CHAPTER 6

"Even with the best charts, we are cautious about fixing our position, for it is so easy to goof. And the easiest way of all is by taking a mark, assuming it is the right one, and ignoring any others that may be in sight."

Patrick Ellam

Landmarks

Introduction and Overview

According to accepted NOAA *Nautical Chart Manual* nomenclature, a *landmark...*

> "...is any fixed natural or artificial object on land which is prominent from seaward and can be used in determining a direction or position. The term excludes objects expressly erected for navigational purposes such as lights or daybeacons. Prominence is the first requisite for a landmark, but ease of positive identification is also important. The unusual or unique feature may qualify as a landmark because it is easy to identify although not particularly prominent."

A more complete list of landmarks typically charted is provided later in this chapter. Briefly, however, landmarks include such objects as buildings, stacks, tanks, domes, towers of various descriptions, spires and radio antennas. (Not all of these objects in a given area would be charted as landmarks, however.) Often, as in the examples presented in this brief list, landmarks are *artificial features.* But landmarks also include *prominent natural features* such as a mountain peak, glacier, volcano, cliffs, or other suitable natural objects.[1]

This chapter provides information on the type and utility of landmarks and how these are depicted on nautical charts. This chapter also identifies sources of additional information (e.g., the *U.S. Coast Pilot, Chart No. 1, United States of America Nautical Chart Abbreviations and Terms* and the *Light List*), which supplement that provided on the nautical chart. Finally, the chapter concludes with practical pointers on the selection of landmarks for navigation and why landmarks are sometimes not seen or identified when underway.

Importance of Landmarks in Coastal Navigation

All mariners, with varying degrees of formality, employ landmarks for navigation. Used in conjunction with "seaman's eye" or informal navigation, landmarks serve to determine an approximate position, define hazardous areas, provide directions for harbor

[1]It is important that natural features have clearly defined reference points that can be accurately located if these are to be charted as *landmarks.* Mountains with rounded peaks would probably *not* be charted as landmarks, although the topography would be shown.

entry, etc. For example, directions to a favorite anchorage based on recent local knowledge might be given as:

> "Stay in the main river channel until passing the red brick pump house on the left (when northbound) then alter course to starboard until the bow is aligned with the blue A-frame building between the flagpole and the marina and the stern with the pump house. Continue along an imaginary line joining these two landmarks until well past the small island on the right-hand side, then turn to port...."

More formally, landmarks are *charted* objects used for determining *LOP* (e.g., with a hand-bearing compass or radar)[2] and *circles of position* (e.g., with radar or an optical range finder for landmarks with charted height information) so as to determine a fix or estimated position for the vessel. Table 6–1 provides both general and specific illustrations of how information derived from landmarks can be used for marine navigation. As with ATONs, discussed in Chapter 5, landmarks can be used to fix the vessel's position, to serve as the visual equivalent of radio beacons for homing or tracking purposes, to evaluate whether or not a vessel is in dangerous waters (e.g., by use of a danger bearing or danger circle), to identify turn points, and for a variety of specialized purposes such as compass calibration or to determine whether or not the vessel's anchor is dragging. Included in the list of references at the end of this chapter are texts that discuss these topics in detail. Names enclosed in parentheses (e. g., Bowditch) denote particularly pertinent references.

In short, *charted landmarks are the logical equivalent of shore-based ATONs for use in coastal waters.* If accurately charted (more below), detectable, and readily identifiable, these can be superior to the use of floating ATONs (buoys)—recall that fixed structures are preferable to floating structures for position determination. In some areas of high population density or numerous conspicuous natural features, charted landmarks are actually more numerous than charted ATONs.

Table 6-1. Utility of Landmarks Shown on Nautical Chart

GENERAL:

- **Used for determining range or bearing by visual means (or radar) in coastal waters so as to determine a fix or estimated position;**

SPECIFIC ILLUSTRATIONS:

- **Used for determination of fix, running fix, estimated position, set and drift of current;**
- **Used for plotting danger bearings, danger circles, horizontal danger angles;**
- **Used (in conjunction with danger bearing or circle) for evaluation of vessel's position with respect to unobservable hazards to navigation;**
- **Used for establishing vessel turning bearings;**
- **Used as visual equivalent of RDF beacon for homing or tracking purposes;**
- **Used for compass calibration; and**
- **Used for determining whether or not an anchor is dragging.[a]**

[a] The landmark need not be charted for this purpose.

[2]Landmarks are generally selected so as to be detectable and identifiable from the sea by visual means. Some may be detectable and identifiable by radar, but charting as a landmark offers no guarantee that the object can be detected and identified by radar. In particular, landmarks in built-up areas, such as cities, are often "lost" among many land returns.

Types of Landmark

Table 6–2 provides a list of the more common artificial landmarks depicted on nautical charts, together with pertinent brief remarks. Refer to the Glossary given in appendix A for more complete definitions. It is worthwhile to study these and to gain practical familiarity with landmarks by systematically comparing the chart representation of landmarks in your area with the physical appearance of the object. These "training sessions" can be made an enjoyable part of each cruise. An experienced navigator can often form a highly accurate mental picture of landmarks to be found in unfamiliar waters merely by studying the chart.

Table 6-2. Illustrative Landmarks

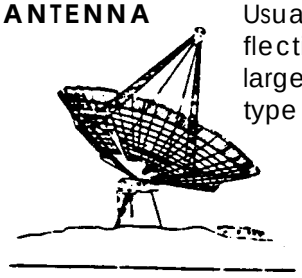
ANTENNA 	Usually reserved for those reflecting antennas which are large in size and of open or grid-type construction.	**DOME (RADAR)** 	A dome known to contain radar type of equipment shall be charted as DOME (RADAR). If the radar use is not known, simply chart as DOME. Their appearance looks like a large "golf ball."
BUILDING 	See HOUSE.	**FLAGPOLE** 	A single staff flagpole rising from the ground and not attached to a building.
CHIMNEY 	A relatively small, upright structure projecting above a building for the conveyance of smoke.	**FLAGSTAFF** 	A flagpole rising from a building is not necessarily the most prominent part of a building for landmark recognition purposes.
CUPOLA 	A turret or small dome-shaped tower which rises from a building and is small compared to the building.	**FLAG TOWER** 	Any scaffoldlike tower on which flags are hoisted, such as a Coast Guard Skeleton steel flagpole.
DOME 	A large, hemispherical cupola, or a roof that is rounded or many sided. Their appearance looks like a large "golf ball."	**GAS TANK**  or **OIL TANK**	Since a gas or oil tank differs in shape and size from a water tank, the compound name is used. These are usually cylindrical.

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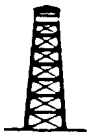
Table 6-2. Illustrative Landmarks (*continued*)

HOUSE or BUILDING

Charted when the building itself is the landmark.

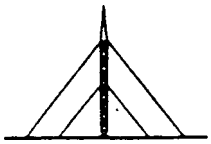
LOOKOUT TOWER

Any tower, usually of open construction, surmounted by a small house in which a watch is habitually kept, such as a Coast Guard Lookout Tower or a Fire Lookout Tower.



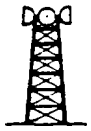
LORAN-C STATIONS

(*See:* Appendix A. Glossary.)



MICRO TR

A tower which contains microwave transmitters and receivers, used in the transmission of communication signals.



MONUMENT

A structure, such as a building or sculpture, erected as a memorial. Also used to denote a boundary marker for surveying or other purposes. There is no standard size or shape to a monument. Some, such as the Washington Monument, resemble an obelisk (i.e., a four-sided shaft that tapers to a pyramidal point), others assume a variety of shapes.

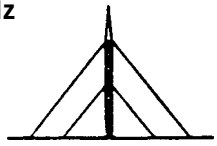
OIL TANK

See GAS TANK.

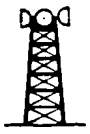
RADIO MAST RADIO TOWER

Radio towers and radio masts are metal structures used to elevate antennas. A RADIO TOWER is a tall structure usually of open lattice-type construction and always self-supporting. A RADIO MAST is a very tall slim structure held vertical by guylines.

RADIO TOWER KAGT 1340 kHz



RADIO MAST 1015 FT (TV, FM) (STROBE, R LTS)



RADIO TOWER 215 ft (MICROWAVE) or MICRO TOWER

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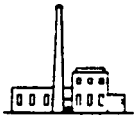
Table 6-2. Illustrative Landmarks (*continued*)

SPIRE

A slender point structure surmounting a building. It is rarely broken by stages or other features. The term SPIRE is not applicable to a short pyramid-shaped structure rising from a tower or belfry. Spires are often seen atop churches.

STACK

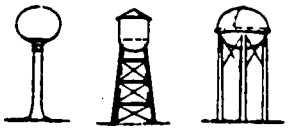


This term is applied to any tall smokestack or chimney, regardless of color, shape, or material when the stack is more prominent as a landmark than any building in connection with it.

STANDPIPE; S'PIPE

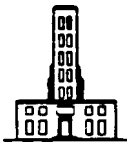
A tall cylindrical structure in a waterworks system, the height of which is several times greater than the diameter.

TANK



A water tank elevated high above the ground by a tall skeleton framework or support. The word "elevated" is omitted since a tank would not be a landmark unless elevated.

TOWER; TR



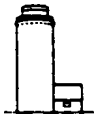
That part of a structure higher than the rest, but having vertical sides for the greater part of the height.

Any enclosed structure, whether or not its sides are vertical, with base on the ground and high in proportion to its base.

TREE

"Lone tree" or "conspicuous tree," are not used since the adjective is assumed. Otherwise the tree would not serve as a landmark.

WATER TOWER



A decorative structure enclosing a tank or standpipe. Its appearance may prevent its being recognized as a water tank or standpipe.

WINDMILL

A self-explanatory term.

OTHER EXAMPLES OF LANDMARKS NOT ILLUSTRATED ABOVE THAT MAY BE USED ON CHARTS:

Battery, Blockhouse, Buddhist Temple, Camping Site, Capitol, Castle, Cemetery, Chapel, Church, Church Tower, Church Spire, Church Cupola, Company, Courthouse, Cross, Elevator, Factory, Flare Stack, Fort, Fortified Structure, Gable, Government House, High School, Hotel, Institute, Josshouse, Magazine, Marabout, Minaret, Mine, Mosque, Pagoda, Pavilion, Quarry, School, Shinto Shrine, Silo, Small Fort, Telegraph, Telephone, Temple, Tomb, University, Well, Windmotor.

Sources: *Desk Reference Guide,* Bowditch, Chart No. 1.

For most landmarks (e.g., buildings, churches, radio towers), object definitions are familiar and the mariner should have little or no difficulty correlating the chart representation with the physical appearance of the object. In some cases (e.g., cupola, dome, chimney, stack), the definitions are more subtle and/or the objects may be less familiar so more study and on-the-water comparisons are appropriate.

Objects Not Normally Depicted As Landmarks

There are also several classes of objects that are *not typically selected as landmarks* on nautical charts. (These objects may be shown on certain charts in areas where suitable landmarks are few and far between.) Table 6–3 provides a list of those either intentionally or unintentionally omitted. In the main, the reasons for not selecting these objects as landmarks are obvious. For example, objects of a temporary nature, such as a construction crane, would be a poor choice for a landmark since the object would probably be moved to another location by the time that the chart was printed.

Trees are another example of an object not normally charted as a landmark. Think of the consequences, for example, if the tree were struck by lightning or chopped down. Even worse, suppose there were another tree standing one-half mile away!

The charting of movable objects as landmarks is generally avoided. A gantry crane at a shipyard may be a very prominent feature, but it would not have a fixed geographic position and, therefore, would have little utility for precise fixing of a vessel's position.

Signs are not typically charted as landmarks. However, an unusually conspicuous sign, especially in an area without other suitable landmarks, may be charted. The elevation and lighting of the sign are considered in making the determination of whether or not to select the sign as a landmark. Signboards displaying navigational information may be considered as landmarks if they display navigationally relevant information, for example, signboards used to mark distances along a waterway. As another example, signs providing water-level information are normally charted even if not visible from a distance.

It may come as a surprise to some readers that not all items potentially suitable as landmarks are actually charted. To be sure, in sparsely populated flat land areas, nearly all suitable landmarks would be charted. But in built-up areas, only a few otherwise suitable

Table 6-3. Items Generally Not Charted as Landmarks on the Nautical Chart

INTENTIONALLY NOT SELECTED:

- **Objects of a temporary nature (e.g., vertical construction crane, exploratory oil-drilling rig, dredge);**
- **Inconspicuous objects, unless specifically requested by a competent authoritative source (e.g., survey tower or target, object used by the USCG in buoy placement);**
- **Objects which move in position;**
- **Classified military objects for which no release by competent authority can be obtained;**
- **Signs, unless unusually tall, large, or otherwise conspicuous or in an area devoid of other objects of landmark value;**
- **Multiple objects of the same type very close together or in a relatively small area (in this case only the tallest or largest items, and/or those on the outer limits of the complex will be charted);**
- **Trees unless (in exceptional circumstances) no other visual references are available to the mariner; or**
- **Omni stations, unless recommended by a reliable source.**

UNINTENTIONALLY OMITTED:

- **Objects missed in a previous survey or those which have been constructed since the last survey.**

objects would be plotted as landmarks.[3] For example, large cities, such as Boston, New York, and Philadelphia, have literally thousands of buildings that might be suitable landmarks. However, in practice only a handful—those believed sufficient for safe and efficient navigation—are actually depicted as landmarks on the chart. Figure 6–1 provides such an illustration for the Philadelphia, PA–Camden, NJ, area. Indeed, one of the criteria for charting landmarks in the *Desk Reference Guide,* is that "consideration should be given to the number and quality of other charted landmarks or reported objects of landmark value in the area." Therefore, the mariner should not expect that the nautical chart will depict *all* possible structures as landmarks. Generally, this poses no particular problem to the informed mariner. But while underway this can sometimes lead to confusion and identification problems. For example, several water tanks may be visible in an area in which only one or two are charted. In this case, the mariner might be faced with the problem of "which of the tanks in view are those charted?"

How Landmarks Are Depicted on the Chart

Landmarks are charted in the exact position reported on source documents. Both a *symbol* and one or more *labels* usually accompany a charted landmark.

–Symbols

In certain cases, the outline shape of a prominent structure may be charted to scale if it is relatively large or of particular interest and of landmark value (e.g., the Pentagon, Fort McHenry). More typically, however, landmarks are charted with standard *symbols.* Landmark symbols are shown in Section E of Chart No. 1. According to the accuracy with which the landmark's location is known, the symbols include:

- An *accurate landmark symbol,* consisting of a black circle 1.18 mm (0.047") in radius with a center dot 0.25 mm (0.010") in diameter in cases where the position of the landmark is considered to be located within 10 feet of its correct geographic location.

- An *approximate landmark symbol,* consisting of a smaller black circle 0.5 mm (0.020") in radius without any center dot in cases where the landmark is less accurately located than above, but generally considered to be within 100 feet of its correct geographic location.

- An approximate landmark symbol explained above, but with the letters "PA" *(position approximate)* as part of the label in cases where the location of the object is considered to be within 101 to 300 feet of its correct geographic location. Such landmarks, sometimes referred to as *inexact position landmarks,* are only charted if they serve a "critical" navigation need.

In some cases a landmark, such as a building, will be drawn to scale and, additionally, have some contained feature depicted with the accurate or approximate position label. For example, the Customs House in Philadelphia, shown in figure 6–1 is drawn to scale. Additionally, the tower atop this building is shown as a landmark with the accurate position symbol. Identifying particular portions of structures as landmarks makes it possible to take accurate bearings.

Excepting those landmarks which are drawn to scale, charted landmarks are shown

[3]Aside from the logistics and compilation problems of charting all possible landmarks, the resultant chart (with requisite labels) would be physically impossible to produce. Moreover, NOAA is actively seeking ways to reduce chart "clutter" and make more "user-friendly" products.

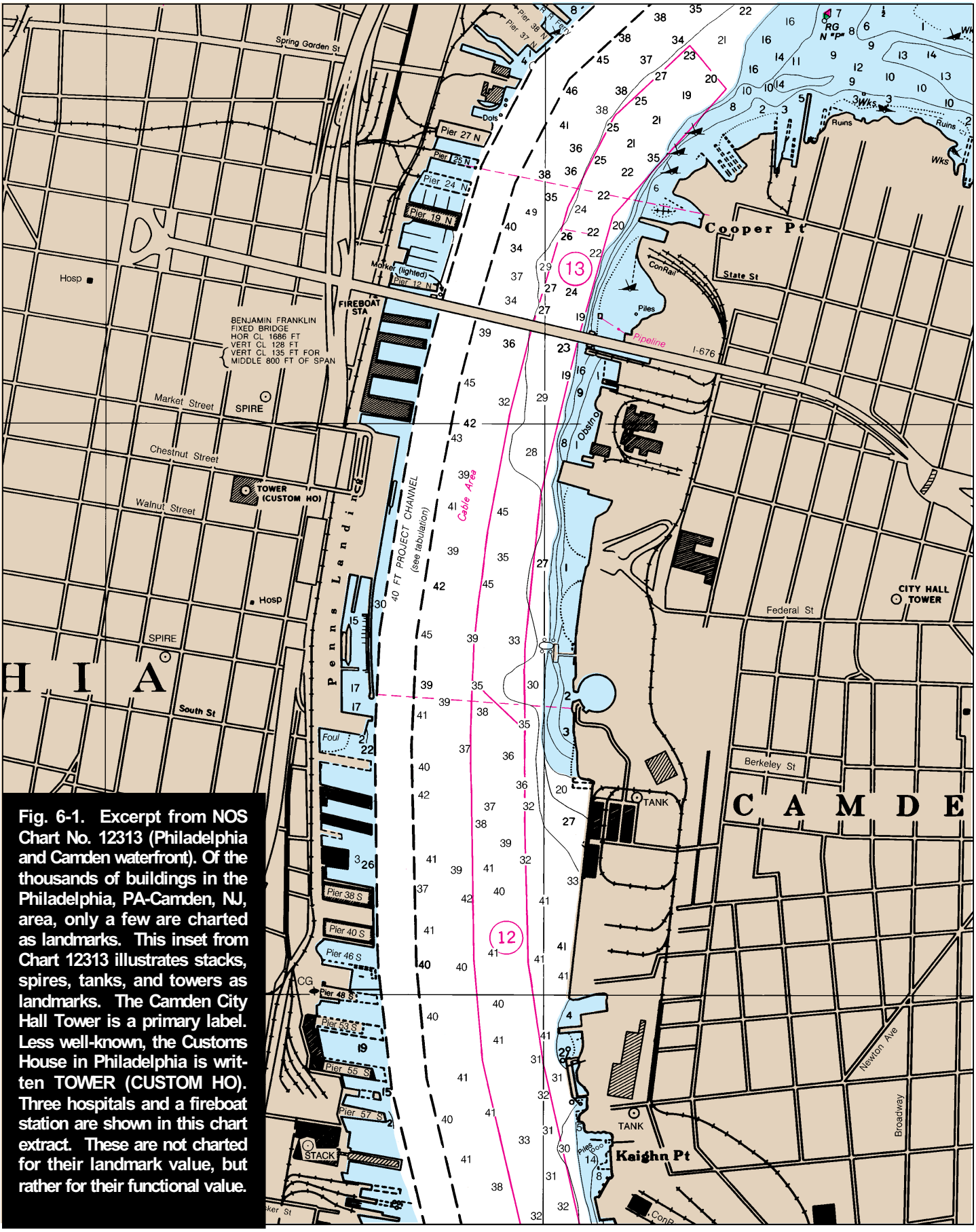


Fig. 6-1. Excerpt from NOS Chart No. 12313 (Philadelphia and Camden waterfront). Of the thousands of buildings in the Philadelphia, PA-Camden, NJ, area, only a few are charted as landmarks. This inset from Chart 12313 illustrates stacks, spires, tanks, and towers as landmarks. The Camden City Hall Tower is a primary label. Less well-known, the Customs House in Philadelphia is written TOWER (CUSTOM HO). Three hospitals and a fireboat station are shown in this chart extract. These are not charted for their landmark value, but rather for their functional value.

in only one of two sizes (1.18 mm radius circle and 0.5 mm radius circle) regardless of actual dimensions. In this sense, all landmarks are alike. Something more is clearly needed to help the navigator identify the landmark. This additional information is provided in *labels* that are printed next to the landmark symbol.

–Labels

Accompanying the landmark symbol is one or more *labels.* Labels are used to provide additional information useful in identifying the landmark. The label also provides a redundant indication of the accuracy with which a landmark is located.

The first label depicts the primary nature or descriptive term most likely to identify the object (e.g., TOWER, STACK, CHIMNEY) set in 6 pt. Newton Medium type and placed in close proximity to the landmark symbol. *Landmarks charted with the accurate landmark symbol are labeled entirely in vertical capital letters, those charted with the approximate landmark symbol are labeled with initial capitals only.* Thus, for example, a tower considered to be located within 10 feet of its correct position would include the accurate landmark symbol and the label "TOWER," whereas one located to within 100 feet of its true location would have the approximate landmark symbol and the label "Tower."[4] A tower with a location uncertainty greater than 100 feet would carry the label "Tower PA." A partial list of standardized labels and authorized abbreviations are shown in table 6–4.

Secondary and descriptive labels may be added for clarity and are enclosed in parentheses to the side or underneath the primary label. The capitalization convention for the secondary label(s) is the same as that for the primary label. Consider a lighthouse, for example. If operational, this would *not* be considered a landmark—rather it would be included as an ATON (see Chapter 5). However, if no longer used as a lighthouse, it would be classed as a "tower." But, because the term "tower" includes many different types of structures, it is desirable to add a secondary or descriptive label, "abandoned lighthouse," to supplement the primary label. Accordingly, such a landmark (if accurately located) would be labeled TOWER (ABAND LT HO).

Names of certain locally well-known buildings may be shown as secondary labels to facilitate identification. For example, DOME

Table 6-4.
Labels and Authorized Abbreviations

ANTENNA (ROUND, PARABOLIC, OR RECTANGULAR)
CHIMNEY (CHY)
CUPOLA (CUP)
DOME (a dome known to contain radar equipment shall be labeled DOME (RADAR)
FLAGPOLE (FP)
FLAGSTAFF (FS)
FLAGTOWER (F TR)
GAS TANK or OIL TANK
HOUSE or BUILDING (HO or BLDG) (if the structure encloses equipment of navigational use, a one-word description shall follow the primary level (e.g., BUILDING (VOR))
LOOKOUT TOWER (LOOK TR)
LORAN STATIONS
MICRO TR
MONUMENT (MON)
RADIO MAST (R MAST) followed by, if known, radio frequency, height, call letters. Also (TV, FM, AM, STROBE, or RLTS).
RADIO TOWER
SPIRE
STANDPIPE (S'PIPE)
TANK
TOWER (TR)
TREE
WATER TOWER
WINDMILL

[4]The lone exception to this rule is the case where an acronym is used in the primary or secondary label of an approximately determined landmark. Here the *acronym* would be included in capital letters, e.g., Tower (USCG). The primary label would be shown in initial capitals only.

(STATE HOUSE) or BUILDING (RITZ TOWER) or TOWER (CUSTOM HO) might be shown on secondary labels. Well-known and unusually prominent landmarks are, on occasion, depicted using the name of the landmark as the primary label. For example, EMPIRE STATE BUILDING and WASHINGTON MONUMENT are shown on nautical charts.

Descriptive labels that identify the *relative size or location* or other *distinguishing characteristics* of the landmark may also be shown in parentheses following or below the primary name. When only one object of a group of similar objects is charted, the descriptive label includes the number of objects in the group. Examples include STACK (TALLEST OF THREE), HOUSE (WEST GABLE), SIGN (LIGHTED).

A descriptive label may also relate to the *shape* of the object. Examples include TANK (OBLONG), TANK (BALL), or TANK (BALL ON TEE). *Color is not normally noted*[5] in a label because this may be only temporary. *Painted names on objects are not normally shown* unless the name or abbreviation is displayed in very large and conspicuous letters that are easily identified. *The material of construction is not described in a secondary label* because the mariner usually cannot identify the material from a distance.

In some cases both a secondary name and descriptive label are included. For example:

STACK (FLARE)
(TALLEST OF THREE)

might be found in a shore side petroleum refinery.

The height of the object is also sometimes included. Heights can be used for determining the vessel's distance from the landmark (see Bowditch) and, with bearing data, to fix the vessel's position. In the case of landmarks, the height is given in feet (or meters for metric charts) measured from the top of the landmark relative to mean high water except in nontidal areas where these are measured relative to the sounding datum. Height information is provided for only a minority of charted landmarks, however.

Aircraft obstruction lights are typically regarded as secondary importance as an aid to navigation. Therefore, these are not normally charted with a light dot and magenta flare unless listed in the *Light List* and given a *Light List* number. Obstruction lights on landmark objects are not labeled unless specifically requested by a reliable source. In this case, no differentiation is made between occulting and fixed lights. For example, a stack (with accurate location) with a white strobe and red obstruction lights would be labeled:

STACK (STROBE, R LTS).

An obstruction recommended for charting as a landmark that is identified only as an aircraft obstruction light is charted with the appropriate landmark symbol and labeled:

OBSTN (R LT).

Radio structures are labeled with the type of function and height (when considered of significant importance for visual sighting). AM broadcast stations will have the call letters and frequency included in the label, as will other stations known to be used for marine navigation assistance. Here are a few examples:

RADIO MAST 862 FT
(TV)
(STROBE, R LTS)

RADIO MAST 483 FT
WSSO
1230 KHZ
(R LTS)

RADIO TOWER 315 FT
(FM, MICROWAVE)
(R LTS)

In very congested areas, a list of stations may be provided elsewhere on the chart to avoid the elimination of important topography and/or hydrography as a result of labeling.

The foregoing provides a useful summary of key charting conventions for landmarks.

[5]Color may be included, however, in *U.S. Coast Pilot* or *Light List* descriptions.

–Other Sources of Landmark Information

In most cases the position and the label(s) shown on the chart will be sufficient for the navigator to use the landmark for navigation. However, other sources may offer useful information as well.

Pictures of selected landmarks are included on the back of certain conventional and small-craft nautical charts. These photographs are very useful in identifying landmarks. For example, the back of NOS Chart No. 13221 (Narragansett Bay) contains several photographs of landmarks and ATONs in the area.

Commercially produced cruising guides of the area sometimes provide descriptions and/or photographs of landmarks.

An important source of collateral information on landmarks is the *U.S. Coast Pilot.* Imbedded in the general text and, in some areas, highlighted in a special section called "Prominent Features," the *U.S. Coast Pilot* provides information on the location, appearance, and suitability of landmarks for navigation. Guidance for the preparation and revision of the *U.S. Coast Pilot* is provided in the *Coast Pilot Manual.* Here is an excerpt from this document regarding how "Prominent Features" should be described:

> "Prominent Features. Describe the best charted landmarks for navigation, such as land formations, lights, tanks, stacks, towers, buildings, etc. Note the color, form, and height of headlands and peaks. Streaks of color in bluffs may be useful in identifying features. If objects such as mountains, hills, cliffs, islets, or rocks are recommended as landmarks, give their measured or estimated heights....
>
> " ...In highly developed areas where there are numerous charted structures, the Coast Pilot supplements the charts in two important ways: by identifying the best landmarks and by describing the structures for positive identification. Give the height, color, and painting pattern of prominent structures if available. Describe the general shape of unusual objects...."

Here are a few passages from *Volume 3, Atlantic Coast: Sandy Hook to Cape Henry* (1993) that illustrate the type of information presented:

- "When approaching Maurice River, mariners should use care and not confuse the structure of East Point Light with a private house with a tower about 1.3 miles to the east, both landmarks are similar in appearance."

- "In 1967, the monument on Liston Point was reported destroyed; and in 1983, the monument on the south side of the entrance to Hope Creek was also reported destroyed. Remains of the structure from Liston Point may exist up to 100 feet offshore and may be covered during high tide."

- "A large, cylindrical water tank, about 1.5 miles west of Ocean City Inlet, is prominent and is a good landmark while entering the inlet."

- "Assateague Light and the lookout tower on the southern tip of Assateague Island are good marks for approaching Chincoteague Inlet."

- "Abandoned Navesink Lighthouse is in a cleared space on the easternmost spur at a ground elevation of 180 feet; the two 73-foot brownstone towers, the north one octagonal and the south square, are connected by a dwelling."

As a final example, consider this description of the entrance to Bridgeport, CT, harbor, taken from *Volume 2, Atlantic Coast: Cape Cod to Sandy Hook* (1993):

> "Prominent Features. The large red and white horizontally banded stack of a power plant on Tongue Point is the most prominent landmark in this area. Other prominent landmarks include a

group of stacks on Steel Point: the towers of a high-voltage line; several church spires; a gas tank with a red-and-white checkered band at the top, on the west side of Pequonnock River; the radio towers at Pleasure Beach; the Bridgeport Harbor Light 13A. The rays of an aerolight about 1.3 miles northwestward of Stratford Point can be seen from offshore."

The *U.S. Coast Pilot* is invaluable as a supplement to nautical charts for many reasons. These few examples illustrate why this is so for the identification of landmarks.

Practical Pointers and Limitations Relevant to Landmarks

The balance of this chapter provides some practical pointers relevant to the use of charted landmarks in navigation. The first part of this section presents practical ideas on the selection of charts and landmarks for navigation. The second part addresses the important topic of why some charted landmarks may not always be able to be seen (or identified) from the vessel.

–Pointers

Perhaps the most important suggestion is to *select the largest scale chart of the area for navigation.* This point is made in several places in this manual, but it is worth restating here. Large-scale charts offer the greatest amount of detail for a small area, and offer the greatest number of charted landmarks—hence the largest number of options for position fixing. Any landmark shown on a small(er)-scale chart will also be shown on the large(er)-scale chart of the area, but many landmarks shown on large-scale charts are not depicted on small-scale charts because it is necessary to generalize charted features from large scale to small scale. As well, the *latest edition of this chart—with corrections given in the NM*—should be used. Although landmarks are relatively permanent (recall that permanence is one of the criteria for charting a landmark), they do change on occasion. Structures are torn down, and new ones are periodically constructed, so it makes sense to have the latest information at hand.

Another important point to reemphasize is that *all sources* of information should be used to fix the vessel's position—not just landmarks. Maintenance of a dead reckoning plot, use of depth information, ATONs, and other means should all be used. Knowledge of even the vessel's approximate position can be helpful in identifying landmarks that might be used for more exact fixes. Moreover, other information (e.g., the depth of water at the vessel's location) can be used to increase the confidence in—or rule out—the tentative identification of a landmark.

–Selecting Landmarks For Use

In low-lying land areas of low population density (e.g., portions of the Delaware and Virginia coast) landmarks may be few and far between, and the mariner may have little choice as to which landmarks to use. Selection guidelines for landmarks are not relevant in this case.

However, other coastal areas offer many more charted landmarks, and the mariner often has a choice of which to use for navigational purposes. Here are four useful selection criteria for suitable landmarks in cases where choices are available:

- Objects should be selected that are *detectable and readily identifiable.* Many features might be used for position fixing, but objects selected by cartographers as landmarks are likely to be conspicuous (see below). Landmarks depicted with the accurate position symbols are to be preferred over those depicted with the approximate location symbol. Refer also to the *U.S. Coast Pilot* or commercially produced cruising guides for information on the appearance of conspicuous landmarks.

- Objects selected should be in a *geometrical configuration suitable to their intended navigational purpose.* For example, if a landmark is to be used to establish a danger bearing, it should be

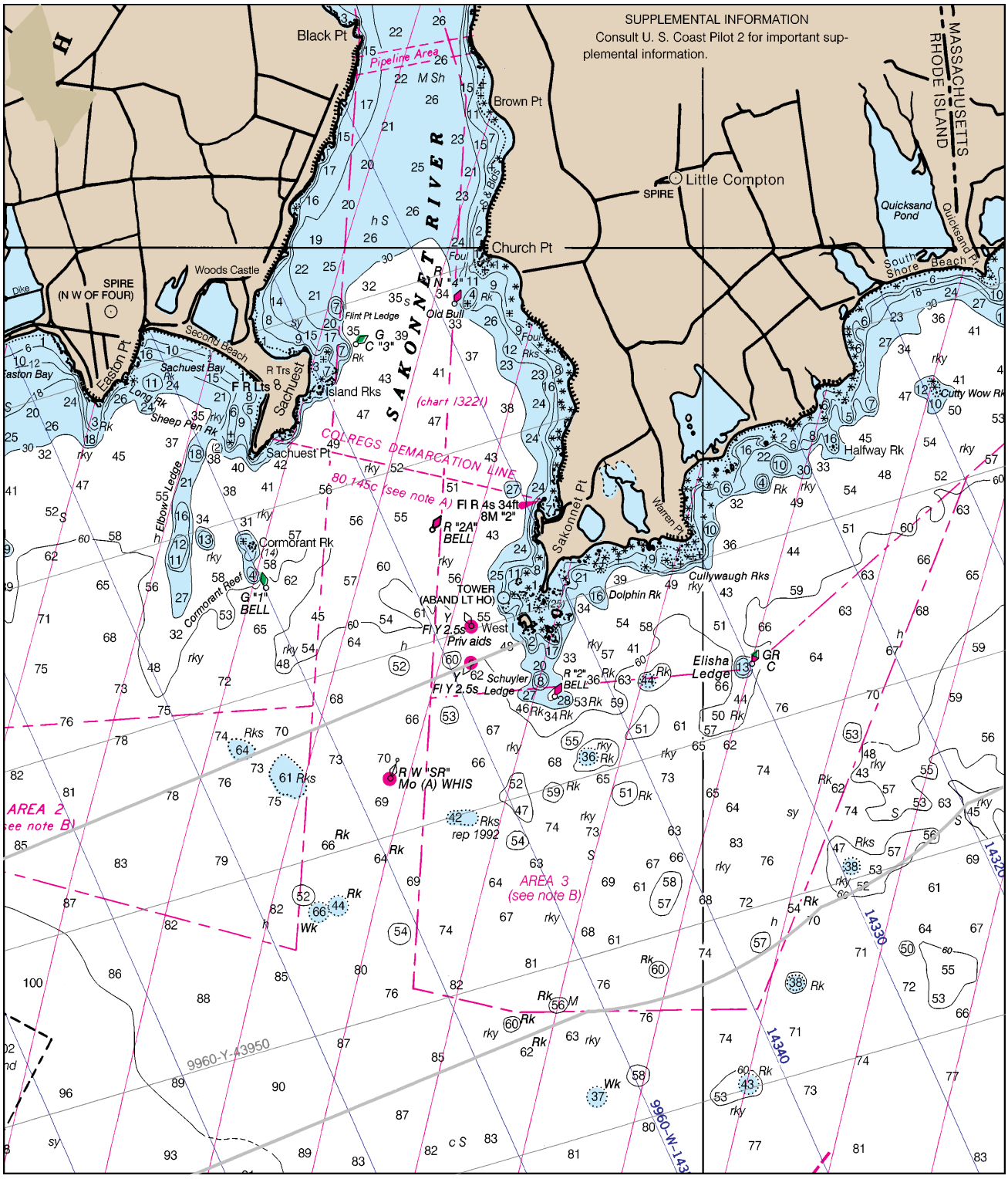


Fig. 6-2. Excerpt from NOS Chart 13218 (Martha's Vineyard to Block Island). The TOWER (ABAND LT HO) off Sakonnet Point is ideally situated to define a danger bearing to avoid Schuyler Ledge when approaching from the south. The accurately known landmark is likely to be conspicuous. Indeed, the lighthouse was probably there precisely for this purpose.

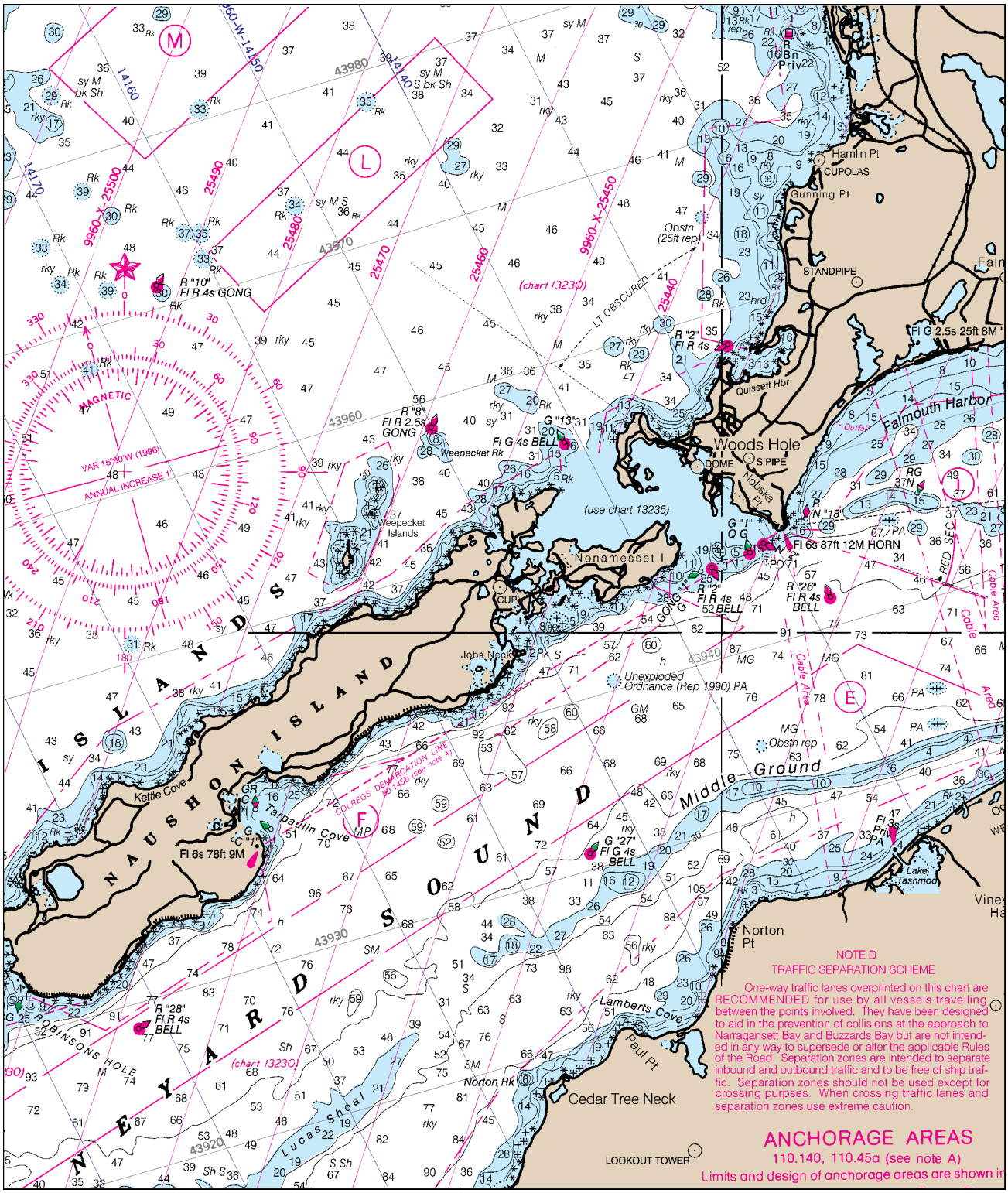


Fig. 6-3. Excerpt from NOS Chart 13218 (Martha's Vineyard to Block Island). The DOME and S'PIPE near Woods Hole would offer a poor crossing angle for a vessel attempting to fix its position in the vicinity of the Middle Ground. Use of either landmark and the CUPOLA at the east end of Naushon Island would be preferable.

appropriately positioned relative to the hazard to be avoided as illustrated in figure 6–2. If more than one landmark is to be used—as, for example, to plot a two or three bearing fix—the landmarks should be chosen so that the resulting crossing angles of the lines of position are best. For two objects, a crossing angle of 90° is optimal, and crossing angles less than 20° or 30° should be avoided. (Refer to figure 6–3 for an illustration.) For three objects, 60° crossing angles are best. (Bowditch, Maxim.) Selection criteria for horizontal sextant angles are more complex, and the reader is directed to some of the references (Bowditch, *Admiralty Manual of Navigation*) for details.

- *Landmarks closer to the vessel are generally preferable to those further away.* This is because errors in bearing (taken with a hand-bearing compass or radar) are nearly independent of the distance, and the position error associated with a given error in azimuth increases directly with distance. If a compass bearing is inaccurate by 5° (a plausible figure, see Dahl), for example, the linear error is approximately 5,300 feet if the landmark is 10 miles distant, but only about 260 feet if the landmark is 1/2 mile distant. (For more detail, see Dahl, Moody, or Brogden.)

- *Taller landmarks should generally be chosen in preference to shorter objects.* Other things being equal, taller objects can be seen at a greater distance than shorter objects due to the curvature of the earth. If He is the height of the observer's eye (in feet) and Ho is the height of the object in the same units, then maximum distance, D (in nautical miles), at which the object can be seen (as a result of the curvature of the earth (Bowditch)) is given by the equation, $D = 1.17\sqrt{He} + 1.17\sqrt{Ho}$.
  Assuming a height of eye of 10 feet, a 20 foot object would be just visible over the horizon at 8.9 nautical miles, a 100 foot high object might be seen at 15.4 nautical miles. (See table 3-1.) Of course, use of this criterion depends upon the height of the object being known and recorded on the chart. Height information is not provided for all landmarks and certain tall landmarks, such as radio towers, may be difficult to see (Eyges) in hazy conditions because these are generally slender objects.

–Limitations

Even experienced mariners occasionally have trouble detecting and identifying charted landmarks (Graves, Eyges). So it is worthwhile to enumerate some of the reasons why landmarks may not be seen. These include:

- *The landmark may no longer be there.* Although landmarks are selected so as to be relatively permanent, artificial structures are occasionally destroyed by natural disasters or demolition activities. Ultimately, this fact is reported to NOAA and the chart is updated to delete the landmark, but this process takes time, and even the latest corrected chart of the area may show "phantom" landmarks.[6] Along with demolition, new construction may create problems regarding landmarks, because new structures (see below) may be confused with charted landmarks.

- *The landmark may not be visible* as a result of horizon geometry (see above) or poor atmospheric visibility. Knowledge of the vessel's approximate position and the prevailing visibility, as well as the landmark's height, can be helpful in determining whether or not a landmark is likely to be visible. Statistical visibility data for various locations

[6]In cases where changes in landmarks are viewed as critical to navigation safety, landmark changes will be reported in the *NM.* Such listing is relatively rare, however.

can be found in the *U.S. Coast Pilot*. These data can be useful for trip planning purposes. Table 6-5, for example, shows the average annual number of days with visibility less than or equal to 1/4 mile for selected locations in the United States, ranked in descending order. In Nantucket, MA, for example, poor visibility occurs an average of 96 days out of each year—approximately one day out of four. St. Croix, San Juan, Hilo, and Honolulu enjoy nearly total freedom from episodes of 1/4-mile visibility. Data in the *U.S. Coast Pilot* also show the distribution of reduced visibility episodes by month. Figure 6-4 shows this information plotted for Nantucket, MA. As can be seen, the worst months at this location are June, July, and August.

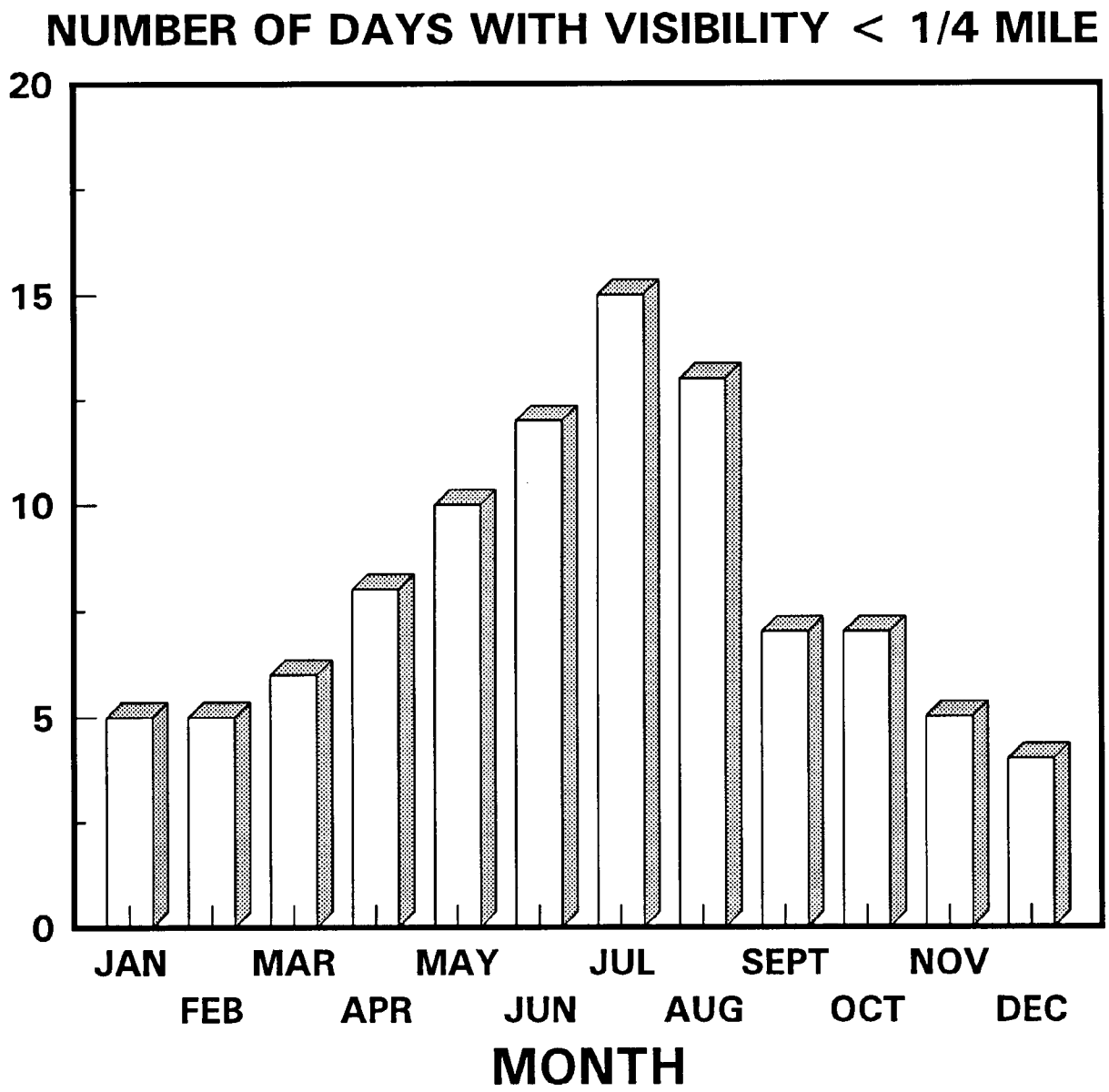
- *The landmark may be masked by other structures, terrain features, or vegetation.* At the time that an object is selected as a suitable object for charting as a landmark, a determination is made that it is "conspicuous." However, in the years since originally charted, events may have occurred which limit the visibility of the object. For landmarks in built-up areas, such as cities, new construction may have taken place which *masks* the landmarks from some or all approach angles. In rural areas, trees or other vegetation may obscure the structure—at least from some ap-

Table 6-5.
Annual Days With Visibility Less Than or Equal to 1/4 Mile for Selected Locations Ranked in Descending Order

LOCATION	STATE/ TERRITORY	ANNUAL DAYS WITH VSBY. LESS THAN OR EQUAL TO 1/4 M	LOCATION	STATE/ TERRITORY	ANNUAL DAYS WITH VSBY. LESS THAN OR EQUAL TO 1/4 M
NANTUCKET	MA	96	CORPUS CHRISTI	TX	29
BLOCK ISLAND	RI	79	CHARLESTON	SC	29
SAN FRANCISCO	CA	64	SAN DIEGO	CA	28
TATOOSH IS	WA	59	NEW HAVEN	CT	28
QUILLAYUTE	WA	49	APALACHICOLA	FL	28
EUREKA	CA	49	BROWNSVILLE	TX	27
ATLANTIC CITY	NJ	48	PROVIDENCE	RI	25
LOS ANGELES	CA	44	PHILADELPHIA	PA	25
SEATTLE	WA	43	WILMINGTON	NC	24
ASTORIA	OR	43	TAMPA	FL	24
PORT ARTHUR	TX	41	NORFOLK	VA	23
HOUSTON	TX	41	FT MEYERS	FL	23
SAVANNAH	GA	40	BOSTON	MA	23
WILMINGTON	DE	39	JUNEAU	AK	22
MOBILE	AL	39	NEWARK	NJ	20
PENSACOLA	FL	37	CAPE HATTERAS	NC	19
SACREMENTO	CA	35	ANNETTE	AK	16
JACKSONVILLE	FL	35	WASHINGTON	DC	13
PORTLAND	OR	33	WEST PALM BEACH	FL	8
NEW YORK	NY	33	MIAMI	FL	7
DAYTONA	FL	32	KEY WEST	FL	1
NEW ORLEANS	LA	31	ST CROIX	VI	0
HARTFORD	CT	30	SAN JUAN	PR	0
BRIDGEPORT	CT	30	LIHUE	HI	0
BALTIMORE	MD	30	HILO	HI	0
RICHMOND	VA	29	HONOLULU	HI	0

SOURCE: U.S. COAST PILOT

FIGURE 6-4. SEASONAL VARIATION IN THE NUMBER OF DAYS WITH REDUCED VISIBILITY AT NANTUCKET, MA: SUMMER MONTHS ARE WORST AT THIS LOCATION



SOURCE: U.S. COAST PILOT

proach angles. (In this case, landmarks may be visible in certain seasons—e.g., winter—and not in others.) Remember also that landmarks are selected to be visible from the sea, but *not necessarily from all possible approach angles.* (Inspection of terrain features and elevations can sometimes help to identify terrain masking.)

- *The detectability of an object by visual means is a complex function of atmospheric visibility, background contrast, and lighting. Landmarks may be "camouflaged"* as a result of limited contrast with background areas or because of lighting conditions at the time of observation. (See Eyges for several illustrations.)

- *The mariner may be disoriented and looking in the wrong place on the chart.* It is commonplace in navigation that it is much easier to determine your position if you already know where you are. On reflection this statement is not as trivial as it seems. A practical tip in identifying landmarks is to plot the vessel's dead reckoning position (or estimated position if one LOP is available). Then, based on this position on the chart, plot the bearings to each of the charted landmarks. Next (binoculars with a built-in compass are best) look along these plotted bearings for the landmark. If the vessel's assumed position is nearly correct (and the visibility is sufficiently great and the landmarks are above the horizon), the landmarks should be visible on bearings within a few degrees of those plotted. This technique will not work if the vessel's position is grossly in error, but can be very helpful otherwise. (For additional details, see Bright (1990).)

- The mariner may actually see the landmark, but *not be able to establish positive identification.* This may occur because of confusion among several possible objects (see below), but may also occur because of ambiguity over the identity or appearance of the object. For example, the term "tower" may be used to describe many related but different objects. Towers (not otherwise distinguished) could include structures as diverse as aircraft control towers, tall buildings (the John Hancock building in Boston, MA), and abandoned lighthouses. (In some cases a secondary label will be included to narrow down the possibilities.) The mariner should study the definitions of each of the landmark terms to maximize the possibility of correct identification.

- Finally, it sometimes occurs that several objects can be seen from the vessel, but it is not immediately apparent *which* is the charted landmark. In other words, *the landmark may be detectable but not identifiable.* For example, only some of the many water tanks in the Philadelphia–Camden area are charted as landmarks. Depending upon the vessel's position, it is not always possible to identify which are the charted landmarks. In such cases the mariner is well advised to search for other identifiable landmarks that could be used to fix the vessel's position. Even an approximate fix may be sufficient to enable correct identification of the original landmark. This technique is known as "shooting up"—measuring the bearing of—each of several candidate landmarks and choosing the one that provides a line of position that passes closest to the vessel's position. (For additional details, see Mellor.)

The competent mariner regards each voyage as a learning experience. *In cases where a landmark is missed, or misidentified, the mariner should make every attempt to determine the reason(s) why this occurred.* If the reason is that the landmark was improperly charted, the mariner should bring this matter to the attention of NOAA and USCG so that appropriate corrections can be made. Every error offers the opportunity to learn a valuable lesson.

Concluding Comments

Landmarks are very useful for coastal navigation and serve to complement the system of ATONs. Careful study of the chart conventions presented in this chapter and the definitions presented here and in the Glossary will pay dividends in improved navigational skills. Student navigators—and that includes all of us—would do well to take the opportunity of comparing the chart presentation of familiar areas with what is observable from aboard the vessel. Finally, prudent mariners do not rely on any one aid or technique for navigation. The navigator should use all available data (e.g., dead reckoning positions, AT0Ns, depth information, electronic position data, and visual or radar observation of landmarks) to navigate safely.

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Exhortation to Apprentices of the Art of Navigation

"When so ever any Shipmaster or Mariner shall set forth from land out of any river or haven, diligently to mark what buildings, castles, towers, churches, hills, downes, windmills and other marks are standing upon the land...all of which, or many of them, let him portray with his pen, how they bear and how far distant."

A. Ashley, 1583, quoted in Naish

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