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The Giant and the Leprechaun

By Thomas A. Tag

Note: All photos and drawings from the author's collection unless otherwise specified.

Introduction

This is the story of one of the most magnificent Fresnel lenses ever proposed and the man who proposed it. The giant in our story is the giant lens proposed in 1892, and our leprechaun is the great Irish inventor John Richardson Wigham.

This story deals with Wigham's composite gas burner, his proposal for the hyper-radial lens, and his later development of the giant lens and its associated intensity burner. For much more on Wigham and his other lighthouse inventions, see *The Keeper's Log*, Vol. 23, No. 2 and Vol. 23, No. 3.

John Richardson Wigham (1829-1906). Photo courtesy Wigham collection.

The Composite Gas Burner

Wigham produced the composite burner in the autumn of 1868. The composite burner had an inner group of 28 gas jets with outer rings of 20 jets each, allowing a total of 108 gas jets. When fully configured to 108 jets, the burner produced nearly 3,000 candlepower.

The lamp consisted of a horizontal hollow-circular disk about one foot in diameter, supported upon a stand and into which the tubes supplying the burners were connected by joints sealed with mercury.

The lamp was designed to burn 28 jets in clear weather. The 28 jets were arranged in concentric rings, the diameter of the outer row being about the same as that of the outer wick of the ordinary four-wick lamp; that is, four inches.

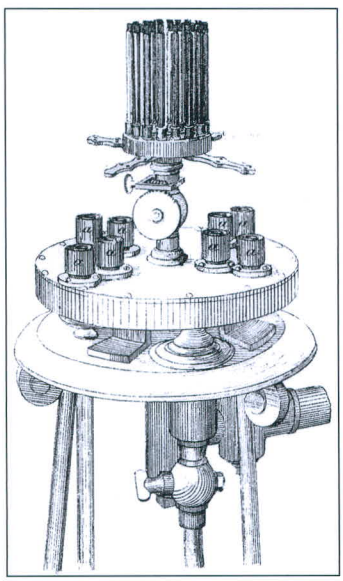
When the atmosphere became hazy, an additional exterior half-ring of 20 jets was simply hand set in position and had two tubes with tapered endings extending downward. The tapered ends of these tubes fit into precision-ground sockets, partially filled with mercury, in the base gas-distribution plate. The mercury created a seal to prevent gas leakage.

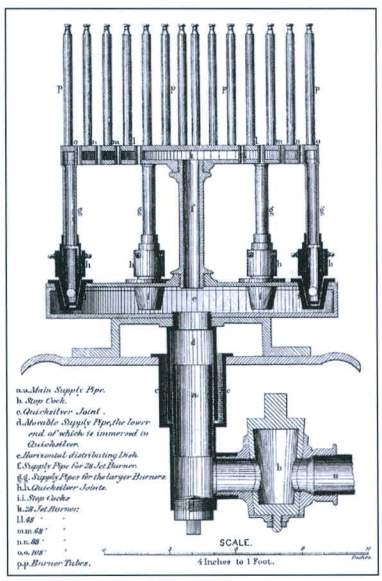
During this operation the flames from the 28 jets forming the nucleus were turned low, and when the gas cocks were reopened, the flame from these lit the added exterior row. Additional rows of jets were successively added as required by the increasing density of fogs or thick weather, each increasing the number by 20, so that from 28 (the number in the nucleus) the various powers were 48, 68, 88, and 108 jets, the latter being used only in very thick weather or dense fog.

There was no chimney directly surrounding the flame. Instead, above it, at a distance of about 12 inches, was suspended a funnel made of mica, into which the upper part of the flame was guided by the funnel shape and carried by the draft through the cowl of the lantern. The mica funnels varied in diameter to suit the different sizes of the flames and were changed in accord with the number of jets used. Mica is a mineral that can be split into very thin slices. The frame of the funnel was made of metal with mica inserts that were so thin that the light from the flames could be seen through the mica as shown in the drawing.

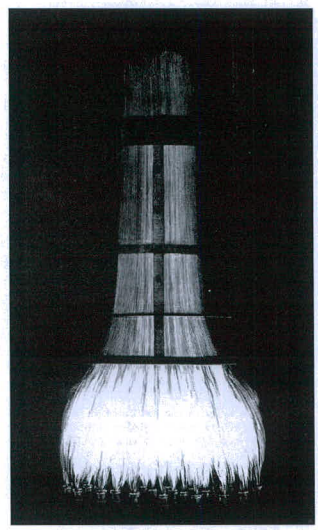
The entire operation of changing from one set of jets to the next higher or lower, and also changing the mica funnels, took less time than the trimming of a four-wick oil lamp.

The diameter of the flames corresponding to the different powers of the lamp were, respectively, 3 ¾, 5 ½, 7 ½, 9 ¼, and 10 ½ inches for the





Left: The 28-jet burner.
Right: The 108-jet burner.



Mica funnel above 108-jet burner.

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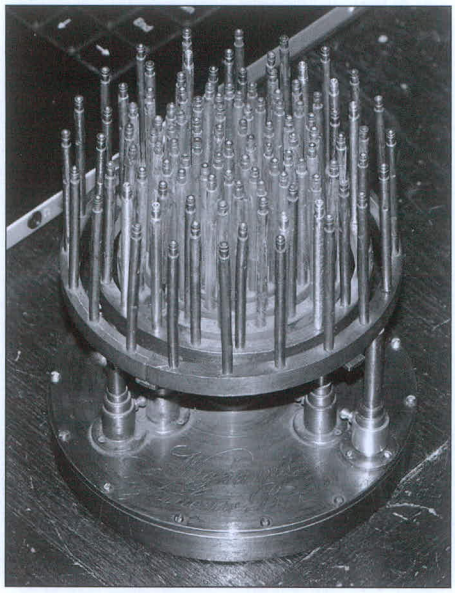
28, 48, 68, 88, and 108 jets. Unfortunately, a great part of the larger flames became ex-focal because the Fresnel lenses in use had been designed for a smaller 4-inch diameter flame at the focus. The larger gas flames increased the divergence of the light and also decreased the intensity of the light due to the great thickness of the flame.



The composite burner. Photo courtesy Chad Kaiser collection.

Wigham's Hyper-Radial Lens Proposal

On various public occasions, Wigham proposed a long focal length hyper-radial lens for use with his gas burners and showed that it was necessary to allow the full development of his larger flames. The size of the gas flames had always been thought to be too ex-focal; and Wigham determined that if a lens with a larger focal length were produced, it would allow his large burner flames to produce more light that could be directed to the horizon.

In 1872 he brought the subject before the Royal Dublin Society and again six years later before the British association. In 1877 Wigham was in communication with the French lens-making firm, Barbier and Fenestre, and had obtained from it drawings and descriptions of a hyper-radial lens with a focal length of 1,330 mm and an estimate of the amount by which the light of his 108-jet gas burners would be enhanced by its use. In 1879 these documents and drawings were shown to Dr. Tyndall, then the scientific advisor to Trinity House. In that same year, Wigham introduced the subject at a meeting of the British Institution of Civil Engineers, where Sir James Douglass, the Trinity House engineer in England, promptly pronounced judgment on it. "The 'Hyper-radial' lenses," he asserted, "would be too large for lighthouse purposes, and their cost would be prohibitory."

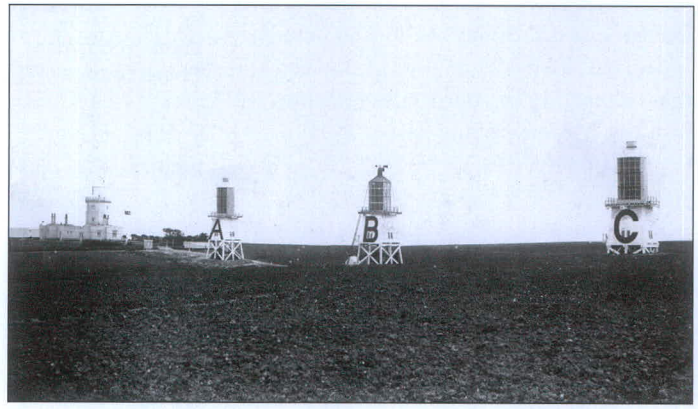
Wigham did not have the political power to get his hyper-radial lens design actually produced. The Commissioners of Irish Lights were neither able nor willing to fund this costly new lens design and nothing further happened with the hyper-radial proposal. A feud between Sir Douglass and Wigham had begun and would continue throughout the next several years.

The Trials of 1885

There was a great difference of opinion as to the relative merits of electric and gas lights in a misty or foggy atmosphere. It was strongly asserted on one side that the electric light had a greater power than any other luminary for penetrating fog, while the opponents of that theory stated that in foggy weather the electric beam was more readily absorbed than the beam from a gas or oil light. It was not a question of intensity or actual candlepower that was involved, because in this respect there was no doubt whatever as to the superiority of the electric light. There was a question connected with the color of the light produced. It was well known that red and orange rays were not as easily absorbed in their passage through a thick atmosphere as were violet rays, and it was asserted that in gas and oil lights the red rays were proportionally more abundant than in the electric light, in which there was an equality of all colors.

The trials in 1885 attempted to determine which type of illumination was preferable by setting up three experimental lanterns located near the South Foreland Lighthouse in England. These test towers could be observed from several points on land as well as from the sea. In addition, a large photometric building was erected to allow the detailed examination of the candlepower of each style of lamp and fuel.

The first test tower was designated for electricity and had one Fresnel lens. The second tower was for testing gas and had four lenses one above the other in what was known as a quad-form lens. There were also four of Wigham's 108-jet gas burners mounted one above the other with one to each lens. The third tower was for testing kerosene and had three lenses, one above the other, in a tri-form arrangement with three six-wick oil lamps arranged one above the other with one to each lens.



The experimental lanterns at the 1885 trials held at South Foreland. Photo courtey Wigham collection.

During the planning for the trials, David A. Stevenson and his partner Charles A. Stevenson, who were engineers for the Northern Lighthouse Board in Scotland, discussed the large-diameter lamp flames with their brother Thomas Stevenson and all decided that a larger lens with a greater focal distance should be tested as a part of the trials and that it should be named the hyper-radiant lens. David and Charles contacted the Barbier and Fenestre Company in France and requested that a hyper-radiant lens panel be produced. Barbier and Fenestre responded with the design they had previously proposed to Wigham of 1,330 mm focal distance. It was also decided to compare this new 1,330 mm panel

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with the largest lens panel then in existence, which was the extra-tall first-order 920 mm panel for the Eddystone Lighthouse.

During the trials there was great interest in the new lens panels and in what the results of using this larger lens size would be. It was found that Wigham's large gas burners did crack one of the standard first-order lenses and that the massive flame did become ex-focal with a corresponding loss of light. When Wigham's burner was used with the new 1,330 mm hyper-radiant lens panel, no damage occurred and there was a significant increase in light output.

When James Kenward of Chance Brothers saw the new lens panel, he was greatly impressed. However, he did not like the name hyper-radiant and proposed the name hyper-radial, which was accepted and remains the most common name in use for these lenses today.

As the great trial went on, Sir Douglass continued his feud with Wigham and was allowed to pronounce judgment on his own designs as well as those of his rival Wigham. With the views of the Trinity House already well known and the stacked deck of judges, it was hardly unexpected that the results of the trial confirmed that gas was of little use, and even when gas was used, the Douglass gas burners were better than Wigham's anyway.

Some observers suggested that the trials were comparing "apples and oranges" and "current technology with proposed technology," but the results were generally accepted. Electricity should only be used in the critical coast lights, kerosene was generally as good as or better than gas, and the new hyper-radial panels should be used with large kerosene burners and with gas if gas were to be used.

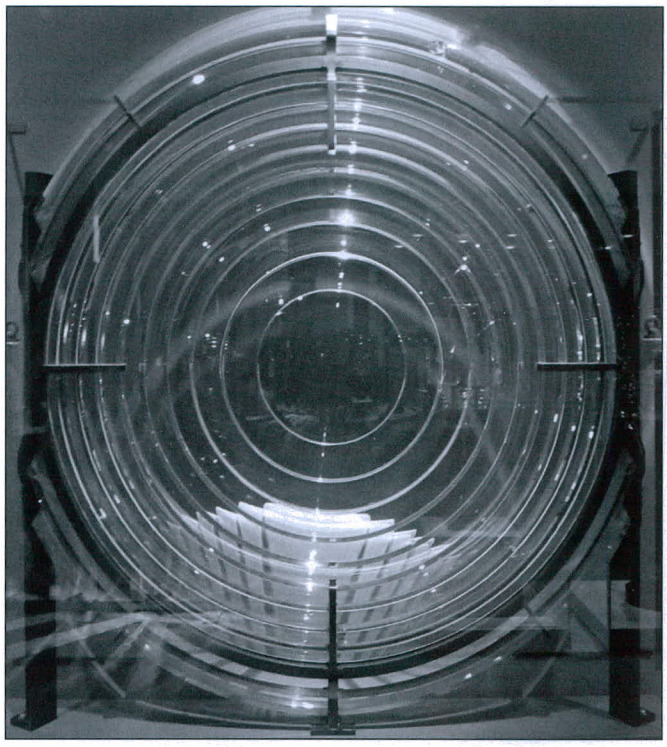
The Hyper-Radial Test Lens Used at the 1885 Trials

The big trial was now complete and the results were generally accepted, Dr. Tyndall had quit his job due to the treatment of Wigham by the trial committee, and Wigham just continued on with his work in Ireland.

The next major event happened in 1887 at Tory Island Lighthouse. At that time the lights on Mew Island and Tory Island were revolving tri-form in design, with burners of 108 jets in each focus of their triple tiers. Still, though the two lights were similar, the Tory beacon was reported by sailors to be by far the better of the two. The superiority was due to the greater focal length (hyper-radial) of the annular lenses employed at Tory Island.

With Sir Douglass firmly against the hyper-radial lens, how was it that they were actually used at Tory Island? According to Dr. Tyndall the answer was simple:

> As long as the advocacy of these great lenses was confined to Mr. Wigham, the notion of introducing them was not tolerated. But, during the experiments at the South Foreland in 1885, the same conception entered the fruitful mind of Mr. Thomas Stevenson, and to this lighthouse veteran the Board of Trade granted, with alacrity, the necessary sanction for the construction of a hyper-radiant lens. It was made by the self-same firm, Barbier and Fenestre, with whom Mr. Wigham had worked out the subject, and from whom he had obtained the requisite drawings seven years previously. To Mr. Stevenson we are indebted for the expressive name, "hyper-radiant." When tried at the South Foreland, its performance was found to be all that Mr. Wigham had predicted it would be. The Commissioners of Irish Lights thereupon took courage to recommend, and indeed gallantly to fight for, the introduction of such lenses at Tory. And though lenses similar to those at Mew had been actually purchased for Tory, they were set aside, and a Tri-form of Hyper-radiant lenses took their place in 1887.



The hyper-radial test lens used at the 1885 trials.

The new light on Tory Island, when full on in fog mode, had a total of 324 jets, equal nearly to 9,000 candlepower. The burners at Tory Island could be flashed (turned on and off mechanically) giving a group flashing characteristic.

One problem remained: when Wigham's composite 108-jet burners were installed in the hyper-radial lens, they still produced a light beam with a rather wide divergence (spread) of 12 ¼ degrees and the intensity of the beam was considerably below what it should have been if it were placed in a lens of the most appropriate size with a still greater focal length.

Thomas Stevenson.

Of course, Sir Douglass thought the design at Tory Island was of little use, stating:

> The optical apparatus for gas described at Tory Island, is of the same dimension as that at the "Bishop Rock Lighthouse," namely, 1,330 millimeters focal distance; but it has three tiers of burners and lenses, instead of two as at the "Bishop," where it would not have been prudent to have risked an apparatus of greater height. The system adopted at Tory Island of producing a "group-flashing" light has two serious defects, especially for a coast light where two or three lights of the same description are required in the same neighborhood, first, the uncertainty in the number of

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The Tory Island Lighthouse.

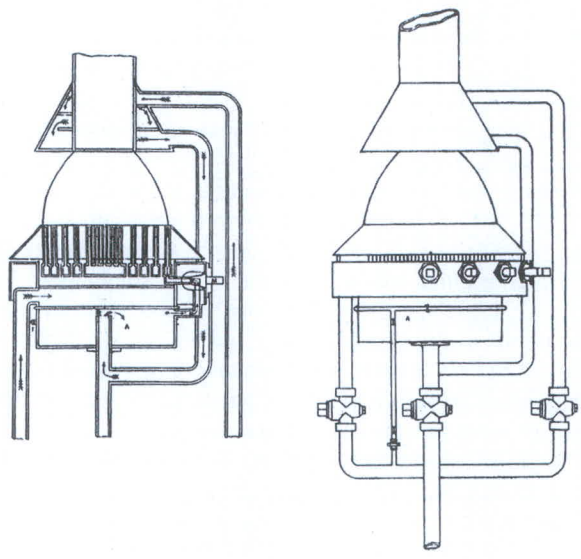
flashes in each group, and secondly, the want of uniformity in the intensity of the flashes. At the "Bishop," the system of Dr. John Hopkinson has been adopted, as is usual with all similar apparatus of the Corporation of Trinity House. With these apparatus, the number of flashes in each group is identical, because a separate lens is devoted to each, as shown; and the flashes from each are also always identical in their intensity.

The Giant Lens Proposal

In 1892 Wigham requested that the F. Barbier Company in Paris produce a giant lens, which was described by James Kenward, the Chance Brothers plant manager in 1897, as follows: "There has also been constructed, at Mr. Wigham's suggestion, as an experiment, what he aptly calls a 'giant lens' of 2,000 millimeters radius (Ed.: focal length), but it is not yet adopted in practice." (Note: F. Barbier took over from Barbier and Fenestre in 1887.)

The Intensity Burner

In order to make the giant lens still more functional, Wigham invented a new, more powerful gas burner that he named the intensity burner. The gas Wigham had used up to that time was made from expensive Stockwell-Cannel coal heated in a retort, which produced a much richer gas flame than ordinary town gas. At each lighthouse a gas generation plant was built that consisted of a furnace building housing the gas retorts. The ordinary operation of gas-making had to occur daily, with great attention paid to the purifying process. The resulting gas was then sent to a large gas-storage tank that was known as the "gas-o-meter." For the intensity burner, Wigham recommended a much less expensive system in which ordinary town gas was enriched by passing it through an element known as naphthalene held in a tray below the burner, whereby its illuminating power or intensity was approximately doubled. The intensity burner had the normal 108 gas jets in its standard configuration and an additional 40 gas jets in its high-power foggy weather configuration.



The Wigham intensity burner.

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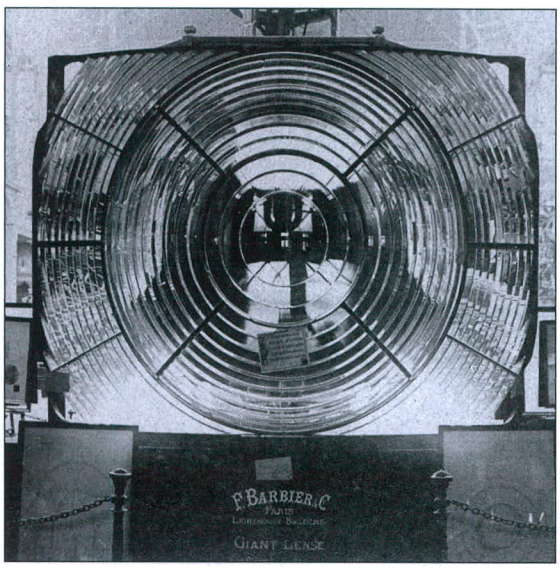
The Giant Lens

The experimental giant lens was made by the F. Barbier Co. in Paris. Only one panel was actually constructed. This panel was 10 feet wide by 7 feet 6 inches tall. The overall proposal was to create a four-sided, tri-form lens that would have stood a total of 22 feet 6 inches tall and required a lantern with a diameter of 17 feet 6 inches and a height of at least 25 feet. The light beam intensity from each panel was calculated at 800,000 candlepower using a standard composite burner with 108 jets; thus, the tri-form power would have been 2,400,000 candlepower. With the new intensity burner, the power was doubled to 4,800,000 candlepower.

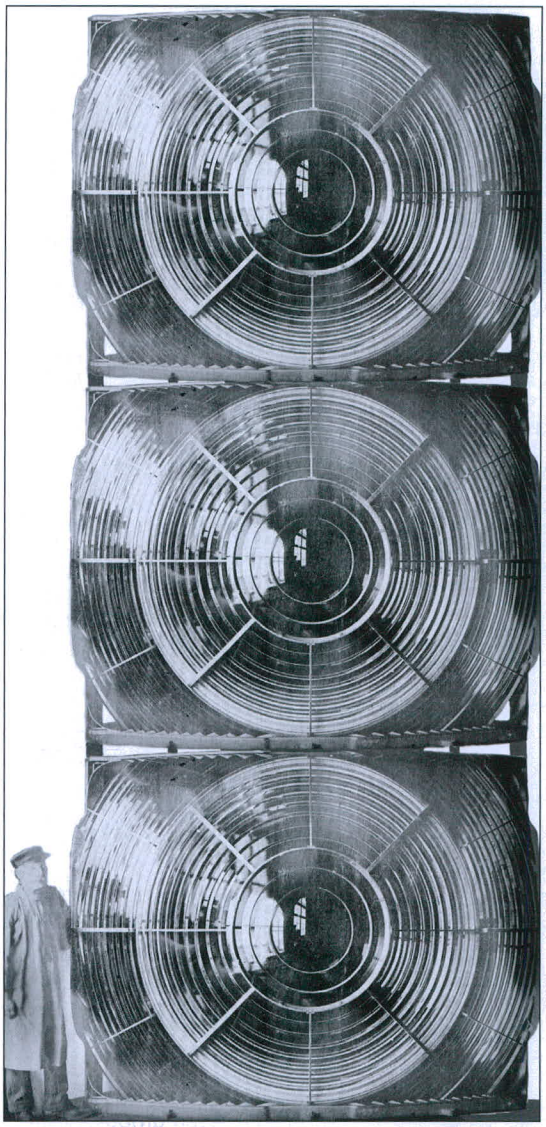
The divergence of the light beam when using the 108-jet intensity burner was more narrow at only 6 degrees; and in foggy weather when the 148 jets were in use, the divergence was still narrow at only 9 ¼ degrees versus the 12 ¼ degrees of the hyper-radial lens. This narrower light beam made the giant lens and intensity burner combination the most powerful light beam produced in the world at that time, surpassing even the output of the electric-arc lamp and hyper-radial lens combination.



The giant lens test panel as shown at the Chicago World's Fair. Photo courtesy Chad Kaiser collection.

Testing of the Giant Lens

The giant lens test panel was first installed in an experimental tower adjacent to the Howth Baily Lighthouse near Dublin. For several months the new lens was tested in all atmospheres from completely clear nights to the densest fog conditions. Observations were made from the Salt Hill Hotel some six miles away as well as from various ships approaching the Dublin harbor. The tests were observed by local ship captains as well as by the pilotage superintendent of Kingstown, the Astronomer Royal of the County Dublin Observatory, Professor Tyndall, and others. The opinion of all was that the giant lens and intensity lamp "cannot fail to be of use to sailors in foggy weather, when even so powerful a light as the well known first-order (Ed.: hyper-radial) revolving lens of the Tory Island pattern must fail."



The giant lens in its proposed tri-form configuration. Photo with three lenses created by author—only one lens panel was ever made.

The Fight to Actually Install a Giant Lens

The giant lens had now been tested, and it was time to try an actual installation in a lighthouse. The Cork Chamber of Commerce and Shipping had received the reports of the successful trials and requested that the new lens and lamps be installed at the Old Head of Kinsale Lighthouse. The Belfast Chamber of Commerce joined in seconding this request.

Their requests fell on deaf ears. The 1885 trials had said that electricity was to be used in major lights, and while the Commissioners of Irish Lights and the British Board of Trade approved of the installation of a standard hyper-radial lens and electric arc-lamp for the Old Head of Kinsale Lighthouse, they would not agree to any installation of the giant lens or intensity burner. The debate went on for several years with the two factions sparring back and forth with no further change in their positions.

Thus the saga of the giant lens and its inventor passed into history and nothing was ever heard of this lens proposal again. The magnificent test panel is also lost to history with no record of its location after about 1905. So, now you know the story of the giant and the leprechaun.

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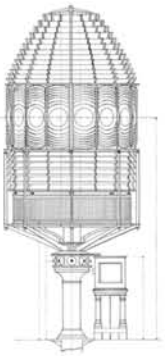

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Thomas Point Shoal Lighthouse, MD

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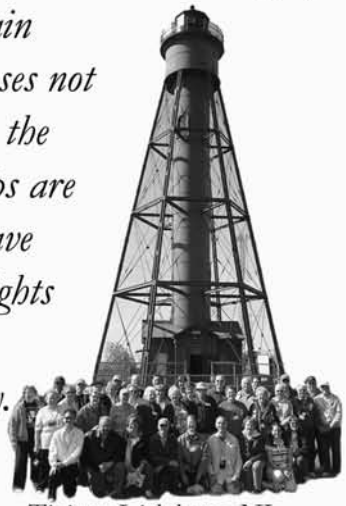

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