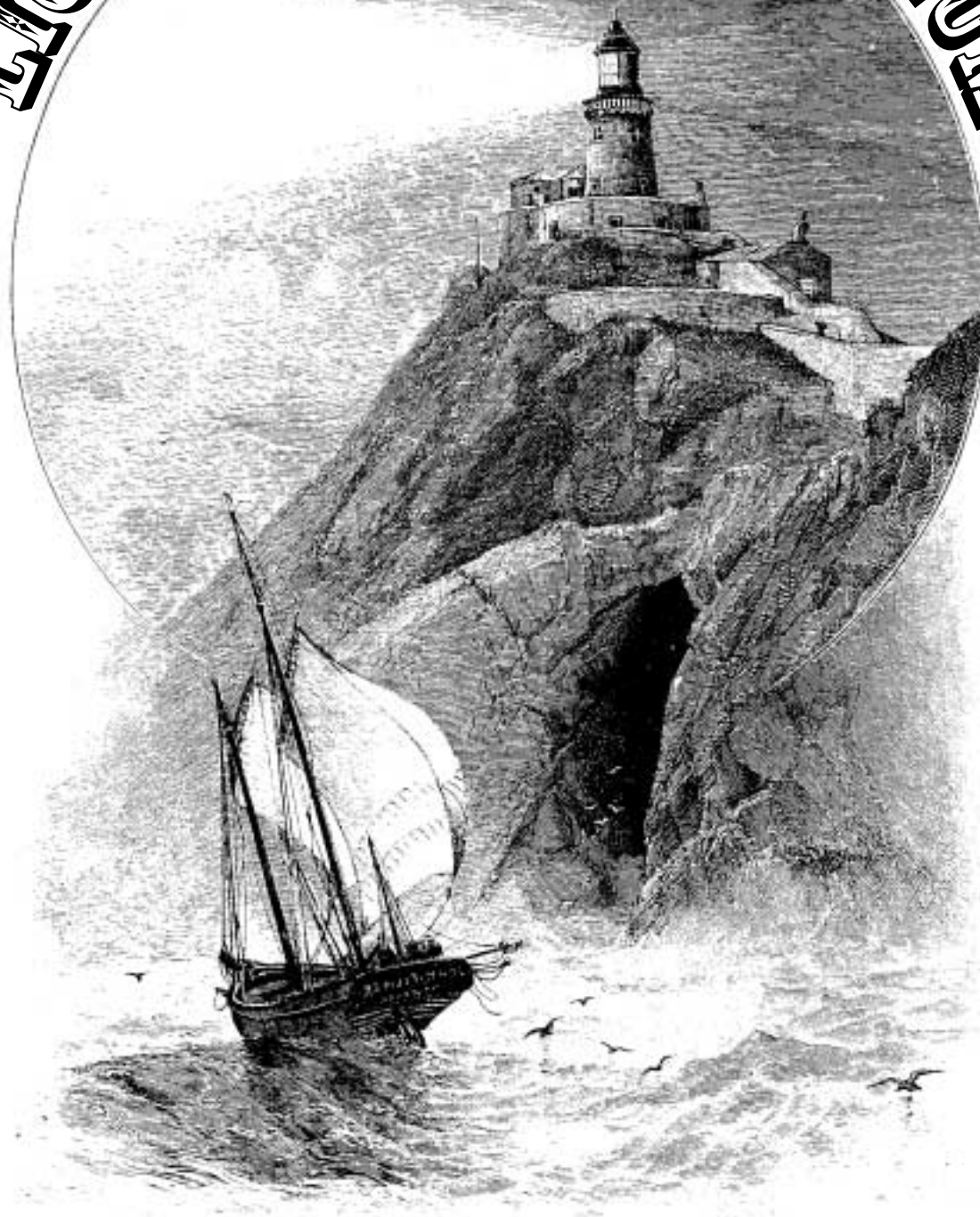


LIGHTHOUSE CURRICULUM

GRADES K-4



An educational service provided by
The United States Lighthouse Society
244 Kearny Street • San Francisco, CA 94108
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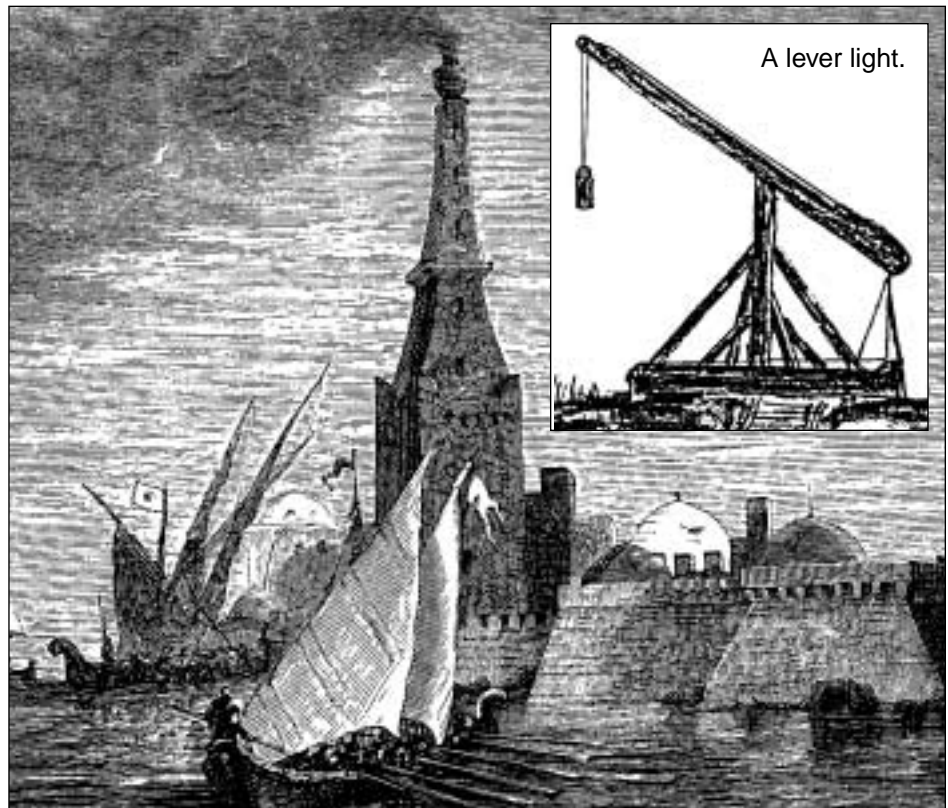
The Story of the Lighthouse

Many, many years ago (thousands of years to be more exact), people lived in a very primitive way — both hunting for and growing their own food (there were no supermarkets in those days, no stores at all!). Eventually they decided to explore the water in a boat to find out what the sea had to offer in the way of food. And, what did they find? They found fish and all kinds of other seafood: clams, mussels, scallops, oysters, lobsters, crabs, etc. During the day they could find their way back to the landing place by looking for a pile of rocks that had been left there.

These were the first daymarks. But how could they find their way home at night? Since much of the shoreline looked very similar, friends had to light a bonfire on a high point to guide them to the right landing area. Still later they used a pole or a tripod to hang a metal basket containing a fire as a method of signaling (a lever light).

Our first lighthouses were actually given to us by Nature herself. Sailors sometimes used landmarks such as glowing volcanoes to guide them. In the Ancient World, trading ships were eventually built enabling navigators to sail long distances to buy and sell goods. In the days of wooden ships with sails, the wind and waves could easily push them against the rocks and wreck them. And so, the need for lighthouses as warning signals arose.

One of the Seven Wonders of the Ancient World was a lighthouse — the famous Pharos of Alexandria, Egypt. It is the first one that is



Pharos lighthouse in Alexandria, Egypt

recorded in history and was built about 280 B.C. Those records tell us that it was the tallest one ever built — 450 ft. (comparable to a 45 story skyscraper) and used an open fire at the top as a source of light. (Can you imagine being the keeper, climbing to the top to light the fire, and then forgetting the matches or whatever was used in those days to start a fire?)

This fantastic structure survived for 1500 years until it was completely destroyed by an earthquake in the 14th Century. Slave labor was used to build it, and it took twenty long years to complete. It was a three-part tower — with a square base, a second story with eight sides and a narrow, taller, round third story. At night they believe its lighted fire could be seen for thirty miles, whereas by day it produced a column of smoke for a daymark. Today we call people who study (or are interested in) lighthouses pharologists. The name comes from that famous lighthouse.

What is a lighthouse?

It is a tower with a bright light at the top, located at an important or dangerous place regarding navigation (travel over water). The two main purposes of a lighthouse are to serve as a navigational aid and to warn boats of dangerous areas. . It is like a traffic sign on the sea. What a seeing eye dog is to a blind person is what a lighthouse is to a seaman.

Do all lighthouses look alike?

Although we often think of a lighthouse as a tall, white conical tower, there are many, many variations of design. Depending on its location, it might be tall (where the land was very flat) or short and squat (where there was a high cliff or rocky coast). It could be square, octagonal (with eight sides), conical (like an ice cream cone upside down), cylindrical (like a very fat pipe), or even like a skeleton.



A tall, conical lighthouse



A screwpile lighthouse

A round caisson, or "sparkplug" lighthouse



A square caisson lighthouse

Lighthouses come in all shapes and sizes...

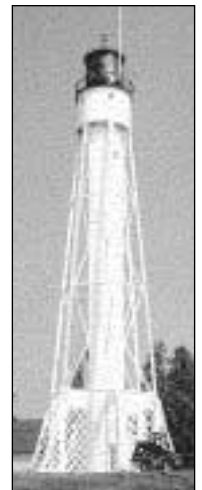
square

octagonal (8 sides)

conical

cylindrical (round)

skeletal



You might find the lighthouse standing alone, attached to the building where the lighthouse keeper lives, or connected to the keeper's quarters by an enclosed walkway. Sometimes the lantern room is built into the roof of the keeper's house.

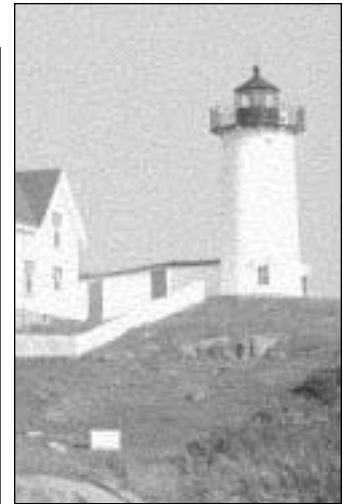
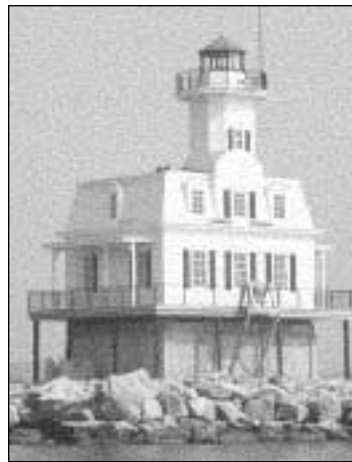
When the lighthouses were built, they were constructed with whatever materials were most readily available. They were designed to fit the local geographic and climatic conditions. Some are made of stone; others brick, concrete, wood, steel, cast iron, and even tabby (a mixture of shells, lime, sand and water). So you can see that each lighthouse is very unique.

Where are lighthouses located?

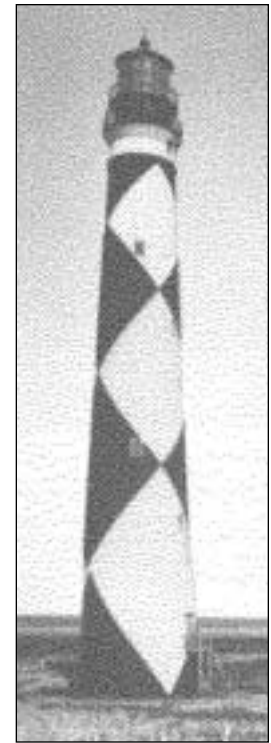
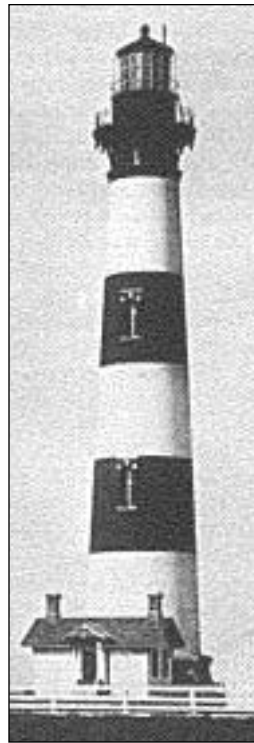
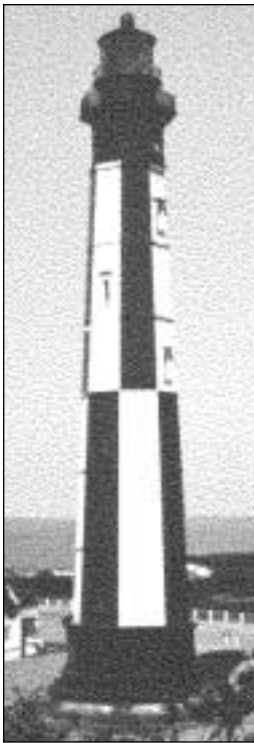
They can be found in a variety of places, on rocky cliffs or sandy shoals on land, on a waveswept reef in the sea, and at entrances to harbors and bays. They serve to warn the sailor of dangerous reefs beneath the sea or perilous rocky coasts on land, and to guide ships into a safe harbor or back out to sea.

So the message of the light-house might be — STAY AWAY, DANGER, BEWARE, or COME THIS WAY. Every lighthouse tells the mariner, "This is exactly where you are."

Our country has several coastlines used by ships from around the world. In the East it borders the Atlantic Ocean, in the West the Pacific Ocean, and in the South the Gulf of Mexico. But we also have another very important area of coastline where the land meets the sea, the Great Lakes. So, all of these four areas bordering our country need and have lighthouses, as well as some of our more important navigable inland waterways.



For example, the Hudson River, Lake Champlain, Chesapeake Bay and San Francisco Bay are also dotted with lighthouses.



Some lighthouses are painted in black and white designs:

Cape Henry, VA

Currituck, NC

Bodie Island, NC

Cape Hatteras, NC

Cape Lookout, NC

How could one lighthouse be distinguished from another?

Years ago, before they had all the sophisticated technology of today — loran, radar, sonar, onship electronics, radio beacons, etc. — ships near shore in the daytime would use lighthouses as a landmark. This use gave them an additional name — a DAYMARK.

Imagine that you are the Captain of a ship sailing along the coast. You need some landmarks to help you find your position. When you look on shore you see a tall red brick tower. Then you sail about forty miles down the coast and you see another round red brick tower — just like the first one. How would you know where you are? This is the way things were along a portion of the Virginia and North Carolina coast in the 1870's. To help the mariner determine his location the Lighthouse Board (which was in charge of lighthouses from 1852 – 1910) issued an order to have each lighthouse painted in different colors and/or designs. This is the best example of DAYMARKS we can see today.

Cape Henry, Virginia (the tallest cast iron lighthouse in the U.S. today) was painted in alternating black and white sections. Currituck, the next one down the coast, was left its natural brick color. Bodie Island was painted with horizontal bands. Cape Hatteras (the tallest one in the country) was given spiral bands. Cape Lookout was painted in a diamond or checkerboard pattern. On some lighthouses elsewhere the color red has been used to help distinguish them. There are two very striking ones painted in red stripes — at West Quoddy, Maine, and Assateague, Virginia.



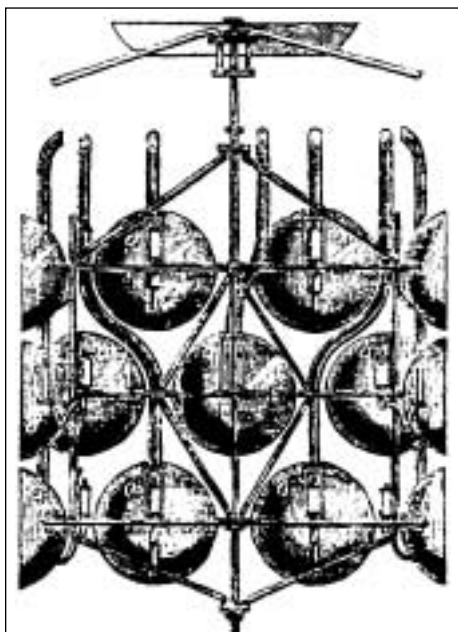
And some are painted red and white:

West Quoddy Head, ME

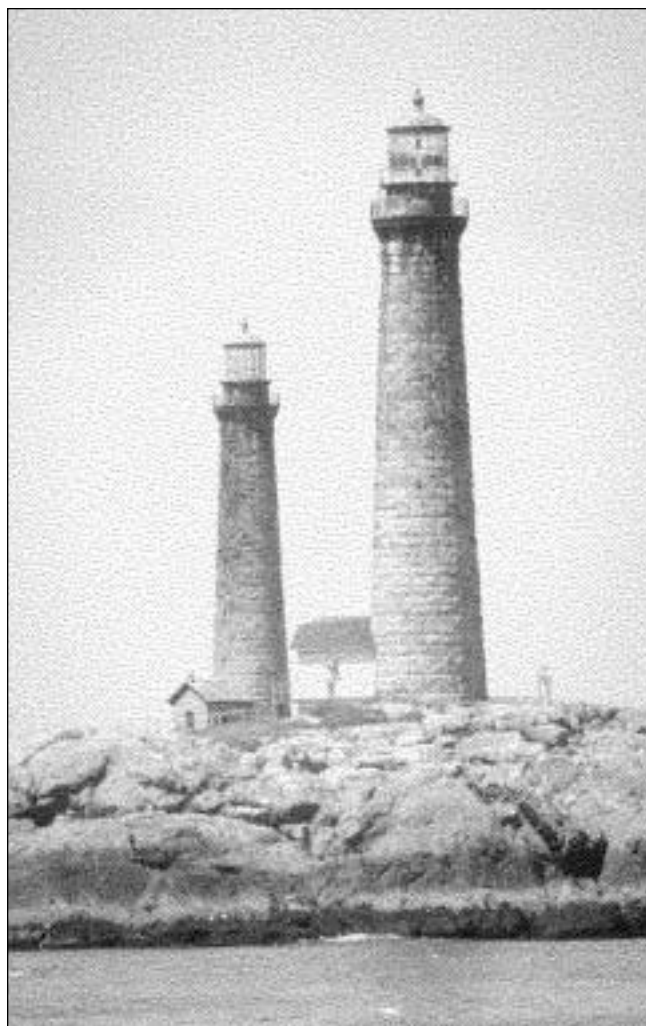
Assateague, VA

But, what about nighttime — the most dangerous time to navigate, and the main reason lighthouses exist? You can't see colors or patterns at night, but you can see lights. However, unless there was some way to make each light different you could have the same problem. Early on, in a few places in our country, they built multiple lights (that is, two or three together.) There are twin lights at Cape Elizabeth, Maine and at Thatcher Island, Massachusetts that are still visible today. On Cape Cod, they built three lights which they call "The Three Sisters of Nauset", no longer in use, but which have been moved to a central location and preserved by the National Park Service for us to see today. Many of the double lights were either torn down or one of the twins was moved to another location. Building double or triple lighthouses was one way to help the sailors at sea determine their location, but it was a very expensive way to do it.

Mounting a group of lights on a rotating framework made it possible to produce a special signature (the first flashing characteristic) for each lighthouse, so they could be easily told apart (more on this follows).



A group of lights mounted on a rotating frame made a lighthouse look like it was flashing its light on and off.



The two lighthouses on Thatcher Island off the Massachusetts coast helped mariners identify their position.



The three lighthouses at Nauset Beach on Cape Cod, known as the Three Sisters, were the only triple lights in this country.

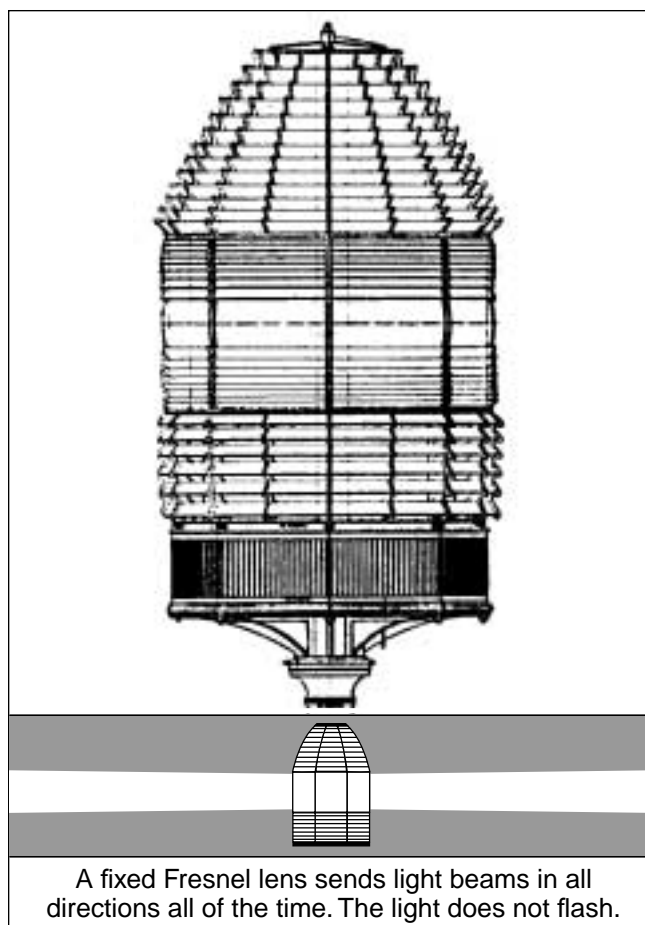
The invention of the Fresnel lens in 1822 was probably the most important discovery in lighting technology. As well as enabling man to produce an unlimited number of flashing combinations, it also intensified (brightened) the light so it was much more helpful to the mariner, and could be seen at greater distances.

The Fresnel (pronounced “Frey Nel”) lens can be compared to a huge lampshade except that it is made of 100’s of pieces of beautiful, specially cut glass. It surrounds the lamp bulb, but differs from a lampshade, which concentrates the light downward. This lens, due to its special design, and because it is made of glass, intensifies (brightens) the glow from the light. It takes the rays of light which normally scatter in all directions and bends (refracts and reflects) them, focusing them into a single beam of light, which shines out in a specific direction.

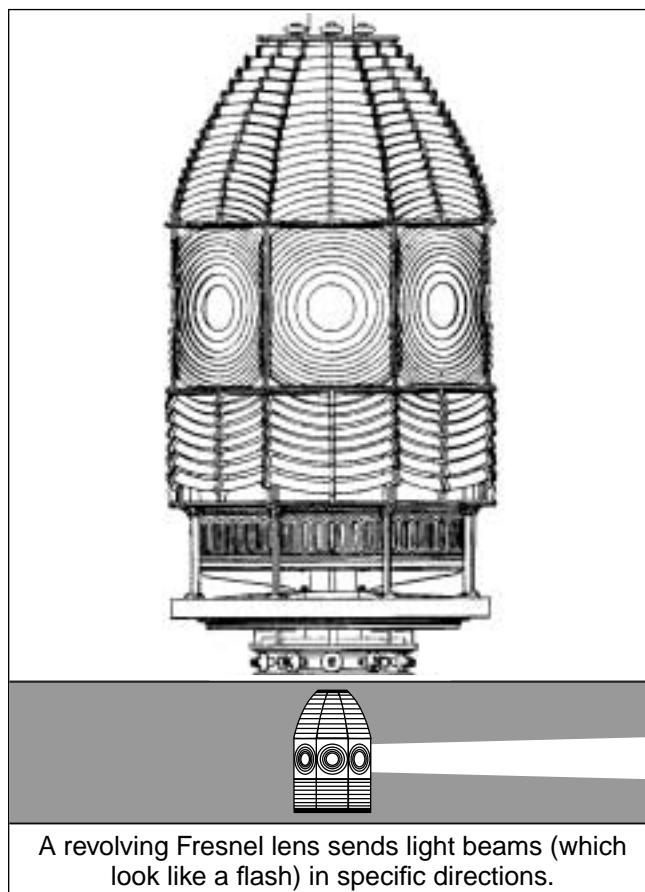
Fresnel lenses are of two types; Fixed — which shows a steady light all around the horizon and Revolving — which produces a flash or a characteristic. The number of flashes per minute depends on the number of flash panels and the speed at which the optic (lens) revolves. (Teacher: See footnote.)

Different periods of darkness and light produce a unique flash pattern for each light. For example a light can send out a flash every five seconds. or it might have a fifteen second period of darkness and a three second period of brightness, or any number of other combinations. The individual flashing pattern of each light is called its **CHARACTERISTIC**. Mariners have to look at a light list or a maritime chart which tells what light flashes that particular pattern and what color the light is as well. Then they are able to determine their position at sea in relation to the land.

Footnote: There was actually one more style for clarification. So as not to confuse young students I elected to leave this off. It is a fixed light varied with flash. However, if your students are particularly precocious, you may elect to use it.



A fixed Fresnel lens sends light beams in all directions all of the time. The light does not flash.



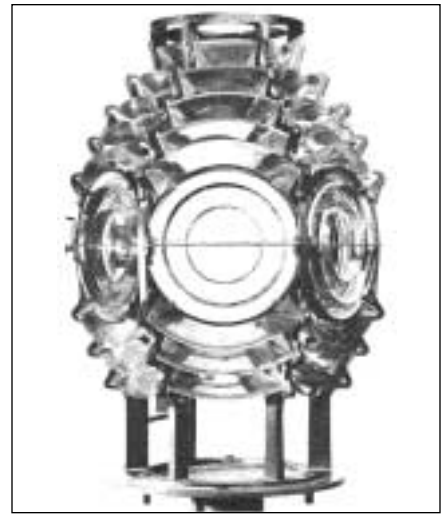
A revolving Fresnel lens sends light beams (which look like a flash) in specific directions.



Modern aerobeacon used in lighthouses today rotates to send a beam of light many miles.



Fixed Fifth order Fresnel lens sends a steady beam of light.



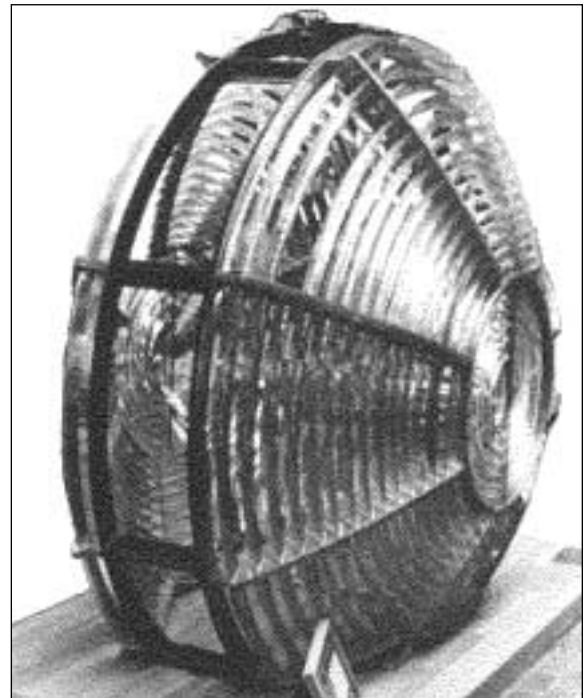
Rotating Sixth order Fresnel lens sends a flashing beam.

Today aerobeacons are also used to help identify each lighthouse. They, along with the Fresnel lens, are the principle behind the automobile headlight.

Fresnel lenses come in seven commonly used sizes (called orders). The larger ones (1st order), used on major seacoasts, flash a more powerful beam which shines as far as twenty-one miles out to sea. Sixth order lights, the smaller ones, are used in bays where they don't have to shine as far or as brightly.

Most look like a beehive or barrel; some have bullseyes and can contain from two to twenty-four different panels. Those with the fewest flash panels (two) are called clamshell or bivalve lens. A clockwork type mechanism (which had to be wound by hand every few hours before the advent of electricity) is used to make these revolving lenses rotate around the lamp itself to produce the flash. The movement of the lens is timed precisely so the bullseye panel will pass by when a flash is due.

These lenses are really beautiful works of art; most contain hundreds of prisms – pieces of specially ground, cut and polished glass which, when arranged in a certain way, bend (reflect and refract) the light. Thus all the rays of the light are collected and redirected into a single pencil beam of light. This makes it



A bivalve, or "clamshell", Fresnel lens sends light beams in only two directions as it rotates.

much brighter and more effective. The lenses themselves can weigh as much as four tons.

There is one light near Boston (Minot's Ledge on the killer reef) which flashes out a characteristic of one flash, darkness, then flash, flash, flash, flash, darkness, then flash, flash, flash, or 1-4-3. The people nearby call it the "I Love You" light because it flashes out the number of letters in each of those words.

Another way to distinguish lights is through the use of color. Although most lights have a white lamp, some do use red and others green lights, as well as combinations of the colors. (Sounds like Christmas, doesn't it?)

What happens in fog when the light isn't visible?

Have you ever been out in a car on a dark, stormy, very foggy night? You know how difficult it is to see other cars on the road. Now, picture yourself sailing along a black-looking sea in a thick peasoup fog with no stars shining or moonlight visible. The windshield wipers are working overtime, but the view of the light from the lighthouse is being blocked by the fog. In situations like this there is another method of notifying the mariner using sound. It is called a foghorn. The first one was used in 1719 at Boston light and it was, of all things, a canon. Can you imagine being a lighthouse keeper and having to fire the canon every hour when there was fog? During a long spell of fog you wouldn't get any sleep. Later they tried various other means of making a noise for warning. Fog bells were used as well as steam whistles and reed trumpets and sirens. The sounds they gave out were generally low pitched and very mournful – almost like a wail. Each one emitted a specific number of blasts every minute so it could be told apart from all others. Today, an automatic sensor which detects moisture in the air turns on the fog signals when needed. There are also soundless fog signals called radiobeacons (an electronic device).

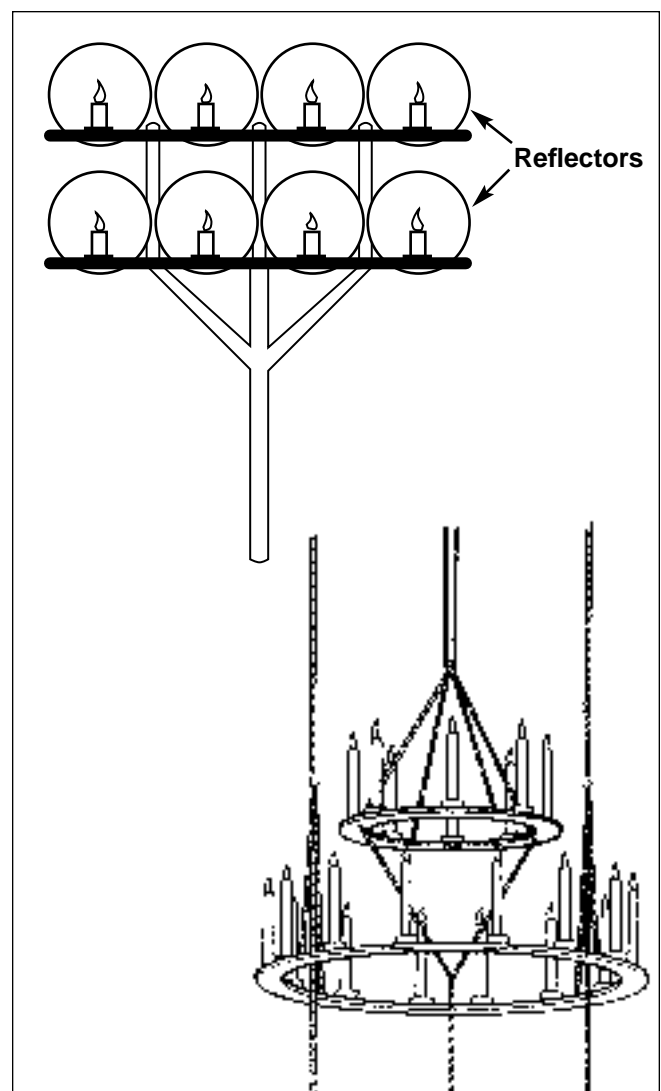
These fog signals were not placed everywhere. Although some places experience no fog problems, fog warning devices are very necessary in New England, on the Pacific Coast, and in Alaska.

What fuels were used to produce light?

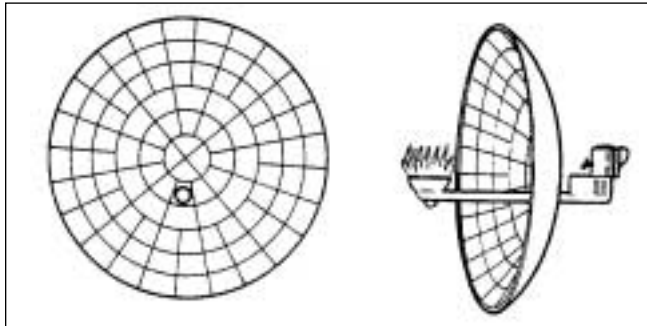
The main source of power for the light today is electricity, although in some places they use

acetylene gas. For thousands of years before the electric lamp (bulb) was invented by Thomas Edison in 1879, different fuels were used to illuminate the lamps. First, it was wood and coal for fires, then bales of oakum and pitch, and rows of candles. Later lamps were lit using various fuels – sperm whale oil (produced by cooking the blubber of the whale), lard oil (from animal fat), kerosene (a fuel like gasoline with a petroleum base), etc.

When they first designed a lighthouse with an enclosed lantern room (the original 1696 Eddystone Light in England) it was possible to employ candles for light. This wave-swept lighthouse used 60 candles! Most used far fewer candles which were sometimes arranged in a circular candelabra or a chandelier with two tiers, or on a frame.



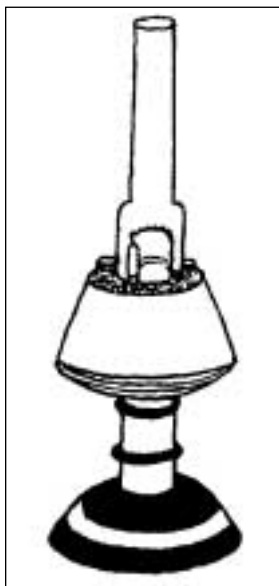
Next came spider lamps which consisted of a shallow brass pan containing oil with either four, eight or more wicks usually arranged in a circle, but other shapes such as a rectangle were also used. (Since a spider has eight legs, the first one probably had eight wicks!)



A parabolic reflector

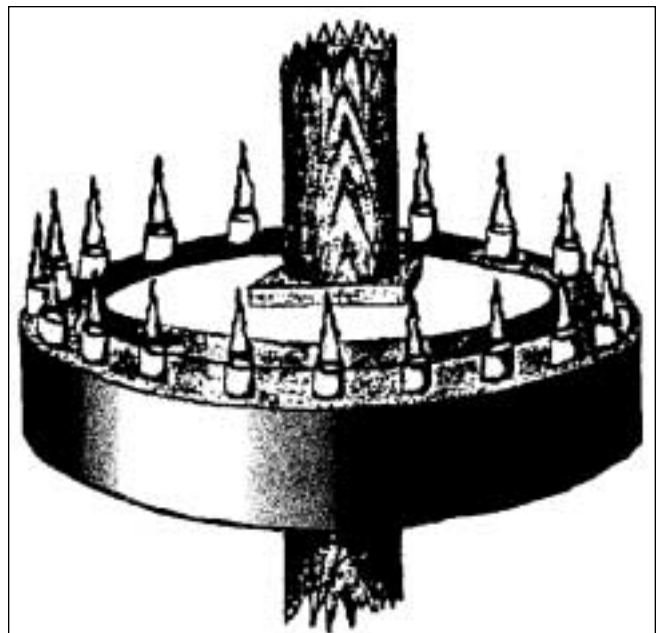
The Argand lamp

Two very important discoveries occurred in the late 1700's. The parabolic reflector was a bowl-like device with a small oil lamp in the center. The light from the lamp was gathered and focused into a beam. This was similar to putting a mirror behind a flame. Thus the first really efficient lighthouse was created. Think of a flashlight which has a silver reflector behind the tiny bulb to increase the brightness of the light. It is based on the same principle.



The invention of the hollow wick oil lamp (the Argand lamp) resulted in a light which was seven times brighter than a candle. This lamp was used with various types of fuel inside the Fresnel lens until the electric light bulb was invented.

The first lighthouse ever to use electricity in this country was the Statue of Liberty in 1886. Yes, this special symbol of freedom was used as a lighthouse in New York harbor for the first fifteen years of her existence.



An early whale oil fueled spider lamp.

Head of the Statue of Liberty showing lights on the coronet.



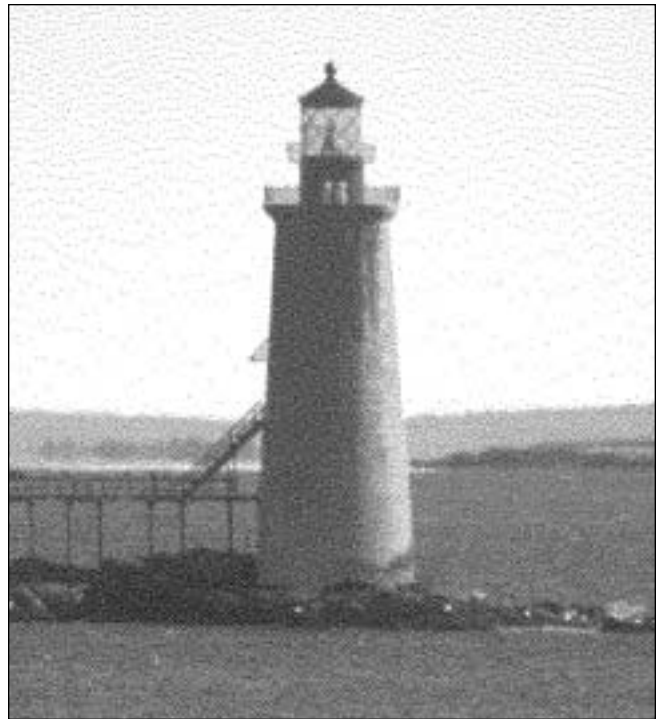
When were the first lighthouses built in our country?

In colonial times, before we became an independent nation, men realized the need for lighthouses at the major ports to help guide ships into the harbors, to prevent them from crashing, and thereby losing their precious cargoes. So, the first lighthouses were built by the colonies (which were called states when we became the United States of America). In those days the ship owners had to pay a fee (toll) for the use of the lights which helped cover the costs of their construction and maintenance. Each ship which passed by a lighthouse on its way into or out of a port paid a tax based on the weight of the cargo it was carrying. They paid a penny for each ton of goods on board ship. (You have to remember that in those days a penny was worth a lot more than it is today.) Once we gained our independence from Great Britain and the federal government took charge in 1789, this fee was eliminated.

Most lighthouses were named for their location, but several were named after ships which wrecked themselves nearby before a lighthouse was built. For example: Carysfort, Fowey, Alligator Reefs, Pigeon Point and Ship John Shoal. Others were named because of events which occurred there: Cattle Point, Dead Man's Rock, Cape Disappointment, Destruction Island and Execution Rocks.

What is the difference between a lighthouse and a light station?

A lighthouse is the tower itself containing the lantern room with the lamp which shines its light. A light station (which is usually onshore, but occasionally on offshore islands) is the property containing all of the



Above: A lighthouse all by itself.

Below: A light station with a lighthouse and buildings.

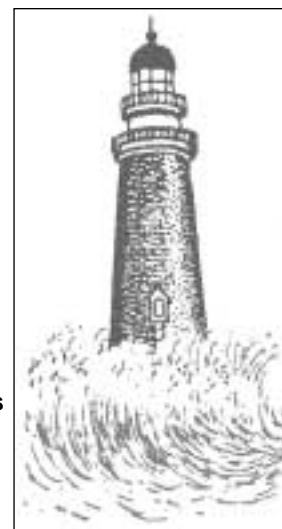
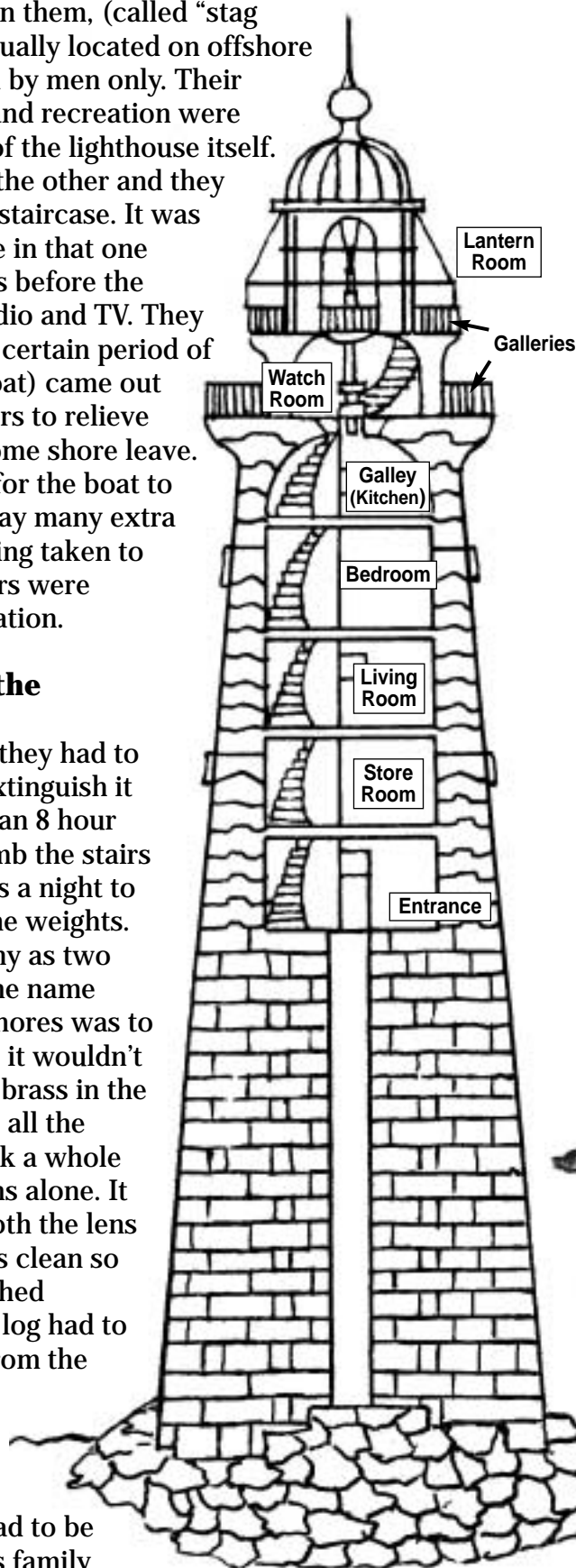


outbuildings (as many as eight) of the "station", as well as the lighthouse tower itself. There were usually separate living quarters (houses), depending on the number of lighthouse keepers and assistants living there. Besides these there would probably be an oil (or fuel) house, a barn, a boat house, and a fog-signaling building.

Lights with no families living in them, (called “stag lights” in some areas) were usually located on offshore islands or reefs, and inhabited by men only. Their quarters for sleeping, eating, and recreation were located on the various levels of the lighthouse itself. One room was located above the other and they were connected by a winding staircase. It was pretty confining to have to live in that one building, especially in the days before the invention of the telephone, radio and TV. They had to stay on the island for a certain period of time before a tender (small boat) came out with supplies and other keepers to relieve them of duty and give them some shore leave. If the weather was too rough for the boat to come out, often they had to stay many extra days or even weeks before being taken to shore. In later years helicopters were sometimes used for transportation.

What were the duties of the lighthouse keepers?

Before the days of electricity, they had to light the lamp at sunset and extinguish it (put it out) at sunrise. During an 8 hour watch at night they had to climb the stairs in the tower one to three times a night to check on the light and wind the weights. Some lighthouses have as many as two hundred steps! They earned the name “wickie” because one of the chores was to trim the burned lamp wick, so it wouldn’t smoke and dirty the lens. The brass in the building had to be shined, and all the windows cleaned. Often it took a whole day to clean and polish the lens alone. It was very important to keep both the lens and the lantern room windows clean so the light would not be diminished (lessened) in any way. A daily log had to be kept detailing everything from the weather to the amount of fuel consumed. The Keeper also had to tend to the mechanism used to operate the fog signal. During the year many items had to be painted. So the Keeper and his family were kept very busy.



What is the most important aspect of the lighthouse?

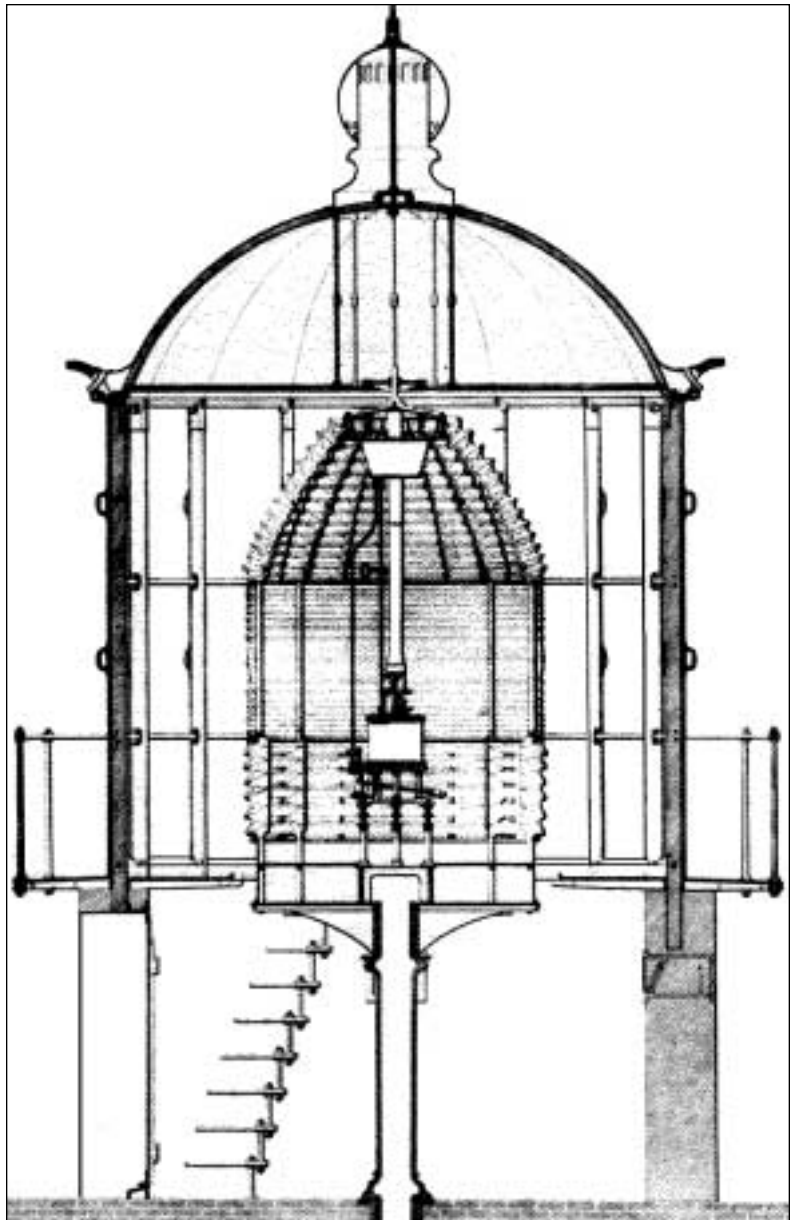
Of course it is the light that shines out from the lantern room at the top which encloses and protects the lens. This lantern room is made of metal and glass which is divided into sections by pieces called astragals. Usually they run vertically (up and down), but some run diagonally.

In this world, at every period in history, there have always been some people who did not want to work for a living, and tried to live off the sweat and toil of other people. During the last century there were men along certain of our Eastern shores who would lure ships to an isolated beach by shining lights to make the sailors think it was a safe harbor. When the ship ran aground and the cargo washed ashore, they stole it and sold the goods. They were called "mooncussers" because they operated on nights when the moon was not shining. Another name for them was "wreckers."

The false lights were called "Judas lights." At one place in North Carolina, they tied a lantern around a horse's neck and walked him back and forth along the beach to lure ships in to their destruction. That is how the place called "Nag's Head" got its name.

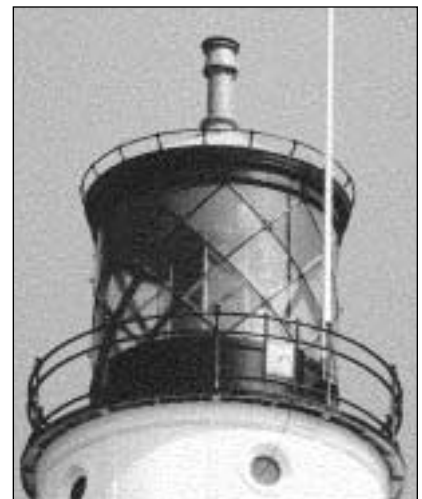
What is happening to lighthouses at present?

Today, all of the lighthouses in our country have been automated, except the one at Boston, which still has keepers, for sentimental reasons only. (Boston light was the first one built on our shores.)



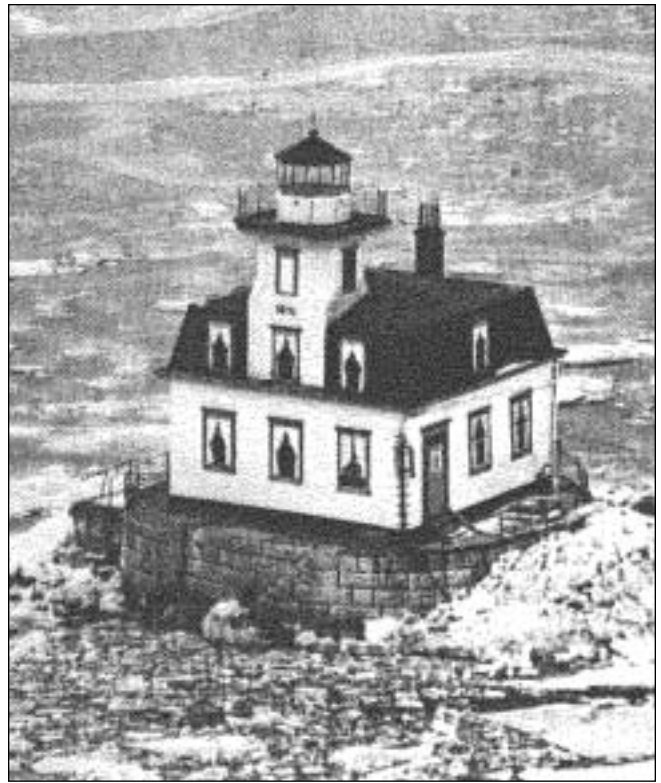
A lantern room with a fixed first order Fresnel lens.

At left, vertical astragals. At right, diagonal astragals.



Many of the lighthouses are no longer needed now due to advances in technology, and they have been or are being turned over to various government agencies or non-profit local organizations to maintain and administer. It is important to keep them in good condition for future generations to learn about their place in the history of our country. And it is a special experience to be able to climb the stairs just as the keepers did and picture what life was like in times past. They also need protection from vandalism and threats of erosion.

Esopus Meadows Lighthouse surrounded by ice in the middle of the Hudson River in New York. To discourage vandals, the Coast Guard painted curtains on the boarded-up windows. One also has a cat painted in and another a flower pot.



HUMAN INTEREST

There are many, many interesting stories of happenings at lighthouses. The following are three that children might enjoy hearing.

THE STORY OF THE FLYING SANTA

Many years ago when lighthouse keepers and their families often had little communication with the outside world (1929) a man named Bill Wincapaw was flying in his small single engine supply plane out of Rockland, Maine. An unexpected snow storm arose and he lost his bearings. If he hadn't seen the beams from the lighthouses which guided him back to Rockland, he probably would have perished because he arrived there just as he was running out of fuel.

He was so thankful for the faithfulness of the lighthouse keepers who manned the lights which guided him to safety that he decided to put together small Christmas packages for the keepers and their families. Each year he delivered them by plane dropping them at all the lighthouses in the area near his home. Thus began the tradition of the "Flying Santa."

Since most of these light stations were located in lonesome places they really looked forward to this touch with the outside world. A few years after he started this Christmas tradition he was replaced by Edward Rowe Snow, a lighthouse author, who continued the flights himself until his death in 1982. At that point the Hull Lifesaving Museum took over the custom.

Mr. Snow wrote in one of his books of missing the tower at Whaleback Light and realizing that the bundle would be lost in the sea. So he circled back and dropped another package. About three weeks later, ninety miles across the bay, the first package was found.

A DOG NAMED SPOT

Spot was a springer spaniel who belonged to a girl named Pauline, the daughter of the keeper at Owl's Head Light in Maine. This little dog loved everything about the lighthouse including the fog bell, and the ships that passed by in the bay. Whenever a boat reached a spot near the cliff, he had a habit of running over to the rope attached to the fog bell and tugging on it vigorously with his teeth a few times until it rang out over the water. When the boat answered with a whistle, he happily dashed down to the shoreline and barked.



One very stormy snowy night, the lighthouse keeper received a telephone call from the wife of the mailboat captain who was very worried because her husband was already several hours late. She knew about Spot and wondered if he might be able to hear the mail boat's whistle. So the keeper let Spot out but he returned in a little while and scratched to be let in. Just as he was about to go to sleep, snuggled up in a cozy corner, he raised up on his haunches, lifted his ears, and tensed his body. He had heard the mailboat's whistle!

The keeper let him out again and off he scampered through snowdrifts to try to reach the bell, but the snow had piled up too high. So he took off to a point high on the cliff, which was nearest to the boat and barked away. The keeper had followed the dog and it was then that he heard the mailboat's whistle and realized if the captain could hear the dog's barking it would tell him where he was in spite of the storm. Spot kept barking furiously and soon three blasts from the mailboat's whistle were heard in answer. They had heard Spot's barking and now they could chart their course home. Spot had saved the boat from disaster!

THE ARMY OF TWO

Two young daughters of the lighthouse keeper at Scituate, Massachusetts performed a remarkable feat during the War of 1812. Rebecca and Abigail Bates were alone at the lighthouse one day in September of 1814 when they saw the large British man-of-war LA HOGUE approach and anchor nearby. They sent their younger brother to town to warn the people of a possible attack. Five longboats from the ship started rowing toward shore.



At this point Rebecca grabbed a drum and handed her sister a fife. She started beating the drum while Abigail played the fife, using familiar military tunes of the day. As the oarsmen neared the lighthouse, they played louder and louder until the British stopped rowing. They began to wonder if American troops were mustering to fight them.

The commander of the warship heard the music and ordered a gun fired signaling the landing party to return. As they hastily left the harbor they fired a parting shot at the lighthouse which missed its mark. Rebecca and Abigail collapsed on the beach in exhaustion but their "phantom army" had saved the town great loss of life and property.

(There is a more detailed account of this in the 1981 issue of COBBLESTONE Magazine, 7 School Street, Peterborough, NH 03458)

ACTIVITY SHEET

ART

Class Projects ---Murals

1. Stag Light (or light tower with no family living in it)

Divide class into 5 teams, one for each floor of the lighthouse, providing each team with a piece of posterboard showing outline of their floor.

Team will draw appropriate furniture, equipment or supplies for that floor. (or cut out and paste on.)

Example - Storeroom - barrel, wooden box, oil drum
Bedroom - bed, picture, door to bathroom
Galley (Kitchen) - stove, pots and pans, ice box (or refrigerator), sink, table, chairs
Recreation Room - bookshelf, TV, chairs, sofa
Draw as one unit > Watch or Service Room - oil drum, supplies
Lantern Room - lens

Tape them all together on wall to produce one tall stag lighthouse.

2. Marine Mural

Draw rocky shore, sandy beach with dunes, marine life under the sea, as well as in tidepools, buoys, lighthouse, pier, fishing and pleasure boats, ocean-going vessels, shorebirds, and gulls.

3. Lighthouse geographical and architectural mural

Students draw various locations lighthouses are found and then determine the appropriate design for each place - rocky cliff - a short tower (so as to be visible below fog or due to height of cliff), sandy shoal - a tall tower, either cylindrical or conical, island - a spark plug or caisson lighthouse, harbor entrance - could have a varied design.

Older children studying landforms could be given a topographical map showing a coastline to determine where they think lighthouses should be located.

4. Coastal, River, Bay or Sound Map of Lighthouses

Use pre-drawn map of any of above or teacher draw map of area where several lighthouses are located. (in children's own state where applicable.)

If children live in N.Y., Michigan, or Maine, choose a particular section of shoreline or a limited number of the more important lighthouses.

Teacher or students to locate places on map where various lighthouses can be found, and mark on map with an X.

Make paper or cardboard 2D model of each lighthouse, and place on map in proper location with double-sided Scotch tape. Leave for a few days. Remove the lighthouses and play a game to see if children can place them in their proper location.

Each child could pick a particular lighthouse and write a few sentences about it giving factual information.

Individual Projects

1. Younger Children - give each child basic shapes to cut out, cylinder, cone, triangle, rectangle, square, half circle. Using shapes paste together on blue background to form a lighthouse. Record what shapes were used and where.

This can be done as a **mathematical** exercise in visualizing and representing shapes by using 3-D materials and constructing a lighthouse.

For a higher grade level, geometric shapes (pentagon, octagon, polygon, etc.) can be identified in photographs of lighthouses. The pattern design can then be reproduced as a 3-D image.

2. Reverse Image

Give each child a piece of blue construction paper. Using chalk or white poster paint, brush and sponge, let each child draw gulls, rocks, waves, clouds, fog, a lighthouse and whatever else their imaginations wish to depict.

3. Jigsaw Puzzles

Give each child a piece of construction paper to draw a lighthouse and color. Cut out, mount on cardboard, then cut into pieces to make a jigsaw puzzle. Exchange with another student to piece together.

4. Daymarks - Patterns of bright colors and bold design which help identify each lighthouse during daylight hours.

Use enclosed daymark outlines (enlarged) with instructions. (See page 21). Give an outline of a lighthouse to each

child to create their own self-stylized daymark.

5. Lantern Room

Using pre-drawn lantern room, have children mark various items - dome, lens, galleries, lightning rod, etc.

6. Collage

Make a lighthouse collage using old cards, calendars, pictures, etc.

7. Stencil

Design a lighthouse stencil and use it to decorate.

8. Home Project - Constructing a Lighthouse

Using recyclable materials, such as glass jars and bottles, aluminum pie plates and foil, paper towel and toilet paper rolls, a shoe box, newspaper, magazines, paper bags, rubber bands, paper clips, plastic milk containers, 6-pack rings, have children construct a lighthouse or a light station.

LANGUAGE ARTS

Teacher read a lighthouse story to the class:

The Army of Two, The Abbie Burgess Story, The Little Red Lighthouse and the Great Gray Bridge, A Dog Named Spot, The Light at Dangerfield, Sal T. Dog, etc.

After initial storytelling, teacher start the story, then have children retell, recounting the various details or - Give an individual word from the story to each child and have them recount some event in the story using that word or - let children write their own lighthouse story using that word, which could also be illustrated.

DRAMA

Class reenact Abbie Burgess Story.

Younger children might act out the story of The Army of Two and learn Yankee Doodle Dandy, which might have been one of the tunes the girls played.

SCIENCE

The Properties of Light

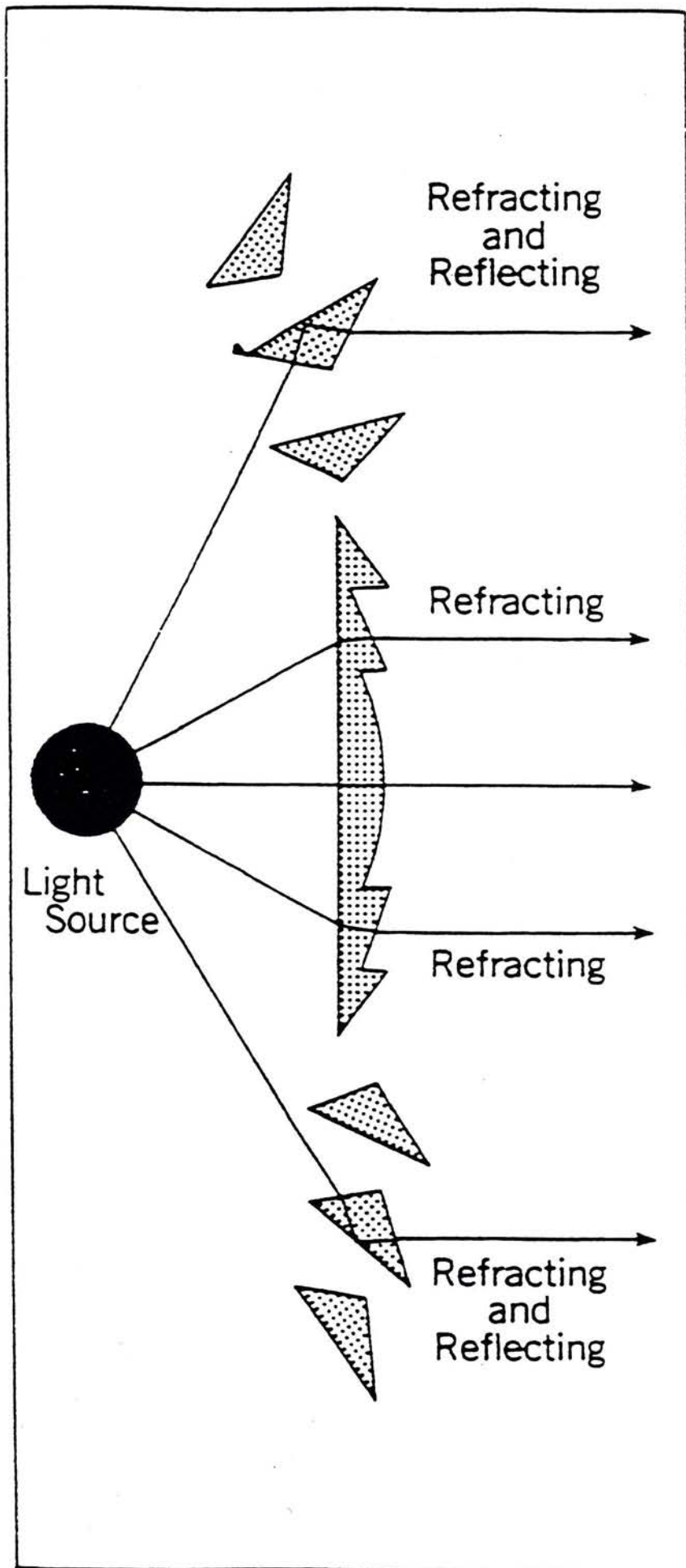
1. Light travels in a straight line if it is not interrupted.
2. When light strikes a surface, it can be reflected, transmitted or absorbed, or a combination of all three.
3. Light travels through some objects but not through others.

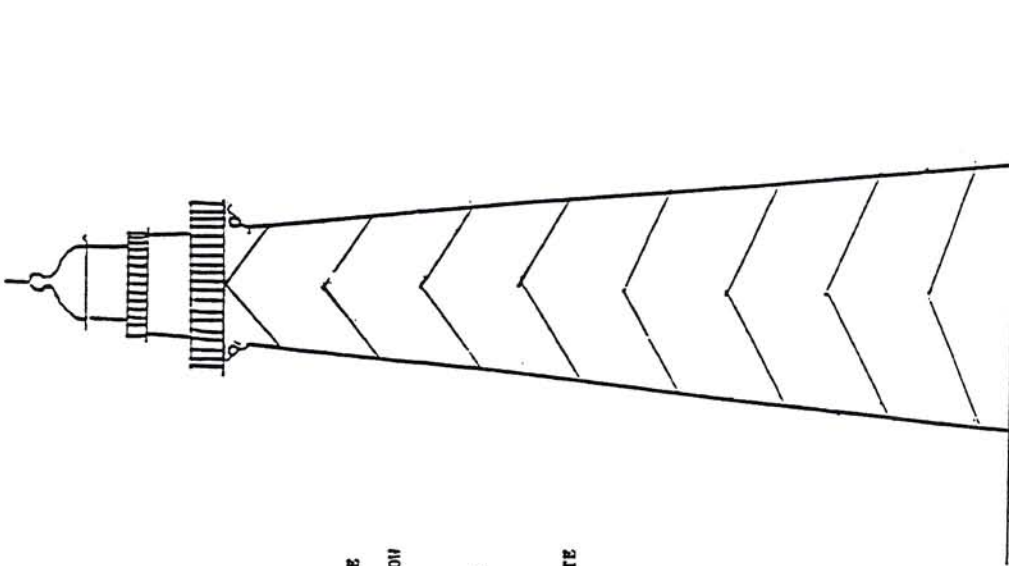
Exercises

- a. Use a flashlight to explain the principle of reflection, which is used in the parabolic reflector. (See page 9 of text.) The silver reflector behind the bulb acts like a mirror, concentrating more light outward, which increases the brightness of the light.
- b. Shine a flashlight on an opaque object such as a desk; this will block the light. The object absorbs (assimilates or takes in) the light.
- c. Shine the flashlight through a drinking glass, a transparent object (one which lets the light pass through). Most of the light will be transmitted (transferred or passed along).
- d. Using a prism (see teacher resources) run the beam of a flashlight horizontally across the room. Place the prism in front of the beam and it will refract (bend) the light, breaking its normal path and causing it to shine on the ceiling, spreading out 1" in all directions.

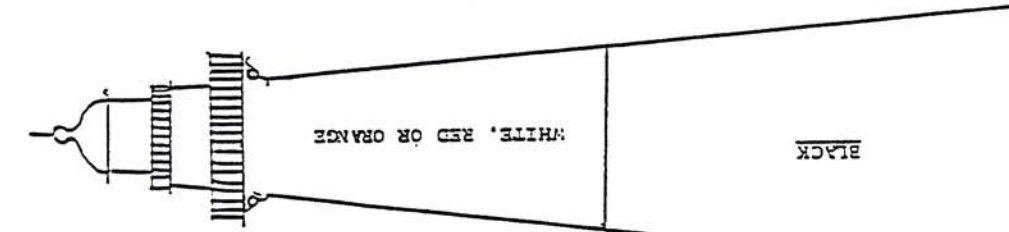
This demonstrates the principle of the Fresnel lens. (see page 6 of text.) The prisms and convex lens (curved outwards) work two ways; their shape and location also influence their effectiveness. (see enclosed diagram). The convex lens refracts (bends or slants) the rays of light as they pass through. The prisms first refract and then reflect (throw out) the light as it passes through.

4. Light can be classified according to its brightness.
 - a. candlepower
 - b. wattage

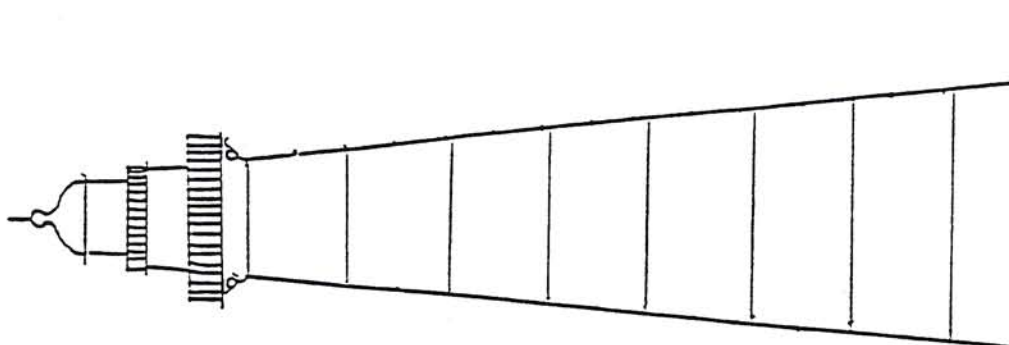




ALTERNATE:
 BLACK - WHITE
 or
 BLACK - YELLOW
 or
 BLACK - RED
 or
 RED - YELLOW
 or
 RED - WHITE
 or
 YELLOW WHITE



OPTION:
 REVERSE COLORS HAVING
 BLACK ON TOP, ORANGE,
 WHITE OR RED ON THE
 BOTTOM



ALTERNATE:
 BLACK - WHITE
 BLACK - RED
 RED - WHITE
 YELLOW - WHITE
 YELLOW - BLACK
 ORANGE - BLACK
 ORANGE - WHITE



LIGHTNING ROD

BALL VENT

DOME

FRESNEL LENS

WINDOW PANE

ASTRAGAL

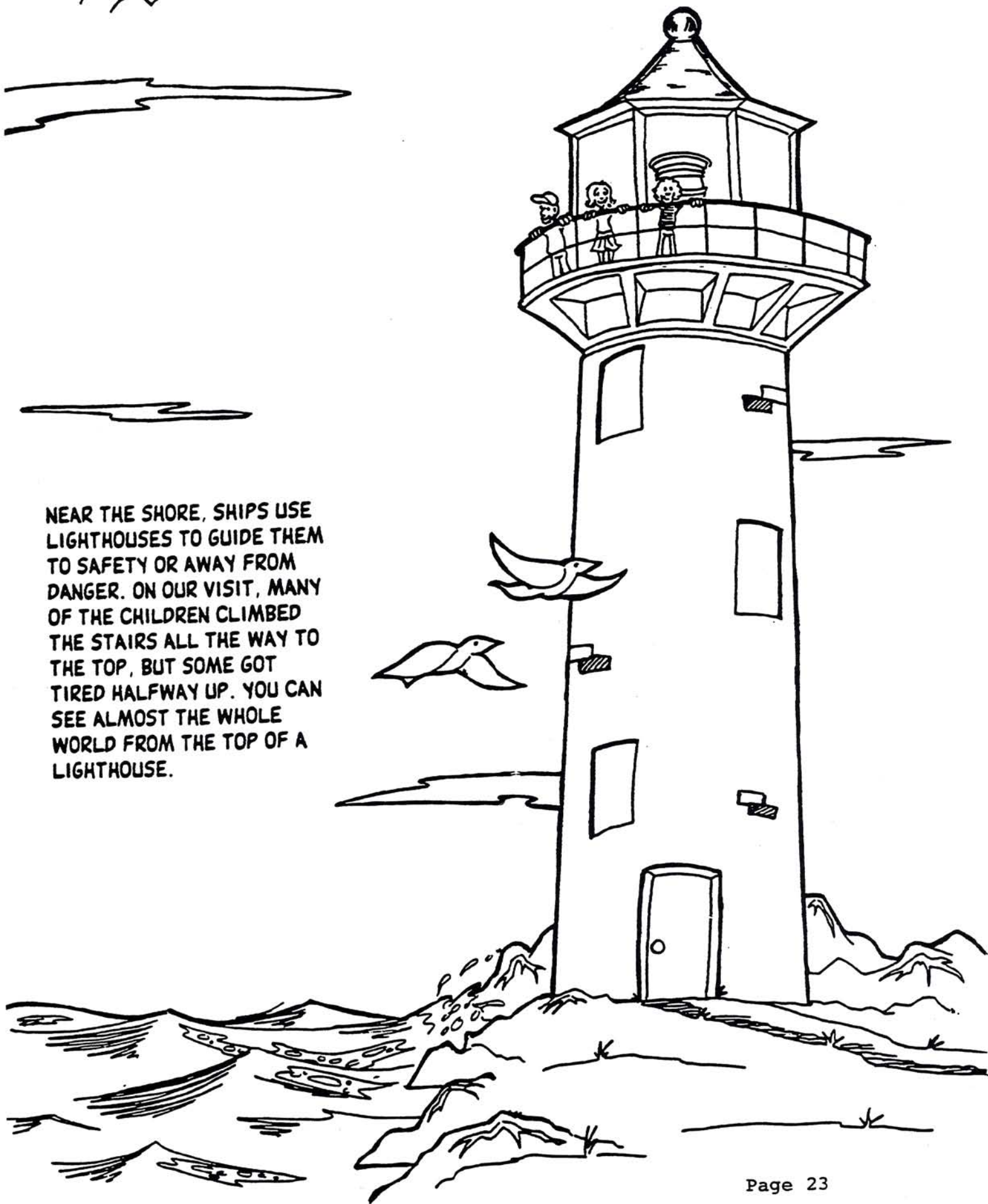
LANTERN ROOM GALLERY

WATCH OR SERVICE ROOM

MAIN GALLERY (BALCONY)

TEACHER - See pp 11, 12 of Text

NEAR THE SHORE, SHIPS USE
LIGHOUSES TO GUIDE THEM
TO SAFETY OR AWAY FROM
DANGER. ON OUR VISIT, MANY
OF THE CHILDREN CLIMBED
THE STAIRS ALL THE WAY TO
THE TOP, BUT SOME GOT
TIRED HALFWAY UP. YOU CAN
SEE ALMOST THE WHOLE
WORLD FROM THE TOP OF A
Lighthouse.



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GLOSSARY OF LIGHTHOUSE TERMS

ARGAND LAMP	A hollow wick oil lamp. (see wick)
AEROBEACON	A modern-day type of light presently used in many lighthouses to produce a characteristic.
ASTRAGAL	Metal bar (running vertically or diagonally) dividing the lantern room glass into sections.
BULLSEYE	A convex lens used to concentrate (refract) light.
CHARACTERISTIC	Individual flashing pattern of each light.
DAYMARK	Unique color scheme or design which identifies a specific lighthouse during daylight hours.
FIXED LIGHT	A steady non-flashing beam.
FOG SIGNAL	A device (such as a whistle, bell, canon, horn, siren, etc.) which provides a specific loud noise as an aid to navigation in dense fog.
FRESNEL LENS	A type of optic consisting of a convex lens and many prisms of glass which focus and intensify the light through reflection and refraction.
FUEL	A material that is burned to produce light (fuels used for lighthouses included wood, lard, whale oil, tallow, kerosene.) Today, besides electricity and acetylene gas, solar power is also used.
GALLERY or BALCONY	On a lighthouse tower, a platform or walkway located outside the watchroom (main gallery) and/or lantern room (lantern gallery.)
KEEPER	Person who takes care of the light in the lighthouse. (The Head Keeper is responsible for the operation of a light station.)
LAMP	The lighting apparatus inside a lens.
LANTERN ROOM	Glassed-in housing at the top of a lighthouse tower containing the lamp and lens.
LENS	A curved piece of glass for bringing together or spreading rays of light passing through it.

LIGHTHOUSE	A lighted beacon of major importance in navigation.
LIGHT STATION	A complex containing the lighthouse tower and all of the outbuildings, i.e. the keeper's living quarters, fuel house, boat house, fog-signaling building, etc.
LOG	A book for maintaining records, similar to a diary.
NAVIGATION	Travel over water.
ORDER	Size of the Fresnel lens which determines the brightness and distance the light will travel.
PARABOLIC REFLECTOR	A bowl-like metal device, silver plated, with a small oil lamp in the center.
PHAROLOGIST	One who studies or is interested in lighthouses.
PRISM	A transparent piece of glass that refracts or disperses light.
REFLECT	Bend or throw back light.
REFRACT	Bend or slant rays of light.
REVOLVING LIGHT	One which produces a flash or characteristic.
SPIDER LAMP	Shallow brass pan containing oil and several wicks.
STAG LIGHT	A lighthouse with no family living in it, i.e. inhabited by men only.
TOWER	Structure supporting the lantern room of the lighthouse.
WATCH ROOM or SERVICE ROOM	A room immediately below the lantern room where fuel and other supplies were kept where the keeper prepared the lanterns for the night and often stood watch. The clockworks (for rotating lenses) were also located there.
WICK	SOLID - A solid cord used in spider lamps that draws fuel up to the flame by capillary action. HOLLOW - A concentric cotton wick used in Argand and other lamps.
"WICKIE"	A nickname given to lighthouse keepers derived from the task of trimming the wick of the lamps.

LIGHTHOUSE FIND-A-WORD

THE FOLLOWING WORDS ARE STOWED AWAY IN THE SQUARE BELOW. THEY READ FORWARDS, BACKWARDS, UP, DOWN, AND DIAGONALLY. SEE HOW MANY YOU CAN FIND.

WATCH
LANTERN
LOG
FOG HORN
KEEPER

LIGHT
UNIFORM
LENS
INSPECT
HATCH

FRESNEL
OIL
WICKIE
SKIFF
BAY

Q	B	W	I	C	K	I	E	T	E	N
U	Z	A	N	H	Y	A	B	W	U	F
N	C	T	S	C	D	E	L	N	F	C
I	G	C	P	T	H	I	R	I	R	R
F	J	H	E	A	G	O	K	L	E	E
O	M	V	C	H	H	S	O	P	S	P
R	I	M	T	G	F	R	T	U	N	E
M	V	L	O	G	W	Y	A	Z	E	E
C	D	F	N	R	E	T	N	A	L	K

LIGHTHOUSE FIND-A-WORD

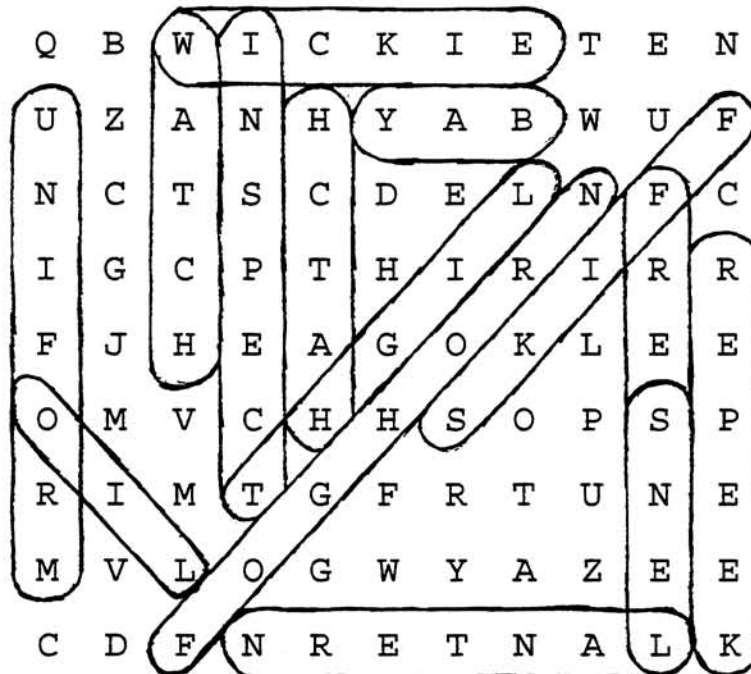
ANSWER KEY

THE FOLLOWING WORDS ARE STOWED AWAY IN THE SQUARE BELOW. THEY READ FORWARDS, BACKWARDS, UP, DOWN, AND DIAGONALLY. SEE HOW MANY YOU CAN FIND.

WATCH
LANTERN
LOG
FOG HORN
KEEPER

LIGHT
UNIFORM
LENS
INSPECT
HATCH

FRESNEL
OIL
WICKIE
SKIFF
BAY



The Light-house-keeper's White-Mouse

by John Ciardi, 1962

*As I rowed out to the lighthouse
For a cup of tea one day,
I came upon a very wet white-mouse
Out swimming in the bay.*

*"If you are for the light-house,"
Said he, "I'm glad we met.
I'm the light-house-keeper's white-mouse
And I fear I'm getting wet."*

*"O light-house-keeper's white-mouse,
I am rowing out for tea
With the keeper in his light-house.
Let me pull you in with me."*

*So I gave an oar to the white-mouse.
And I pulled on the other.
And we all had tea at the light-house
With the keeper and his mother.*





UNITED STATES LIGHTHOUSE SOCIETY

244 Kearny St. - 5th Floor
San Francisco, CA 94108
(415) 362-7255

LIGHTHOUSE FACTS

- * The first known lighthouse was the Pharos of Alexandria, Egypt. It was constructed between 300 and 280 B.C. by Ptolemy I and his son Ptolemy II. It stood about 450 feet high. This lighthouse was one of the Seven Wonders of the Ancient World. It was destroyed in stages by invaders and earthquakes, being destroyed in the 1300's.
- * The oldest existing lighthouse in the world is considered to be La Coruna in Spain that dates from ca. 20 B.C. A Roman lighthouse is located on the Cliffs of Dover in the UK that was constructed in 40 A.D.
- * The first lighthouse in America was at Boston on Little Brewster Island (1716). The first keeper was George Worthylake who was drowned, along with his wife and daughter, when returning to the island in 1718. The original tower was destroyed by the British and eventually reconstructed in 1784.
- * The oldest existing lighthouse in America is Sandy Hook, NJ (1764) which is still in operation.
- * There were 12 lighthouses when we became a nation in 1776.
- * The tallest lighthouse is Cape Hatteras, NC (200 ft. built in 1872).
- * The most expensive lighthouse built in America is St. George Reef, off Crescent City, CA. It took ten years to construct (1882 - 1892) and cost \$715,000.00. It was abandoned by the Coast Guard in 1972.
- * The Lighthouse Service was created in 1789 by the 9th Act of the first Congress. Over the years, lighthouses were placed under the direction of Department of Revenue (this department was disbanded in 1820), Treasury (until 1903), the Commerce and Transportation. The Lighthouse Board (of the U. S. Lighthouse Establishment) held sway from 1852 to July 1, 1910 when Commerce created the Bureau of Lighthouses. The Coast Guard took over on July 7, 1939.
- * After 1852 the country was divided into Districts; originally eight, they eventually numbered 19. Today the Coast Guard only has ten districts. The USLHE had a District Inspector (Naval Officer) as operational control. He ran the district in tandem with an Army Corps of Engineer who was in charge of engineering projects. In 1910 civilians started replacing the military officers.
- * There were never more than ca. 850 lighthouses in operation at once, although about 1,500 were constructed in this country over the years -- they hey-day being about 1910. There were 220 constructed on the U. S. shores of the Great Lakes. Michigan had the most with ca. 90 followed by Maine with ca. 80.
- * Lightships were employed where the water was too deep to construct a lighthouse or it was impracticable. The first lightships were located in the lower Chesapeake Bay (1820) and the most stations were in 1915 when there were 72 lightships manning 55 stations. The extra ships were used for relief. Lightships displayed lights at the tops of their mast(s) and in foggy areas sounded a bell or other fog signal such as a whistle, siren or horn. In 1921, lightships began being equipped with radiobeacons. The last lightship was removed from the Nantucket station in 1984.

* The first fog signal in this country was at the Boston Lighthouse and it was a cannon. Other fog signals have been whistles, sirens, reed trumpets, bells, diaphone (BEEEEoooooh) horns and diaphragm (brrrrrrrrr) horns.

* Whale oil was used with solid wicks as the source of light until a parabolic reflector system was introduced around 1810. Although the Fresnel lens was invented in 1822, it wasn't used in this country until the 1850's. Colza oil (pressed from wild cabbages) replaced whale oil in the early 1850's, but our farmers lack of interest in growing this caused the service to switch to lard oil in the mid 1850's. Kerosene started replacing lard oil in the 1870's and the service was finally totally converted by the late 1880's. Electricity started to replace kerosene around the turn of the century. All U. S. lighthouses had Fresnel lenses by 1860.

* Lighthouses are constructed of wood, granite, brick, sandstone, steel, cast iron, reinforced concrete and one has an outer skin of aluminum.

* The source of light is called the 'lamp' (be it electric or fueled by oil), the magnification of the light is caused by the 'lens' or 'optic'. They are located in the 'lantern room' of the tower and the glazings are called 'storm panes'.

* The reflector system and the Fresnel system had fixed (steady light) and revolving (flashing) optics. The type of signal is called the characteristic. Other characteristics are occulting, group flashing, quick flashing, and equal interval. Some lighthouses display a green or red light and some a white light with a green or red sector created by substituting a colored 'storm' for a clear one.

* Light stations were manned by one to five keepers.

* Uniforms were not introduced into the service until 1884.

* Keepers were paid a lower middle class wage. George Worthylake, our first, received 50¢ (\$250) a year. By today's standards that would be the equivalent of \$16,000. During the 19th century, the Head Keepers pay ranged from \$250 to \$600, others were paid less. The exception to this was in the west, where keepers were paid \$1,000 during the Gold Rush. The service supplied certain food stuff during most of their history.

* There were many female lighthouse keepers (Society has files on 80), but most obtained their position when their husband died or became incapacitated.

* The most powerful optic produces a light seen 25 miles at sea. Although aircraft have reported "picking up" a light at 40 or 50 miles.

* Towers are given special (painted) patterns -- diamond shapes, spirals, stripes, etc. -- or colors to distinguish them from each other.

* Some famous American lighthouses are: Buffalo, NY - Oldest on the Great Lakes; Makapuu Point, Oahu, HI - Has the largest lens in this country; Navesink, NJ - Site of first Fresnel experiments in this country; Point Pinos, CA - Oldest existing on the west coast in continuous operation with original 3rd order lens; St. George Reef, CA - Most expensive; Split Rock, MN- One of the prettiest settings; Thomas Point Shoal, MD - Last screwpile on Chesapeake Bay; Tillamook Rock, OR and Minots Ledge, MA - Exemplary engineering feat.