the trim of its sails, as, on the starboard tack, it has the wind coming from the starboard side. See "The Prevailing Winds" section (Appendix A). 3) The lower forward corner of a fore-and-aft sail. 4) On a square-rigged ship, the line that leads forward from the clew of a course and opposes the sheet.
tack jigger	A tackle used to haul down the weather tack of a square sail.
tacking	A maneuver by which a vessel sailing close hauled is brought to another course by turning her head toward and through the wind so that she will sail with the wind on the other side. The opposite of Wearing Ship.
tackle	(Pronounced taykle) A combination of lines and blocks working together, or any similar device affording a mechanical advantage to assist in lifting or controlling a weight or applying tension on board a vessel.
taffrail	The railing about a vessel's stern.

taffrail log	A mechanical device used to determine the distance a vessel has sailed in which the register or recording dial is secured to the taffrail.
tailing	Keeping a steady pressure on a line coming from a sway hook, block, or capstan.
take a strain	When all the slack in a line is pulled in and pressure begins to be exerted on the line.
take a turn	Passing a line around a pin to keep it fast.
tanker	A vessel specially designed and constructed to carry fluid cargoes in bulk.
tarpaulin	A sheet of waterproof material used for covering or protecting objects or areas such as a hatch cover.
taut	Tight, snug, no slack.
tend a line	To control a line that is running.
that's well	A command used to indicate a line has been hauled enough.
thimble	A metal or wooden ring used in rigging to reduce chafing or to control the motion of a line.
throat	The forward upper corner of a four-sided fore-and-aft sail.
throw off	To take a line off a pin and see that the line runs freely.
tiller	A bar of metal or wood connected with the rudder head, and usually leading forward, used to control the rudder.
timber ports	An opening below the hawsepipe or in the stern, used as a cargo port for loading or discharging long pieces of timber. The stern timber ports on the Star of India were closed while at sea with the iron covers seen to either side.
timenoguy	A line led through the mizzen shrouds, used to lift the main brace to prevent it from fouling when bracing.
to windward	Heading into the direction of the wind.
tonnage	A measure of the cargo-carrying capacity of a vessel (see gross tonnage). Not to be confused with displacement, which refers to the weight of a vessel.
top	A platform which rests upon the trestle trees at the head of a lower mast.
top hamper	In sailing vessels, refers to the upper rigging and spars, sails and other gear kept aloft.

topgallant	(Pronounced t'gallant) Relating to the topgallant mast, yard, sails, or stays.
topgallant mast	In a mast made of multiple spars with their ends overlapped, the third spar up from the deck.
topgallant sail	(Pronounced t'gans'l) Square sail set from the topgallant yard (which is carried on the topgallant mast) and is next above the topsail yard.
topmast	In a mast made of multiple spars with their ends overlapped, the second spar up from the deck.
topping-lift	An adjustable line that supports the end of the boom.
topsail	The sail next above a course. It is frequently in two sections, called the upper and lower topsail.
torpedo	A naval weapon used principally by light craft, submarines and aircraft. Usually a self-propelled, neutrally buoyant missile which carries an explosive charge. In the Civil War era, mines were called torpedoes.
trade winds	Aerial currents which form part of the general circulation of the atmosphere, caused by the rising of heated air in the equatorial region and the resulting in-draft from adjacent temperate zones. The word "trade" in this term means "track", as these winds blow with regularity along a fixed track.
traverse board	An approximate means of making out the course made good by a ship during a watch. See the "Navigation" section (Appendix B).
trestletrees	Fore-and-aft framing resting on shoulders of wood bolted to or part of a lower mast, and supporting the weight of the crosstrees and topmast.
trim	1) The condition of a vessel with reference to her horizontal position in the water. The difference between the draft forward and aft. 2) To haul or position the yards and sails of a vessel in such a manner that the wind strikes them at the desired angle.
triple-expansion engine	A multiple-expansion steam reciprocating engine in which the expansion is conducted in three stages, with one high-pressure cylinder, one intermediate-pressure cylinder, and one low-pressure cylinder.
truck	1) The upper extremity of a mast. 2) A wooden disk set on the uppermost extremity of a mast to protect the end grain of the mast from weather. It may have two small sheaves for flag halyards.
trunk	1) The long leg of a knee timber. 2) A vertical shaft.
truss	A heavy swivel with a horizontal and a vertical pivot forming the center of motion for bracing or topping a yard. It is attached to the mast by a metal band. See also yoke.

turnbuckle	A device for adjustment of length fitted at the lower end of shrouds, stays, guys and similar supports, in lieu of deadeyes and lanyards.
turning block	A block that changes the direction of a line.
turtleback	A structure with a pronounced camber or crown like a turtle's back which is installed at the stern of a vessel to protect against injury or damage from the breaking on board of heavy seas.
'tween deck	A deck below the upper deck and above the lowest deck.
twine	Small light line used for whippings and servings.
two-blocked	When two blocks in a tackle are drawn together, preventing further hauling.
two-fold purchase	A purchase using two double sheaved blocks which provides a four-to-one mechanical advantage. See double purchase.
tye chain	A chain attached to the middle of a yard, which is used to hoist the yard. The tye chain passes through a sheave in the mast, and is attached to a halyard for raising and lowering the yard.
under full sail	Said of a vessel when it is under way with all sails set.
unfurl	To cast loose a sail by throwing off the gaskets.
up behind	A command to those holding a line to drop the line so that it may be belayed.
vang	A line leading from the deck to the end of a gaff to keep it steady.
ventilator	A cylindrical tube with a cowl to catch the wind, leading below from the weather deck for ventilation.
vessel	A general term for a floating structure which carries passengers or cargo, or both, and is capable of being used as a means of transportation on water.
waist	An area of the main deck amidships between the bow and stern.
walk away with	The command to haul on a line by grasping it with both hands and walking with it.
walking beam engine	A type of engine in which a beam is pivoted in the center above a vertical cylinder and transmits the motion of the piston down to a crankshaft by a long connecting rod. The most conspicuous use of such an engine is on older side-wheel vessels.
wash port	An opening in the bulwark of a vessel to drain seawater overboard.
watch	1) A system for dividing the day into regular periods of work and rest at sea. This may

be done in a variety of ways. A typical method is to divide each day into six 4-hour watch periods, with bells rung every 30 minutes. At eight bells the 4-hour watch is changed. (For example, 0800 – 8 bells, 0830 – 1 bell, 0900 – 2 bells, 0930 – 3 bells, on to 1200 – 8 bells.)

2) The part of a ship's company on duty during a stated period, as above.
See also dog watch and eight bells.

watch bell	A bell aboard ship used to announce the time for watch-keeping purposes.
waterline	The line indicated along the sides of a vessel by the plane of the surface of the water.
waterway	Gutter at the side of a ship's deck to carry water to the scuppers.
wear ship	A maneuver by which a vessel is brought to the opposite tack by turning her head away from the wind. See "The Prevailing Winds" section (Appendix A). See also jibe.
weather	Toward the point from which the wind is blowing. The weather side of the ship faces the wind.
weigh anchor	To raise or lift an anchor.
wharfage	The exact meaning of this term varies in different ports. It can be defined in a general way as a charge against a vessel for the use of a wharf, quay, or pier.
wheel	See ship's wheel.
whip	A single block with a line rove through it.
whipping	Twine or cord bound around the strands at the end of a rope to prevent them from unlaying or fraying.
whipstaff	A vertical pole used to move the tiller, which controls the rudder. Superseded by the development of the ship's wheel.
widow makers	The sheet blocks for the headsails.
windjammer	1) A term used to describe the class of large, usually square-rigged sailing vessels, lineal descendants of the clipper ships, which operated principally as cargo carriers from the 1870s to the 1930s. Built of iron and steel, rather than wood, most were at least 300 feet long, with some reaching beyond 400 feet, and had masts towering as high as 200 feet above the keel. They could carry large amounts of cargo at impressive speeds over long distances. 2) Colloquially, a merchant sailing vessel, or a person who has sailed in such craft.
windlass	A large winch used to hoist anchors, house them safely, and warp a ship when in harbor.
windward	The general direction from which the wind blows. A point of reference in designating a movement or a location.

worm	To fill the space between the strands of laid rope with small stuff.
worm gear	A spiral device, frequently of metal, with threads which fit into a toothed wheel, which is used to apply power to the wheel.
wythe	A metal band round the yardarm that has eyes for attaching the lifts, braces, and the earing of a square sail.
yacht	A sail, steam, or motor vessel used for pleasure, as distinguished from one used for commerce, war, or scientific purposes. Originally used by nobility for hunting trips along the coasts of northern Europe and Great Britain. Dutch, jacht, later jagt, from their word, jagen, to hunt.
yard	A long, nearly cylindrical spar, tapering toward the ends, and crossing a mast horizontally, which is used to support and extend a sail.
yardarm	The outer end of a yard; that part which lies outboard of the lifts.
yawl	1) A ship's small boat with four to six oars. 2) A sailboat with two fore-and-aft rigged masts, the after mast the smaller of the two and stepped aft of the rudder post.
yoke	The U-shaped metal bar that is secured to the center of the yard and to the truss. See also truss.
z-bar frames	Reverse angle irons which in cross section are z-shaped, used for frame and bulkhead stiffeners.

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H. Torpedoes at the Maritime Museum

Torpedoes figure in three of the Museum's exhibits. Along *Berkeley's* starboard passageway is a model of the 400-foot oil tanker *SS Montebello*, the ship was torpedoed and sunk off California's central coast near the village of San Simeon on 23 December 1941, just over two weeks after the attack on Pearl Harbor. During the early morning attack the Japanese submarine *I-21* launched at least two torpedoes. One may have hit the tanker but did not explode; the other caused significant damage when it struck the starboard side and *Montebello* sank within an hour. The captain and crew of 37 survived without injury, although one of the four lifeboats was damaged by fire from the submarine's deck gun. Included in the Museum's exhibit is the tail-section of one of the Type 95 torpedoes that *I-21* launched. This torpedo may have missed the target; the compressed oxygen tank could have exploded, causing it to separate from the torpedo's tail-section. It was recovered in a fishnet years later near the position where the *SS Montebello* went down.

The Soviet submarine *B-39* carries a replica of a Russian Type 53 torpedo in the forward torpedo room. During the Cold War the Type 53 was the primary weapon of the Soviet submarine fleet. It is designated as Type 53 because it is 53 centimeters (21 inches) in circumference.

Aboard *USS Dolphin* there is no longer any physical evidence of the torpedo tube or the Mark 48 torpedoes that were tested early in the career of this U.S. Navy deep-diving research submarine. The tests determined that the Mark 48 could be successfully launched and operated at depths greater than 3,000 feet.

A Brief History of Torpedoes

In 1800 American inventor Robert Fulton is believed to have introduced the name "torpedo" for an explosive charge to be towed by his submarine *Nautilus*, to demonstrate that *Nautilus* could be used to sink warships. The name comes from the electric ray (genus *Torpedo*, family *Torpedinidae*); both words are derived from the Latin *torpidus*, meaning numbness or stiffness. Two generations after Robert Fulton, during the Battle of Mobile Bay in August of 1864, Rear Admiral David G. Farragut is reported to have given the command, "Damn the torpedoes, full speed ahead!" In doing so he was ordering the Union fleet to steam through what today we would refer to as a minefield. In those days towed, floating or partially submerged explosive devices were called torpedoes.

After the Civil War, weapons technology steadily advanced to the point where explosive charges could be motorized. The word "torpedo" came to mean a self-propelled weapon, while non-motorized weapons became known as mines. Both weapons continue to have similarities. Either can be launched or planted from aircraft, surface ships or submarines. The mine will wait for the target to approach, while the torpedo will go directly toward the target's location or will seek out a target

that may be trying to evade detection. Torpedoes and mines can both be designed to detonate on contact with the target or in proximity to it. Both weapons can have a more destructive effect if they explode beneath the target rather than hitting it.

Torpedo Characteristics

Torpedoes can be driven by battery-powered electric motors or by combustion engines such as turbines and high-pressure water jets. The WWII Japanese Type 95 and American Mark 14 torpedoes were powered by steam turbine engines and could travel at well over 40 knots. Today there are torpedoes that travel at more than 60 knots. Older torpedoes were aimed at targets and could follow a compass course, but they could only score a hit if the moving target's position had been correctly calculated. In the late 1940s homing torpedoes were developed to search for targets using active sonar (pinging and listening) or passive sonar (listening). More recent torpedoes are capable of tracking targets by detecting turbulence produced by propellers or a ship's wake.

Modern torpedoes vary in their destructive power. A tactical weapon might carry a charge just big enough to disable a ship; others can carry payloads of 800 pounds or more, enough to break the keel of a very large vessel. We now know torpedoes with atomic warheads were carried aboard Russian "Foxtrot" submarines during the October 1962 Cuban Missile Crisis.

Torpedo Engines

Electric torpedoes are relatively simple. A battery or series of batteries deliver power to the propulsion motor and to the guidance and homing equipment. Torpedoes that travel at high speeds or go great distances need more power than can be provided by electric motors. Greater power is generally achieved using a combustion engine, requiring oxygen to allow the alcohol, kerosene or other fuel to burn. The U.S. Navy Mark 14 torpedoes of WWII used steam-turbine engines fueled by alcohol and air compressed at 3000 psi. The compressed air tank made up about a third of the torpedo's 21 ft. overall length. While compressed air is easily produced and contained, it is composed mostly of nitrogen (78%) so other richer sources of oxygen were sought to improve power and efficiency of the torpedoes. The Japanese used compressed oxygen in their torpedoes, but experienced many accidental explosions on the way to the target. Americans developed a Mark 16 torpedo that used hydrogen peroxide to provide both oxygen and water for the steam chamber. Much of the exhaust from the Mark 16 was water which eliminated the visible wake of air bubbles characteristic of most steam-driven torpedoes, however the chemical fuel proved to be somewhat unstable and their long-term storage aboard patrolling submarines was considered risky. Today's higher-performance torpedoes make use of a variety of oxygen-producing chemical mixes called monopropellants, which are employed to maximize the volume of oxygen going into the torpedo's engine. The oxygen engines of high-speed impeller jet torpedoes, including newer versions of the Mark 48 that *USS Dolphin* launched

more than 40 years ago, are well beyond the technology of the World War Two and Cold War weapons that can be seen at the Maritime Museum.

Torpedo Warheads

Torpedoes are likely to be stored on board for a long period of time necessitating safety precautions to reduce or eliminate risk of an accidental explosion. The warhead's main explosive charge is a highly stable chemical compound which needs an explosion, known as a booster charge, to set it off. The booster is triggered by an even smaller explosion from a detonator. The detonator contains a small and very fragile explosive that can explode on concussion, from a spark, or on exposure to a sudden change in temperature. This sensitive explosive is housed in a sealed protective chamber. The booster and detonator may be enclosed within the warhead or can be held separately on the ship until ready for use. When the torpedo is launched it must travel a specified distance before the detonator's sealed chamber opens and exposes its small charge to the booster. The torpedo is then fully armed and ready to explode if it hits the target or comes close enough to the target's magnetic field, or otherwise meets the detonation criteria. Interestingly, due to the speed at which sound travels in sea water, if the target is within a mile or so of the firing submarine when the torpedo hits the target and blows up, the three separate explosions (detonator, booster and warhead) can often be clearly heard as click, bang, and BOOM.

The Museum's Torpedoes

The **Japanese Type 95** was similar in many respects to the American Mark 14 torpedoes of the WWII period, and was probably a re-engineered and enhanced copy of the Mark 14. The power plant was a steam turbine engine fueled by kerosene and compressed oxygen, instead of the alcohol and compressed air used by the American version. Because the Japanese had been carefully preparing and refining their weapons during the late 1930s, the Type 95 and other Japanese torpedoes were superior to U.S. torpedoes, which were plagued by erratic exploder mechanisms and faulty depth controls during the first years of the war. The Type 95 and Mark 14 torpedoes were about the same size; 21 inches in diameter and 22 feet long, but the Type 95 was faster with a longer range and carried a fifty percent larger payload.

Note: News accounts of the sinking of the SS *Montebello* indicated that the submarine launched two Type 93 torpedoes, one of which sunk the ship. This information is incorrect. Type 93 torpedoes were too big (by 3 inches in diameter and 6 feet in length) to be launched from Japanese submarines. The Type 93 torpedo was designed as a heavy-duty weapon for use by surface ships such as destroyers and cruisers. With fewer large battleships than the U.S. Navy, Japan wanted to provide extra fire power to its other ships. Because of its size and its 20-mile range, the Japanese Type 93 became known as the Long Lance; it was probably the most famous (or notorious) torpedo of the war. It was often credited with sinkings that were later determined to have been caused by mines or by the

Type 95 fired from submarines. The Type 93 carried nearly twice the payload of the American Mark 14.

The **Russian Type 53** is a class of torpedoes that are each 53 centimeters (21 inches) in diameter. There are several different torpedo models within the Type 53 class. The 53-27 was powered by a standard lead-acid battery and electric motor; other models in the Type 53 class had steam turbine engines. The 53-61 was the first Soviet homing torpedo to run at over 40 knots, quite fast for an early homing torpedo. The 53-65 torpedoes were introduced in 1965 and it is very likely *B-39* would have carried some of these; they were widely used in the Soviet submarine fleet and were also exported to other countries. The 53-65s were wake-homing torpedoes designed to destroy surface ships. These torpedoes were considered very threatening by the U.S. Navy because they detected the turbulence of the target ship's wake rather than the noise of its screws; they could not be fooled by the noise-making devices that were typically used to divert most homing torpedoes. By the mid-1970s the Soviet Type 65 torpedoes (24.6 in. diameter, 30 ft. length) were introduced, using advanced monopropellant power plants which could deliver large payloads at well over 50 knots. These were big torpedoes, the size of the WWII Japanese Long Lance weapons, and were too large for the tubes of older Foxtrot submarines like *B-39*. Soviet torpedoes of the Type 53 class could carry atomic warheads, and signage aboard *B-39* indicates that it might have carried such weapons.

The **American Mark 48** torpedo was designed at the end of the 1960s to keep up with Russian submarine technology. Operational since 1972, the Mark 48 with an oxygen engine became the principal weapon of U.S. Navy submarines, replacing the Mark 14 (compressed air, steam turbine) and Mark 37 (instant-charged battery and electric motor) torpedoes. With the entry into service of the new Soviet Alfa-class submarines in 1972, it was decided to make significant modifications to the Mark 48. Tests were run to ensure that the weapon could keep up with developments, and it was modified with improved acoustics and electronics. The new version of the weapon (also known as Mark 48 Mod 4) was extensively tested and production started in 1985, with entry into service in 1988. From then on, various upgrades have been added to the torpedo. Newer versions of the Mark 48 can be guided from a submarine by wires attached to the torpedo. They can also use their own active or passive sensors to execute programmed target search, acquisition and attack procedures. The torpedo is designed to detonate under the keel of a surface ship, breaking the ship's back and destroying its structural integrity. In the event of a miss, it can circle back for another attempt. The torpedo is propelled through the water by a high-pressure water turbine assembly, which for our purposes might be called a water jet.

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