A History of Buoys and Tenders

by Amy K. Marshall

The need for dependable aids to navigation can be traced to the beginnings of maritime commerce. Today, mariners in unfamiliar waters still welcome the sight of lighthouses, buoys, beacons, and other navigational aids as guideposts to safe harbor.

Traditionally, historians and other writers studied individual lighthouse structures. Examples of this scholarship include studies of the ancient Egyptian lighthouse Pharos, and the more modern structure of Eddystone Light off the coast of Great Britain. Yet, the smaller aids, perhaps more important since they represent a first line of defense against wrecking, are largely ignored or given merely cursory attention.

While lighthouses continue to be the most recognizable aids, the development of safe systems of buoyage, and accompanying changes in the vessels responsible for tending them, deserve a more solid place in maritime history.

While some types of floating markers may have existed before the 13th century, the first recorded buoy was mentioned in La Compasso de Navigare. Located in the Guadalquivir River, this buoy aided mariners approaching Sevilla, Spain.

The first buoys in Northern European waters, recorded 30 years later, were in the Vlie River which empties into the Zuider Zee. They guided ships to the commercial centers of Amsterdam and Kampen. The maintenance of these buoys, mostly hollow wooden casks bound with iron bands and moored with chain and a large stone, was the responsibility of individual port authorities.

"Light fees," collected from mariners and merchants, paid for maintenance. It would be another 200 years before governments would begin maintaining aids.

In 1514, King Henry VIII of England granted a charter to the Guild of Shipmen and Mariners to maintain aids in response to their petition that inexperienced individuals were endangering English shipping.

The guild was also concerned about the "dangers of allowing foreigners to learn the secrets of the King's streams."

The result of this charter was the creation of Trinity House. Another 70 years would elapse, however, until Trinity House earned the right to establish buoys and beacons - a right granted in 1594 by Queen Elizabeth I.

Early aids to navigation in the United States

Maritime commerce was a vital part of the life-blood of the newly established English colonies in North America. England and the colonies quickly realized the importance of maintaining safe sea lanes. Most of these early aids were lighthouses.

Boston Light, established in 1716 on Little Brewster Island, was the first North American lighthouse. The Colonial-American lights followed the European pattern of establishing navigational aids around important commercial centers.

Buoys were rarely, if ever, registered in lists of navigational aids for the colonies. The exceptions are the cask buoys in the Delaware River, recorded in 1767, and the spar buoys in Boston Harbor, recorded as early as 1780.

After independence, the federal government quickly became involved in the development of buoys. On Aug. 7, 1789, the First Congress passed An act for the establishment and support of light-houses, beacons, buoys, and public piers. This act provided for the establishment of lighthouses, beacons and other aids. It placed their upkeep under the Department of the Treasury in general, and specifically the Fifth Auditor of the Treasury, Stephen Pleasanton.

The fledgling administration of lighthouses followed the lead of its counterparts in Europe. Pleasanton raised funds for the maintenance of aids by levying light fees on ships entering U.S. ports. This practice stopped in 1801 when Congress began funding the aids.

Early buoyage descriptions are far from complete. The Collectors of Customs contracted with local pilots and other concerns for the establishment and maintenance of minor aids on an annual basis. Spar buoys, made of long cedar or juniper poles, and cask buoys were the predominant buoys in U.S. coastal waters until the 1840s.

The United States did not have a standard system of buoyage until 1848. Colors, shapes and sizes varied from port to port. This lack of regulation gave individual contractors free reign to decide the types of buoys necessary for a given area or harbor.

The lack of standardization caused problems for coastal pilots. When asked to comment on buoyage to Congress in 1850, they complained bitterly. Their most common complaint was that the buoys were so small, that to see them they had to run them down.

Records of buoys from this era are so lacking that a clear picture of U.S. buoys is difficult to piece together. Buoys were tended privately by contractors who relied on small boats with limited lifting capability or, worse yet, sailing vessels with such limited maneuverability as to render the accurate placement of buoys impossible.

Contractors also supplied buoys. This suggests that they manufactured them according to the capability of their vessels. Buoys thus remained small and were of little use to local pilots, who relied on landmarks to establish their positions. But these small buoys were particularly hazardous to inexperienced or unfamiliar mariners.

By 1846, Secretary of the Treasury Robert L. Walker knew the time for change had come. He admitted that buoys placed by local authorities under loose regulations, coupled with the lack of standardized colors and numbers, were practically useless. Congress, sensitive to complaints about the ATON system, began taking steps to correct the problems in 1848. It adopted the Lateral System for implementation nationwide. It is from the Lateral System that the familiar "right, red, return" has its origin.

While Pleasanton was an able administrator, he was first and foremost a bureaucrat. His inability to understand the needs of mariners and his unwillingness to spend the necessary funds rendered the system of aids more dangerous than helpful.

Pleasanton's preoccupation with financial matters led to the investigation by Congress which, in turn, led to the creation of the Lighthouse Board in 1852.

Significant improvements

Armed with its mandate to correct and improve aids, the newly-established Lighthouse Board stumbled into action. The board made every effort to learn from the advances of lighthouse construction and buoyage in Europe, which was far ahead of the United States. The governments of Great Britain and France placed considerable emphasis on the maintenance of safe sea roads.

Under the stricter eye of the Lighthouse Board, buoyage in the United States steadily improved. Spars and cask buoys gave way to can- and nun-shaped riveted iron buoys. These buoys were set according to the Lateral System: red nuns to the starboard of channels as observed by ships returning to port, and black can buoys to the port. The board also standardized sizes to maximize visibility.

This system continues in use even today, except that can buoys are now painted green. Tests in the 1970s showed that green is more highly visible from a greater distance. The board began purchasing buoys through inspectors and superintendents in individual districts. The demands of maintaining buoys required district inspectors and engineers to have extra buoys on hand in depots and aboard tenders should emergencies arise. Typical emergencies involved a buoy breaking loose or sinking after a collision.

The inclusion of top scientists in its administration was also important to the Lighthouse Board.
Professor Joseph Henry, better known for his role as first secretary of the Smithsonian Institution, experimented with the aberrations of sound and light over water, and studied improvements in buoy designs such as the Courtenay's Buoy, a whistle buoy developed in 1875 by John Courtenay. It was in the careful analysis and adoption of new buoy designs that the Lighthouse Board created a more modern system.

Whereas many government and private concerns in the 19th century were hesitant to embrace new technology, Henry and his fellow board members sought out new and ingenious ways of marking, and later lighting America's sea roads.

The nun, can and spar buoys are the oldest style of minor aids in America's coastal waters. Durable but unlit, these buoys are probably among the most familiar to the non-mariner.

By 1852, in its attempt at buoy standardization, the Lighthouse Board categorized these buoy types into three sizes: first-class buoys served primarily at the entrances to harbors and wherever large, highly visible buoys were needed. Second-class buoys, which were smaller, marked rivers and secondary harbor approaches. Third-class buoys, the smallest class, marked areas where larger, deeper-draft vessels could not go. This system worked well, but changes in design gave way to new types of buoys that would change the face of minor ATON forever.

Specialized buoys: light and sound

In 1851, Charles Babbage, of London, published a paper about putting lights on buoys. However, it would be another 20 years before technological advances could make lighted buoys a reality in the United States. Inventors patented designs that employed oil-vapor lamps, similar to those used in lighthouses, but they had no concept of the dynamics to which a buoy was regularly subjected.

Some designs were more fanciful than others. One inventor patented an electric buoy with a motion sensor which, upon detecting a ship passing close by, would sound an alarm, send up a rocket flare and light its lamp. One can only imagine what New York harbor would have looked like on a busy evening.

The first electrically-lit buoy tested by the board was a simple spar with a lantern housing and light on top. Deployed in Gedney's Channel, New York harbor, in 1888, a series of these buoys was lit by a cable running to a generator on Sandy Hook, N.J. These were removed in 1903.

Richard and Julius Pintsch and John Foster independently developed and tested compressed gas buoys as early as 1883. The Foster buoy resembles the Courtenay's buoy in shape, but contained acetylene gas which lit a lantern on top. Problems with this buoy included its tendency to roll down into a swell in rough seas and extinguish itself.

The Pintsch gas buoys were the most successful of the compressed-gas lighted buoys, but it took years of testing and improving before they were marketable. Originally designed and patented in Germany, these buoys were sold to the Lighthouse Service in the early 20th century through the Safety Car and Electric Company of New York. They had removable 6- to 8-foot-long cylindrical containers which held six to 12 months' of fuel. They were relatively easy to tend.

Audible signal buoys were also developed. The earliest recorded in the United States is the Brown's Bell Buoy developed by a Revenue Marine captain in the 1850s. This relatively simple buoy had a base supporting a superstructure upon which hung a bell with four clappers that struck as the buoy rolled in the sea. From this simple design a myriad of whistle, bell and foghorn buoys developed.

The most successful was the Courtenay's buoy. Courtenay never obtained a U.S. patent for this design which, most likely, led to its ready acceptance by the Lighthouse Board after extensive experiments under Henry. Courtenay developed this buoy while working for the British East India Company. He brought the design with him when he emigrated to the United States.

The Courtenay's Buoy is based on the physics of air escaping under pressure from a tube through a whistle. Henry described the buoy in the appendix of the 1878 Annual Report of the Lighthouse Board. He believed it represented a major technological advance in navigational aids. After testing, the Lighthouse Board adopted Courtenay's Buoy and used it at all points where it would be of service to mariners.

Early buoy tenders

The original report of the Lighthouse Board to Congress in 1851 lamented the existing buoyage system's ineffectiveness. The development of steam vessels made the adoption of light and sound buoys more critical.

The board felt that the approaches to major harbors and trade centers were not marked and lit efficiently enough to ensure the safe passage of the faster steam vessels. Larger and faster vessels demanded larger and more visible buoys.

The Lighthouse Board also recognized that larger buoys required larger, more maneuverable tenders. The small boats used by earlier contractors could not cope with the changes in design and larger sizes.

More accurate placement was also more critical in the age of steam. Sailing tenders were useless for accurate placement because they were difficult to hold steady.

Few records exist of how early sailing tenders set, hauled in and cleaned buoys. The journals and letters of the Lighthouse Board point to the use of a three-point mooring system. This system kept the tender steady while its crew set a buoy. Other tender logs describe working buoys near sandy shoals. Tenders in this situation would run their vessels aground on the shoals in order to maintain a steady work platform. This practice suggests a stronger hull or even double-hull construction for the early sailing tenders.

It is likely that sailing tenders employed "spuds" like those found on inland river tenders today. Spuds are large poles inserted through the deck to hold the vessel in place.

The use of spuds for a coastal tender, however, would have been time-consuming and costly in terms of accuracy. The Lighthouse Board sought to remedy this by obtaining steam-propelled tenders.

The first of these steam tenders, which has the distinction of being the first built by the Lighthouse Board, was the USLHS *Shubrick*. Completed in 1857 at the Philadelphia Navy Yard, the new tender served on the Pacific Coast and demonstrated beyond doubt the advantages of steam over sail. The success of the *Shubrick* convinced the board to purchase other steam vessels.

The board also took responsibility for the placement of buoys. Previously, contractors marked obstructions, wrecks, shoals and sides of channels according to their own plans or preferences. The board changed this practice by holding supreme authority over the placement of aids in order to right the wrongs of the contractors under Pleasanton.

The Lighthouse Service

By 1910, Congress discontinued the Lighthouse Board and created the Lighthouse Service. The new agency was under the control of the secretary of commerce. The first Commissioner of Lighthouses was George Putnam. Putnam was the first and, very nearly, the last commissioner of the Lighthouse Service. His tenure extended from the service's inception until his retirement in 1935.

Putnam did more for the cause of navigational aids and their maintenance than any other individual. He continued the Lighthouse Board's policy of experimentation and encouragement of new buoy designs. He also convinced Congress to allocate money for Lighthouse Service vessels, and crusaded for his employees.

Under Putnam the most important advances in long-range aids took place. The United States led the way with the new technology - the radio beacon. The advent of radio-beacon technology made buoys, lightships and lighthouses "visible" from significantly greater distances. No longer did a mariner have to physically see a buoy. The radio beacon made it possible for vessels equipped with a radio direction finder to take a bearing up to 70 miles from a navigational aid and, once identified, set a course relative to the aid.

Safety issues

Lighted buoys using compressed gas as a fuel gained popularity during Putnam's superintendence. Thirty years of trials and improvements, however, did not render the buoys entirely safe. The service issued instructions concerning safety in tending Pintsch, Willson, and American Gas Accumulator buoys because of the explosive nature of compressed gas.

Most safety problems occurred during pressure tests. For example, in December 1910, an explosion of a Pintsch gas buoy killed a machinist attached to the tender Amaranth. The machinist had completed a routine pressure test and had shut down the compressor.

According to Lighthouse Service reports, the buoy's cagework sheared away the mainmast of the Amaranth. The force of the explosion separated the top cone of the buoy from the body at the weld and hurled it through the roof of the depot's lamp shop. The blast forced the body of the buoy and its counterweight through the dock. The next issue of the Lighthouse Service Bulletin carried detailed instructions for pressure testing Pintsch gas buoys.

The Willson buoy, designed and patented by Canadian inventor Thomas Willson, was inexplicably adopted by the Lighthouse Service. It also was a compressed- gas buoy, but worked on the carbide and water principle. Instead of pressurized gas, the fuel was solid calcium carbide, soaked with kerosene oil during the loading or "charging" process. This helped reduce the risk of explosion of the calcium carbide.

The Willson buoy was charged by drying the inside of the buoy completely and applying mineral oil to the sides of the fuel chamber. The calcium carbide slid through a canvas chute into the chamber. This was risky business. Even with the best precautions the risk of explosion still existed, as happened aboard the tender Hibiscus in 1913.

One explanation for this explosion was that a lump of carbide struck the side of the chamber and created a spark. This accident occurred in a dead calm. Charging this type of buoy on a blustery day or in a fast-moving current must have been exciting, if not nearly impossible.

New tenders for more advanced buoys

The end of World War I marked a turning point for the Lighthouse Service buoy tenders. During the war, men, vessels and equipment were transferred to the Navy. It quickly discovered the tenders' usefulness in laying mines, as well as for patrol duty off the Atlantic coast.

When the war ended, and the vessels were returned to the Lighthouse Service, the Navy proposed sending their old mine-layers to the service to work as tenders. This occurred at the same time Putnam was seeking money for new tender construction. The Navy, and several congressmen, believed that the Lighthouse Service could convert the old mine-layers into tenders. Congressional debates questioned the true nature of tenders, with some representatives openly asserting that these, of course, were merely pleasure boats for Lighthouse Service members. Putnam quickly suggested that the honorable congressmen come out for a day aboard a buoy tender and see just how pleasurable it was.

In the end Putnam, Congress and the Navy reached a compromise: several ex-Navy mine-layers were converted for lighthouse supply service, and Putnam got what he was after in a more scaled-down form - a new building program to update his aging fleet - most still steam-powered, and some with stern- or side-paddle wheels. The new tenders were larger, diesel-powered, screw-propelled, and had a more advanced derrick and boom system. These tenders made the handling of compressed-gas buoys safer and more efficient.

Putnam retired in 1935. Congress moved the Lighthouse Service out of the Department of Commerce and incorporated it into the Coast Guard in 1939. This was part of a government-wide reorganization.

ATON and the Coast Guard

The Coast Guard continued the traditions of experimentation and adoption of new buoy technology. In the early 1940s, the service conducted experiments with more specialized buoys intended to withstand swift currents and still remain highly visible.

Plastic buoys were the subject of experimentation in the 1940s, the 1950s, and again in the late 1970s and early 1980s. Color tests in 1979 and '80 proved green-colored buoys were more visible than the traditional black can buoys.

The Coast Guard embraced the promise of atomic power with the induction of its "Ensign Peaceful Atom." This buoy, and its cartoon personification, was touted by the media and the Coast Guard as the new wave in powering navigational aids. It was tested in Baltimore Harbor in 1961 and was quietly removed in 1966 after reports that the nuclear generator failed to keep the buoy lit. Later reports on the atomic buoy experiment admitted that it was a dismal failure.

Baltimore Harbor is also the site of the Star-Spangled Banner Buoy, which marks the spot where Francis Scott Key wrote the national anthem.

In 1966, the Coast Guard began investigating the possibility of replacing lightships with Large Navigational Buoys or LNBs.

Far from being a minor navigational aid, these so-called "monster buoys" have hulls up to 40 feet in diameter with a depth of up to 7 1¦2 feet. The LNB prototype, constructed in 1969, had a steel hull subdivided by six bulkheads. These more cost-effective LNBs, along with "Texas Towers," huge, permanent platforms, served as the death knell of lightships in the United States.

Modern tenders

Tenders currently used by the Coast Guard are divided into seven distinct classes based upon the size and tending capacity. Seagoing tenders are 180 feet long and are capable of lifting up to 20 tons. They are equipped for long voyages, and have ice-breaking bows for winter tending.

The second group of tenders are the coastal tenders. They are 133 and 175 feet long and are characterized by their 10-ton lifting capacity and their high degree of maneuverability. The 157-foot class is equipped with twin controllable-pitch screws, twin rudders and bow thrusters as well as a 10-ton boom.

Inland tenders are divided into two classes - large (100 to 131 feet), and small (65 to 91 feet). The larger tenders are used primarily in the sheltered waters of bays and harbors. Along with their 10-ton capacity booms, they sometimes come equipped with a pile driver. This enables them to double as construction and repair vessels. Their hulls are also characterized by broad flat bottoms, which usually draw about 3 feet when fully loaded.

The small inland tenders are the pusher-tenders so familiar along U.S. rivers. The pusher-tender combination is comprised of a "living vessel" and a working barge complete with boom and pile driver. It is also characterized by its spuds. The spuds, two to four large timbers not unlike telephone poles, drop down through slots in the barge. This holds the barge in place, and is an effective mooring system in sheltered waters.

River tenders are also divided into two classes: large (104 to 115 feet) and small (65 to 75 feet). These are flat-bottomed, shallow-draft vessels. They draw between 3 to 9 feet of water and have a 10-ton boom capacity. Crews on these tenders range from nine to 25 people.

New directions

The CGC *Juniper* is the first of a new class of seagoing tenders. The cutter is 225 feet long, 46 feet at the beam, and has a draft of 13 feet. Launched in July 1995 and due for commissioning in the spring of 1996, the Juniper, along with the *Ida Lewis* - the first of the "Keeper" class, represents the new wave in buoy tending.

The *Juniper's* twin diesel engine propulsion system supplies the speed and maneuverability necessary to tend coastal buoys and offshore exposed location buoys. Perhaps the most important advancement is the use of a new Dynamic Positioning System. DPS uses the Differential Global Positioning System to fix a position. Using this technology, the crew of the *Juniper* will be able to maintain the vessel's position within a 10-meter circle in conditions including winds of up to 30 knots with waves up to 8 feet. When setting buoys with this new technology, the *Juniper's* margin of error should be near zero percent.

Conclusions

While the tools and methods of maintaining minor aids in U.S. waters changed substantially during the past 206 years, the mission remains the same. Mariners continue to rely on every country's commitment to the preservation of safe and viable sealanes. The United States made a decision in 1852, when it created the Lighthouse Board, to honor that ideal. It is a promise that continues today.

Pleasure boaters and beach visitors may only briefly notice a buoy rocking in the swells before turning their eyes, and cameras, to America's more picturesque lighthouses.

Buoys usually become newsworthy only when they break their moorings and lure ships to destruction, or embark on far-flung ocean voyages. But buoys are vital guideposts for mariners, and those who tend them do some of the toughest and most hazardous work in the Coast Guard.