THE SIGNIFICANCE OF AIDS TO MARINE NAVIGATION

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TREASURY DEPARTMENT
UNITED STATES COAST GUARD

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CONTENTS

FOREWORD

The purpose of this publication is to acquaint those who are beginners in study of the science of navigation with the basic principles underlying the marking of coasts and waterways of the United States and its possessions with lighthouses, lightships, fog signals, radiobeacons, radio direction finders, and buoys. It explains briefly the significance of the varying colors of lighthouses and lightships, of the wide variety of light and fog signal characteristics, and of the system of radio aids to navigation. It states in simple terms the manner in which the information provided by these aids is applied in actual navigation.

The text treats primarily with the manner in which the physical characteristics of the various aids to navigation serve the mariner. Engineering problems connected with the construction and maintenance of the aids to navigation are not discussed, or is the publication intended to replace the Light Lists, Coast Pilots, and other Government publications which should be at hand during actual navigation.

GENERAL

DEFINITION

The expression "Navigational aids," as used herein, includes lighthouses, lightships, radiobeacons, fog signals, buoys, minor lights, and daybeacons.

THE PURPOSE OF NAVIGATIONAL AIDS

Aids are placed at various points along the Nation's coast and navigable waterways as markers and guides to enable mariners to determine at all times their exact position with relation to the land and to hidden dangers. Within the bounds of actual necessity and reasonable cost, each and every aid is designed to be seen or heard over the greatest practicable area.

Navigational aids assist mariners to make landfalls when approaching from overseas, mark isolated dangers, make it possible for vessels to follow the natural and improved channels, and provide a continuous chain of charted marks for coast piloting.

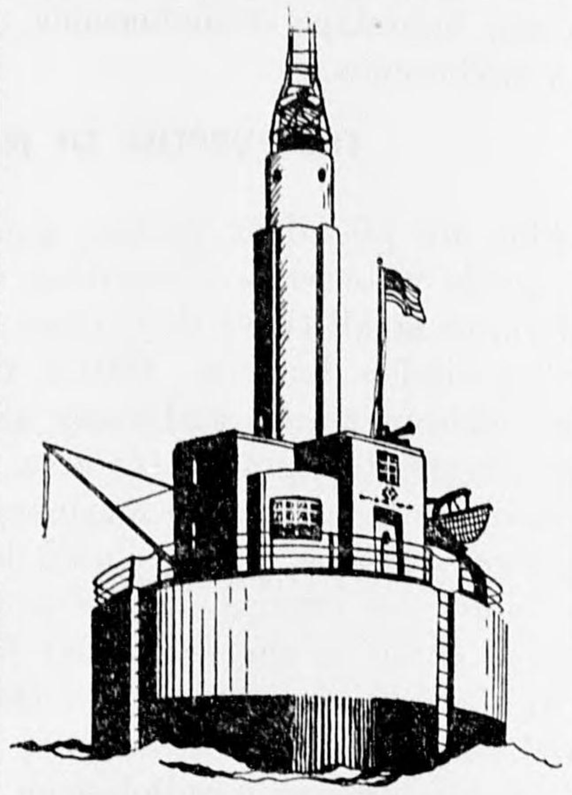
As all navigational aids serve the same general purpose, such structural differences as those between an unlighted buoy and a lightship, or a lighthouse and a radiobeacon, are solely for the purpose of meeting the conditions and requirements of the particular location at which the aid is to be established.

LIGHTHOUSES

Lighthouses are found upon all coasts of the United States, upon the Great Lakes, and along many of the interior waterways of the country. Such structures are so well known as to require little description. Lighthouses are placed where they will be of most use, on prominent headlands, at entrances, on isolated dangers, or at other points where it is necessary that mariners be warned or guided. Their principal purpose is to support a light at a considerable height above the sea. The same structure may also house a fog signal and radiobeacon equipment, and also contain quarters for the keepers. However, in the majority of instances, the fog signal, the radiobeacon equipment, and the operating personnel are housed in separate buildings grouped around the tower. Such a group of buildings constitutes a light station.

TYPICAL LIGHT STRUCTURES

MASONRY STRUCTURE



CYLINDRICAL TOWER SQUARE HOUSE ON CYLINDRICAL BASE

CYLINDRICAL CAISSON STRUCTURE

SKELETON IRON STRUCTURE

The location of a lighthouse, whether in the water or on shore, the importance of the light, the kind of soil upon which it is to be built, and the prevalence of violent storms, have a direct bearing upon the type of structure erected and on the materials of which it will be built. Engineering problems will not here be entered into, but it is important to note that the materials of and the types of construction differentiate one lighthouse from another and hence aid identification.

Lighthouses vary markedly in their outward appearance because of the points already mentioned and also because of the great difference in the distances to which their lights should be seen. Where the need for a powerful light is great and the importance and density of traffic warrants, a tall tower with a light of high candlepower is erected. Conversely, at points intermediate to the major lights, where the traffic is light, and where long range is not so necessary, a less expensive structure of more modest dimensions suffices.

The terms, secondary lights, minor lights, and automatic lights indicate in a general way a wide variety of lights, each class shading imperceptibly into the next. These lights may be displayed from towers resembling the important seacoast lighthouses, or may be shown from almost any type of inexpensive structure. The essentials of a light structure where keepers are not in residence as for all lights, are: best possible location dependent on physical conditions of the site, sufficient height for the location, a rugged support for the lantern, and a housing for the tanks of compressed gas or electric batteries from which the light is operated. Meeting these essentials are many types of structures—small tank houses surmounted by a short skeleton tower, a cluster of piles supporting a battery box and the lens, and countless other forms.

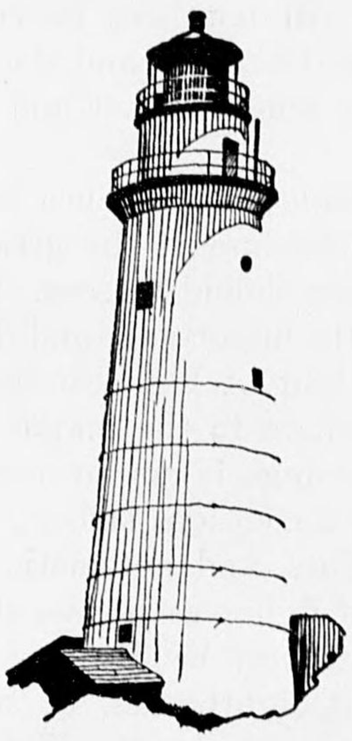
At the present time many of the lighthouses which were originally cared for by resident keepers are operated automatically, because of the availability of commercial electric current. There are also now a great many automatic lights on inexpensive structures, cared for through periodic visits of Coast Guard cutters or of keepers placed in charge of a group of such aids.

The recent introduction of much new automatic apparatus means that the relative importance of lights cannot be judged on the basis of whether or not they have resident keepers, for a number of powerful lights in towers of great height are now operated without continuous attention.

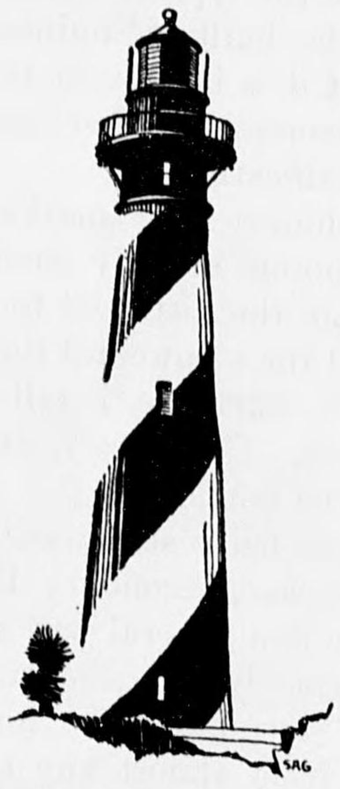
COLORING OF STRUCTURES

Color is applied to lighthouses and automatic light structures for the purpose of making them readily distinguishable from the background against which they are seen, and to distinguish one structure from others in the same general vicinity. Solid colors, bands of color, and various other patterns are applied for these purposes.

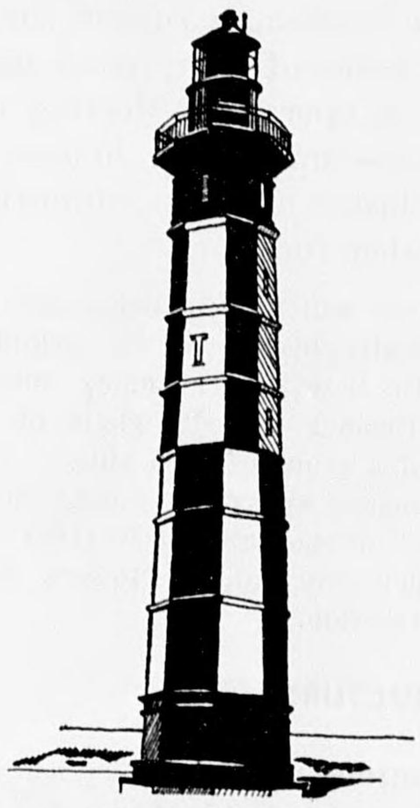
COLORING OF TYPICAL LIGHTHOUSES



BOSTON, MASS.



ST. AUGUSTINE FLA.



CAPE HENRY, VA.

TYBEE, GA.

Minor light structures are sometimes painted black or red, to indicate the sides of the channel which they mark, following the same lateral system used in the coloring of buoys. When so painted, red structures mark the right side of the channel, and black structures the left side of the channel, entering from seaward.

LIGHT CHARACTERISTICS

Lights are given distinctive characteristics so that one light may be distinguished from another, or as a means of conveying certain definite information. This distinctiveness is obtained by employing lights of various colors, by having lights that burn steadily, and others that flash at intervals of great variety. The following are the principal "characteristics" employed for lighthouses and lightships. In addition to these, certain other special characteristics are used for lighted buoys.

FIXED: A continuous steady light.

FLASHING: Showing a single flash at regular intervals, the duration of light always being less than that of darkness.

FIXED AND FLASHING: A fixed light varied at regular intervals by 1 or more flashes of greater brilliance, or different color or both. A flash is preceded and followed by a diminution of light or an eclipse.

GROUP FLASHING: Showing at regular intervals groups of flashes.

OCCULTING: A steady light totally eclipsed at intervals, the period of light being equal to or greater than the period of darkness.

GROUP OCCULTING: A steady light totally eclipsed by a group of 2 or more eclipses.

ALTERNATING: An alternation of colors at regular intervals.

COLORS

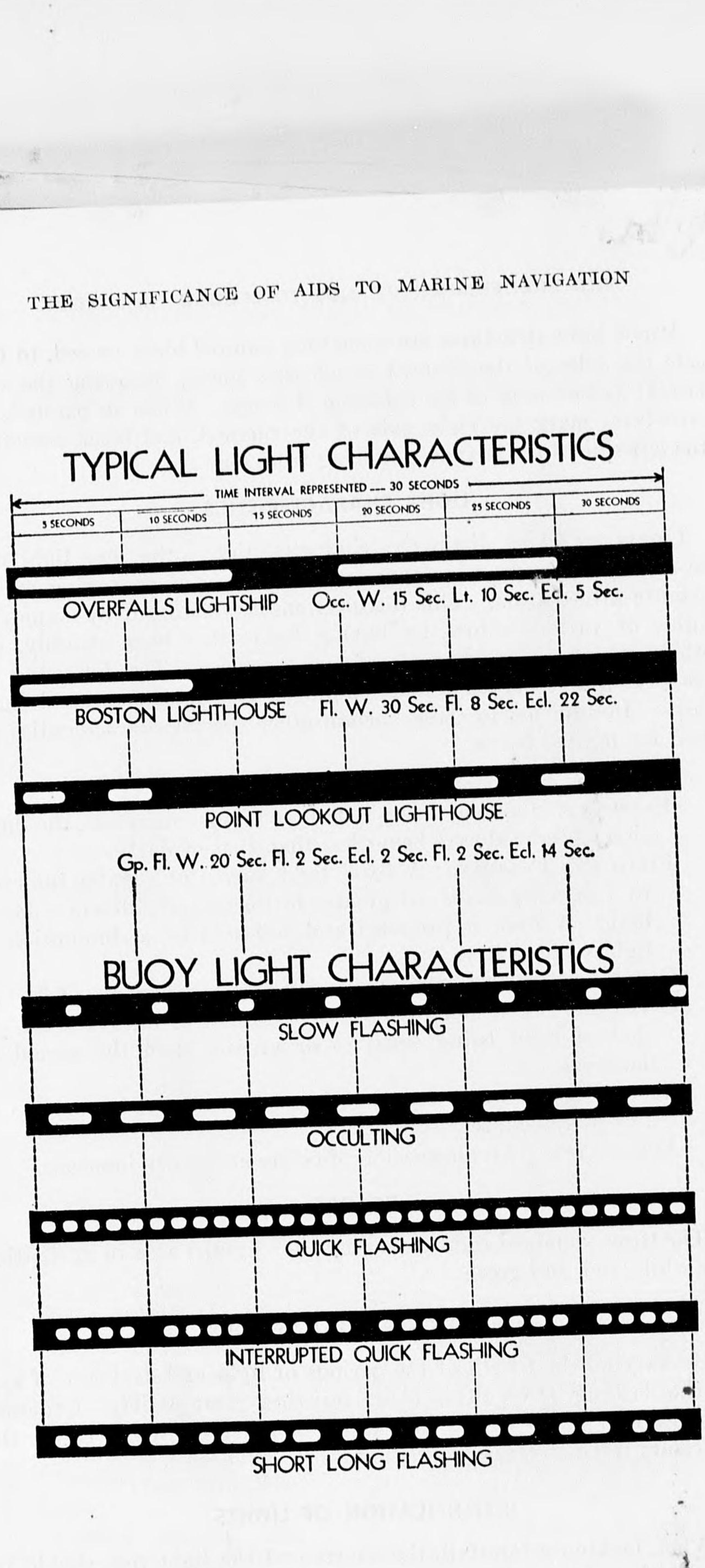
The three standard light colors used for lighted aids to navigation are white, red, and green.

LENGTH OF LIGHT PERIODS

By varying the length of the periods of light and darkness of any of the flashing or occulting characteristics, great variety of characteristics may be obtained. Advantage is taken of this to secure the necessary distinctiveness between aids of a given area.

IDENTIFICATION OF LIGHTS

When making a landfall, the charts and the light lists should be consulted to learn the exact characteristics of the light or lights


TYPICAL LIGHT CHARACTERISTICS
TIME INTERVAL REPRESENTED --- 30 SECONDS
5 SECONDS
10 SECONDS
15 SECONDS
20 SECONDS
25 SECONDS
30 SECONDS
OVERFALLS LIGHTSHIP Occ. W. 15 Sec. Lt. 10 Sec. Ecl. 5 Sec.
BOSTON LIGHTHOUSE Fl. W. 30 Sec. Fl. 8 Sec. Ecl. 22 Sec.
POINT LOOKOUT LIGHTHOUSE
Gp. Fl. W. 20 Sec. Fl. 2 Sec. Ecl. 2 Sec. Fl. 2 Sec. Ecl. 14 Sec.
BUOY LIGHT CHARACTERISTICS
SLOW FLASHING
OCCULTING
QUICK FLASHING
INTERRUPTED QUICK FLASHING
SHORT LONG FLASHING

which it is expected will be first seen. When a light is observed, its color is noted and, by means of a watch or clock with a second hand, a note is made of the time required for the light to perform its full cycle of changes. If color, cycle, and number of flashes per cycle agree with the information in the light list correct identification has been made. The light list should be examined to ascertain if any other light in the general locality might be seen and mistaken for the desired light. If there is doubt, a careful timing of the length of all flashes and dark intervals, for comparison with the light list, is usually conclusive.

HOW FLASHES ARE PRODUCED

The flashing lights of lighthouses and minor lights are produced in several ways. In some of the larger lights the flashes result from the rotation of the lenses in which various flash panels are incorporated. The use of electricity as the illuminant has also made it possible to produce flashes by means of timing devices which interrupt the flow of current or conceal the light source at definite intervals.

In those minor lights where acetylene gas is used, the flashes are produced by interrupting the flow of gas by means of a bellows-like device, each small charge of gas being ignited at the burner by a constantly burning nonluminous pilot flame.

Electricity is the illuminant now used in most of the larger lighthouses, electric incandescent lamps placed inside the larger sizes of lenses producing beams of as much as 5,000,000 candlepower where such brilliance is required. Lenses, which are aggregates of highly polished glass prisms are assembled in a variety of types to produce the characteristics desired.

VISIBILITY OF LIGHTS

The theoretical visibility of a light in clear weather depends upon two factors, the height of the light above water, and its intensity or brilliance. The height controls what is known as the geographic range, while the intensity controls what is known as the luminous range.

As a rule, for the principal lights the luminous range is greater than the geographic, and the distance from which such lights are visible is limited by the earth's curvature only. Under some atmospheric conditions the glare or loom of these lights, and occasionally the light itself, may be visible far beyond the computed geographic range. On the other hand, and unfortunately more frequently, these distances may be lessened by fog, rain, snow, haze, or smoke.

Lights on inside waters, where their radius of usefulness is not great, are frequently of insufficient intensity to reach to the full limit of their geographic range.

SECTORS

Sectors of colored glass are placed in the lanterns of certain lighthouses to mark shoals or to warn mariners off the nearby land. Lights so equipped show one color from most directions and a different color or colors over definite arcs of the horizon indicated in the light lists and upon the charts. A sector changes the color of a light, when viewed from certain directions, but not the characteristic. For example, a flashing white light having a red sector, when viewed from within the sector will appear flashing red.

Sectors may be but a few degrees in width, marking an isolated rock or shoal, or of such width as to extend from the direction of the deep water toward shore. Bearings referring to sectors are expressed in degrees as observed from a vessel toward the light.

In the majority of cases, water areas covered by red sectors should be avoided, the exact extent of the danger being determined from an examination of the charts. In some cases a narrow sector may mark the best water across a shoal. A narrow sector may also mark a turning point in a channel.

FOG SIGNALS

These signals form an important part of the equipment of many lighthouses situated in sections of the country where fog or low visibility is prevalent. Identification is made in the same manner as with lights. Each fog signal station is assigned a signal consisting of a definite number of blasts recurring at stated intervals. The sound or tone of the signal varying with the type of mechanism employed, also assists in identification. Fog signals are treated in greater detail in the chapter beginning on page 10.

RANGE LIGHTS

Two lights, located some distance apart, visible usually in one direction only, are known as range lights. They are so located that the mariner by bringing his ship into line with them, when they will appear one over the other, places his ship on the axis of the channel. If he steers his ship so that the lights remain continuously in line, he will remain within the confines of the channel. Entrance channels are frequently marked by range lights. The Delaware River and the St. Johns River on the Atlantic coast, and the Columbia River on the Pacific coast are examples of successive straight reaches marked in this manner.

The lights of ranges may be any of the three standard colors, and may also be fixed flashing, or occulting, the principal requirement

being that they stand out distinctly from their surroundings. Most range lights lose brilliance rapidly as a ship diverges from the range line. Ranges should be used only after a careful examination of the charts, and it is particularly important to determine for what distance the range line can be safely followed, this information not being obtainable from the lights themselves in all cases.

LIGHTSHIPS

Lightships serve the same purpose as lighthouses, being equipped with lights, fog signals, and radiobeacons. They take the form of ships only because they are to be placed at points where it would be impracticable to build lighthouses. Lightships mark the entrances to important harbors or estuaries, dangerous shoals lying in much frequented waters, and also serve as leading marks for both transoceanic and coastwise traffic.[1]

COLOR OF LIGHTSHIPS

All lightships in United States waters, except Lake Huron Lightship, are painted red with the name of the station in white on both sides. Superstructures are white; masts, lantern galleries, ventilators, and stacks are painted buff. Relief lightships are painted the same color as the regular station ships, with the word "RELIEF" in white letters on the sides.

RELIEF LIGHTSHIPS

These may be placed at any of the lightship stations, and, when practicable, will exhibit lights and sound signals having the characteristics of the station. Relief ships may differ in outward appearance from the regular station ships in certain minor details.

SIGNALS

The masthead lights, the fog signals, and the radiobeacon signals of lightships all have definite characteristics, so that each lightship may be distinguished from others and also from nearby lighthouses. As with lighthouses, details regarding these signals are shown briefly on charts and more completely in the light lists.

A lightship under way or off station will fly the International Code signal flags "PC" signifying lightship is not at anchor on her station. It will not show or sound any of the signals of a lightship,

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[1] Many United States lightships have been temporarily removed from their stations because of war conditions. In most instances, however, the stations are marked with lighted or unlighted buoys.

but will display the lights prescribed by the International or Inland Rules for a vessel of its class. While on station a lightship shows only the masthead light and a less brilliant light on the forestay, the latter serving to indicate the direction in which the ship is heading. By day the lightship will display the International Code signal of the station, whenever it appears that an approaching vessel does not recognize the lightship or requests the information. As lightships ride to a single anchor, the light on the forestay also indicates the direction of the current.

POWER PLANTS

Almost without exception, United States lightships are self-propelled vessels capable of proceeding to and from their stations under their own power. By this means ships also work back to their stations if driven off by storms, and also use their engines to relieve the strain on their moorings in severe weather. A number of lightships are Diesel propelled, some direct connected, others with geared drive, and still others with an electric motor connected to the propeller shaft and served by four Diesel electric generating sets. Several ships still employ reciprocating steam engines, usually with oil-fired boilers.

Most lightships, when on station, derive power for the operation of their signals from Diesel driven auxiliaries. In the Diesel-electric ships, one or more generating sets are used for auxiliary purposes in accordance with the demand for power.

The names appearing on the sides of lightships are the names of the stations which the ships occupy at the time. Individual ships of the service are identified by permanent numbers. During a lifetime of 40 or 50 years a lightship may occupy a half-dozen stations, having the name of each in turn painted upon it.

FOG SIGNALS

Any sound-producing instrument operated in time of fog from a definite point shown on the charts, such as a lighthouse, lightship, or buoy, serves as a useful fog signal. To be effective a mariner must be able to identify it as a fog signal, and to know from what point it is sounded. The simpler fog signals are bells and whistles on buoys, and bells struck by hand generally at lighthouses. As such signals on buoys which are operated by the action of the sea do not produce sounds on a regular time schedule, positive identification is not always possible.

At most lighthouses and lightships fog signals are operated by mechanical means and are sounded on definite time schedules, providing the desirable feature of positive identification.

The various types of apparatus employed for sounding fog signals are of interest to the mariner principally because each type produces distinctive sounds, familiarity with which assists in identification.

SIGNAL CHARACTERISTICS

These are composed of blasts and silent periods. A definite time is required for each signal to perform a complete cycle of changes. This time, stated in the light list is one of the means of identification. Where the number of blasts and the total time for a signal to complete a cycle is not sufficient for positive identification, reference may be made to details in the light list regarding the exact length of each blast and silent interval.

The various types of fog signals differ in tone, and this facilitates the recognition of the respective stations. The type of fog signal apparatus for each station is stated in the light lists.

Diaphones produce sound by means of a slotted reciprocating piston actuated by compressed air. Blasts may consist of two tones of different pitch, in which case the first part of the blast is high and the last of a low pitch. Theses alternate-pitch signals are called "two-tone."

Diaphragm horns produce sound by means of a disc diaphragm vibrated by compressed air, steam, or electricity. Duplex or triplex horn units of differing pitch produce a chime signal.

Reed horns produce sound by means of a steel reed vibrated by compressed air.

Sirens produce sound by means of either a disc or a cup-shaped rotor actuated by compressed air, steam, or electricity.

Whistles produce sound by compressed air or steam emitted through a circumferential slot into a cylindrical bell chamber.

Bells are sounded by means of a hammer actuated by hand, by a descending weight, compressed gas, or electricity.

RADIO AIDS TO NAVIGATION

GENERAL

Radiobeacons are radio stations installed at lighthouses, on lightships, or at other points well known to mariners, for the automatic transmission of radio signals upon which passing ships may take bearings, by a direction finder or radio compass as a means of determining their position.

POSITION FINDING BY MEANS OF RADIO

Vessels at sea employ radio signals as well as celestial bodies and visible objects on shore in their continuous efforts to know their position. Position finding by means of radio resolves itself chiefly into the utilization of the network of marine radiobeacons which is available to ships fitted with the appropriate devices.

Direction-finder-equipped ships may take bearings also on the transmissions of any radio station, the exact position of which is known, within certain frequency bands.[2]

Radio bearings, regardless of how obtained, are lines of direction, from the ship to known points shown on the charts. For short distances they may be plotted in the same manner as bearings on visual objects such as lighthouses or lightships. For distances greater than 50 miles, they may be employed in the same manner as other lines of position if due regard is given to the fact that they are great circle courses. A single radio bearing from a station at a great distance can be plotted on a chart only by assuming an approximate distance, and applying the correction to compensate for the difference between a great circle and a rhumb line. Cross bearings on two radio stations must be similarly corrected for greatest accuracy.

However, a ship may readily sail the great circle course which is the shortest distance between her position and the radio station by steering the various headings obtained by successive observations.

A most important practical consideration in using radio signals is the fact that they have a range many times as great as even the most powerful visual signal. A further advantage is their availability at all times, regardless of fog, rain, or snow.

Some of the uses of radio bearings in obtaining a fix are: Cross bearings taken on two or more stations, a single bearing crossed with a line of position of a heavenly body, a bearing and a sounding, a bearing and a synchronized air fog signal, and two bearings on the same station and the distance run between bearings.

RADIOBEACONS

These are radio stations installed at lighthouses, or lightships, or at other points as shown on the charts, for sending out radio signals in all directions for the guidance of mariners. Each radiobeacon is readily distinguished from other radiobeacons by the characteristic of its signal, as is a lighthouse by its distinguishing light beams. The radiobeacons operate within the frequency range 285–315 kilocycles set aside for this purpose. About 180 radiobeacons are operated

[2] Successful bearings cannot be taken on the radio ranges operated for air navigation unless, by chance, a vessel happens to be on or very close to the range line.

in the waters of the United States and its possessions by the United States Coast Guard.

To enable a mariner to make proper use of the radiobeacon signals available on all parts of the coasts and on the Great Lakes, his vessel must be equipped with a radio direction finder. While on the largest ships this instrument may cost several hundred dollars, small vessels may now be fitted with sets costing less than $200.

A radio direction finder consists essentially of a small loop antenna capable of rotation and equipped with a pointer operating over a dial graduated in degrees, as is a ship's compass, and a radio receiver provided with headphones or loudspeaker. When located in the pilothouse or on the navigating bridge, the direction finder enables the navigation officer to obtain bearings himself without reference to others and without delay. The loop antenna may be mounted directly on the receiver if the superstructure of the vessel on which it is used is of wood. If the pilothouse is of steel construction, the loop must be mounted above the pilothouse and connected to the dial and rotating handwheel near the receiver by an appropriate shaft. The original installation and calibration require approximately the same care as for a magnetic compass, and changes in rigging or erection of additional antennas on a vessel should not be undertaken without carefully recalibrating the radio direction finder afterward.

To get a radio bearing, the navigator tunes his receiver to the frequency of the radiobeacon on which the bearing is desired, having before him a list of the radiobeacon stations with their frequencies and characteristic signals. When a signal is heard and the station identified, he is prepared to take a bearing on it. The loop is rotated, causing the signal to be heard either fainter or louder. A brief manipulation of the loop handwheel, to which the dial pointer is attached, is usually sufficient to discover the point at which the signal is heard faintest, or at which, preferably, no signal is heard. With the handwheel in this position, the bearing is read. A simple procedure is usually employed to determine which of two possible bearings, 180° apart, is the correct one.

If the radio direction finder dial is of the "dumb" card type, indicating degrees from the ship's head, a simultaneous reading of the ship's heading on the steering compass must also be taken. The reading of the "dumb" radio direction finder card added to the reading of the steering compass (and minus 360 if the total is larger than this) is the direction of the radiobeacon from the observing vessel expressed in degrees "per steering compass." By applying the proper correction for deviation, a bearing in degrees magnetic is obtained, and this in turn is converted into degrees true by applying the proper variation.

Section of Page of Radiobeacon Characteristics

Station	Latitude N.	Longitude W.	Operate on— Kilocycles	Operate on— Power [2]	Signal characteristic transmitted
ATLANTIC COAST					
West Quoddy Head Light Station, Maine	44 48.9	66 57.1	288	C	▬ • ▬ ▬
Mount Desert Light Station, Maine	43 58.1	68 07.7	288	C	▬ • • •
Matinicus Rock Light Station, Maine	43 47.0	68 51.3	294	C	• ▬ ▬ •
Manana Island Fog Signal Station, Maine	43 45.8	69 19.7	300	B	▬ ▬ ▬ •
Halfway Rock Light Station, Maine	43 39.4	70 02.2	312	B	▬ ▬ ▬
Portland Lightship, Maine	43 31.6	70 05.5	288	B	▬ • ▬
Eastern Point Light Station, Mass	42 34.8	70 39.9	292	C	• ▬ • ▬
Boston Lightship, Mass	42 20.4	70 45.5	302	B	▬ ▬ • •
Canal Breakwater Light Station, Mass	41 46.5	70 29.8	292	C	• • ▬
Cape Cod Light Station, Mass.[3]	42 02.4	70 03.6	302	A	▬ ▬ • ▬
Pollock Rip Lightship, Mass	41 36.1	69 51.1	314	A	▬ • • ▬
Nantucket Shoals Lightship, Mass	40 37.0	69 37.0	314	A	▬ ▬ ▬ ▬
Warning beacon				Special	▬ ▬ ▬ ▬

DISTANCE FINDING STATIONS

SYNCHRONIZED RADIOBEACON AND SOUND SIGNALS

STATION, FREQUENCY IN K.C. AND CHARACTERISTIC OF RADIOBEACON SIGNAL		OFF MINUTES OF RADIOBEACON	OPERATING MINUTE OF RADIOBEACON
PARTRIDGE ID., CAN. 294 K.C.	RADIOBEACON	SILENT	52 — 55
	SOUND SIGNAL	23 — 23	55
WEST QUODDY HEAD 288 K.C.	RADIOBEACON	SILENT	52 — 53
	SOUND SIGNAL	24 — 24	53
MOUNT DESERT 288 K.C.	RADIOBEACON	SILENT	52 — 53
	SOUND SIGNAL	26 — 26	53
MATINICUS ROCK 294 K.C.	RADIOBEACON	SILENT	52 — 53
	SOUND SIGNAL	13 — 13 — 13 — 13	13 — 13 — 53
MANANA ISLAND 300 K.C.	RADIOBEACON	SILENT	52 — 53
	SOUND SIGNAL	30 — 30 — 30	53
HALFWAY ROCK 312 K.C.	RADIOBEACON	SILENT	52 — 53
	SOUND SIGNAL	34 — 33	53

In general, radiobeacons are located at all important entrances and at outstanding intermediate points along the coasts. All lightships are equipped with radiobeacons. Many are also placed in sounds and bays, notably Long Island Sound, Chesapeake Bay, and Puget Sound, as well as on the Great Lakes. Full details regarding the location and operation of radiobeacons are given in the light lists,[3] published annually, and on the special radiobeacon charts, of which three are now published showing respectively the Atlantic and Gulf, the Great Lakes, and the Pacific coast areas. These radiobeacon charts, suitable for posting in pilothouses or elsewhere near radio direction finders, are issued free to vessels on request addressed to a United States Coast Guard District Commander or to the Commandant, United States Coast Guard, Washington, D. C. All changes in radiobeacons as in other aids to navigation are announced in the weekly Notice to Mariners.

Radiobeacons may be used as leading marks for which to steer directly, correcting the course by successive observations, but it is important that courses invariably be set to pass lightships with sufficient clearance to avoid possibility of collision.

Experience shows that lightships cannot be safely used as leading marks to be passed close aboard, but should invariably be left broad off the course, wherever sea room permits.

When approaching a lightship or a light station on a submarine site, on radio bearings, the risk of collision will be avoided by insuring that the radio bearing does not remain constant.

Many stations equipped with radiobeacons also have sound-in-air fog signals, the two being synchronized for distance finding purposes. A vessel provided with a radio receiver covering the band 285–315 kilocycles may, by a single observation, determine its distance from such a station, when within audible range of the sound signal. Any radio receiving set capable of receiving on the proper frequency is sufficient, although if the vessel has a radio direction finder, and takes a radio bearing at the same time, its position is at once determined by both the distance and the bearing. Distance finding signals are based on the fact that signals are transmitted practically instantaneously, and that sound signals in air travel at the rate of 1 mile in about 5 seconds. The approximate distance in miles from the sending station is readily obtained by measuring the time in seconds between the reception of the radio and of the sound signals and dividing this time by 5.5 for nautical miles, or by 5 for statute miles.

[3] See bibliography on page 32.

BUOYS [4]

THE SIGNIFICANCE OF BUOYS

The primary function of buoys is to warn the mariner of some danger, some obstruction, or change in the contours of the sea bottom, and to delineate the channels leading to various points, that he may avoid the dangers and continue his course safely. The utmost advantage is obtained from buoys when they are considered as marking definitely identified spots, for if a mariner knows his precise location at the moment and is properly equipped with charts, he can plot a safe course on which to proceed. Such features as size, shape, coloring, numbering, and signalling equipment of buoys, are but means to these ends of warning, guiding, and orienting the navigator.[5]

THE LATERAL SYSTEM

The coloring and numbering of buoys is determined by their position with respect to the navigable channels, as such channels are entered and followed from seaward toward the head of navigation. This method of channel marking, known as the lateral system, is uniform in all United States waters. As all channels do not lead from seaward, arbitrary assumptions must at times be made in order that the system may be consistently applied. In coloring and numbering of offshore buoys along the coasts and along traffic routes not leading distinctly from seaward or toward headwaters, the following system has been adopted: Proceeding in a southerly direction along the Atlantic coast, in a northerly and westerly direction along the Gulf coast, and in a northerly direction along the Pacific coast, will be considered as proceeding from seaward, and accordingly, coastal buoys which are to be kept on the right hand side are red and have even numbers. On the Great Lakes offshore buoys are colored and numbered from the outlet of each lake toward its upper end. The Intracoastal Waterway is marked from the North Atlantic States to the lower coast of Texas, regardless of the compass headings of individual sections.

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[4] The subject of buoyage is more fully covered in the pamphlet, Buoys in Waters of the United States, published by the United States Coast Guard, and available for distribution without cost.

[5] Buoys are the most valuable aids to navigation for close work, especially for marking dredged channels, and are used in great quantities for this purpose.

TYPE OF BUOYS

The buoyage system adopted for the waters of the United States consists of several different types of buoys, each kind designed to serve under definite conditions. Broadly speaking all buoys serve as daymarks, those having lights are also available for navigation by night, and those having sound signals also are the more readily located in time of fog as well as by night. The following are the principal general types.

Spar Buoys: Large logs, trimmed, shaped, and appropriately painted. Buoys of the same spar shape are also constructed of steel plates.

Can and Nun Buoys: Buoys built up of steel plates having the distinctive shapes designated by these names.

Bell Buoys: Steel floats surmounted by short skeleton towers in which the bells are fixed. Most bell buoys are sounded by the motion of the buoy in the sea. In a few buoys the bells are struck by compressed gas or electrically operated hammers.

Gong Buoys: Similar in construction to bell buoys, but sounding a distinctive note because of the use of sets of gongs each gong of which has a different tone.

Whistle Buoys: These buoys provide a sound signal which is useful at night and also during fog and low visibility. As the whistle mechanism is operated by the motion of the buoy in the sea, these buoys are used principally in exposed locations. A type of sound buoy is also in use in which a horn is sounded at regular intervals by mechanical means.

Lighted Buoys: A metal float on which is mounted a short skeleton tower at the top of which the lens is placed. Tanks of compressed acetylene gas, or electric batteries, on which the light is operated, are placed in the body of the buoy below the water level.

Combination Buoys: These are buoys in which a light and a sound signal are combined, such as a lighted bell buoy, lighted gong buoy, lighted whistle buoy.

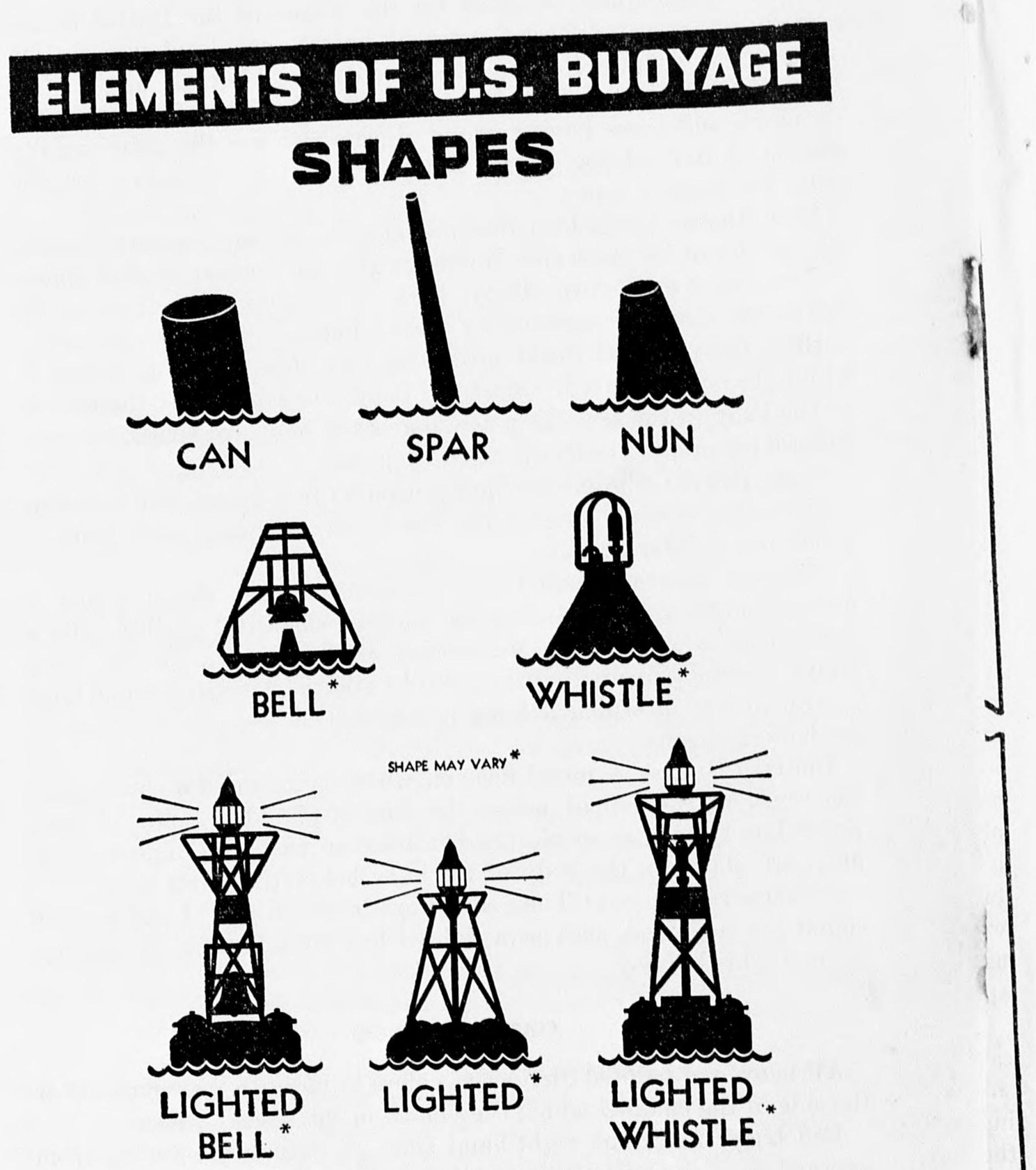
COLORING OF BUOYS

All buoys are painted distinctive colors to indicate their purpose or the side of the channel which they mark in the lateral system.

Red buoys mark the right-hand sides of channels, entering from seaward.

Black buoys mark the left-hand sides of channels, entering from seaward.

Black and red horizontally banded buoys mark obstructions, or a junction of one channel with another and indicate that there is a channel on both sides. If the topmost band is red, the principal



NOTE: The Coloring of Buoys is not shown on this drawing

channel will be followed by keeping the buoy on the right-hand side of the vessel, when entering from seaward. If the topmost band is black, the principal channel will be followed by keeping the buoy on the left-hand side of the vessel, when entering from seaward. When proceeding toward the sea, it may not be possible to pass on either side of these buoys, and the chart should always be consulted.

Where a secondary channel leads off from a main channel at right angles or nearly so, this channel will be marked with the usual entrance buoys, black buoys on the port side and red buoys on the starboard side, and the junction will not be marked with a red and black horizontally banded buoy.

Black and white vertically striped buoys indicate the middle of a channel, and should be passed close to, but on either side, for safety.

White buoys mark anchorages.

Yellow buoys mark quarantine anchorages.

White buoys with green tops mark areas in which dredging is being carried on.

Black and white horizontally banded buoys mark the limits of areas in which fish nets and traps are permitted.

Red or black (unlighted) buoys with white tops have the same significance as similar buoys without the white tops, and white painting being added so that the buoys may be readily picked up at night by a ship's searchlight.

NUMBERING OF BUOYS

Most buoys are given numbers, which are painted conspicuously upon them. These numbers serve to indicate which side of the channel buoys mark, and also facilitate the locating of the buoys upon the charts.

Numbers increase from seaward and are kept in approximate sequence on the two sides of the channel by omitting numbers where required.

Odd numbered buoys mark the left-hand sides of channels entering from seaward.

Even numbered buoys mark the right-hand sides of channels entering from seaward.

Numbers followed by letters, such as 1DR, are used on important buoys, particularly those marking isolated offshore dangers. The letters are initials of the station name, in this instance, Duxbury Reef, and the number has the usual significance.

Letters without numbers are applied in some cases to black and white vertically striped buoys marking fairways, and to red and black horizontally banded buoys marking junctions or bifurcations.

SHAPES OF BUOYS

In a large portion of the unlighted buoys used in the United States waters, the shape of the buoy has a definite significance, indicating which side of the channel they mark. Cylindrical buoys with flat tops are known as can buoys, and if painted black, mark the left-hand sides of channels entering from seaward. Conical buoys with pointed tops are known as nun buoys, and if painted red, mark the right-hand sides of channels entering from seaward.

Cylindrical or can buoys, painted in red and black horizontal bands, with the topmost band black, are used to indicate an obstruction or a junction of one channel with another, where the principal channel, entering from seaward, lies to the right of the buoy. Conical or nun buoys, painted in red and black horizontal bands, with the topmost band red, are used to indicate an obstruction or junction where the principal channel, entering from seaward, lies to the left of the buoy.

Can or nun buoys with black and white vertical stripes indicate the middle of a channel, and may be passed safely but close to on either side. In these the shape has no significance.

No special significance is to be attached to the shapes of spar buoys, bell buoys, gong buoys, whistle buoys, lighted buoys, or combination buoys, their purpose being indicated only by their coloring, numbering, or the characteristic of the light.

COLOR OF LIGHTS

For all buoys having lights, the following system of coloring is used. Green lights are used only on buoys marking the left-hand sides of channels, entering from seaward. Red lights are used only on buoys marking the right-hand sides of channels, entering from seaward. White lights may be used on either side of the channel, and such lights are frequently employed in place of colored lights, at points where a light of considerable brilliance is required, particularly as leading or turning lights. White lights are the only lights used on midchannel buoys.

REFLECTORS

Many unlighted buoys are fitted with reflectors. These greatly facilitate the locating of the buoys at night by means of a searchlight. Reflectors may be white, red, or green, and have the same significance as lights of these colors.

LIGHT CHARACTERISTICS

Fixed lights (lights that do not flash or occult) may be found on either black or red buoys.

Flashing lights (flashing at regular intervals and at the rate of not more than 30 flashes per minute) are placed on either black buoys or on red buoys.

Quick flashing lights (not less than 60 flashes per minute) are placed on black buoys and on red buoys, at points where it is desired to indicate that special caution is required, as at sharp turns or sudden constrictions, or where used to mark obstructions which may be passed only on one side.

Interrupted quick flashing lights (the groups consisting of a series of quick flashes, with dark intervals of about 4 seconds between groups) are placed on buoys painted in red and black horizontal bands, indicating obstructions or a junction of one channel with another.

Short-long flashing lights (groups consisting of a short flash and a long flash, the flashes recurring at the rate of about eight per minute) are placed on buoys painted in black and white vertical stripes, indicating a fairway or the middle of a channel. These buoys should be passed close-to. The lights are always white.

The lights of the majority of buoys are produced by means of acetylene gas stored in cylinders in the body of the buoy and piped to a flashing mechanism in the base of the lantern. There are also many buoys the lights of which are electric, batteries for the purpose being stored in the buoy body in much the same manner as the acetylene cylinders.

In order that lighted buoys may function for a reasonably great length of time without requiring a replenishment of the gas supply or a replacement of the batteries, the length of the light flashes as compared with the intervening periods of darkness is made quite short. Buoys at isolated points frequently function for 6 months or more without attention.

DAYBEACONS

There are many aids to navigation which are not lighted. Structures (not buoys) of this type are called daybeacons. They vary greatly in design and construction,[6] depending upon their location, and the distance to which they must be seen. A daybeacon may consist of a single pile with a daymark at the top, a spar with a cask at the top, a slated tower, or a structure of masonry. Daybeacons are colored, as are lighthouses, to distinguish them from their surroundings and to provide a means of identification. Daybeacons marking the sides of channels are colored and numbered in the same manner as buoys and minor light structures; red indicating the right side entering, and black the left side entering. Many daybeacons are also fitted with reflectors to facilitate locating them at night in the same manner as with lighted buoys.

[6] A constant effort is being made to standardize daybeacon markings which have become established by custom over many years.

INTRACOASTAL WATERWAY

DEFINITION

The Intracoastal Waterway, to which is applied the system of marking about to be described, is that comparatively shallow channel lying parallel to and extending along the Atlantic and Gulf coasts from Chesapeake Bay nearly to the Mexican border. The special marking is applied to the so-called "inside route" proper and to those portions of all connecting waterways which must be crossed or followed in order to make a continuous passage.

DISTINCTIVE MARKING

All buoys, daybeacons, and light structures marking the Intracoastal Waterway have some portion of them painted yellow. This is the distinctive coloring adopted for the Waterway. Buoys have a band of yellow at the top, daybeacons have a band or border of yellow, and light structures are similarly painted.

The coloring and numbering of buoys and daybeacons, and the color of the lights on buoys and on light structures is on the same lateral system as that prevailing in other waterways. The basic rule is that RED buoys and daybeacons are on the right-hand side of the channel when proceeding from Chesapeake Bay toward Mexico, and BLACK buoys and daybeacons are on the left-hand side of the channel when proceeding in the same direction. This rule is applied in a uniform manner from one end of the Intracoastal Waterway to the other, regardless of the widely differing compass headings of the many sections, and the fact that rivers and other waterways marked on the seacoast system are sometimes followed.

Numbering of Intracoastal Waterway aids follows the basic rule, numbers increasing from Chesapeake Bay toward Mexico. Aids are numbered in groups, usually not exceeding 200; numbering begins again at "1" at certain natural dividing points.

Lights on buoys follow the standard system of red or white lights on red buoys, and green or white lights on black buoys. The color of the lights on fixed structures also follow this general rule. Range lights, not being lateral markers, may be any of the three standard colors.

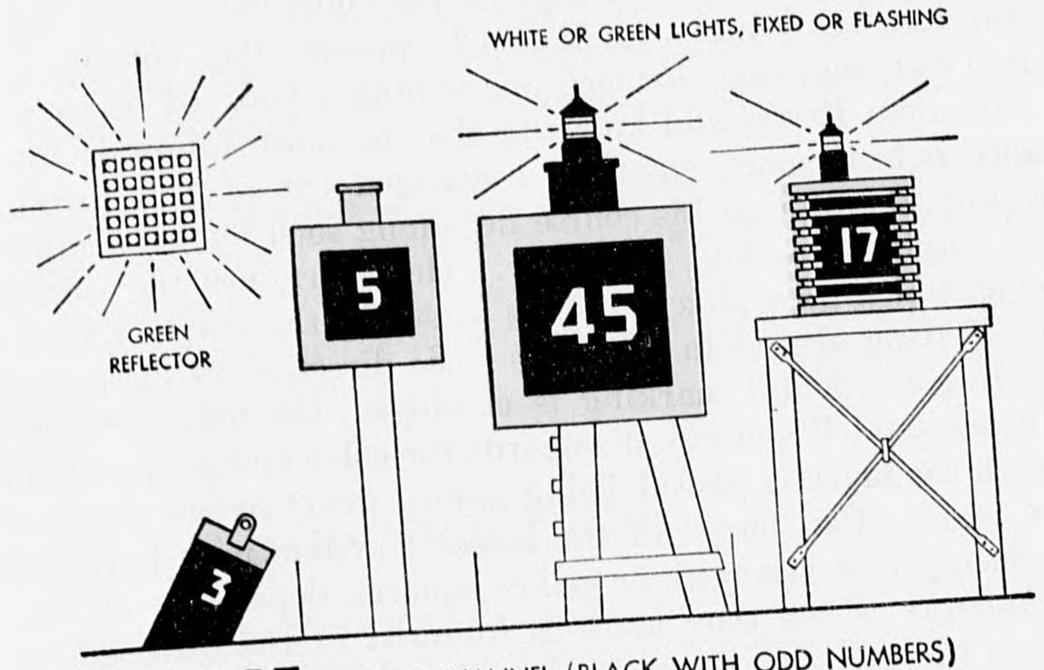
COINCIDENTAL MARKING

In order that vessels may readily follow the Intracoastal Waterway route where it coincides with another waterway such as an important river marked on the seacoast system, special markings are employed. These special markings are applied to the buoys or

TYPES OF

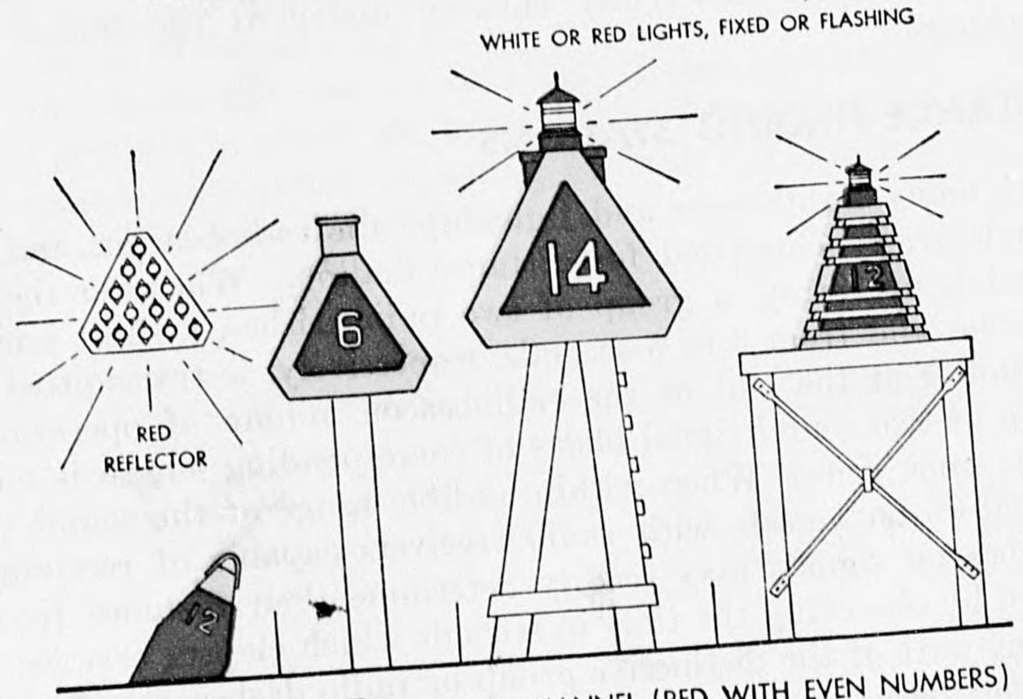
INTRACOASTAL WATERWAY

AIDS TO NAVIGATION



PORT SIDE OF CHANNEL (BLACK WITH ODD NUMBERS)

ENTERING FROM N. & E. AND TRAVERSED TO S. & W.



STARBOARD SIDE OF CHANNEL (RED WITH EVEN NUMBERS)

ENTERING FROM N. & E. AND TRAVERSED TO S. & W.

other aids which mark the river or waterway for other traffic. The special marks consist of a yellow square and a yellow triangle, painted on a conspicuous part of the dual-purpose aid. The yellow square, in outline similar to a can buoy, indicates that the aid on which it is placed should be kept on the left hand when following the Intracoastal Waterway from Chesapeake Bay toward Mexico. The yellow triangle, in outline similar to a nun buoy, indicates that the aid on which it is placed should be kept on the right hand when following the Intracoastal Waterway from Chesapeake Bay toward Mexico. By this marking, the mariner approaching a body of water such as the Savannah River, and knowing that he must follow it for some distance before again entering a dredged cut of the Intracoastal Waterway, knows that his course lies along such buoys or other aids as are specially marked in yellow. He determines the side of his vessel on which these aids should be passed by the shape of the yellow marks, bearing always in mind the basic direction of his travel.

Where coincidental marking is employed, the mariner following the Intracoastal Waterway disregards the color and shape of the aid on which the mark is placed, being guided solely by the shape of the yellow mark. Can buoys of the seacoast system may have painted upon them yellow triangles or yellow squares, depending on whether the waterway which they mark is followed in the direction of the sea or in the direction of its headwaters, as the Intracoastal Waterway is followed in the direction of Mexico. Mariners not traversing the Intracoastal Waterway entirely disregard the special yellow markings.

DISTANCE-FINDING STATIONS

At many lighthouses and lightships the radiobeacons and sound signals are synchronized for distance finding. Whenever the sound signal is operating, a group of two radio dashes, a short and long, 1 second and from 3 to 5 seconds, respectively, is transmitted every 3 minutes at the end of the radiobeacon minute of operation. A group of two sound signal blasts of corresponding length is sounded at the same time. When within audible range of the sound signal, navigators on vessels with radio receivers capable of receiving the radiobeacon signals may readily determine their distance from the station by observing the time in seconds which elapses between hearing any part of the distinctive group or radio dashes, say the end of the long dash, and the corresponding part of the group of sound blasts, say the end of the long blast, and dividing the result by 5 for statute miles and by 5.5 for nautical miles. The error of such observations should not exceed 10 percent.

The 1-second dash preceding the long dash is a stand-by or warning signal as is also the 1-second blast. The latter serves as an identification signal to assure the observer that he is taking time on the correct sound signal blast.

For observations on sound-in-air signals, a watch with second hand is all that is needed, although a stop watch is more convenient.

Observations for distance are not restricted to vessels with direction finders, but may be made by any vessel having a radio receiver capable of receiving in the band 285 to 315 kilocycles within which radiobeacons are operated. A loudspeaker is desirable although not necessary.

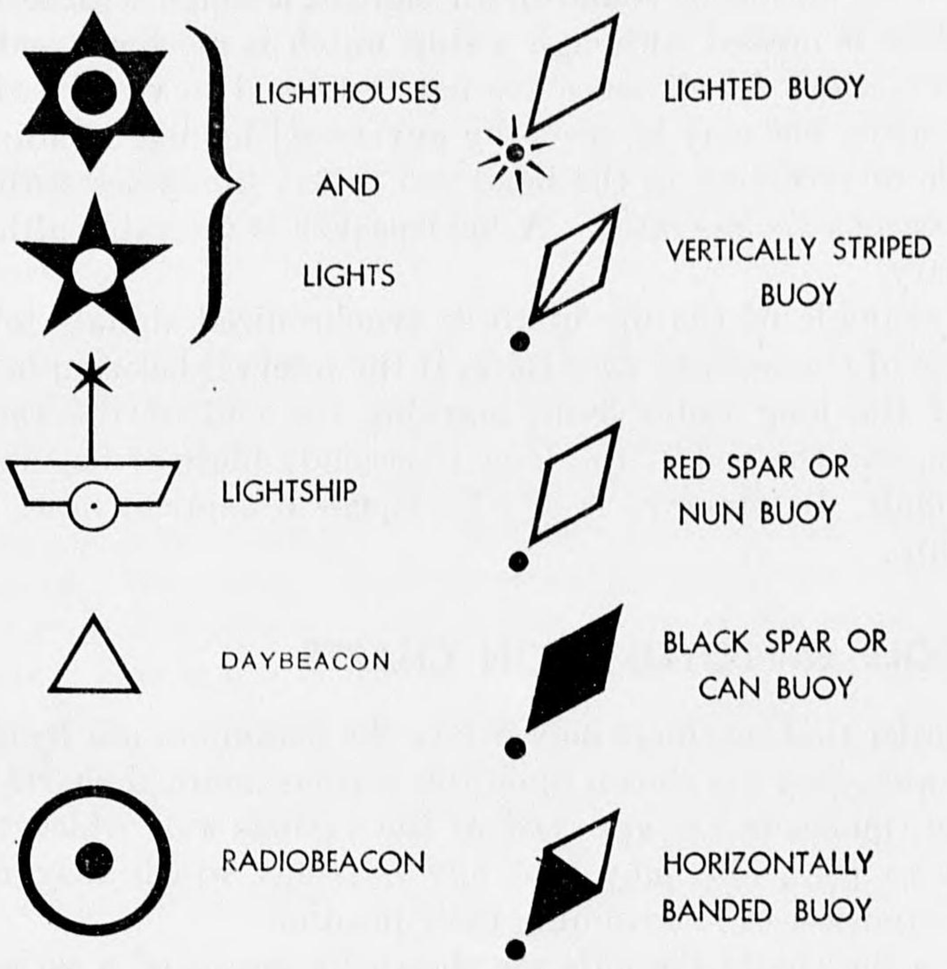
An example of the use of these synchronized signals follows: In the case of *Chesapeake Lightship*, if the interval between hearing the end of the long radio dash, marking the end of the radiobeacon minute, and the end of the long (5-second) blast of the diaphone is 33 seconds, the observer is $33 \div 5.5$ equals 6 nautical miles from the lightship.

SYMBOLS EMPLOYED UPON CHARTS

In order that mariners may derive the maximum use from navigational aids, they are shown upon the various nautical charts. In this manner, mariners are apprised of the various aids which they may expect to pass, and may plot any bearings which they may take for the purpose of determining their position.

Upon the charts the aids are shown by means of a series of conventional symbols to which are appended various abbreviations giving condensed information regarding the aids. Following are the principal symbols and abbreviations.

SYMBOLS FOR NAVIGATIONAL AIDS USED ON CHARTS



ABBREVIATIONS

W	White.
R	Red.
G	Green.
F	Fixed.
Fl	Flashing.
F. Fl	Fixed and flashing.
Gp. Fl	Group flashing.
Qk. Fl	Quick flashing.
I. Qk. Fl	Interrupted quick flashing.
S.-L. Fl	Short-long flashing.
Occ	Occulting.
Gp. Occ	Group occulting.
Alt	Alternating.
Alt. Fl	Alternating flashing.
Alt. F. Fl	Alternating fixed and flashing.
Alt. Gp. Fl	Alternating group flashing.
Alt. Occ	Alternating occulting.
Bn	Daybeacon.
Ref	Reflector.
R. Bn	Radiobeacon.

LIGHT LISTS

Light lists, describing the aids to marine navigation maintained by the United States Government, are published by the Coast Guard. Revised editions appear each year. The following volumes are issued:

Light List, Atlantic and Gulf Coasts (St. Croix River, Maine, to the Rio Grande, including the U. S. West Indian Islands).
Light List, Great Lakes (United States and Canada).
Light List, Mississippi River (and Tributaries).
Light List, Pacific Coast (United States; Alaska; Canada; Hawaiian, Guam, and Samoan Islands).
Light List, Intracoastal Waterway.

PURPOSE

Light lists are compiled and published to provide mariners with more complete details regarding navigational aids than are to be found on the charts.

ARRANGEMENT

Aids are listed in geographic order and in tabular form. Seacoast aids for a given district are listed first. These are followed by main-channel aids in bays, harbors, and important rivers. Next are listed the aids in the less important tributaries. The information is classified as follows:

Name.—This is the official name of the aid or its station, and is to be preferred to local names which have become associated with certain aids.

Location.—The brief description of the location enables the mariner to find the aid on the chart, to identify it as it is approached, and to know in what depth of water it is located if not on land. The latitude and longitude of the more important lights is stated to assist in referring to charts.

Character and period of light.—Under this heading is stated the color of all lights, whether they are fixed, flashing, or occulting, and if flashing or occulting the time required for the mechanism to perform a complete cycle. Also indicated in this column is the fact that certain lights are unwatched or unattended.

Height of light above water.—From this mariners may calculate the distance to which a lighthouse will probably be seen in the daytime. In conjunction with the candlepower, it also indicates the approximate range of visibility by night.

Miles seen.—Indicates the distance to which a light may be expected to be seen under normal conditions, the height of the light and its candlepower having been taken into consideration. The

Sections of Pages of LIGHT LISTS

1382	*CHESAPEAKE LIGHT-SHIP.* Occ. W., 4 sec. Radiobeacon. Distance-Finding Station. (Chesapeake Bay, see No. 1449.)	In 63 feet, 15 miles 78° from Cape Henry Lighthouse. Off entrance to Chesapeake Bay. 36 58.7 75 42.2	66	14
1383	CAPE HENRY..... Gp. Fl. W., R. sector, 20 sec. 3 flashes. Radiobeacon. Distance-Finding Station.	On south side of entrances to Chesapeake Bay. 36 55.6 76 00.4	157 170	19 1881

1382	16,000 500 mm e	Light 2 sec., eclipse 2 sec. Light shown from mainmast if foremast light is inoperative. Riding light, F. W. 40 cp., on forestay. DIAPHONE, two-tone, air; blast 3 sec., silent 27 sec. Bell, hand, if diaphone is disabled. RADIOBEACON: Transmits on 312 kc, groups of dot; 2 dashes, dot (• ▬ ▬ •) Antenna lead-in at center of ship.	Red hull, "CHESAPEAKE" on sides; red tubular masts with black lantern and gallery. Station buoy 600 yards 0° from lightship. 1928 Code flag signal and radio call NNBF. DISTANCE-FINDING STATION. For method of operation, see p. 7. Radio messages of importance in the maintenance of aids to navigation or on other urgent matters will be received during the first 15 minutes of each hour from 0800 to 2015, standard time.
1383	W. 160,000 R. 48,000 1 e	Flash 1 sec., eclipse 2 sec., flash 1 sec., eclipse 2 sec., flash 7 sec. eclipse 7 sec. Red from 155° to 233°, covers shoals outside Cape Charles and Middle Ground inside of bay. DIAPHONES, 2, air; horns point 77° and 333°, blast 2 sec., silent 18 sec. Siren, blast 2 sec., silent 18 sec., if diaphone disabled. RADIOBEACON: Transmits on 290 kc, groups of dash, dot, dash (▬ • ▬). Antenna lead-in 310 feet 38° from lighthouse.	Octagonal pyramidal tower; upper and lower half of each face alternately black and white. 1791 170 1881 DISTANCE-FINDING STATION. For method of operation, see p. 7.

figures used are based upon the observer's eyes being 15 feet above sea level. Visibility for other heights may be computed with the aid of a supplementary table published in the front of each light list.

Candlepower.—This serves as a rough gage of the distance to which a light may be seen, and indicates the relative brilliance of lights in the same general locality. In the case of a light of alternating colors it indicates the relative distances to which each color will be visible.

Apparatus and illuminant.—Of use primarily to maintenance personnel of the Coast Guard.

Light characteristics.—Additional details giving the exact length of all periods of light and darkness. Information regarding colored sectors is noted here.

Fog signal.—Includes details regarding the type and characteristics of fog signals. Radiobeacon operating characteristics are also stated in brief under this heading, more complete details being given in a table in another part of the list.

Structure, vessel, or buoy.—These brief descriptions of the shape and coloring of the various aids assist in location and identification.

Established, rebuilt.—These dates serve as an indication of any recent change in the outward appearance of an aid.

Top of lantern above ground.—This information is provided to enable a mariner to compute a vertical danger angle. With a sextant, the angle subtended by the top of the lantern and the base of the tower is measured. Knowing this angle, and the height, which becomes one side of a triangle, the length of another side of a triangle can be computed. The length of this second side is the distance between the observer and the lighthouse.

NOTICES TO MARINERS

Information regarding changes in navigational aids is made public in several ways. Notices to Mariners, a weekly publication, is issued jointly by the Coast Guard and the Hydrographic Office of the Navy. It contains information regarding changes in the United States navigational aids maintained by the Coast Guard, as well as information regarding aids in other parts of the world District Coast Guard officers issue Local Notices to Mariners regarding aids in their respective districts. Such notices contain considerable detail not published from Washington. Important notices are also broadcast by radio as the need arises.

When vessels are in active operation navigators should keep themselves fully informed of the proposed changes in the navigational aids in the localities where the ships will cruise.

Section of Page of NOTICE TO MARINERS

(2484) **LONG ISLAND SOUND—Connecticut River—Lighted buoy changed.**—Connecticut River Lighted Buoy has been painted red and changed to show a *flashing red* light every *2.5 seconds*, flash *0.5 second*, eclipse *2 seconds*, of 10 candlepower, 5 feet above the water, and renamed *Connecticut River Lighted Buoy 30A*.

Approx. position: 41°23′06″ N., 72°22′48″ W.

(N. M. 21, May 24, 1947.)

(N. M. 52, C. G., New York, May 7, 1947.)
U. S. Coast Survey Chart **215.**
U. S. Light List, Atlantic Coast, 1947, No. **767.**
U. S. Coast Pilot, Section B, 1940, page 207.

(2526) **ALASKA—Yakobi Island—Greentop Island—Light established.**—Greentop Island Light, an unwatched light showing *flashing white* every *5 seconds*, flash *1 second*. eclipse *4 seconds*, of 140 candlepower, has been established 79 feet above the water on a small white house on the southern end of Greentop Island, 3,450 yards 291° from Lislanski Strait Entrance Light. The light is obscured from 143° to 318°.

Approx. position: 57°51′21″ N., 136°29′00″ W.

(N. M. 21, May 24, 1947.)

(U. S. Coast Guard, Washington, D. C., May 9, 1947.)
U. S. Coast Survey Charts **8258, 8260, 8202, 8252.**
U. S. Light List, Pacific Coast, 1947, No. **2417.3.**
U. S. Coast Pilot, Alaska, Part I, 1943, page **396.**

EARLY HISTORY

The maintenance of aids to marine navigation is one of the oldest Federal functions, the work of erecting and maintaining lighthouses being provided for at the first session of Congress by act of August 7, 1789 (the ninth law enacted by Congress). Twelve lighthouses which had previously been built by the Colonies were ceded to the new Federal Government, and became the nucleus of a system of navigational aids which over a period of 150 years has been increased to a present total of over 31,000.

Federal maintenance of navigation aids was first carried on under the direct supervision of the Secretary of the Treasury. Somewhat later, when the duties of the Secretary of the Treasury had greatly increased, administration of the navigational aids was delegated to the Commissioner of the Revenue. In 1820, the superintendence of the lighthouse establishment was assigned to the fifth auditor of the Treasury, and in 1845 again transferred, this time to the Revenue Marine Bureau, an organization which later became the Coast Guard. The collectors of customs through all this period served as local superintendents of lighthouses.

A Lighthouse Board was created in 1852, to administer the constantly expanding service, being composed of officers of the Army and the Navy, and of civilian scientists. In 1903 the Lighthouse establishment was transferred from the Treasury Department to the newly created Department of Commerce and Labor and in 1910, the Lighthouse Board was superseded by the Bureau of Lighthouses in the Department of Commerce. On July 1, 1939, the Lighthouse Service was consolidated with the United States Coast Guard.

The United States Coast Guard today maintains over 36,000 aids to marine navigation. The greater number of these are lighthouses, automatic lights, and buoys. There are also about 180 radiobeacons, 28 lightship stations, and about 1,900 fog signals, including those on buoys.

JURISDICTION

The maintenance of aids to marine navigation is a function of the United States Coast Guard, having been placed under that organization on July 1, 1939, and consists of the maintenance of lighthouses, lightships, radiobeacons, fog signals, buoys, and beacons upon all navigable waters of the United States and its possessions; including Atlantic and Pacific coasts of continental United States, the Great Lakes, the Mississippi River and its tributaries, Puerto Rico, the approaches to the Panama Canal, the Hawaiian Islands, and Alaska.

The chief administrative officer is the Commandant of the Coast Guard, with headquarters at Washington, D. C. Under his direction

the functions of establishment, construction, maintenance, and operation of aids to navigation are carried on through administrative and engineering divisions in Washington. Because of the wide geographic distribution of aids to navigation on the sea coasts, the Great Lakes, and navigable rivers of the United States, with an aggregate coast line of over 40,000 miles, the field work of the service is carried on by district organizations. There are 12 Coast Guard districts, carrying on lighthouse work, as well as other functions of the Coast Guard. Each district is under the supervision of a commander,[7] assisted by a suitable engineering and administrative force, and equipped with the necessary supply and buoy depots, and with suitable vessels for the maintenance of the navigational aids.

BIBLIOGRAPHY

Where navigational aids are used in actual navigation, the following Government publications should be kept at hand and consulted as required:

Published by the United States Coast Guard, available through the Superintendent of Documents, Washington, D. C., or through sales agencies in the principal ports:[8]

Light List, Atlantic and Gulf Coast.
Light List, Great Lakes.
Light List, Pacific Coast.
Light List, Intracoastal Waterway.
Light List, Mississippi River.

Published jointly by the Coast Guard and the Navy Hydrographic Office:
Notice to Mariners (issued weekly).

Published by the United States Coast Guard, available through Coast Guard Headquarters, Washington, D. C., without charge, to all vessels equipped with radio direction finders:

Radiobeacon Chart, Atlantic and Gulf Coasts.
Radiobeacon Chart, Great Lakes.
Radiobeacon Chart, Pacific Coast and Islands.

Published by the Hydrographic Office, United States Navy:[9]

Radio Navigational Aids (H. O. No. 205). Contains a complete list of radio stations throughout the world, as well as instructions for the use of radiobeacon signals.

The following Coast Pilots[10] contain information regarding lighthouses and other aids to navigation in United States waters. They

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[7] In time of war, with the Coast Guard operating under the Navy Department, the Coast Guard districts function under the direction of the commandants of the various naval districts, the ranking officer having the title of District Coast Guard Officer.

[8] Distributed on a sales basis. Prices for 1947 editions ranged from 40 cents to $2.00.

[9] Light Lists for all waters of the world other than those of the United States also are published by the Hydrographic Office of the Navy.

[10] Coast Pilots for all waters of the world other than those of the United States are published by the Hydrographic Office of the Navy.

are compiled and published by the Coast and Geodetic Survey of the Department of Commerce and may be obtained from sales agencies in most seaports:

	Published
Atlantic Coast, Section A: St. Croix River to Cape Cod	[11] 1941
Atlantic Coast, Section B: Cape Cod to Sandy Hook	1940
Atlantic Coast, Section C: Sandy Hook to Cape Henry, including Delaware and Chesapeake Bays	1937
Atlantic Coast, Section D: Cape Henry to Key West	1936
Gulf Coast: Key West to the Rio Grande	1936
Puerto Rico and Virgin Islands	1939
Pacific Coast: California, Oregon, and Washington	1942
Alaska, Part I: Dixon Entrance to Yakutat Bay	1943
Alaska, Part II: Yakutat Bay to Arctic Ocean	1938
The Hawaiian Islands	1933
Inside Route Pilot: New York to Key West	1936

Instructional pamphlets intended for the use of those who are beginners in the study of navigation.

Published by the United States Coast Guard, and available without charge through Coast Guard Headquarters, Washington, D. C.

Buoys in Waters of the United States	10 pp.
Marine Radiobeacons (mimeographed)	16 pp.

[11] Supplements are issued from time to time, and should always be consulted when a volume is used.

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