

# Ahoy Teacher!

We are happy you have chosen to visit the **Noble Maritime Collection**. This letter is confirmation of your trip, so please review all the logistics carefully. *Please present the attached form with your payment balance when you arrive with your class.*

Enclosed you will find your materials and lessons to use in your classroom, and a map to Building D at Snug Harbor Cultural Center. You will be receiving a pre-visit call from a staff educator prior to your trip to review the details of the lesson they have planned for you. Also, our *gift shop trunk* is open for business, and several inexpensive maritime items are available. If your class would like to shop, please tell your educator when they call.

Questions? Call the Education Department at 447-6490 between 9:00 AM and 5:00 PM. We look forward to meeting you and your students, until then....

Hold fast and smooth sailing.

Sincerely,

DB Lampman  
Programs Director

---

Today's date: \_\_\_\_ / \_\_\_\_ / \_\_\_\_

You are registered for \_\_\_\_\_ at \_\_\_\_:\_\_\_\_ until \_\_\_\_:\_\_\_\_  
*Lesson Title*

on \_\_\_\_\_, \_\_\_\_ / \_\_\_\_ / \_\_\_\_, with \_\_\_\_\_ students @ \$ \_\_\_\_ each  
*Day of week, month d yr #*

The total fee for your lesson is: \$ \_\_\_\_\_  
A deposit of \$ \_\_\_\_\_ has been received.  
A balance of \$ \_\_\_\_\_ will be collected upon arrival.

- ♦One adult for every ten students must accompany groups.
- ♦Programs are subject to change.
- ♦Cancellations: Refunds will be given only to those who have notified us at least two weeks in advance, or if there is an official school closing.

## **THE NOBLE MARITIME COLLECTION**

**1000 Richmond Terrace, Staten Island, NY 10301 (718) 447-6490**

### **DIRECTIONS TO THE MUSEUM**

#### ***By car from New Jersey:***

Take the Goethals Bridge east to route 278 East. Exit at Richmond Road/Clove Road. (Do not take the Richmond *Avenue* exit.) Follow the service road to the first light, make a left, and follow Clove Road to Richmond Terrace, where you can go no further. Make a right on Richmond Terrace and follow it until you come to Snug Harbor on the right; it is marked by a black, wrought-iron fence. Go past Snug Harbor to Tysen Street; make a right on Tysen Street, then make the next right on to Fillmore Street, and enter the parking lot of Snug Harbor, which is immediately on your left inside the Snug Harbor fence.

#### ***By car from the Verrazano Narrows Bridge:***

Take the lower level of the Verrazano Narrows Bridge west to Route 278 West; stay in the right lane on the bridge and exit at Bay Street, the first exit after the bridge. Take the service road to the light, make a left, and follow Bay Street five miles, past the Staten Island Ferry Terminal, to Tysen Street on the left. Make a right on Tysen Street, then the next right on Fillmore Street, and enter the parking lot immediately on the left.

#### ***Once you have parked:***

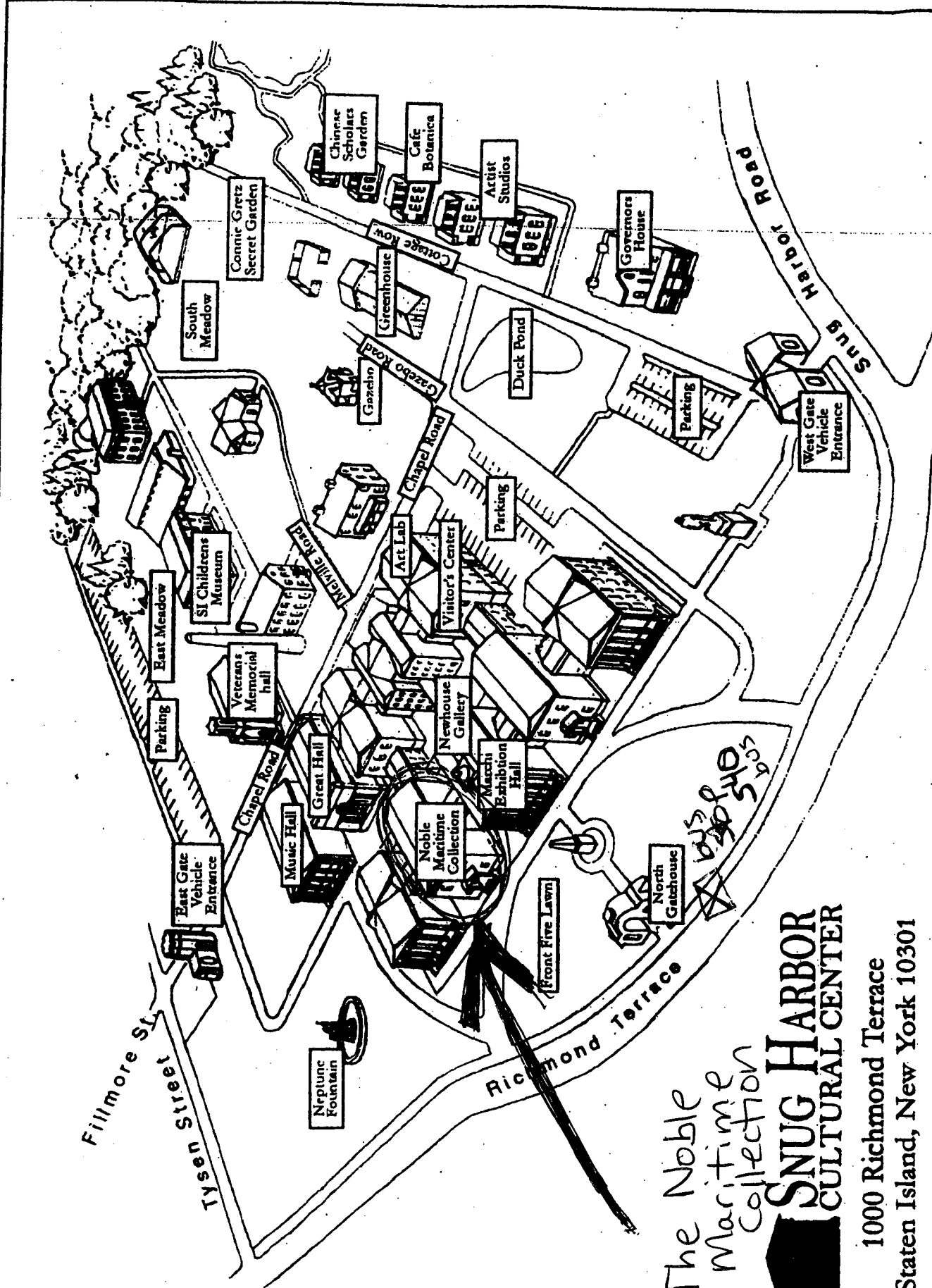
Walk out of the parking lot, across Chapel Road, and down East Randall Way. Follow East Randall Way past the Neptune Fountain on the right, to the front lawn of Snug Harbor overlooking the water. The Noble Maritime Collection is the second building on the left.

#### ***From the St. George Ferry Terminal:***

Take the S-40 bus to Snug Harbor. Cross Richmond Terrace and enter through the main gatehouse. The Noble Maritime Collection is the second building from the left when you are facing the “front five” buildings.

#### ***Parking and Entrance for the Disabled:***

To reach our parking for the disabled, enter at Tysen Street, make the very first right. It is marked “Access for the Disabled to the Noble Maritime Collection ONLY.” Follow that road, East Randall Way, past the Music Hall construction project on your left. At the fork in the asphalt path, make a sharp left. Drive approximately 15 feet until you can go no further, and turn right. The handicapped parking spot approximately 15’ down the slight incline. To reach the handicapped accessible entrance to the museum, leave the parking spot, turn right, and walk down Shinbone Alley to the windowed door at the back of the museum. Ring the bell on the left side of the door, and our staff will welcome you.



The Noble  
Maritime  
Collection

**SNUG HARBOR**  
CULTURAL CENTER

1000 Richmond Terrace  
Staten Island, New York 10301  
718-448-2500 • [www.snug-harbor.org](http://www.snug-harbor.org)

## John A. Noble

How he came to love ships and tell their stories.

*John A. Noble used his artwork to tell the story of the great sailing vessels that traveled the world. He paddled throughout New York Harbor alone in his rowboat to draw, photograph, and learn about ships. The following story will introduce Noble to your class, please read it to them and discuss it before they visit.*

John A. Noble was born in 1913, in Paris, France. His father, John Noble, was an American painter from Kansas, and his mother, Amelia, was from Germany. Young John, or "Boy", as he was nicknamed, grew up among many artists and the "bohemian" social scene around them. His family accompanied by his grandmother, moved from France to England during World War I, and after the war to the United States; John was six years old. They traveled aboard the *Royal George*, a steamship, on the trip from England to New York. John spent the long trip following the ship's carpenter around. He held his tools for him and asked questions as the man worked.

Young John's love of ships continued when his family settled in Provincetown, Massachusetts. This seaside town was both an artist colony and a busy fishing port, and John spent most of his free time playing with the fishermen's children, and had many adventures discovering wrecked ship hulls along the beaches. He sat fascinated, listening to the fishermen's stories of their work and shipwreck disasters. His ears tingled! He began to understand that the sea was not merely a pretty place to play and swim in, but a place to work, full of danger and excitement.

In 1922, when he was nine years old, his parents, grandmother, and little brother Billy, moved to New York City, a growing center for art and the busiest harbor in the world. John was a good student, but things at home were difficult. His father had started to drink alcohol, and was often cruel to him and his mother and brother. John loved his father, but rarely heard a kind word from him.

Rather than head straight home after school, young John "discovered" New York harbor. At age 13, he ventured out along the piers of the waterfront, meeting crews and captains, eager to help aboard the tugs and wooden schooners docked there. The beautiful old sailing vessels, used like waterborne trucks, hauling and delivering bulk cargo, intrigued him. In the summer of 1928, at age fifteen, John begged his parents to allow him to make a trip on a ship named the *Anna Sophia*. She was the largest two-masted schooner on the

East Coast, and was headed to Maine where she was to take on granite to deliver back to New York. His father objected, but his mother saw her son's desire. She paid the captain to take care of her boy, and the *Anna Sophia* cast off with an excited teenage *mate* aboard.

On his way out of New York harbor, along the Kill van Kull, John saw something that he would never forget: the largest boneyard of abandoned wooden sailing ships in the world. He was awestruck by the drama of this quiet, haunting sight. For the rest of his life John watched the harbor change. His beloved wooden sailing vessels, the schooners, disappeared from the waterways and slowly sank into the mud along the shore. Their wooden "bones" are still out there today, though John Noble has been dead since 1983.

John never forgot his boyhood feelings or the smell of the salt air and the breezes ruffling his hair as he worked on the water. He was always drawn to the sea. His life's ambition was to capture the strange ends and beginnings of things on the water, and tell their stories. The people of his hometown of Staten Island treasure his drawings, photographs, prints, and things he collected. It's their history that he recorded, and that's why they built a new museum and study center where Noble's artwork can be enjoyed.

### **Discussion - How about you?**

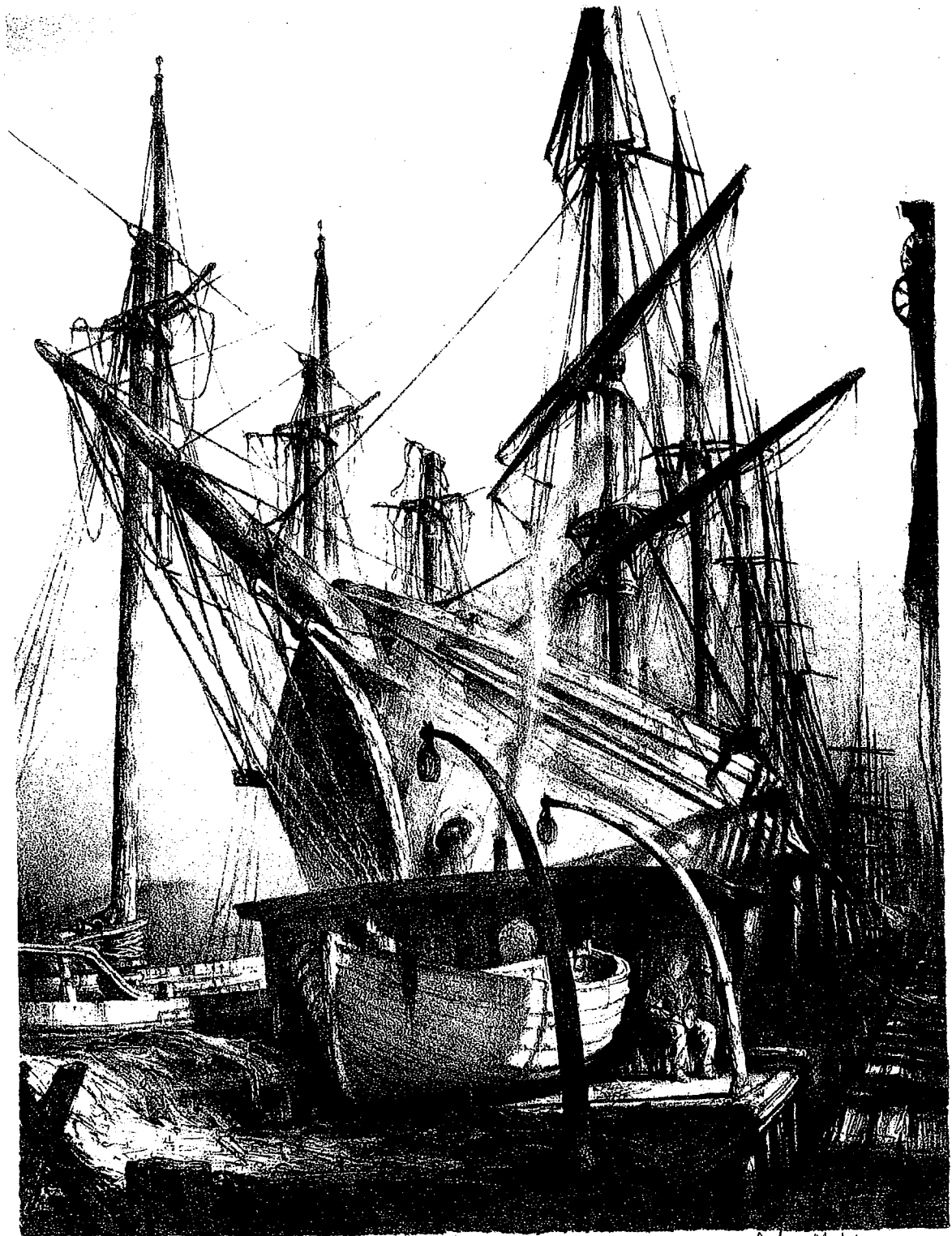
Can you imagine working aboard a sailboat during your summer break?  
Can you describe something remarkable that you have seen or witnessed?  
How about drawing it?

### **What can a picture say to you?**

Look at the enclosed copy of a lithograph called *Cape Horner*, made in 1955 by John Noble. How does it make you feel? Imagine you are in a small rowboat; what can you hear, smell, and touch near this old ship?

### **Start a sketchbook.**

Use a pen or pencil to draw an object you think is special or interesting. The more you draw the better you will get, but don't throw any sketches away. Give your drawings titles and start a scrap/sketch book in which you can write notes, paste items and draw. This is how artists collect ideas while training their eyes and hands.

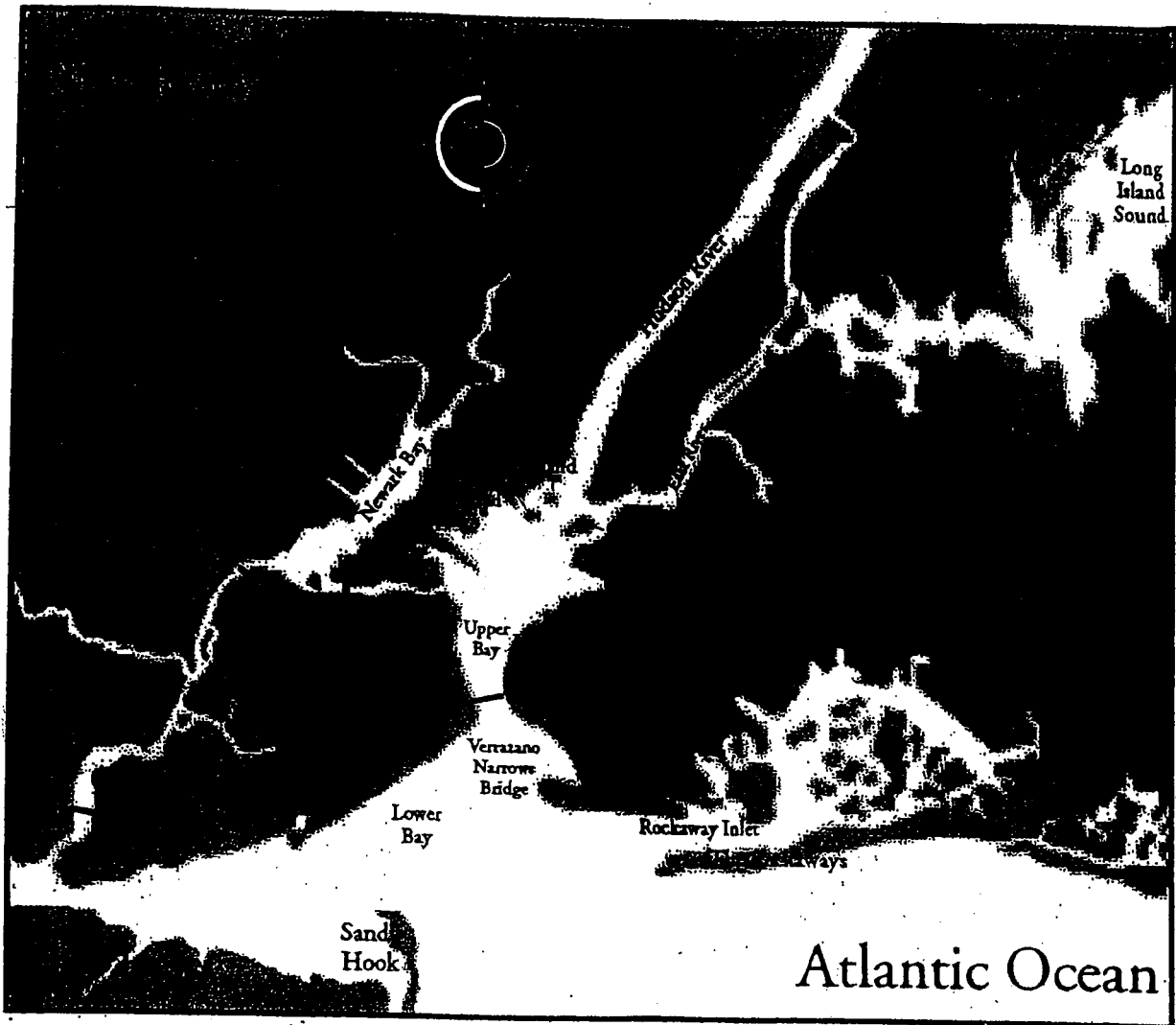


Watchman of the Deck -

John a. Niles

*My Ship, the*

# New York Harbor



Did you know that...

...carved by a glacier during the Ice Age, New York's harbor is so big the great harbors of Hamburg, Liverpool, London, Amsterdam, and Antwerp could all fit inside?

...today New York harbor is the busiest on the East Coast, with over 1000 vessels crossing her waters daily? These include tugboats, cargo ships, barges, ferries, U.S. Coastguard vessels, police boats, and pleasure craft.

... the Staten Island Ferry makes 104 trips daily?

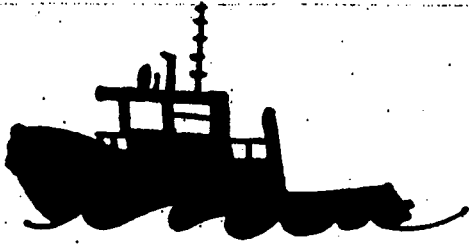
...every large ship entering the lower bay must stop and allow a Sandy Hook Pilot to board and navigate it safely to its upper bay anchorage?

...half of all Americans today have ancestors who arrived as immigrants through New York harbor's Ellis Island?



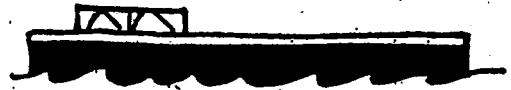
## Spot these Ships.

It's your watch! Learn the shape, name, and use of the following ships. All but one of these vessels can often be seen in New York harbor today, can you spot the exception? *Hint: It doesn't stop for gas.*



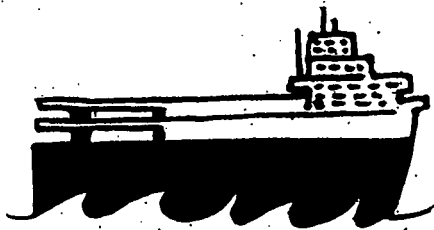
### Tug

The familiar tugboat pulls and pushes large vessels in the harbor, safely guiding them to their mooring. The special cushioned bumpers that surround this boat allow it to touch other hulls without damage.



### Barge

This flat-bottomed vessel has no power of its own. Tugs are used to push or pull a barge with liquid or solid cargo, often to and from large ships, or for moving garbage, construction materials, and debris.



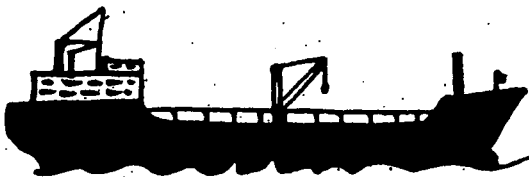
### Ro-Ro

This odd name stands for "roll-on/roll-off." On this ship cars and other vehicles are driven on and off using a ramp, rather than lifted. A Ro-Ro has a very high deck, standing as much as 100 feet out of the water.



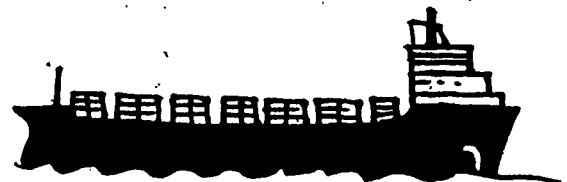
### Schooner

Pictured is a three-masted schooner, a wooden sailing vessel first built in the early 18<sup>th</sup> century. These fast ships were the mainstay of American shipping until the 1930s.



### Tanker

This ship lies low in the water. It is designed to carry liquid cargo, such as fuel, which is pumped in and out of the tanks through a hose.

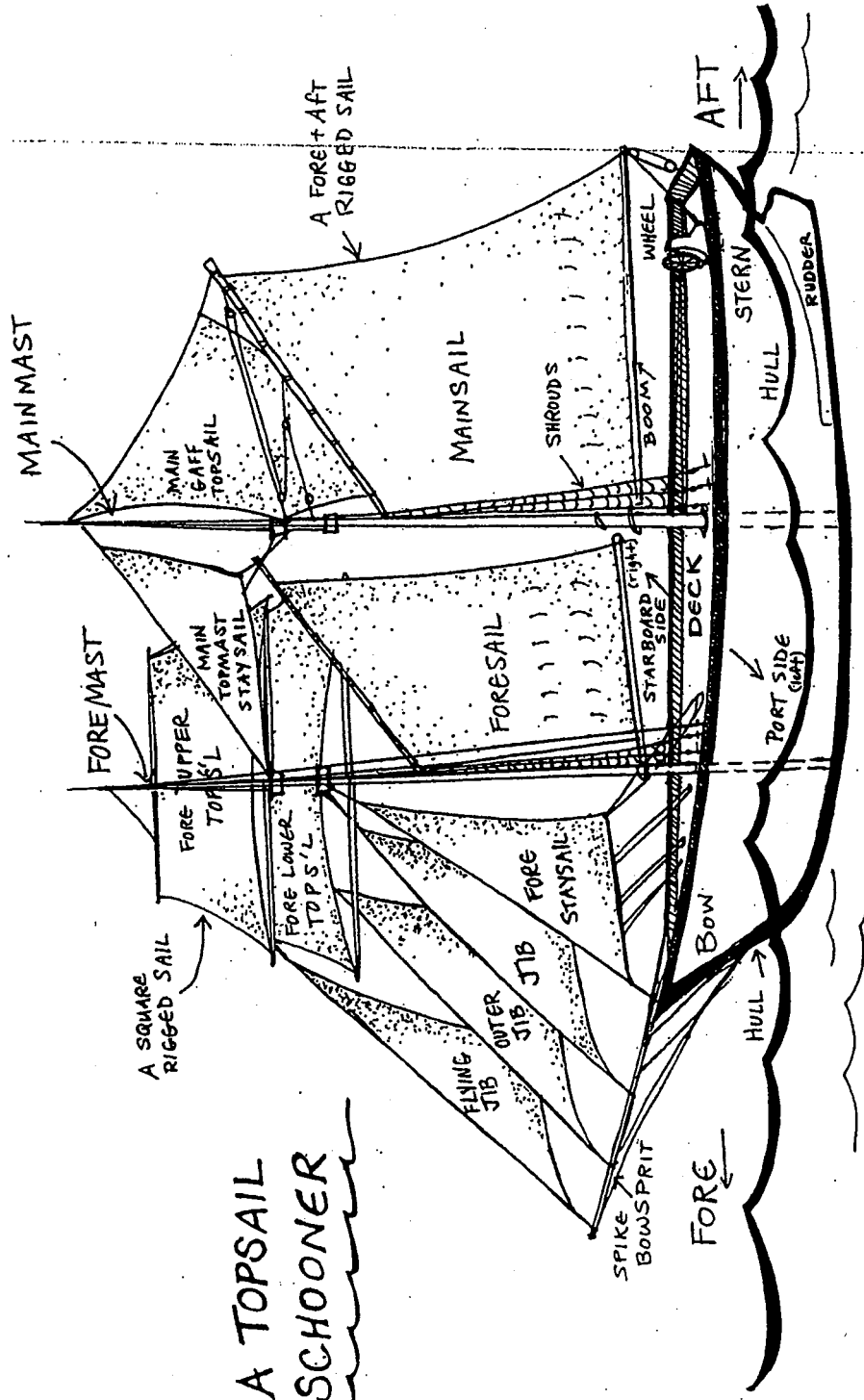


### Containership

Today most goods are packed into large steel containers and loaded onto these long, low ships. Look for the containers piled up on their decks.

# The Parts of a Ship

## A TOPSAIL SCHOONER



### Learn the words, Sailor!

Each part of a sailing ship has a name. To work aboard such a ship safely, you have to learn this new *language*; then, when the first mate calls out an order, the crew works together quickly. The best ways to learn the parts of the ship, without getting your feet wet, is to make a model; or draw a picture of one. Study the diagrams above then try designing your own ship inside the rope-frame page your teacher can copy for you. Then, if you ever get *shanghaied*, you'll know your way around the ship!

## Maritime Vocabulary Words

### Parts of Ships and Waterways:

**Vessel** - any floating craft larger than a rowboat. (ship, boat, barge, ferry, tug,..)

**Deck** - the "floor" of a vessel.

**Bow** - the forward part of a vessel.

**Stern** - the "after" or back end of a vessel.

**Hull** - the underside of the vessel that touches the water.

**Mast** - a pole that carries a sailing vessel's sails.

**Line** - the rope used aboard a ship for tying and rigging.

**Sail** - a cloth used to catch the force of the wind, pushing a boat through the water. Fore-and-aft sails look triangular, while square sails are rectangular.

**Boom** - the pole that holds out the bottom edge of a sail.

**Anchor** - a chained weight that holds (moors) a vessel still by digging into the sea bottom.

**Cargo** - Any goods or merchandise that are carried aboard a trading ship.

**Pier** - a structure built out into the water for docking and boarding a vessel.

**Depth** - the measurement from the surface of the water to the bottom.

**Buoy** - an anchored floating marker that marks a channel or other positions in the water.

**Harbor** - a calm area of water protected by land, where ships can be moored.

**Boneyard** - a place where discarded wooden ships are left to rot away.

### Specialized Nautical Words:

**Starboard** - the right-hand side of a vessel.

**Port** - the left-hand side of a vessel.

**Rudder** - the moveable fin that steers a vessel when the helmsman turns the wheel.

**Mariner** - a seaman, sailor, or experienced seafarer.

**Navigation** - the art or science of getting a ship from one place to another. Answers: where are we now, and which way do we go?

**Channel** - a deep route in a harbor or river safe for a ship to travel.

**Draft** - the depth a boat needs to float freely, a measure from the waterline to the vessel's bottom.

**Chart** - a mariners map of the water, it shows depth, buoys; current, direction, land, etc...

**Fathom** - a way to measure depth; one fathom equals six feet.

**Knot** - a tying of rope; a measurement of speed; one knot equals one nautical mile, or 6,080 feet, per hour.

**Hawser** - a very thick rope used for towing ships.

**Hardtack** - a biscuit which can be stored for long periods without rotting.

**Schooner** - a type of fast wooden ship designed in the 1880's. With two or more masts and triangular looking *fore-and-aft* sails rigged to hang in line with the ship's length. (see picture on the ship spotter page)

**Dry dock** - a place to repair and clean the hulls of large vessels.

# Visual Art Vocabulary

<p><u>Basic Drawing and Watercolor</u></p> <p><b>Still life</b> - a picture of things, a view of objects carefully arranged by the artist.</p> <p><b>Landscape</b> - a picture of an outdoor vista.</p>	<p><u>Printmaking</u></p> <p><b>Plate</b> - a flat base used to create a print. Usually carved-out or built-up, and inked before being run through a press. (often made of metal, cardboard, wood, or linoleum.)</p>
<p><b>Composition</b> - the design of a picture. The placement of color, forms, lines, etc...</p> <p><b>Focal point</b> - a picture's main subject, the part of a composition your eye is drawn to.</p> <p><b>Horizon line</b> - the line where the sky meets the ground, the wall meets the floor, or where lying down meets standing-up.</p> <p><b>Vanishing point perspective</b> - a method of drawing an object or scene so it appears to go back into space.</p> <p><b>Fore-, middle-, and background</b> - three areas of a picture, from the front into the distance.</p> <p><b>Palette</b> - a surface to prepare and mix paint; the group of colors one uses in a picture.</p> <p><b>Hue</b> - another word for color.</p> <p><b>Warm hues</b> - reds, oranges and yellows, colors that tend to jump out at you.</p> <p><b>Cool hues</b> - blues, greens and bluish purples, colors that tend to go back or recede.</p> <p><b>A Wash</b> - a mixture of watercolor hues and water.</p> <p><b>Intensity</b> - how bright or powerful a color is.</p> <p><b>Pentimenti</b> - happy mistakes that add energy to artworks.</p> <p><b>Realism</b> - depicting what your eyes really see.</p> <p><b>Abstraction</b> - depicting what your senses or emotions respond to, rather than what your eyes see.</p>	<p><b>Press</b> - the machine that squeezes (applies pressure) to a sandwich of plate, ink, and paper, creating a print on the paper.</p> <p><b>Press bed</b> - The sliding table part of a press where the plate, paper, and blankets are stacked for printing.</p> <p><b>Press Blanket</b> - the wool cloth used to safely hold, pad, and squeeze the plate and paper together when printing on an etching press.</p> <p><b>Print</b> - an artwork usually stamped from a plate onto paper, often printed many times to create identical copies. <b>To print</b> - to off-set or stamp with ink onto another surface.</p> <p><b>Edition</b> - a series of identical prints (or multiples) each signed and numbered by the artist.</p> <p><b>Proof</b> - any test print an artist makes from a plate before creating an edition of final prints.</p> <p><b>Reverse image</b> - the backwards or mirror image created by printing (your name comes out backwards.)</p> <p><b>Monotype</b> - a print made by painting onto a smooth plate, then printing it onto paper. Mono means one, only <i>one print</i> can be made.</p> <p><b>Etching or Intaglio</b> - a print made by filling inscribed areas of metal plates with ink, and wiping the top areas clean, then printing.</p> <p><b>Lithograph</b> - a print made by drawing an image on a special stone or metal surface, then chemically sensitizing it to receive or repel ink, and printing.</p>

## A Timeline — Featuring New York harbor maritime history and events that changed the world!

To string time together: Copy this timeline onto heavy paper. Have each student cut along the dotted lines, and punch the holes as marked. Use string to connect the pieces to make one long line. Hang vertically. To review, act out the events for each other.

- |         |  |         |  |      |  |
|---------|--|---------|--|------|--|
| Ice Age | A series of glaciers carve out the New York harbor area.   | 1562    | John Hawkins ships the first cargo of slaves from Sierra Leone to the West Indies; the slave trade to the Americas begins.   | 1801 | Robert Richard Randall, son of Thomas Randall, wills his estate to create Sailors' Snug Harbor, a home for mariners.                                       |
| 2600 BC | The compass is invented in China.  | 1577-80 | Sir Francis Drake sails the <i>Golden Hind</i> , on a voyage of exploration around the world.  | 1807 | The first successful steamship, Robert Fulton's <i>Clermont</i> , takes her maiden trip up the Hudson River to Albany.                                     |
| 750 AD  | The Vikings start expeditions, undoubtedly reaching North America.   | 1609    | Henry Hudson arrives in New York harbor. The telescope is invented.  | 1817 | The Black Ball Line, a New York shipping company, advertises regularly scheduled trips to Liverpool, England and back; the packet ship enterprise is born. |
| 1001    | Viking explorer Leif Ericson winters in Newfoundland.  | 1765    | The Boston and New York Tea Parties occur; British cargo is dumped into the harbors.   | 1825 | The Erie Canal opens.  |
| 1300's  | Algonquin tribes migrate into New York harbor area.  | 1775-81 | The American Revolution is fought on land and sea.   | 1827 | Slavery is abolished in New York City.   |
| 1492    | Columbus sets sail towards the Americas.   | 1789    | Thomas Randall, a privateer, merchant, and Sons of Liberty founder, organizes a naval parade across New York harbor carrying George Washington to his inauguration as the first U. S. President. | 1833 | Sailors' Snug Harbor, a home for aging mariners, opens.  |
| 1524    | Giovanni de Verrazano, a white navigator, is the first European to sail into New York harbor. Estaban Gomez, a black captain, is the second. |         |  | 1835 | The Great Fire burns down most of old New Amsterdam.   |


- 1838 A steamboat crosses the Atlantic, with only enough room for coal, water, food, and crew.
- 1840-56 Three million immigrants, arriving aboard ships, pour into New York City.
- 1849 Clipper ships speed 12,000 miles from New York to San Francisco, around Cape Horn in response to the California Gold Rush.
- 1860 The United States develops the world's largest merchant navy fleet.
- 1861-65 The Civil War rages on land and sea. Many merchant ships are used and destroyed in the war effort.
- 1866 The torpedo is invented.
- 1869 Intercontinental Railroad is opened, making westward land travel easier.
- 1879 Telephones are first used in New York City; "Ahoy!" is the conventional greeting.
- 1880's A steady change to steam powered ships; the *Age of Sail* nears its end.
- 1882 Thomas Edison's incandescent light bulb "electrifies" Manhattan.

- 1886 The largest statue in the world "Liberty Enlightening the World" is dedicated in NY harbor.
- 1891 Ellis Island is opened to process new immigrants.
- 1904 The first nine miles of subway track are completed in Manhattan.
- 1912 The passenger steamship Titanic, considered "unsinkable" goes down on her way from England to New York, killing 1,502 people. The disaster causes maritime safety rules to be updated or reformed.
- 1912-50's New York harbor is the busiest in the world.
- 1913 John A. Noble is born in Paris, France.
- 1914 World War I breaks-out in Europe.
- 1919 John A. Noble's family comes to the United States.
- 1921 The Port of New York Authority is created to coordinate harbor activity.
- 1941 Pearl Harbor is attacked; the United States enters World War II.
- 1950 Containerization, a system of shipping is introduced in New York



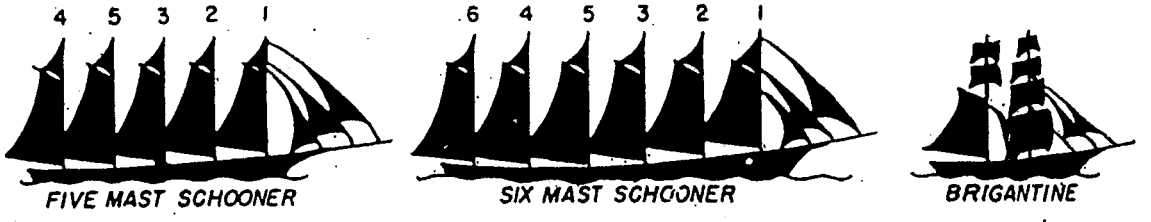
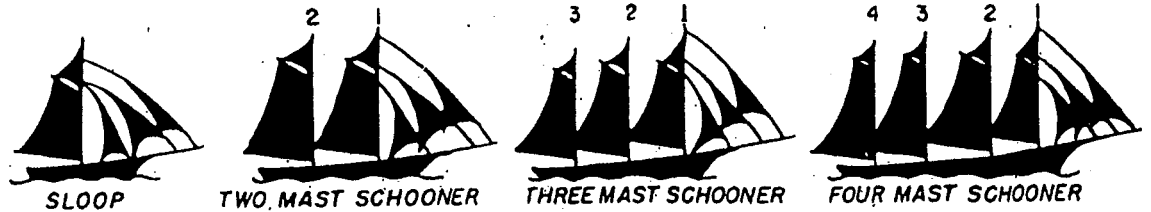
- 1964 The Verrazano Narrows Bridge opens.
- 1969 U.S. Commander Neil Armstrong is the first man on the moon.
- 1976 The Bicentennial ship flotilla in New York harbor; the last Sailors' Snug Harbor residents move to Sea Level, North Carolina.
- 1983 John A. Noble dies; a parade of vessels salutes his memory.
- 1986 A restored Statue of Liberty celebrates her 100<sup>th</sup> birthday; Operation Sail, a maritime parade, fills New York harbor.
- 2000 July 4<sup>th</sup> Op-Sail 2000, the largest peacetime maritime event in history occurs in New York Harbor.
- 2001 September 11<sup>th</sup>, the World Trade Towers of lower Manhattan are attacked and destroyed by terrorists; over 3000 lives are lost. Tugboats, ferries, and coastguard boats evacuate of thousands of citizens to safety.
- 2002 -

# CHART of SHIP, MAST, and RIGGING TYPES

SKYSAILS  
ROYALS  
TOPGALLANTS  
TOPSAILS  
COURSES



FORE AND AFT SAIL  
SQUARE SAIL

- TYPES OF MASTS**
- |               |                |
|---------------|----------------|
| 1. FOREMAST   | 4. SPANKERMAST |
| 2. MAINMAST   | 5. JIGGERMAST  |
| 3. MIZZENMAST | 6. PUSHERMAST  |



609-44005  
x

## Lines and Knots

Sailors use ropes (or lines) to do many jobs aboard a ship, including rigging sails, fastening a vessel to a pier, towing other boats, lifting or tying-down cargo, to name a few. Learn the following *line lingo* and try the five knots we've written out. Be forewarned, even the simple knots are tricky without a sailor on hand! Once you triumph, practice a knot *twenty times in a row*. Try tying-up newspapers at home. Good luck!

**Line** – ropes used aboard ships and boats. Made from many different substances such as hemp, Manila, cotton, coconut husk, and manmade fibers.

**Bitter end** – the end of the line.

**Turn** – to pass a rope around a post.

**Bend** – to fasten; *to bend* one rope to another, the anchor to its cable, etc.

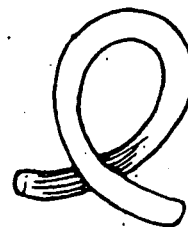
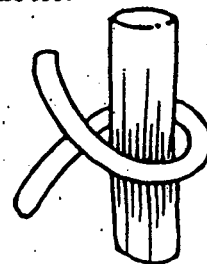
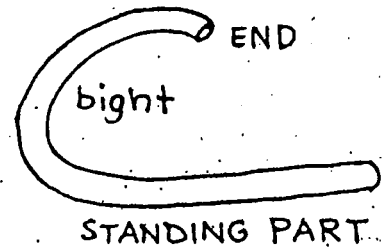
**Bight** – a bend or loop in a rope.

**Overhand loop** – when the rope crosses on top of itself.

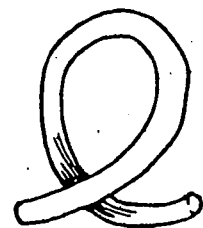
**Underhand loop** – when the rope crosses under itself.

**To coil** – to lay a rope down in circular turns. The coiling of lines is done for safety, neatness, and to preserve the rope. Also rope is sold by the *coil*, which equals 200 fathoms (1200 ft.)

**Fathom** – a measure of rope, or depth, one fathom equals six feet.



OVERHAND LOOP



UNDERHAND LOOP



## Related Books to enjoy:

### *Art and Printmaking*

**The Etcher's Studio**

By Arthur Geisert

Houghton Mifflin Company Boston, 1997

### **Simple Printing Methods**

by Jeanne Cross, S.G. Phillips, Inc.,

New York, 1972

### *Nautical Stories, History, and Reference:*

**What's Inside? Boats**

Conceived, edited and designed by DK  
Direct Limited, 1992

### **The Visual Dictionary of Ships and Sailing**

A Döring Kindersley Book, New York,  
1991

### *Lower Elementary Grades:*

**Jenny's Journey**

by Sheila White Samton

Scholastic Inc., 1991

### *Upper Elementary Grades:*

**The Tale of Neptune's Car**

by Joe Lasker

Viking Press, 1977

### **The Sailor's Alphabet**

Illustrated by Michael McCurdy

Houghton Mifflin Co., Boston, 1998

### **Pirates, Robbers of the High Seas**

By Gail Gibbons

Little, Brown, and Co. Boston, 1993

### *Young Adult:*

**The Sea Rovers, Pirates, Privateers, and**

**Buccaneers**

By Albert Marroin

McClelland & Stewart

### **The Statue of Liberty, America's Proud Lady**

By Jim Haskins, Lerner Publications

Company, Minneapolis 1986

### *Adult/ High School Historical Reference and Stories:*

**Hulls and Hulks in the Tide of Time, The Life and Work of John A. Noble**

by Erin Urban, The John A. Noble  
Collection, Publishers, New York, 1993

**Before The Wind, A Memoir of an American Sea Captain, 1808-1833**

by Charles Tyng

Viking Press, 1999

**Sailors' Snug Harbor, 1801-1976**

by Barnett Shepherd

Snug Harbor Cultural Center, 1979

**Two Years before the Mast,**

by Richard Henry Dana, Jr.

The Collection of Biography and  
Autobiography, The New American Library,  
1985

### **The Endurance, Shackelton's Legendary Antarctic Expedition**

by Caroline Alexander, in Association with  
the American Museum of Natural History,  
Alfred A Knopf, New York, 1999

**The Perfect Storm**

by Sebastian Junger,

W. W. Norton and Co. 1997

**Built on Honor, Sailed with Skill**

The American Coasting Schooner

Frederick F. Kaiser

Sarah Jennings Press

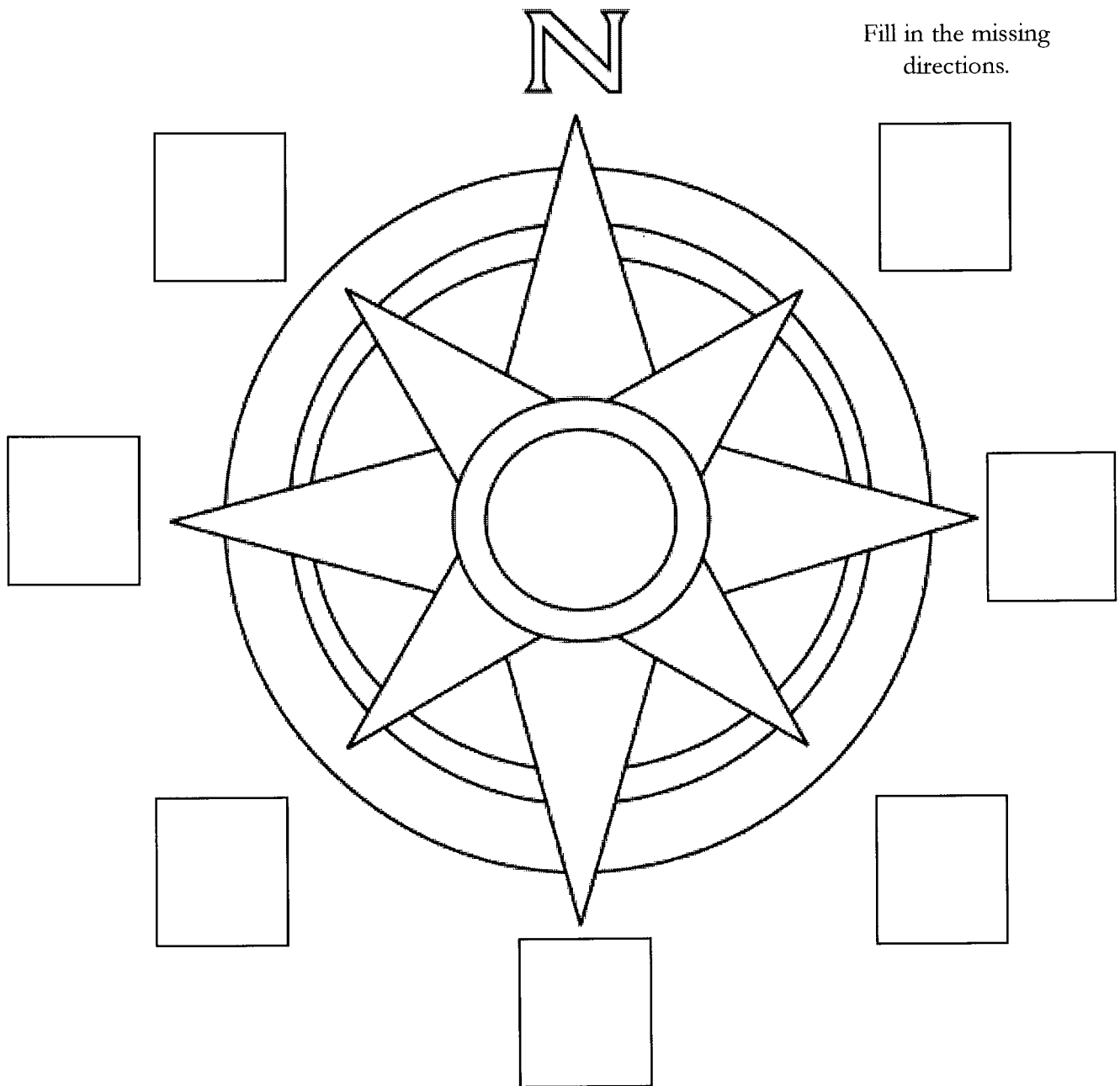
Ann Arbor, 1989

**Hen Frigates, Wives of Merchant**

**Captains Under Sail, by Joan Druett**

Simon and Schuster, 1998

# The Compass Rose

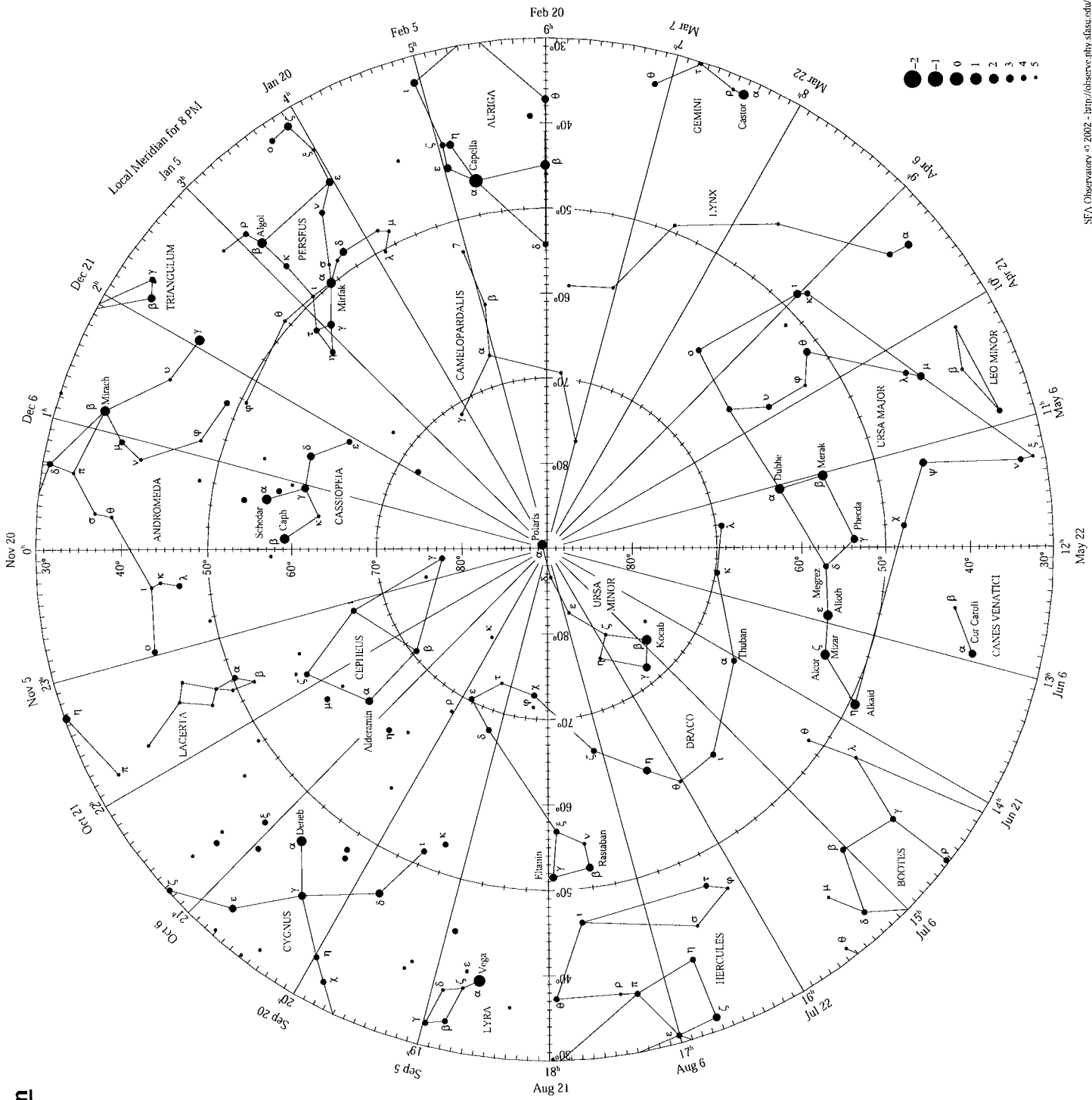


Fill in the missing directions.

A compass rose, sometimes called a windrose, is a figure on a map or nautical chart used to display the orientation of the cardinal directions, — north, south, east, and west. It is also the term for the graduated markings found on the traditional magnetic compass. Today, the idea of a compass rose is found on, or featured in, almost all navigation systems, including nautical charts, non-directional beacons (NDB), VHF omnidirectional range (VOR) systems, global-positioning systems (GPS), and similar equipment and devices. Early forms of the compass rose were known as wind roses, since no differentiation was made between a cardinal direction and the wind which emanated from that direction.

# SFA Star Chart 1 - Northern Region

- ANDROMEDA - Daughter of Cepheus and Cassiopeia
- ANTLIA - Air Pumpe
- APUS - Bird of Paradise
- AQUILA - Eagle
- AQUARIUS - Water Carrier
- ARA - Altar
- ARIES - Ram
- ARIES - Ram
- AURIGA - Charioteer
- BOOTES - Herdsman
- CAELUM - Graving Tool
- CAMELOPARDALIS - Giraffe
- CAPRICORNUS - Sea Goat
- CARINA - Keel of the Ship Argo
- CASSIOPEIA - Ethiopian Queen on a Throne
- CENTAURUS - Half horse and half man
- CEPHEUS - Ethiopian King
- CETUS - Whale
- CHAMAELEON - Chameleon
- CIRCINUS - Compass
- CANIS MAJOR - Larger Dog
- CANIS MINOR - Smaller Dog
- CANCER - Crab
- COLUMBA - Dove
- COMA BERENICES - Berenice's Hair
- CORONA AUSTRALIS - Southern Crown
- CORONA BOREALIS - Northern Crown
- CRATER - Cup
- CRUX - Cross
- CORVUS - Crow
- CANES VENATICI - Hunting Dogs
- CYGNUS - Swan
- DELPHINUS - Dolphin
- DORADO - Goldfish
- DRACO - Dragon
- EQUULEUS - Little Horse
- ERIDANUS - River
- FORNAX - Furnace
- GEMINI - Twins
- GRUS - Crane
- HERCULES - Hero
- HOROLOGIUM - Clock
- HYDRA - Sea Serpent
- HYDRUS - Water Snake
- INDUS - Indian



## The Mariner's Quadrant

Imagine that you are lost at sea on a small boat. You look in every direction but all you can see is the blank horizon. There is no land in sight to show you which direction you are travelling in, or if you are moving at all!

As night falls the sky fills with glittering stars. You know that the brightest star, the Pole Star, indicates north. If only you could measure the height of the Pole Star every night, you could work out your latitude - how far north or south you were drifting....

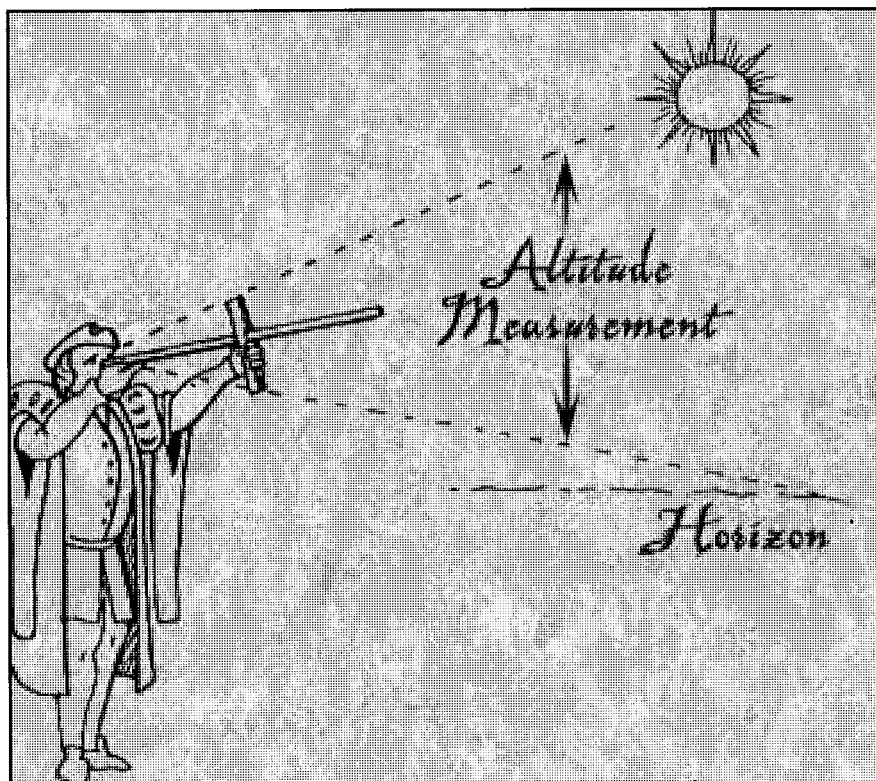
Then you remember. You rummage under some old sails and find the quadrant. Will you be able to use it to find your way safely back to land?

The quadrant is a very simple instrument of medieval origin used to determine the altitude of a heavenly body. It takes its name from its shape, which is a quarter of a circle. The curved edge is divided from 0 to 90 degrees. At the apex is a right angle, where a cord with a small weight, or plumb-bob, of lead or brass is attached. Along one straight edge are mounted two upright pieces with holes for sighting. When in use, the quadrant is held vertically so the plumb-line falls across the scale of degree markings, and from this the angle of elevation can be read.

There were several types of quadrants in use from an early time: The Islamic quadrant had an astrolabe quadrant on one side; the gunner's quadrant was a simple sighting device used by artillery officers; the astronomer's quadrant was engraved with geometrical and square lines showing the sun's path through signs of the zodiac.

The mariner's quadrant was cut from a piece of metal plate - sometimes wood. Its radius was about 6-8 inches. It had a pair of rectangular plates with pinhole sights on one of the straight edges for sighting. The only scale needed was the degree marks on the curved edge. It was light and easy to handle.

Navigators like Christopher Columbus used tools like the quadrant to track latitude across the Atlantic Ocean.





## CHAPTER II.

## INSTRUMENTS USED IN NAUTICAL ASTRONOMY

## 1.—THE SEXTANT.

**Art. 175.** The most important of the nautical instruments for the purposes of the Navigator is the *Sextant*, owing to its small dimensions, its adaptability, and its great degree of accuracy, although it cannot be expected to give results as accurate as those attained by fixed instruments, but sufficiently accurate for Navigation.

Fig. 49 represents the common form of the Sextant. The frame is of brass; the graduated arc, AA, inlaid in the brass, is usually of silver, sometimes of gold or of platinum.

The divisions of the arc are usually 10' each, which are subdivided by the Vernier to 10".

The handle, H, by which it is held in the hand, is of wood. The mirrors, M and *m*, are of plate-glass, silvered. The upper half of the glass *m* is left without silvering, in order that the direct rays from a distant object may not be intercepted.

To give greater distinctness to the images, a small telescope, E, is placed in the line of sight; it is supported in a ring, K, which can be moved by a screw in a direction at right angles to the plane of the sextant, whereby the axis of the telescope may be directed either toward the silvered or the transparent part of the mirror. This motion changes the plane of reflection, which, however, always remains parallel to the plane of the sextant; the use of the motion being merely to regulate the relative brightness of the direct and the reflected images.

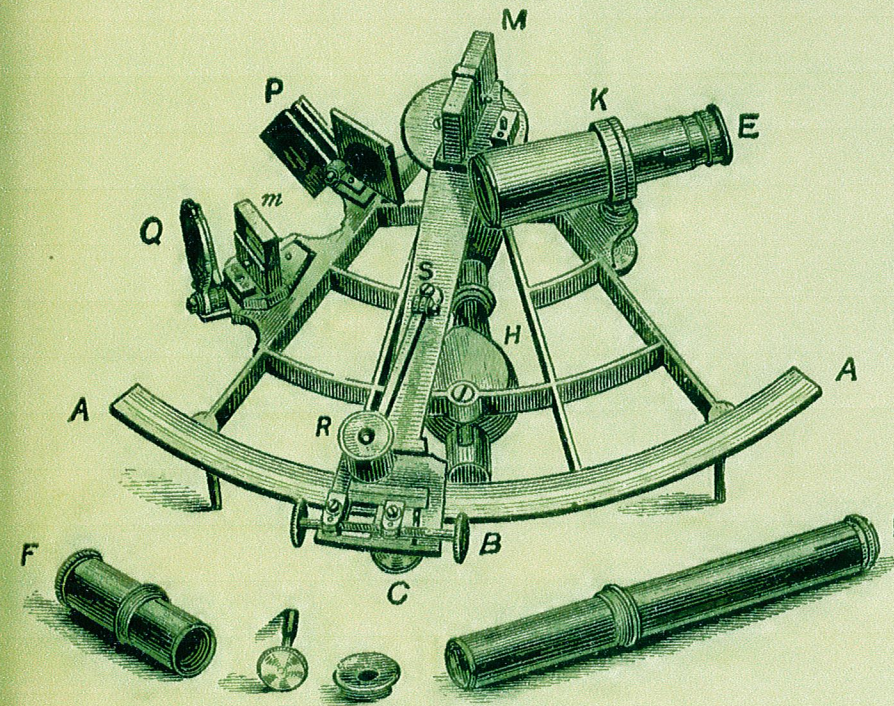


FIG. 49.

The vernier is read by means of a glass, R, attached to an arm which turns upon a pivot, S, and is carried upon the index-bar.

The *index-glass*, M, or central mirror, is secured in a brass frame, which is firmly attached to the head of the index-bar by screws. This glass is generally set perpendicular to the plane of the sextant by the maker with no adjusting screws; other instruments have an adjusting screw at the back of the mirror, to be used in order to replace the mirror in a perpendicular plane, if by accident it has been displaced.

The fixed mirror, *m*, is usually called the *horizon-glass*, being that through which the horizon is observed in taking altitudes. It is usually provided with screws, by which its position with respect to the plane of the sextant may be rectified.

At P and Q are colored glasses of different shades, which may be used separately or in combination to shield the eye from the intense light of the sun.

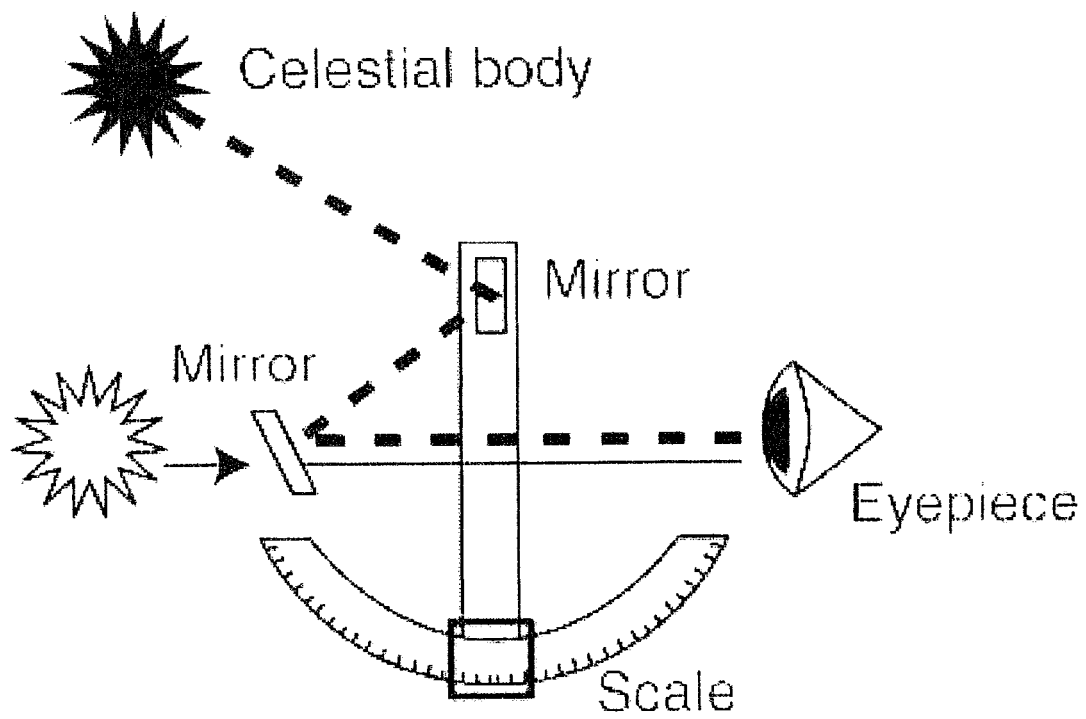
In order to observe with accuracy and make the images come precisely in contact, a *tangent-screw*, B, is fixed to the index, and by this it can be moved with greater regularity than by hand, but this screw does not act until the index is fixed by the screw C at the back of the sextant. Care must be taken not to force the tangent-screw, when it arrives at either extremity of its arc.

When the index is to be moved any considerable quantity, the screw C must be loosened; and when the index is brought nearly to the division required, the screw C must be tightened, and then the index moved gradually by the tangent-screw.

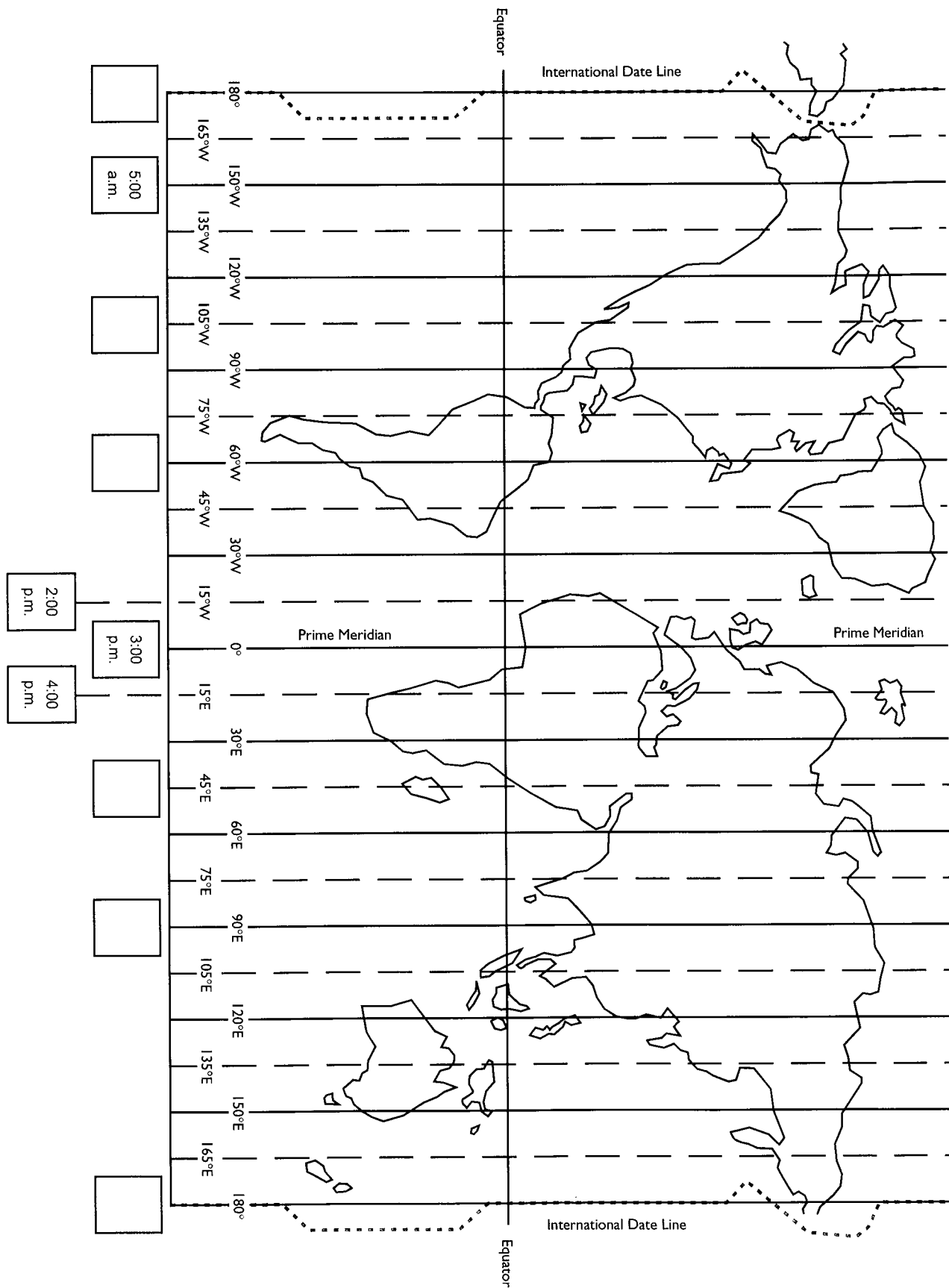
Besides the telescope, E, the instrument is usually provided with an inverting telescope, I, and a tube without glasses, F; also rings with colored glasses to put on the eye-end of the telescope as a substitute for the shades, P and Q, to eliminate any possible errors which might arise from non-parallelism of their surfaces.



## How a sextant works



# ACTIVITY 3 BLACKLINE MASTER: LONGITUDE AND TIME



Earth turns 360° in 24 hours (all the way around in one day). Earth turns 15° in one hour ( $15^\circ = 360^\circ/24$ )

## Longitude, John Harrison and the Marine Timekeepers

In the early 21<sup>st</sup> century, over fifty years after Gould's death, studies in the history of Science and Technology are increasingly teaching us to appreciate and commemorate the vital role played by the backroom boys of technological history: the ones who preserve and record the evidence. In conserving, illustrating and interpreting the scientific and technical evidence left behind, men such as Gould are now beginning to take their proper place alongside the great inventors and scientists; they are just as important in our understanding of the advances that were made. Gould's greatest achievement in this respect was his restoration of the great Longitude timekeepers by John Harrison; a few words of explanation may be useful.

Up until the middle of the 18th century, navigators had been unable to determine their position at sea with accuracy and they faced the huge attendant risks of shipwreck or running out of supplies before reaching their destination. It was, as Dava Sobel has described it: 'the greatest scientific problem of the age'.

Knowing one's position on the earth requires two very simple but essential coordinates; rather like using a street map where one thinks in terms of how far one is up/down (one's Latitude) and how far side to side (one's Longitude). The latitude, how far north or south of the equator one is, is relatively easy to find by the height of the Sun at midday or (in the northern hemisphere) by the height of the pole star; sailors had been finding their latitude at sea for centuries. The longitude is a measure of how far *around* the world one has come from home and has no naturally occurring base line like the equator. The crew of a given ship was naturally only concerned with how far round they were from their *own particular* home base.

Even when in the middle of the ocean, with no land in sight, knowing this longitude position is very simple... in theory. The key to knowing how far around the world you are from home is to know, at that very moment, what time it is back home. A comparison with your local time (easily found by checking the position of the Sun) will then tell you the time difference between you and home, and thus how far round the Earth you are from home. The Earth can be divided up, like the segments of an orange, into 24 one-hour time zones, the 24 hours making up the whole 360 degrees round the earth and each hour's time difference equivalent to 15 degrees of longitude.

The great flaw in this 'simple' theory was – how does the sailor know time back home when he is in the middle of an ocean? The obvious, and again simple answer is that he takes an accurate clock with him, which he sets to home time before leaving. All he has to do is keep it wound up and running, and he must never reset the hands throughout the voyage.

This clock then provides 'home time', so if, for example, it is midday on board your ship and your 'home time' clock says that at that same moment it is midnight at home, you know immediately there is a twelve hour time-difference and you must be exactly round the other side of the world, 180 degrees of longitude from home.

The principle is indeed simple, but the reality was that in the 18th century no one had ever made a clock that could suffer the great rolling and pitching of a ship and the large changes in temperature whilst still keeping time accurately enough to be of any use. Indeed, most of the scientific community thought such a clock an impossibility. Even the great Sir Isaac Newton considered it so. But the stakes were high, especially after 1714 when the British government offered the huge sum of £20,000 for a solution to the problem, with the prize to be administered by the splendidly titled *Board of Longitude*.



## John Harrison

It was this prize, worth about £2 million today, which inspired the self-taught Yorkshire carpenter, John Harrison (1693–1776), to attempt a design for a practical marine clock. History relates that, after a life dedicated to achieving this seemingly impossible goal, resulting in the creation of an extraordinary series of five prototype timekeepers, Harrison succeeded in his goal. With the work of a small band of horological pioneers following in his footsteps, the practical marine chronometer became a reality. From the early years of the 19th century and through the following century and a half, chronometers served in regular use aboard Navy ships and merchant vessels alike.



John Harrison (1693–1776) in the engraving by Tassaert (c.1768) after the portrait by Thomas King (c.1765). Harrison's extraordinary series of five prototype marine timekeepers led to the solution to the longitude problem, and the fourth, H4, was also the first of all precision watches (NMM ref: PAG6373).

It was these fantastically complex and abstruse timekeepers of Harrison's that, after a century and a half of neglect, Gould restored to their former glory during the 1920s and 30s. In order to convey the magnitude of what Gould achieved with the restoration of these machines, it will be helpful to explain a little of Harrison's development work, and the nature of the timekeepers themselves.

The Government prize of £20,000 was the highest of three sums on offer for varying degrees of accuracy, the full prize only payable for a method that could find the longitude at sea within half a degree. If the solution was to be by timekeeper (and there were other methods since the prize was offered for any solution to the problem), then the timekeeping required to achieve this goal would have to be within 2.8 seconds a day, a performance considered impossible for any clock at sea and unthinkable for a watch, even under the very best conditions.

At the time, the only precision timekeepers, of any kind, were pendulum clocks. In the 1720s Harrison himself was making such clocks, which he claimed were capable of maintaining an accuracy of better than one second in a month, in spite of the fact that they were mostly made of wood. To achieve this high precision, Harrison incorporated several extremely ingenious new ideas, including a mechanism to automatically compensate for the effects of temperature. All clocks and watches, rather like the people who use them, tend to go slow when they experience a rise in temperature. Harrison invented a special form of compensated pendulum, using a grid of brass and steel wires, to ensure his clock kept time, whatever the temperature.

He also designed his clocks to run without the need for any oil, the 'Achilles heel' of clockwork: in the eighteenth century clock oil was derived from animal fat and often quickly deteriorated into a kind of acidic glue. By designing and incorporating bearings that used rolling contact, instead of sliding contact, Harrison's anti-friction bearings cleverly sidestepped this problem. No one before Harrison had ever made a mechanical clock to work without oil, and very few have done so since.

Watches on the other hand, were universally dismissed, being seen as jewellery, and not as serious timekeepers. Even the very best pocket watches of the day could only keep time to within about a minute a day and their timekeeping was generally thought of as impossible to improve. So clocks looked like the logical instrument to develop, but a pendulum clock would be of no use at sea, owing to the ship's motion. So Harrison decided to create something based on his precision long case clocks, but made to withstand movement and wide temperature changes.

And so it was that in 1728 John Harrison began to design a series of 'sea clocks', as he called them, which were to become the most celebrated and arguably the most important timekeeping devices ever constructed in the history of mankind. These were the machines that led Harrison to prove, in the face of universal skepticism, that a marine timekeeper was a practical possibility. Harrison's machines led directly to the solution to the longitude problem, immeasurably strengthening the British Royal and merchant navies and saving of countless lives at sea over the following two centuries.

Harrison eventually built five timekeepers, the last two in the form of large watches, and since the 1950s they have generally been referred to as 'H1' to 'H5'. It should be noted that the term *marine chronometer* was not widely used until after Harrison's death. The word 'timekeeper', however, had very special significance in the 18th century. It was only used to describe a portable machine capable of high accuracy.