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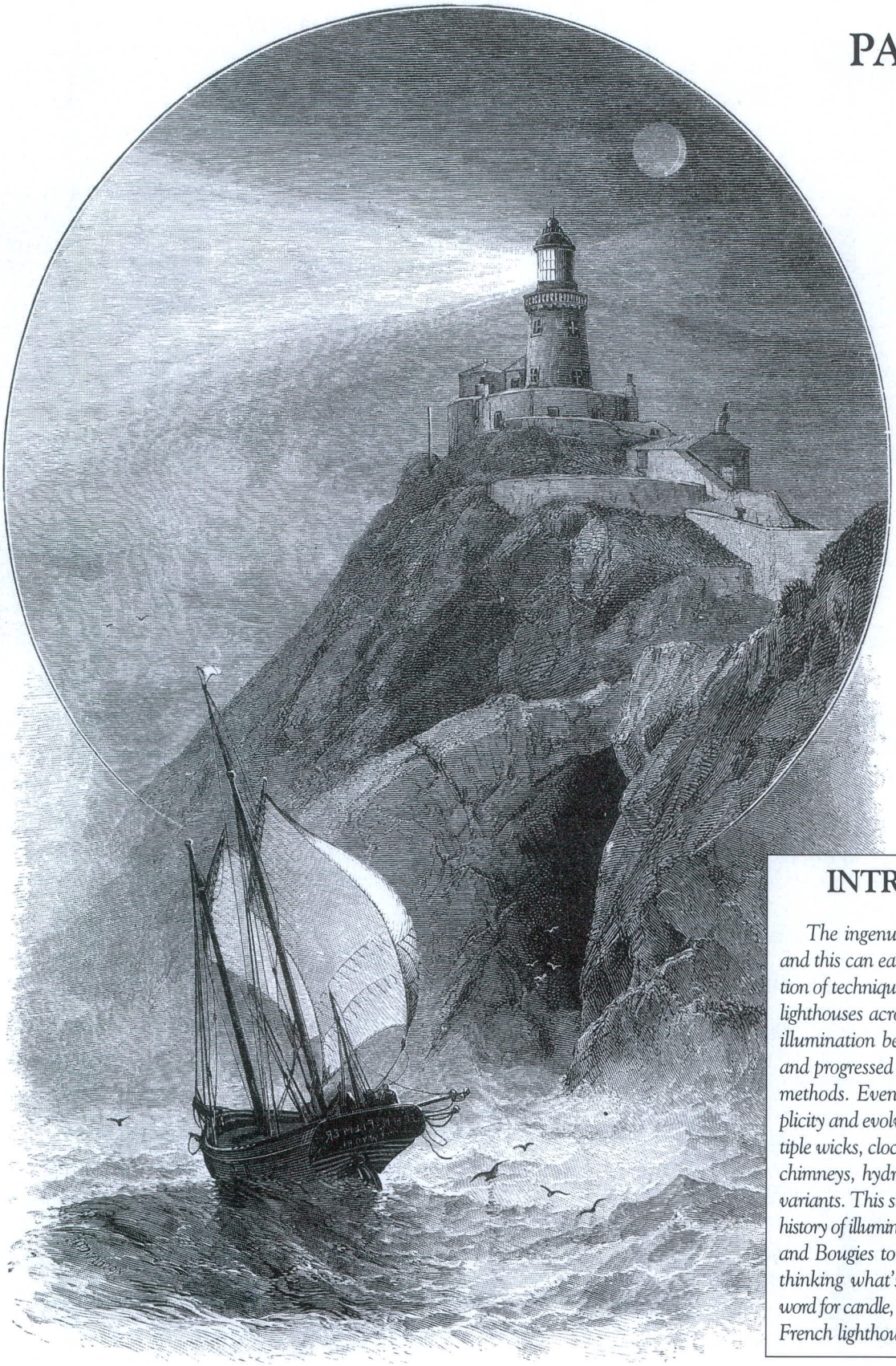
From Braziers and Bougies to Xenon

By Thomas A. Tag

PART III



INTRODUCTION

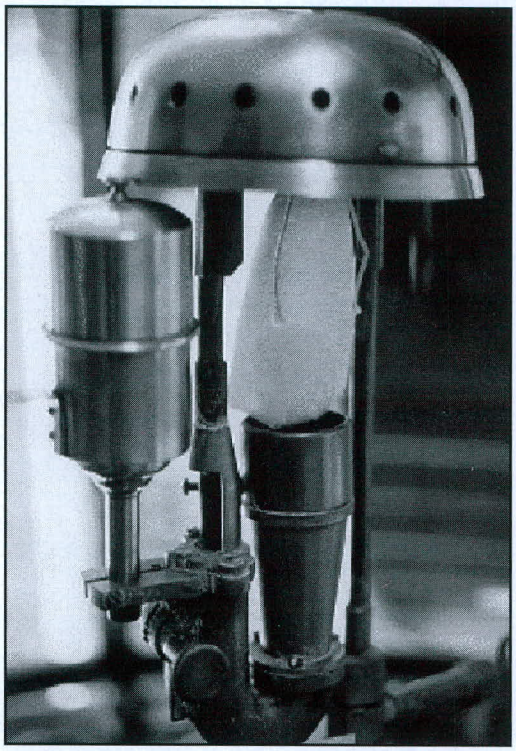
The ingenuity of man is truly amazing and this can easily be seen in the odd collection of techniques used for the illumination of lighthouses across the centuries. Lighthouse illumination began with simple wood fires and progressed through generations of other methods. Even the oil lamp began in simplicity and evolved into a machine with multiple wicks, clockwork oil pumps, specialized chimneys, hydraulic, pneumatic, and other variants. This story will take you through the history of illumination methods, 'From Braziers and Bougies to Xenon.' Ok, I know you're thinking what's a Bougie; it is the French word for candle, and Bougies were used in early French lighthouses.

INCANDESCENT OIL VAPOR LAMPS

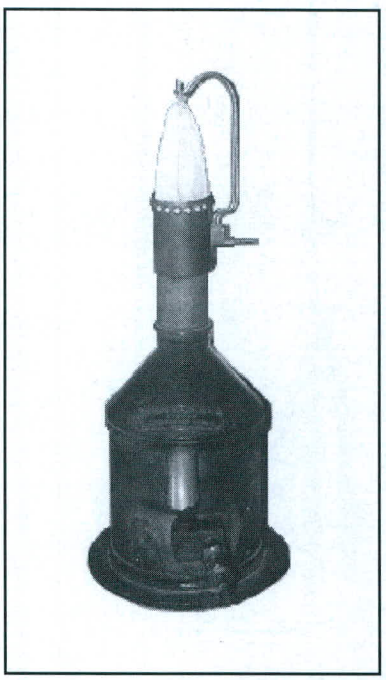
One of the first lamps burning gasified oil was developed by Nyberg and Lyth in Sweden in 1881. It worked by vaporizing colza oil and burning it without a mantle as a Bunsen burner does. However, this type of lamp was not efficient at producing additional light output. The next step was the addition of the incandescent gas mantle invented by Carl Auer von Welsbach, in Vienna, in 1885. This led to the first crude kerosene Incandescent Oil Vapor (I.O.V.) lamp, which was installed at the L'lle Penfret lighthouse, by the French, in 1898. It used air pressure and a fuel vaporizer tube where the kerosene was preheated into a fine vapor before it was ignited as a flame. This dramatically increased the oxygen at the flame and provided a brighter flame using less fuel.

In 1901, Arthur Kitson, an American, invented an improved burner in which the oil was converted into vapor under pressure in a retort and then mixed with air in a mixing chamber to form a gas for heating a mantle made of platinum gauze. The platinum gauze quickly carbonized and within a short time Kitson abandoned it in favor of a Welsbach style incandescent mantle made of silk impregnated with zirconia. This lamp produced at least three times the light output of the Argand style lamps previously used. Another similar incandescent burner was developed by C. W. Scott, the engineer to the Commissioners of Irish Lights in 1902, and still other versions were developed by Sir Thomas Matthews, engineer to the Trinity House in England, Pintsch in Germany and by Luchaire and Diamond in France. The I.O.V. lamp was first used in America at the Sandy Hook lighthouse in 1904. Matthews, in England, invented the triple mantle I.O.V. lamp around 1904 and the American Lighthouse Service began testing this lamp in 1913. One of these lamps was first used in America in 1916 at the Cape Lookout lighthouse. Finally in 1921, David Hood further improved and simplified the Kitson burner.

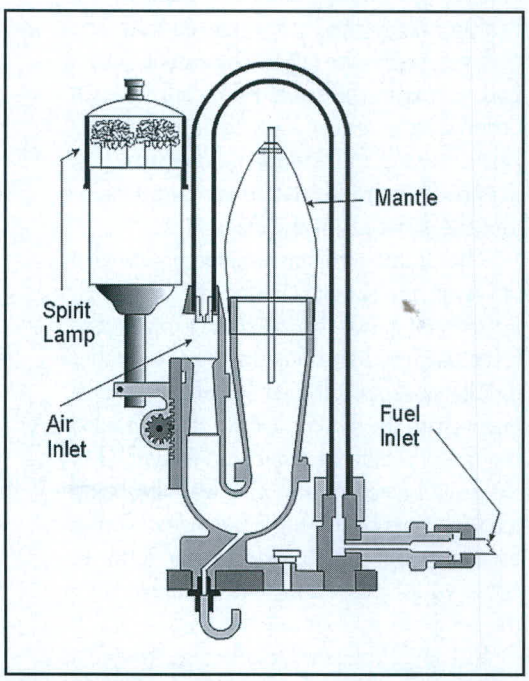
The original Kitson IOV lamp (1901) as modified by Matthews. Photo from the author's collection.



French Luchaire IOV lamp (circa 1904). Photo from the author's collection.



An early Chance Brothers IOV lamp (circa 1904). Photo from the author's collection.



French Luchaire IOV lamp burner cutaway view. Drawing by the author from official drawing.

ELECTRICITY

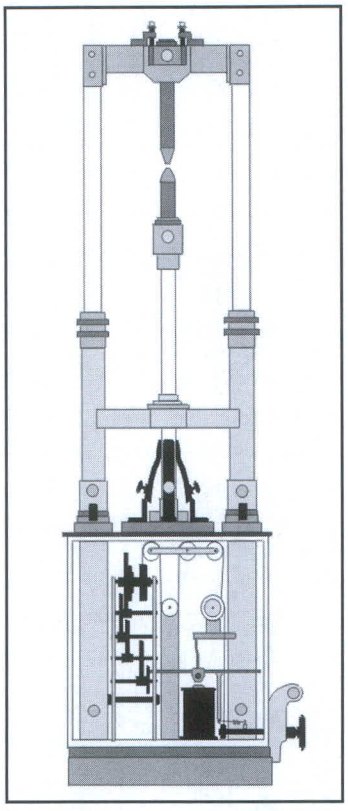
Arc Lamps

Electricity was not available in lighthouses before 1857. The electric arc had been demonstrated by Sir Humphry Davy in 1808-9. François Arago, who worked with Augustin Fresnel to develop the multiple-concentric-wick-oil lamp, also worked on the arc lamp during 1820. In 1836, Michael Faraday suggested that trials be made using arc lamps in lighthouses in England, however, it was not until 1853, that Professor Holmes made the first crude magneto-electric generator to power an arc lamp for use in a lighthouse. The first trial of this machine was made by the Trinity House, in England, in 1857. Also in 1857, Monsieur V. L. M. Serrin, in France, invented an arc lamp with automatic adjustment of the carbon rods through the use of a clockwork mechanism and electrical solenoids. Serrin's lamp was further improved by Monsieur Lontin.

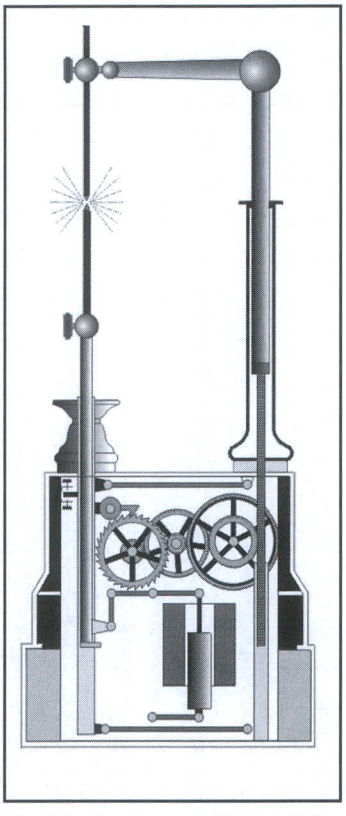
In 1858, at the request of Professor Faraday, an Alliance magneto-electric generator, modified by Professor Holmes, was tested at South Foreland lighthouse, in England, and the electric arc light was first shown to the mariner. Holmes' machine was able to generate electricity, which was applied to two tiny 6 _ mm.-square-carbon rods between which a spark, or arc, was drawn by means of the electric current. The intense heat generated by the electric current liquefied a portion of the carbon rods as the current passed from one carbon point to the other. The carbon points had to remain the same distance from each other in order for the lamp to properly function. Serrin's clockwork mechanism was designed to move the carbon rods and maintain the distance for the electric arc.

The electric-arc lamp was officially installed at Dungeness, England (old tower) in 1862, a Serrin lamp was first used in France at the Cape La Heve lighthouse in 1863, and other installations soon followed. In America, experiments with the Electric light in 1868 included the use of a magneto machine made by Mr. Wilde of Liverpool. Progress was also being made in other countries. In Germany, Werner Siemens invented the dynamo generator in 1866, which proved far more reliable than the generators previously used.

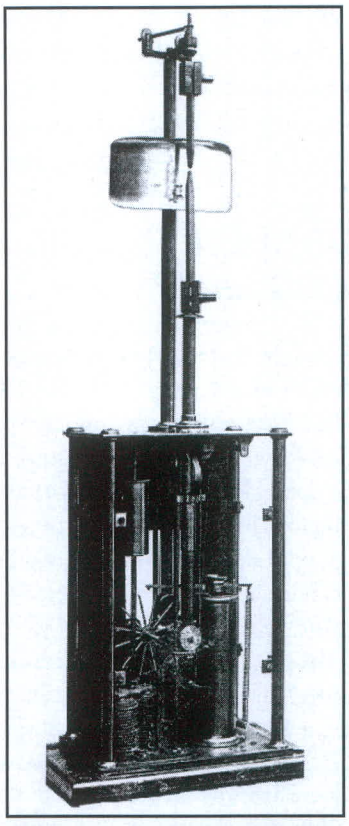
In 1869, Professor Holmes constructed a new dynamo-electric generator for Trinity House. The invention of the dynamo brought the first break-through in electric lighting by



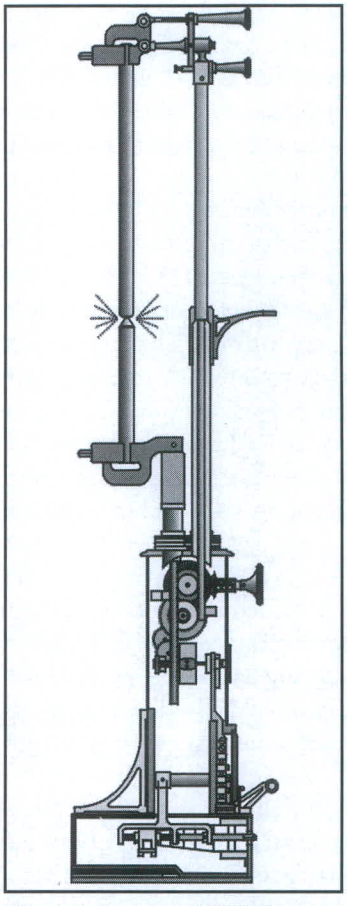
French Arc Lamp (circa 1900). Both upper and lower carbons are movable. Drawing by the author.



Serrin's Arc Lamp with regulator (1857). Drawing by the author.



Holmes Arc Lamp with regulator (1857). Drawing by the author.



Siemen's Arc Lamp (1878). Drawing by the author.

supplying a constant and reliable current to feed the lamp. The second breakthrough was the development of carbon rods with softer cores in 1877. These new style carbon rods had the ability to more easily maintain the arc in the center of the rod, giving a brighter and steadier light.

Various experiments were carried out in 1876-77 and again in 1883-84 at South Foreland to determine the best machine for generating electricity and to compare electric lights with oil and gas lights. Later, in 1885, three De Meritens alternating-current magneto generators along with three arc lamps of the Duboscq-Gaiffe model were put on trial.

The carbon rods first used were the De Meritens pattern, square in section and made up of smaller carbons. These carbons were found ineffective, because the interior of the upper carbon had a tendency to fall out as the bands binding it together burned up during the consumption of the carbon. Later, cylindrical carbons up to 40 millimeters in diameter were used, the most effective being the 30-millimeter Berlin core carbon, which had a core of graphite 3 millimeters in diameter. Sir James Douglass invented a rod with fluted sides that provided additional steadiness to the arc, and soon larger carbons up to 50 millimeters diameter were tried.

The brilliance of the arc lights far exceeded any earlier oil lamp, but there were differing views about their penetration ability during fog. It was first thought that light produced from electricity would not penetrate fog to anywhere near the extent that the light from an oil lamp could, because the oil lamp produced a light that was strong in the yellow-orange-red part of the spectrum and the light from the electric arc was in the blue portion of the spectrum. Later, this was found to be false through the trials held at the South Foreland Lighthouse in 1884.

In America, experiments were also conducted on electricity and arc lamps during 1885 and the Lighthouse Board reported on the experiments as follows:

"It will be necessary to state first the reasons which appear to have prevented the adoption in our service of electric lighting apparatus of the pattern now being introduced to a considerable extent in the lighthouses of foreign countries. The principal objections to the adoption of the new light, in its present form, are the expense of installation and the increased cost of maintenance.

For the present at least, and until the complete reliability of the new light under the keepers' management shall be established, the advantage offered by an electric light, while being greatly superior in intensity to the oil lamp, would require alteration of the lantern or lens. The construction of an incandescent electric lamp adapted for this purpose, and designed so as to give the maximum amount of illumination in the most efficient direction, would best meet our needs. In the progress of this work many serious difficulties were encountered, but a practicable lamp much superior in luminous intensity and compactness to the first-order flame was produced. But, a lamp with satisfactory luminous intensity, justifying the establishment of a steam-plant to produce it, has not yet been attained, although there has been continued progress in this respect.

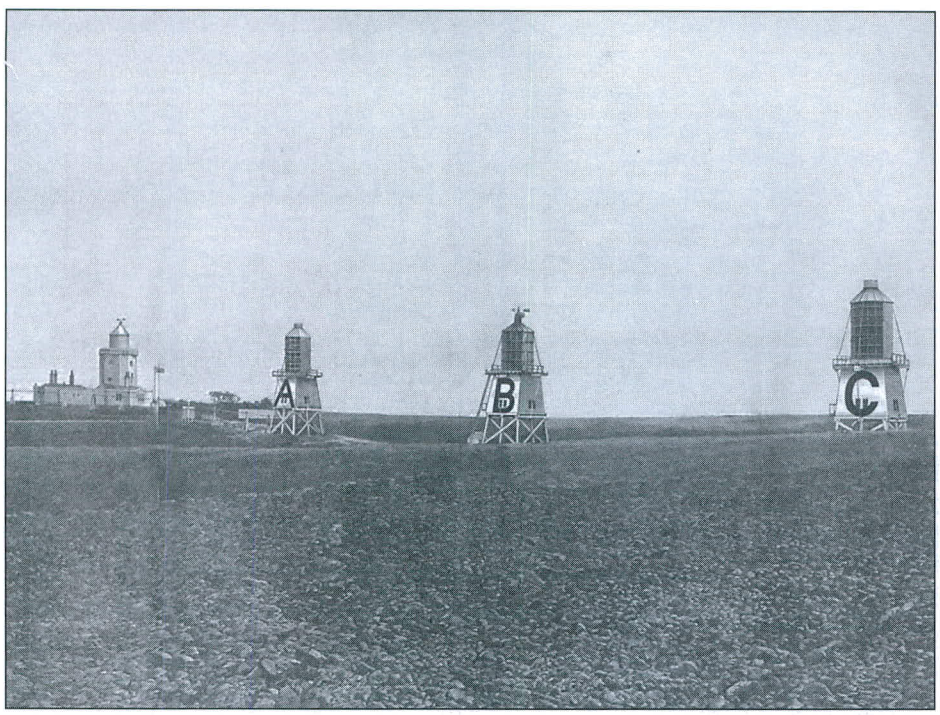
Regarding the superiority of the arc-electric light over all other modes of illumination yet developed for primary seacoast lights there can no longer be any question. This fact was definitely established by the very exhaustive experiments made at South Foreland, England, by a committee of the Trinity House, as stated in their report of August 1885. It is further sustained by the increasing number of electric lighthouses in actual operation and the favor with which they are received by mariners.

The first electrically lit light in America, was the Statue of Liberty in 1886. The statue served as a lighthouse beacon for seventeen years.

The first American buoy lit with electricity was a series of spar buoys in Gedney's Channel in New York harbor in 1888. Unfortunately the underwater power cables kept breaking and the project was finally abandoned in 1903. The electric light was first installed in an American lighthouse at Navesink in 1898.

America's first lightship using electric illumination was the Cornfield Point lightship, No. 51, delivered to the Staten Island Depot in July 1892. The Lighthouse Board reported that the lightship operated in a highly satisfactory manner when deployed. Tests were also run on the electric light at Hallet's Point NY, known as the Hell Gate electric light.

In 1905, the Germans (Prussians) invented the 'Differential Arc Lamp,' where the positive carbon rod is held horizontally and the negative carbon rod is placed at a seventy-seven-degree angle to the positive rod. The German engineers felt that the Differential Arc Lamp allowed better control of the arc within the focus of a reflector or lens.



Towers at the South Foreland Light Station, England, used for illuminant experiments. Illustration from the 1885 *Annual Report of the Lighthouse Board.*

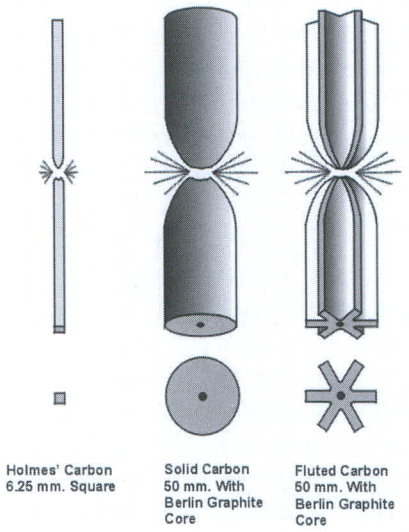
DE MERITENS MAGNETO GENERATOR

The French De Meritens magneto generators were found to work with great steadiness and with good efficiency, revolving at 600 rpm. A De Meritens magneto was installed at the Lizard lighthouse, in England, and was used from 1881 until May 1950. It produced 32v at 120 cycles, giving an AC output of 3.5kw, and ran the arc lights at the station until 1926. The arc lights were then replaced with filament bulbs of 3kw, and the voltage from the De Meritens generator was transformed up to 80v.

MODERN ELECTRIC LAMPS

The early incandescent light bulbs were very unreliable and while they were experimented with at many locations they were not put into use. It was after Thomas Edison invented the tungsten filament light bulb that similar (but much larger) bulbs were used in lighthouses. Bulbs of 1000-3000 watts replaced arc lights in many lighthouses in the early 1900s.

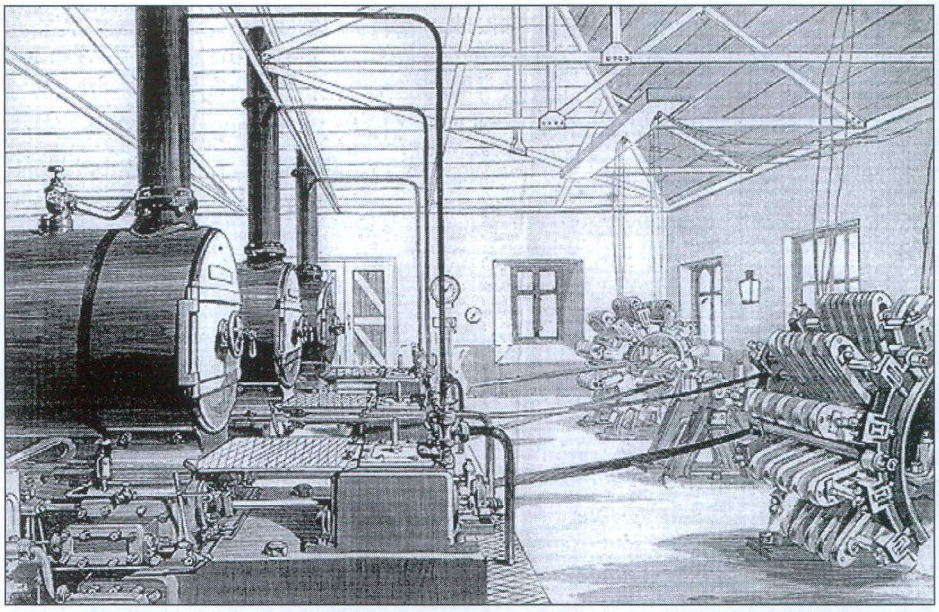
When commercial power became available the first station to be connected in England was South Foreland, and in 1922 it became the first British lighthouse to be lit by an incandescent lamp. These early lamps had very large globes and optical difficulties were encountered as the filaments presented a complex patterned light source, later bulbs became smaller and the filaments were made smaller as well. The Xenon discharge lamp, first introduced in 1947, gave a highly concentrated light source. It has one drawback in that its beam is very vertically narrow and the beam provides little, if any, of the 'loom' in the sky that mariners prefer to see. Later, in the Terschelling, Brandaris and other Dutch lighthouses, old incandescent bulbs were replaced by a super-high pressure mercury-iodine lamp, and in the United States, and elsewhere, various forms of Halogen lamp bulbs are now the norm.



The carbon rods used in arc lamps varied in size based on the amount of electrical current applied.

CURRENT APPLIED	DIAMETER OF ROD
25 Amps	10 mm
50 Amps	16 mm
100 Amps	23 mm

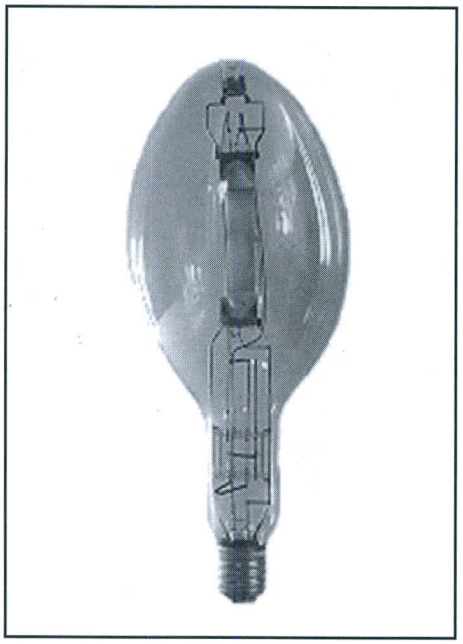
Larger carbon rods of 50 mm and more in size were also produced.



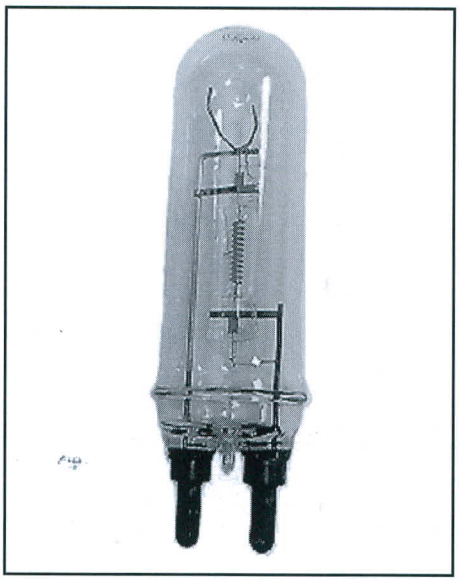
Steam engines and De Meritens Generators in the generator room at the Lizard Lighthouse, England. Drawing from an old newspaper.

Bulbs

The light sources used in lighthouses changed significantly over the years. Many styles of light sources were tried, some were a great success and some proved of little value. Yet all forms, 'From Braziers and Bougies to Xenon,' helped to make the lives of the mariners safer.

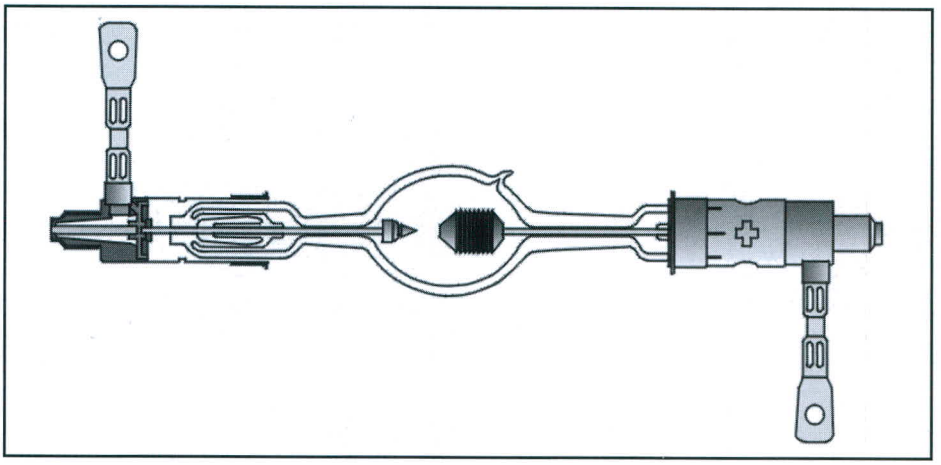


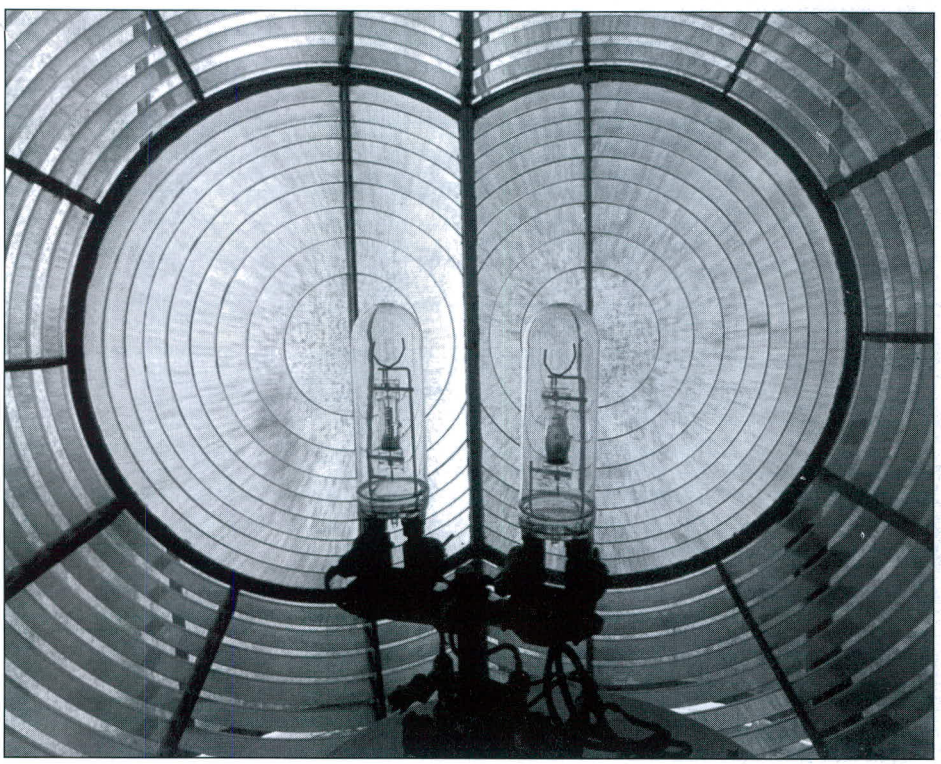
English 1000-watt Metal-Halide lamp. Photo from the Egbert Koch collection.



Left – American 1000-watt halogen lamp. Photo from the author's collection.

Below – Drawing of a 2000-watt Xenon lamp (1947). Drawing by the author from an OSRAM drawing.





A Note About Candlepower

The determination of the light output of lamps is usually measured in candlepower. In the early years of lamp development there were no accurate methods of measuring candlepower and later, in the early 1800s the methods used were very subjective and unscientific by our current standards. The candlepower is also dramatically affected by the size of the flame, the type of oil used as a fuel, the maintenance of the lamp and polish of the reflector and by other factors such as the clarity of the air and alignment of the reflector with the horizon. In describing the various apparatus in this story I have used the candlepower ratings developed or estimated by the various inventors. However, the candlepower ratings should only be used as a very rough estimate of the relative power of each instrument as compared to the others and not as a true rating of its actual light output.

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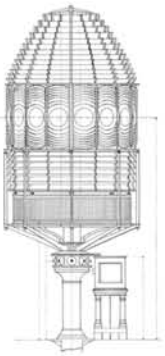

Restoration & Preservation

Thomas Point Shoal Lighthouse, MD

The U.S. Lighthouse Society has donated to many lighthouse preservation projects throughout the U.S. Most recently we were honored by being presented with the Preserve America Stewardship Award from The White House for our restoration work at Thomas Point Shoal Lighthouse.

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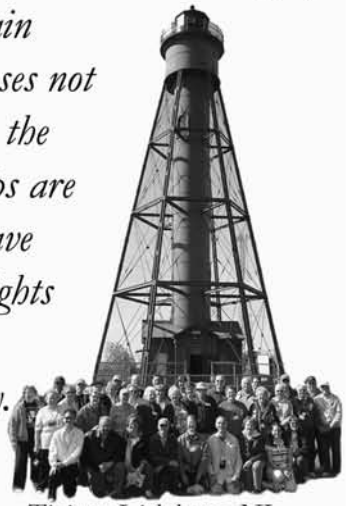
Education

The Keeper's Log *magazine is the only one of it's kind and has been published quarterly since 1984. Receive this award-winning publication as a benefit of membership.*

The Society organizes domestic and international lighthouse tours. Many of our excursions gain access to lighthouses not normally open to the public. These trips are a great way to have fun, see lots of lights and learn about lighthouse history.



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