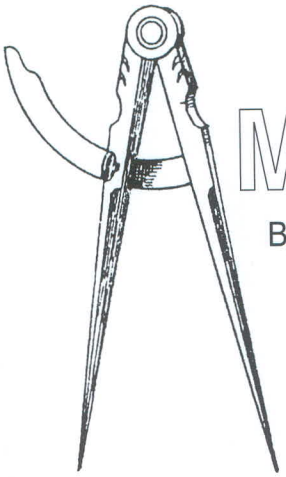
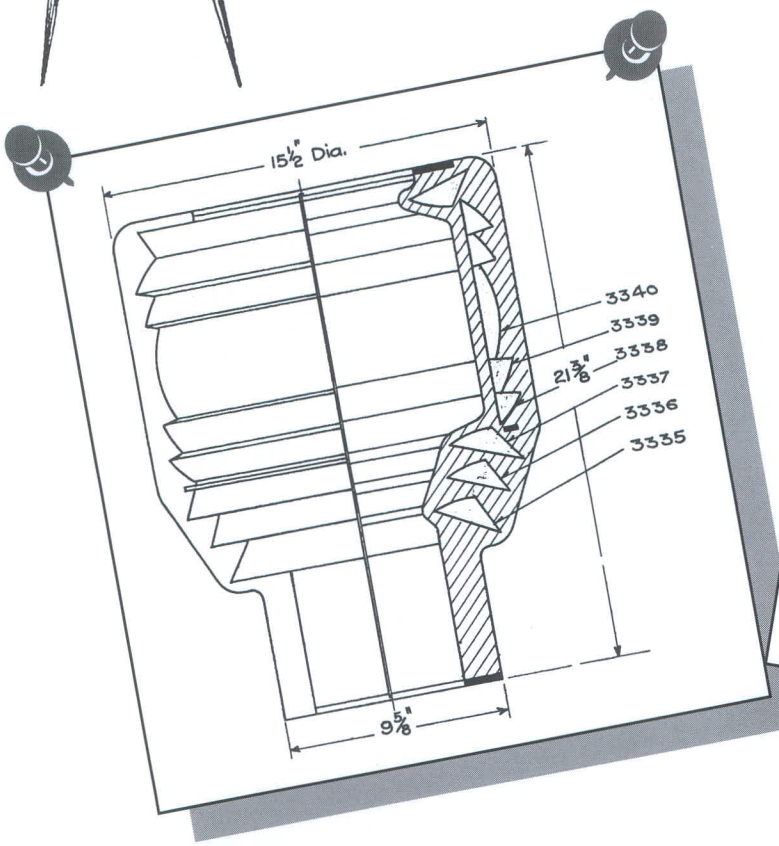
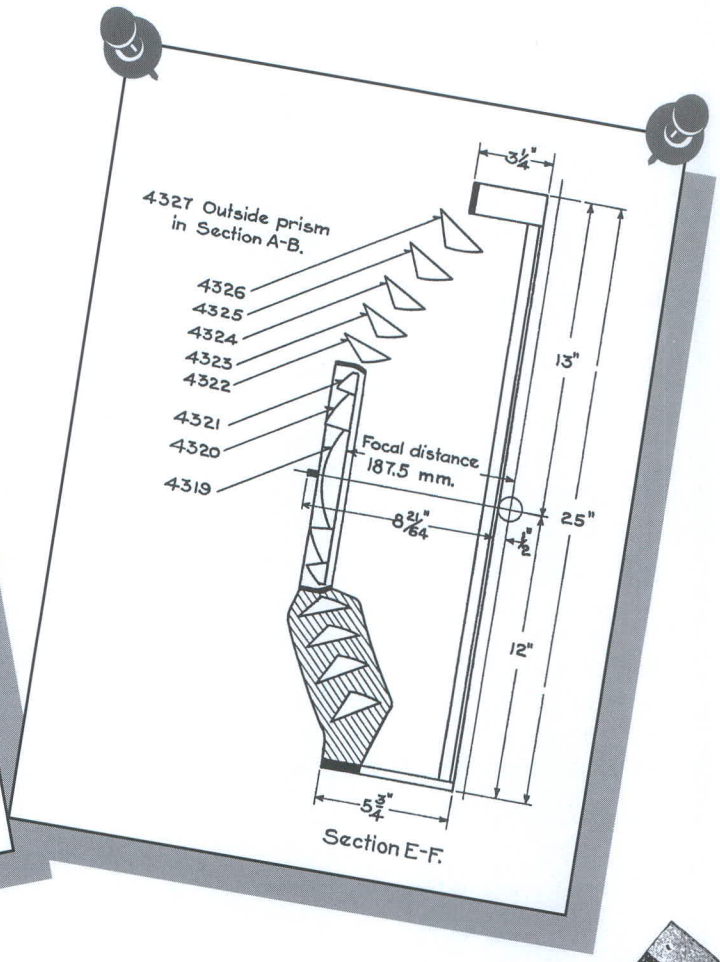


# MERICAN MADE LENSES

By Thomas A. Tag



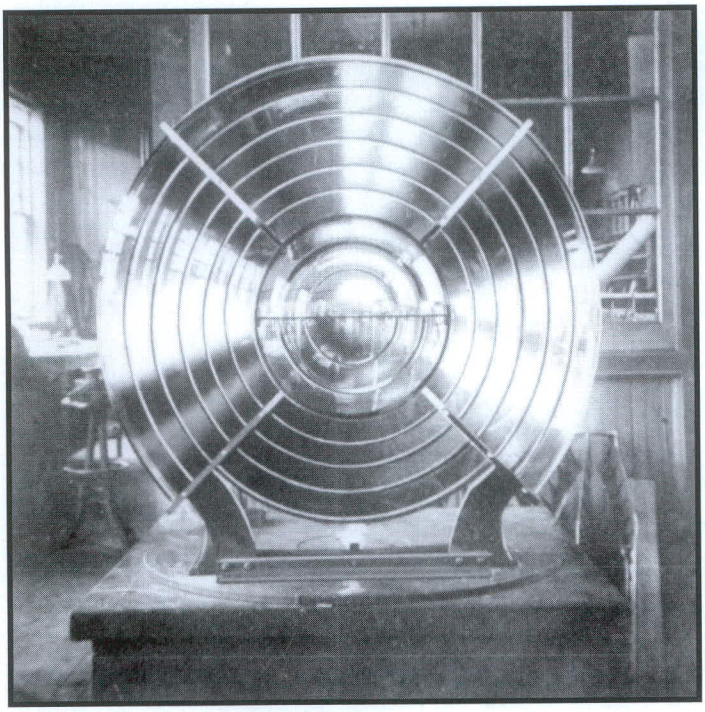
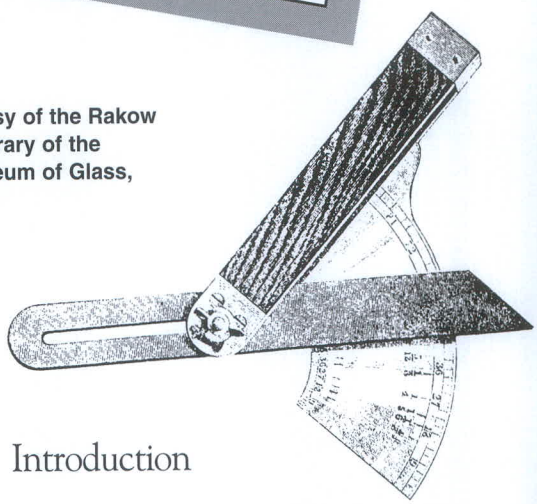



**Photo courtesy of the Rakow Research Library of the Corning Museum of Glass, Corning, NY**



## Introduction

Most people, even most lighthouse enthusiasts, do not know that Fresnel lenses were made in America. The following story will tell how an American glass-maker, a disgruntled Frenchman, the need for an astronomical telescope in Japan, $11.95 of erroneous import duty, and our government's strong desire for 'Made in America' led to the manufacture of American Fresnel lenses.

## A Short History of Optical Glass Manufacture

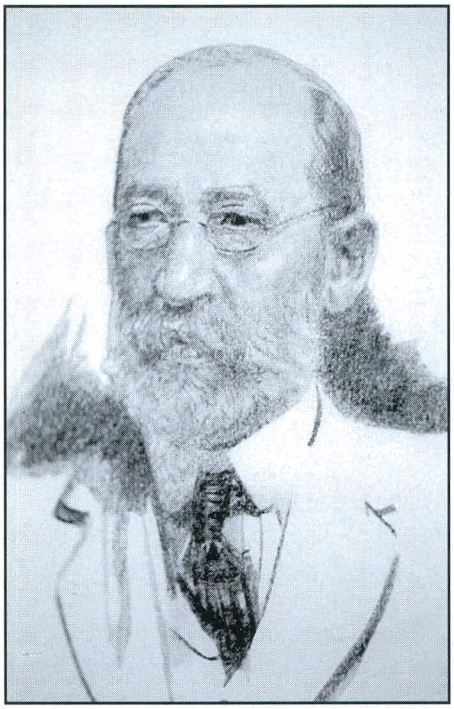
In 1788, lighthouse lenses, with a diameter of 21 inches and a thickness of five inches, were made by Thomas Rogers in England. Rogers lenses were made from thick slabs of ordinary poor quality window glass with many bubbles and striae (an imperfection in the glass characterized by nearly transparent wavy lines or patches). Rogers ground down the slabs of glass to make his thick lenses. The glass was so poor and the lenses were so thick that they were reported to actually reduce the light output rather than enhance it and were used in only a few English lighthouses.

In America in 1810, Winslow Lewis made nine inch diameter lenses that varied from 2.5 to four inches thick. Lewis' lenses were made from poor quality green bottle glass. These lenses also reduced the light output and were later abandoned. True optical glass and new lens designs to reduce the thickness would be required before efficient optics for lighthouses could be produced.

Around the world, many glass-makers had long tried to make optical quality glass. It was not until around the year 1790 that a Frenchman, Pierre Louis Guinand, invented the first truly successful process and set of ingredient formulas for the production of optical glass. Prior to this time, it was only possible to produce optical quality lenses with a diameter of about three inches. By 1790, Pierre Guinand was able to make optical quality lenses of up to nine inches with his new process.

Pierre Guinand's secret process involved the use of a two-foot long stirring rod made of fire-clay. This rod was used to stir the molten optical glass mixture within the furnace, to produce a homogeneous glass that was nearly free from bubbles and striae. Pierre Guinand kept his process and list of ingredients closely guarded as did each of the other glass manufacturers at that time. In 1805, Pierre Guinand joined two German optical glass-makers, and together they developed the manufacture of optical glass in Germany.

In 1819, another Frenchman, Augustin Fresnel began his design of lighthouse optics resulting in the now famous Fresnel lens, which was first installed in the Cordouan Lighthouse in France in 1823. His was the first use of optical glass and advanced lens design principals in a lighthouse lens. During this time, Monsieur Soleil and one of Pierre Guinand's assistants, Monsieur Bontemps, continued optical glass production in France and were able to produce single lenses with a diameter of 14 inches in the year 1828. Later, in 1848, Monsieur Bontemps went to work for Chance Brothers in England where he was essential to Chance's manufacture of optical glass and lighthouse lenses.



**George MacBeth**

Charles Feil, a grandson of Pierre Guinand, founded his own glass factory in France and continued the family tradition of optical glass-making there. In 1872, he placed his company under the direction of his son Edmond Feil. Under Edmond's leadership, or lack thereof, the Feil company floundered within a few years and Charles regained control. Edmond Feil left his father's business and started his own very small optical lens factory. By 1885, Charles Feil took his son-in-law, Edouard Mantois, as a partner and they jointly ran the business until early 1887 when Charles died.

Edmond Feil thought he would return to the business as a partner on his fathers death, but he was left out of the partnership contracts and Monsieur Mantois took over as sole proprietor. Edmond Feil was devastated, and became quite vindictive. He immediately wrote to Chance Brothers in England and offered to sell them the processes and ingredient formulas for many types of optical glass then produced only in France and Germany.

Chance Brothers accepted Edmond's offer and purchased drawings of various glass-making tools and moulding equipment, as well as all of Edmond's formerly secret glass formulas. In addition, Edmond Feil made it generally known throughout the glass industry that he was available for hire or consultation. In 1890, George Macbeth brought Edmond to America as the general manager of his new glass factory which was then under construction in Elwood, Indiana.

## George A. Macbeth (1845-1916)

George Macbeth began his glass-making career in Pittsburgh, Pennsylvania in 1872 with the manufacture of glass chimneys for oil lamps and became one of the world's largest producers of lamp chimneys by 1880.

In 1899, Macbeth Glass merged with the Thomas Evans Glass Company to form Macbeth-Evans, which then became the world's largest producer of lamp chimneys and major manufacturers of a variety of other glass articles.

## First Optical Glass Made in America

The Spencer Lens Company and the Lennox Glass Company both tried to make optical glass in the 1860s, but could make only very tiny quantities of rather poor glass. In 1890, George Macbeth built a glass factory in Elwood, Indiana. Elwood was chosen because a very large source of natural gas had just been found in the area which could fuel the glass melting furnaces.

The Elwood plant was specifically designed to produce large quantities of lamp chimneys, but Macbeth had a fascination with optical glass and he devoted a special room and one pot furnace to its production. The plant was completed early in 1891. On August 5, 1891, Macbeth organized a special train that picked up 365 of his workers, their families, and household goods in Pittsburgh, Pennsylvania and moved the workers, and Edmond Feil, to Elwood, Indiana. The factory then began lamp chimney production and

Feil, in addition to his management duties, began making very small experimental batches of optical glass.

Later in 1891, an astronomy equipment manufacturer, and friend of George Macbeth, named John Brashear was working on telescope lenses to be used in the Tokyo Observatory in Japan. An accident occurred in the grinding process and several lenses were destroyed. The lens glass John Brashear was using had been imported from France and it would take several months to receive a replacement order. Brashear went to Macbeth and asked if there was any possibility of obtaining replacement lens glass in America. This was just the opportunity for which George had been looking. He contacted Feil at the Elwood plant and discussed the project. They decided they would try to produce the lenses at Elwood. Production quantities of materials were immediately purchased and within a few weeks Feil made his first attempt at producing the lens blanks. The first glass produced was perfect and the lens blanks were quickly made and sent to the grinding process. John Brashear was elated and immediately gave Macbeth orders for glass lens blanks for eventual use in telescopes being built for the Gill Observatory in South Africa, Dudley Observatory in New York, Princeton Observatory, and others.

No other American company was then able to make high quality optical glass in quantity, for use in instruments, lenses, and laboratory equipment. The plant eventually produced leaded glass as well as various flint and other specialty optical glasses.

Macbeth won a prize at the Columbian Exposition in 1892 for producing the first high quality optical glass in America. Although no records exist, it was probably at this exposition where Macbeth was first approached by the U. S. Lighthouse Board in regard to the potential manufacture of Fresnel lenses. The Lighthouse Board had a large display at the exposition and various Lighthouse Board members were probably visitors.

Unfortunately, the production costs of American labor could not compete, at that time, with those in Europe. After only five years of very limited production, Edmond Feil left the Macbeth-Evans Company and the production of optical glass was stopped. However, optical glass research continued and experimental batches of optical glass were still produced.

## Enactment of a Tariff on Optical Glass

On June 10, 1890, Congress passed a Tariff Act that provided:

> "Duties shay be collected on Lenses of glass or pebble wholly or partially manufactured and not especially provided for in this act, at 45 per centum ad valorem."

This Act caused an immediate cost increase for all Fresnel lenses imported by the Lighthouse Service.

The Lighthouse Board reacted by requesting an increased appropriation for 'Supplies of Lighthouses' in 1891 and they also added the following to their request:

> "Heretofore certain articles of lighthouse supply not manufactured in this country were imported duty free. Under the present tariff act duties must be paid on them. This will be an additional drain upon this too slender appropriation. Thus it will be seen that with the means at hand it will be necessary to practice the severest economy to keep the present lights properly supplied."

In addition, they requested an increase in the appropriation for 'repairs' and added the following:

> "The cost of duties laid by the new tariff act upon illuminating apparatus and other material which was formerly admitted duty free must be met."

A similar statement relative to 'Supplies of Lighthouses' was made in the request for appropriations in 1892.

The Lighthouse Board was also quietly lobbying Congress to make an exemption to the tariff for optical glass used for lighthouse purposes. In early 1893, they were successful and the Act of March 3, 1893 for 'Supplies of Lighthouses' was passed stating:

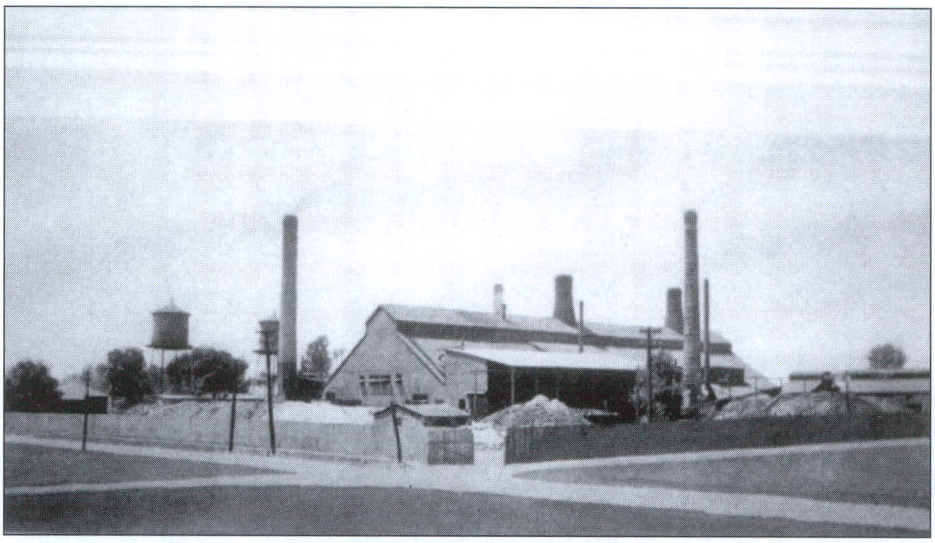
> "It is provided: That lenses and lens glass for the use of the Lighthouse Establishment may be imported free of duty."

Fresnel lens costs returned to their actual cost, saving the Lighthouse Board 45 percent. This happy status remained in effect for the next eight years.

Then, it happened! In late 1900, Lieutenant Colonel D. P. Heap who was Engineer of the Third Lighthouse District and in charge of the Lighthouse Depot at Tompkinsville, New York, ordered some lens prisms from France to repair a damaged lens. The prisms were shipped to New York in January 1901 by the American Express Company. When they arrived, the local customs agent was apparently told only that the package contained optical glass, and he then requested $11.95 for the optical glass duty, which was paid by the American Express Company. Lieutenant Colonel Heap did not find out about the erroneous charge for several weeks until the American Express billing arrived.

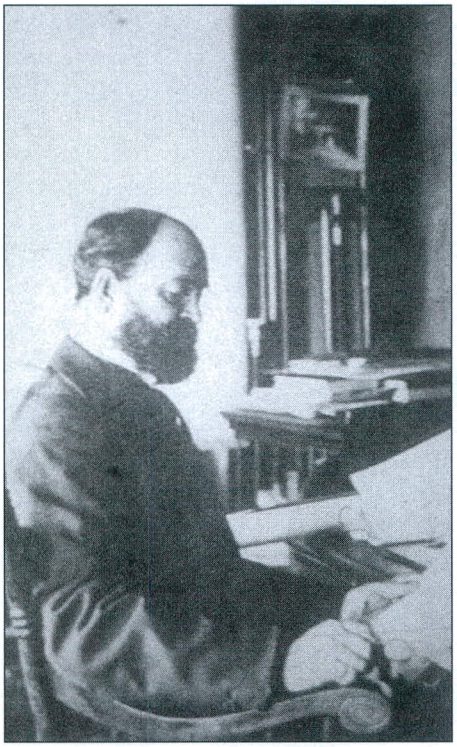
He then made his first mistake. Heap wrote to the Lighthouse Board requesting that the government refund the $11.95.

Lieutenant Colonel Heap should have known better. Although he was a member of the U. S. Army Corps of Engineers, he had been assigned duty in the Lighthouse Board



**MacBeth's Elwood Works in Elwood, IN. Photo courtesy of the author.**

since 1880. There he had been the Engineering Secretary of the Lighthouse Board from 1883 through 1887 and was assigned as the Third District Engineer from 1887 through 1894, and again starting in 1897. He should have realized that bureaucrats don't like paperwork and especially don't like to fill out numerous forms and letters for insignificant sums. Heap's letter was forwarded to the Treasury Department who promptly rejected the request. Unfortunately, that did not stop Heap. He again wrote a letter requesting a refund, this time to the Assistant Secretary of the Treasury who replied as follows:



**Lieutenant Colonel D.P. Heap**

> "In reply I have to state that, while the articles were entitled to free entry under the said provision of the law, there is no provision of law under which refund of the duties paid as aforesaid could be made in the absence of a timely written notice of dissatisfaction to the collector of customs at New York, under the provisions of section 14 of the act of June 10, 1890. Your application is therefore again denied."

Now, Heap made his big mistake, he again wrote a letter to the Treasury Department as follows:

> "I now request to be advised if I can reimburse the American Express Company for duty paid under misapprehension — this reimbursement to be charged against the appropriation from which the cost of the prisms was paid."

This time the response from the Treasury was not what Heap expected. The response was written on June 21, 1901, directly by R. J. Tracewell, Comptroller, who agreed to Heap's request, but also added a long dissertation about the original wording of the Act of March 3, 1893, concluding as follows:

> "I am therefore of the opinion that neither the language nor the nature of this proviso indicates an intention to enact general and permanent legislation, and that it must be construed to be limited in its operation to the particular appropriation of which it forms a part.
>
> "Adopting this construction, it follows that duties were legally exacted, and you are therefore authorized to reimburse the express company for the amount thereof paid by it to the Government"

This meant that, in the Comptroller's opinion, the original provision should have ended at the end of that fiscal year, and the free importation of optical glass by the Lighthouse Board was at an end, unless Congress re- worded the language of the Act of 1893 and re-enacted it into law. Based on this finding, the customs collectors were advised to start collecting the tariff on ALL optical glass from June 21, 1901 forward.

> On July 24, 1901, the Lighthouse Board sent Lieutenant Colonel Heap a telegram:
>
> "Report at once by letter, all illuminating apparatus ordered from abroad which manufacturers were informed was subject to free entry. Name Firms."

The Lighthouse Board was really upset and began lobbying Congress to re-write the act. Lieutenant Colonel Heap was ordered relieved of duty in the Lighthouse Board on August 9, 1901, and returned to the U. S. Army Corps of Engineers, serving in California. The Lighthouse Board also got the Secretary of the Treasury to write a letter to Congress on January 30, 1902, asking that the act:

> "be modified, reenacted, and made part of the next sundry civil appropriation act in that part relating to repairs, etc., of lighthouses ..."

For some unknown reason, Congress refused to add the requested new wording, and, from 1902 until 1907, the Lighthouse Board's Annual Report carried the following request:

> "Free entry asked for goods imported for lighthouse purposes."

But, this was all useless activity, as Congress failed to respond and the tariff duty continued to be collected.

At the same time, another major change was underway for the Lighthouse Board. From its inception, the Lighthouse Board had been under the Secretary of the Treasury and the Treasury Department. On July 1, 1903, the Lighthouse Board was transferred to the Department of Commerce and Labor. The combination of the increased costs from the re-imposed tariff and the pressures of being under new management set the Lighthouse Board in action to find an immediate solution. The Lighthouse Board began to solicit American glass manufacturers about the possibility of developing the capability to produce optical glass and the needed Fresnel lenses in America.

The September 26, 1903 issue of Scientific American reported:

> "The United States Government has afforded experts in this country every opportunity to learn the art of making Fresnel lenses, but up to the present without success. One of the most prominent American optical firms was given one of these lenses to copy, but after nearly a year of experiment was obliged to abandon the attempt. Consequently, Uncle Sam has to send abroad for his lighthouse equipment The same holds true in the mounting of the lenses. This is also done abroad, so that whenever a lens is broken it must be shipped back to Europe for repairs."

No American firm would take up the challenge and the Lighthouse Board continued to buy from abroad at ever increasing cost, including the tariff. Over the next few years additional attempts were made to find an American supplier, without result. Additionally, in 1909 Congress decided to restructure the Lighthouse Board and they passed a law which took effect July 1, 1910, terminating the Lighthouse Board and replacing it with the Bureau of Lighthouses under the leadership of Commissioner George Putnam.

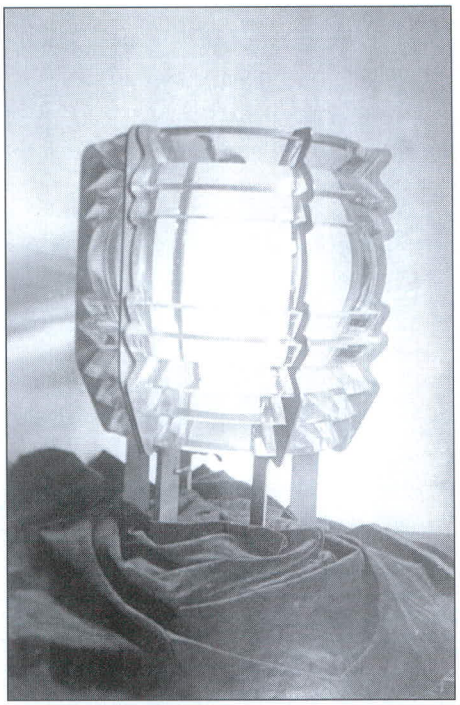
## Development of Navigational Aids at Macbeth-Evans

In 1910, the Bureau of Lighthouses approached Macbeth-Evans and requested that they evaluate the possibility of producing a small 5th Order Fresnel lens for use on American lightships. By this time, Macbeth-Evans was back in limited production of optical glass and was looking for a project with a continuing need for relatively small quantities of the glass, and, while American labor costs had not come down, the use of sophisticated grinding and polishing tools, design for part interchange, and advanced production processes were in place, lowering overall costs.

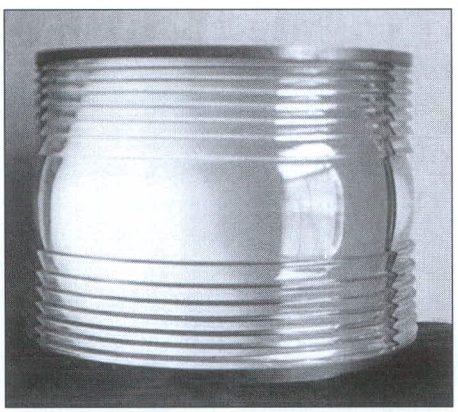
Macbeth-Evans accepted the Fresnel lens project and started an evaluation of all parts of the design and construction of such lenses, as well as the composition and manufacture of the lens glass.

The glass used in all of Macbeth-Evans lenses was different from that used by the European makers. Macbeth-Evans used glass with an index of refraction of 1.55, versus the European standard of 1.52, and a specific gravity of 2.95, versus 2.52 for Europe. The glass was known as non-hygroscopic, meaning that it does not absorb any moisture. It was a heavy, brilliant glass with a very slight gray color, and it would take a finer polish than European glass. This type of glass was harder to make, especially without bubbles and striae.

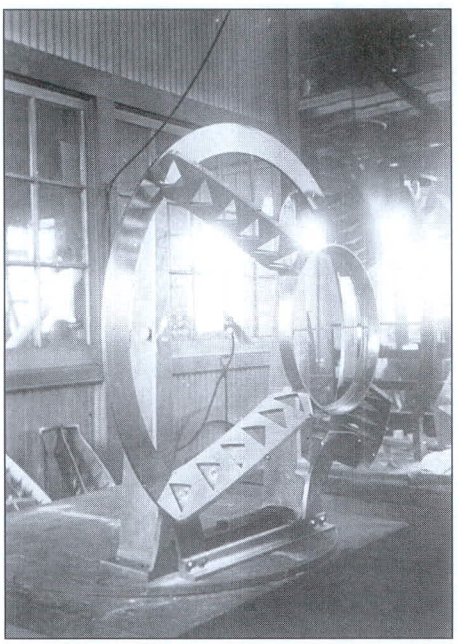
Macbeth-Evans lenses were also improved over European lenses in their physical design. George Macbeth hired Professor Harry S. Hower, of the Carnegie Institute of Technology, to design the prisms used in his lenses. Professor Hower noted that in the first prisms produced in Europe, the sides were straight, utilizing only the principles of total reflection and refraction. In later European prisms, one of the sides of the prisms was slightly curved which improved its ability to direct the light as needed. The Macbeth-Evans prism design was constructed with two conical surfaces and the third surface was a hyperboloid of revolution giving still more enhanced light throughput and control. This structure was more complicated than any other manufacturer had successfully produced, and Macbeth-Evans lenses were found to transmit as much as 50 percent more light than the European lenses of the same type and size.



**5th order fixed lens for lightships.**



**300mm pressed glass lens for buoys.**



The Macbeth-Evans prisms were manufactured completely by machine. The grinding and polishing equipment was developed by Mr. Heupel, the Macbeth-Evans manufacturing engineer, and allowed highly accurate and lower cost manufacture. Mr. Heupel also developed designs for all of the brass-work that was used to create the finished lens panels. This brass-work was held to very high tolerances which reduced the cost for the initial setup and testing of the lenses.

## Red Glass for use in Characterizing Lighthouses

The European glass-makers used ruby glass made by adding gold to the molten glass mixture. Ruby glass was produced in panels for use external to the Fresnel lens and was also formed into lamp chimneys. Ruby glass provided the red color used to create part of the lighthouse's characteristic and to mark dangerous areas. Unfortunately, it was brittle and easily broken. The European panels were generally made at least one-quarter inch thick to reduce breakage. Ruby glass absorbs approximately seventy-five percent of the light passing through the red panels. This is due to the fact that only the red light rays and some useless blue light rays pass through and, also, due to the thickness of the glass panels which absorb many of even those light rays.

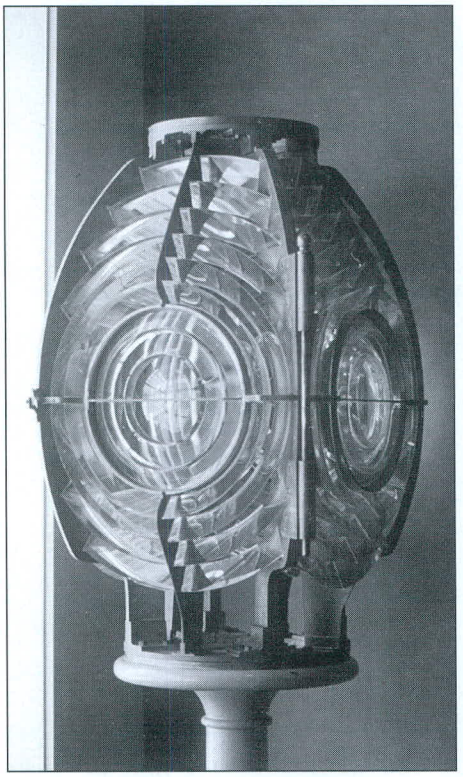
Beginning in 1911, the Bureau of Lighthouses asked Macbeth-Evans to produce red glass panels and chimneys. However, Macbeth's glass was specifically designed to have a red-orange color, and the color was produced with chemicals other than gold, allowing the glass to be made far less brittle and, consequently, to be produced with reduced thickness. The Macbeth-Evans red-orange panels and chimneys absorbed less than sixty percent of the light, giving a more powerful light for mariners.

**Photos this page courtesy of the Juliette K. & Leonard S. Rakow Research Library of the Corning Museum of Glass, Corning, NY**

**The brass-work was held in very high tolerances. At left is a brass frame for a 4th order clam shell (bivalve) style lens.**

## Fresnel Lenses and Other Navigational Aids made by Macbeth-Evans

The 187.5 mm. 5th Order, three panel, fixed lightship lens was the first attempted by the Macbeth-Evans Company. The first lens was successfully delivered to the Bureau of Lighthouses in 1910. In 1912 Macbeth-Evans agreed to undertake the development of 4th Order lenses. By the early part of 1913, Macbeth- Evans produced their first 4th Order lenses and 'Made in America' became a reality.



**4th order flashing lens. Author photograph.**

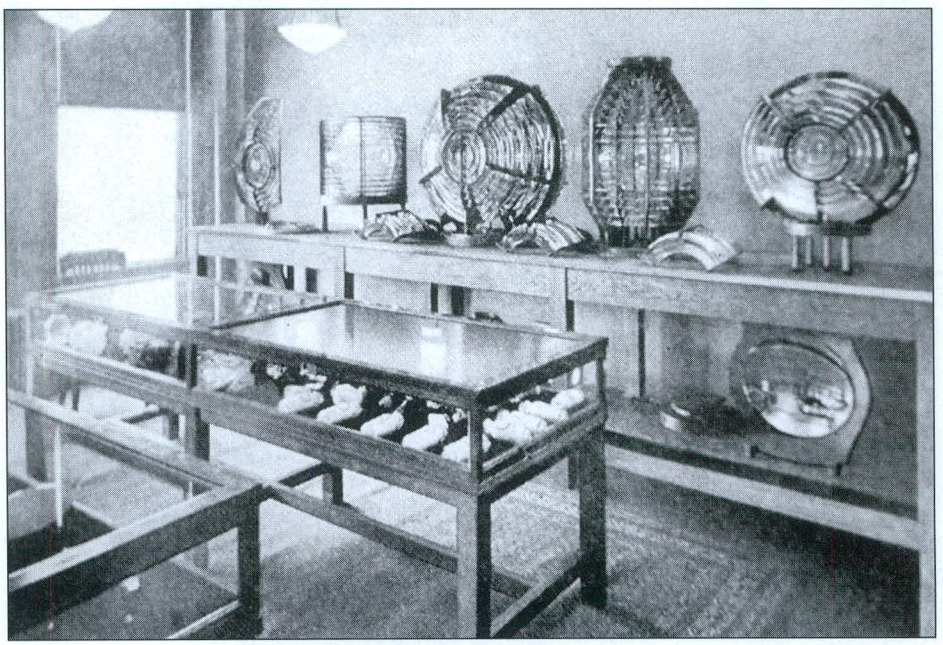
## Views of the Bureau of Lighthouses

Lighthouse Service Bulletin No. 17 from May 1913 states:

> "Until recently it has been necessary to procure all the cut-glass lenses used in the Lighthouse Service from either France, England, or Germany, most of them coming from France. The making of a lighthouse lens has hitherto been largely a matter of manual labor, and, as labor abroad is cheaper than in this country, the American manufacturers have declined to compete with foreign makers.
>
> "Recently the matter has been taken up with an American firm of glass manufacturers with the idea of ascertaining if a better lens could not be made in this country than abroad by using some modern manufacturing methods. The first lenses made were 187.5 mm. radius, or what is known as the fifth-order, and they were so successfully made that there are now being manufactured a number of fourth-order fixed and flashing lenses. The first one of the last lot has been delivered to the general depot and when tested was found to be superior to foreign lenses and can be made for the same cost or less than those furnished from abroad. The glass is hard, white, and brilliant and will keep its polish much longer than the soft glass previously used. The prisms are regular, sharp, and fit close into the frames, and the frames are designed to give maximum strength and rigidity with least obstruction of light.
>
> "The essential feature of the American method of manufacture is that the prisms are formed by machines instead of by hand. Every part is made to fit an accurate template or jig so that they are true to size and pairs of the same number are completely interchangeable.
>
> "It is hoped in a short time that the American factory will be equipped to furnish all lenses except those of large size, where the demand is so small as not to warrant the large equipment cost necessary."

An internal letter of the Bureau of Lighthouses dated June 26, 1913 and signed by Mr. Bowerman, Chief Constructing Engineer, makes the following statement:

> "There are now in the old lamp shop two 4th order range lenses and the parts of other 4th order lenses, made by the Macbeth-Evans Glass Co., of lead glass prisms, cast in iron moulds and ground and polished. They are beautiful specimens of lighthouse lenses and Mr. Haskell claims that they are more correctly cut and set than the soda glass prisms made abroad. I understand that Mr. Macbeth has taken a great interest in these apparatus and has spent considerable sums of money in perfecting them and they have already excited the interests of the old manufacturers abroad. They are made from his pearl glass stock, the index of refraction is about 1.56, according to Mr. Haskell, and the only thing about them in anyway detrimental is the presence of a number of air bubbles about 1/16 diameter scattered through the prisms. I understand that Macbeth has sold the Service lenses at $300 which cost him $800 to make. I think he should be encouraged to go ahead, and if the photometric and other test show them to be equal or superior to the foreign article, it is a matter of satisfaction to all concerned."



**The MacBeth showroom.**
**Photo courtesy of the Corning Incorporated Department of Archives and Records Management, Corning, NY**

## End of an Era

Unfortunately by the time Macbeth-Evans developed the capability to produce Fresnel lenses, the major lighthouse construction era had ended and there were few orders. From 1910 to 1932, Macbeth-Evans built a large number of buoy lenses and small quantities of Fresnel lighthouse lenses. Macbeth-Evans also built most, possibly all, of the 4th Order range lenses used along the Panama Canal.

Total Lenses Built: (Does not include those at the Panama Canal)

| Basic Orders | Identified Receiving Locations |
|---|---|
| (8) 4th Order 6 Panel Fixed | (1) Light Vessel No. 94 (1) Miah Maull Light |
| (16) 4th Order 4 Panel Flashing | (1) Light Vessel No. 95 (1) Alki Point Light |
| (3) 4th Order 2 Panel Bivalve | (1) Slip Point Light |

Current Lens Locations:

| Type | Current Location |
|---|---|
| 6 Panel Fixed | White Pine Village Museum, Michigan |
| 6 Panel Fixed | Charlotte-Genesee Lighthouse Museum, New York |
| 4 Panel Flashing | Calvert Marine Museum, Maryland |
| 4 Panel Flashing | Shore Village Museum, Maine |
| 2 Panel Bivalve | U. S. C. G. National Aids to Navigation School, Virginia |

Unfortunately, optical lens manufacture was never a significant part of Macbeth-Evans business. However, they were very proud of being the only U. S. manufacturer with these capabilities and the government was very happy that importation was no longer required except for lenses of the 1st through 3rd Orders.

At the end of 1936, Macbeth-Evans Glass Company merged with the Corning Glass Company and, in 1938, the Elwood plant was closed and sold.

## Lens Work by the Tompkinsville Lighthouse Depot and Others

375 mm. Pressed-glass Buoy Lenses

In Lighthouse Service Bulletin No. 60, from December 1916 it was reported:

> "Experiments have been carried on for some time at the general lighthouse depot, Tompkinsville, NY with a view to the manufacture of 375 mm. pressed-glass buoy lenses for use in place of the present expensive cut-glass lenses. The third inspector now reports that pressed-glass lenses, which from practical tests both with the naked eye and with the photometer have proven of equal efficiency to the cut-glass lenses, can be made for about $150 each, a saving of $250 over the cost of the cut-glass lenses. The pressed-glass lenses will be adopted for use in all 375 mm. lanterns purchased hereafter."

The Tompkinsville Depot also constructed some Fresnel lenses on site. It is not known which glass manufacturer supplied the glass for these lenses or if they were simply constructed from parts of other lenses. The style of the lens elements suggests that they were not made by Macbeth-Evans and most probably came from a European firm.

Other glass companies produced Buoy lenses or lens parts for the Bureau of Lighthouses as follows:

- Corning Glass: 200 mm. Pressed, 300 mm. Pressed, 375 mm. Pressed
- McKee Glass: 200 mm. Pressed
- AGA: 200 mm. Pressed
- Lovell-Dressel Co.: Lens frames and lens assembly

After 1932, there is no indication of additional lens orders for anything other than buoy lenses, although a few repair panels for lighthouse lenses may have been purchased. Thus, the era of American lens manufacture ended, and, by the 1960s, lens manufacturing around the world was also severely curtailed. Today, cut-glass Fresnel lenses are, for the most part, a museum curiosity.

## Products:

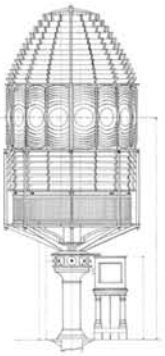
150 mm. Cut Glass Buoy Lenses
200 mm. Pressed Glass Buoy Lenses
300 mm. (150 mm. Focal Length) 6th Order, 3 or 4 Panel, Fixed Pressed Glass Buoy Lens, Ground on Inside
187.5 mm. 5th Order Range Lens
250 mm. 4th Order Range Lens
250 mm. 4th Order Bivalve Lens - 4 Segment
250 mm. 4th Order Bivalve Lens - 5 Segment
250 mm. 4th Order 6 Panel Fixed Lens
250 mm. 4th Order 4 Panel Flashing Lens
187.5 mm. 5th Order 3 Panel Fixed Lightship Lens
Margin Mirror Reflectors 225 mm. Radius Spherical Silvered Mirrors with 60°, 90°, 120° Sectors
250 mm. 4th Order Dioptric Cylindric Lens
187.5 mm. 5th Order Flashing Lens (Not Shipped)
Red-Orange Glass Panels

## Acknowledgments:

In writing almost any story, a great many sources are researched and many individuals and organizations contribute to the success of a project. That was surely the case in developing this story. I wish to thank the following for each of their contributions:

White Pine Village Museum, Mason County Historical Society, Michigan
Marion Indiana Public Library
United States Lighthouse Society - Wayne Wheeler
Elwood Indiana Public Library
The Calvert Marine Museum - Richard J. Dodds
Corning Incorporated, Department of Archives and Records Management - Michelle Coffon
The Corning Museum of Glass - Rakow Library - Virginia Wright and others
Charlotte-Genesee Lighthouse Historical Society - William T. Davis
Shore Village Museum - Ken Black
The Nautical Research Centre' - Colin MacKenzie
U. S. Coast Guard Historian
U. S. Coast Guard National Aids to Navigation School - Yorktown, Virginia
The National Archives

# Join the U.S. Lighthouse Society Today or Give the Gift of Membership!



## *Restoration & Preservation*

*Thomas Point Shoal Lighthouse, MD*

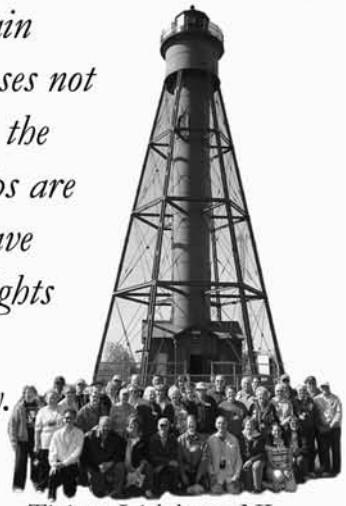
*The U.S. Lighthouse Society has donated to many lighthouse preservation projects throughout the U.S. Most recently we were honored by being presented with the Preserve America Stewardship Award from The White House for our restoration work at Thomas Point Shoal Lighthouse.*

## Help Support Our Important Mission!

## *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.*



*Tinicum Lighthouse, NJ*

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