

# LENSES & LANTERNS

by Harlan Hamilton

The first really efficient light was created by an Englishman, William Hutchinson, in 1763. The idea came to him at a meeting of scientists in Liverpool when one of its members wagered he could read a newspaper by the light of a candle 200 feet away if he lined a wooden bowl with pieces of mirror stuck into putty. Hutchinson's refinement of this idea was to place oil lamps in the center of a reflector and to place glass covers over unprotected lights. Reflectors were first used in the United States in 1810.

## Augustin Fresnel

Highly unsatisfactory, these lights gave way to catatropic and diatropic lenses, which, although they focused the light in a solid flow, let much light escape up, down and to the sides. Development of increased illumination seems to have been one of the lighthouse engineer's chief problems, surviving the days of the pharaohs in ancient Alexandria, Egypt. Many devices were tried, but no real progress was made until 1822, when a 35-year-old French physicist, Augustin-Jean Fresnel (1788-1827), while working as an engineer repairing roads (a job he loathed), succeeded in uniting both the catatropic and diatropic approaches into one lens (1st order) which he first displayed in France's famous Cordouan Lighthouse (completed in 1611 and worth a visit) at the mouth of the Gironde River in 1823. It had a range of 21 miles.

Fresnel's remarkable device, frequently referred to today as a "classical" lens, soon became standard equipment in all primary and secondary lighthouses throughout the world, except the United States, largely due to the successful lobbying efforts (even then!) of Winslow Lewis on behalf of his own inferior lamp system. Fresnel's lens could be fixed or made to revolve to produce a flashing characteristic. Skippers returning from European voyages reported in detail the excellent lighthouse system they had seen along the French coast and elsewhere and how much better it was than our own.

Although the first Fresnel lens was brought to the States from France in 1841, and installed in the south tower of the Navesink Light Station, Highlands, NJ., the newly formed Light-House Board in Washington, DC did not officially adopt the new lens until 1852. It proved to be so efficient that by 1859, practically all of Lewis's reflectors in our lighthouses had been replaced by the superior Fresnel lenses. Unfortunately, Augustin Fresnel died of tuberculosis on Bastille Day, 1827, when he was only 39 years old. Years passed before his contribution to the theory of optics was fully realized.

Fresnel's lenses solved the problem of intensity and control of the beam. Contemporary Fresnel lenses differ little from those used first in 1822. Fresnel's principles revolutionized lighthouse technology and optics science. His discoveries resulted in design and construction of a glass optic or lens which refracted 65 to 70 percent of all light emitted from a central single light source. The aggregation of beautiful cut glass prisms set in brass frames, concentrated a high percentage of the light emitted by the lamp and directed it out along useful horizontal beams. The glass used in the older Fresnel lenses made in France is sodium-

based which gives the glass a green tint; lenses made here are of clear glass.

## The Order of Lenses

In addition to inventing the principle of the lenticular system of lenses, Fresnel designed six "orders" or sizes for his lenses. The largest order (1st & 2nd) were installed in major landfall lights such as Block Island SE Light (1st) and Little Gull Island Light (2nd). The mid-range orders (3rd, 3 1/2, 4th) were designed for coast and harbor entrance lighthouses such as Eaton's Neck Light (3rd) and Montauk Point Light (3.5). Twenty-seven of the lighthouses in Long Island Sound had 4th order lenses. The smallest lenses (5th & 6th) served in structures located in bays and estuaries, such as Black Rock Harbor Light (5th) and the today neglected Cedar Island Light (6th).

Later, a giant hyperradiant lens was added. It is 149 inches high, 106 inches in diameter and weighs 10 tons. The optic was designed by Messrs. Barbier, Paris, France in 1885 and also by the Chance Brothers in England. The only hyperradiant lens in this nation is Makapuu Point Light on the island of Oahu, Hawaii. Many lighthouses serve dual functions. For instance, a major seacoast lighthouse may be warning of a reef or low island and serve also as a landfall aid to navigation. A seacoast light can assist a navigator fix his position and at the same time serve as a harbor or entrance beacon.

By the late 19th century, sweeping lights and flashing lights came into existence. Sweeping lights were visible to all ships regardless of their position. Flashing lights enabled mariners to distinguish one lighthouse from another by the frequency and duration of the flashes. Today's lights are capable of producing as much as 14 million candlepower.

Fresnel's priceless, hand-cut lenses have disappeared from most lighthouses in the United States as the Coast Guard replaces them with more modern, economical plastic lenses. Today, only six lighthouses in Long Island Sound still have Fresnel lenses, either as a working lantern or on exhibit: Block Island SE Light (working, 1st order); Little Gull Island Light (on exhibit, 2nd order); Eaton's Neck Light (working, 3rd order); Montauk Point Light (on exhibit, 3.5 order); Point Judith Light (working, 4th order); and Lynde Point Light (working, 5th order). The 3.5 lens on display at Montauk Point Light is an original which dates back to 1904. It is a bi-valve lens and is commonly referred to as a "clamshell" lens because of its shape. See photo on this page.

Regretfully, mindless vandals have on occasion used the Fresnel lens in a lighthouse for target practice, thus damaging its priceless and irreplaceable prisms. For example, in November 1992, the Coast Guard replaced the 4th order Fresnel lens in Stepping Stones Light with a modern 300mm lantern after it discovered bullet holes in the gallery glass surrounding the lens and chipped prisms on the lens.

There are a number of maritime museums which display Fresnel lenses and lighthouses memorabilia, and I encourage our readers to visit them:



At Montauk Point Light, the 3.5 order bivalve or "clamshell" Fresnel lens was in the tower from 1904 to 1987, when it was replaced with a DCB-224.

Shore Village Museum, Rockland, ME  
Old Lighthouse Museum, Stonington, CT  
East End Seaport Maritime Museum, Greenport, NY  
Montauk Point Light Museum, Montauk Point, NY  
Horton Point Light Museum, Southold, NY  
The Maritime Museum, Kings Point, NY  
Chesapeake Bay Maritime Museum, St. Michaels, MD

The Coast Guard's Aids to Navigation School, Yorktown, VA maintains a collection of all the orders of Fresnel lenses.

Today, the Coast Guard is replacing most lanterns in its lighthouses (in Long Island Sound, at least) with a totally new optical system called VEGA VRB-25, a medium intensity rotating beacon. The VEGA is a low-voltage marine beacon for use in 15-22 nautical mile applications. It was specifically designed for solar powering with excellent energy efficiency. Its optical projection system comprises six acrylic Fresnel lens panels arranged symmetrically on a carousel which rotates around a stationary lamp. If alive, I suspect Augustin Fresnel would be most interested in the modern developments of his 1822 invention.

**Editors Note** - The late Harlan B. Hamilton, a life-long Down Easter and holder of advanced degrees in English from Columbia and Boston Universities, was one of our most popular contributing writers. "Hal" was a keen sailor of Long Island Sound and the Caribbean, but his special interest was lighthouses. In 1987 he wrote *Lights & Legends*, a historical guide of 39 lighthouses sited on Long Island Sound, Fishers Island Sound, and Block Island. His articles will reappear in these pages on occasion as memorable tributes to his talents as a chronicler of substantial maritime achievement.