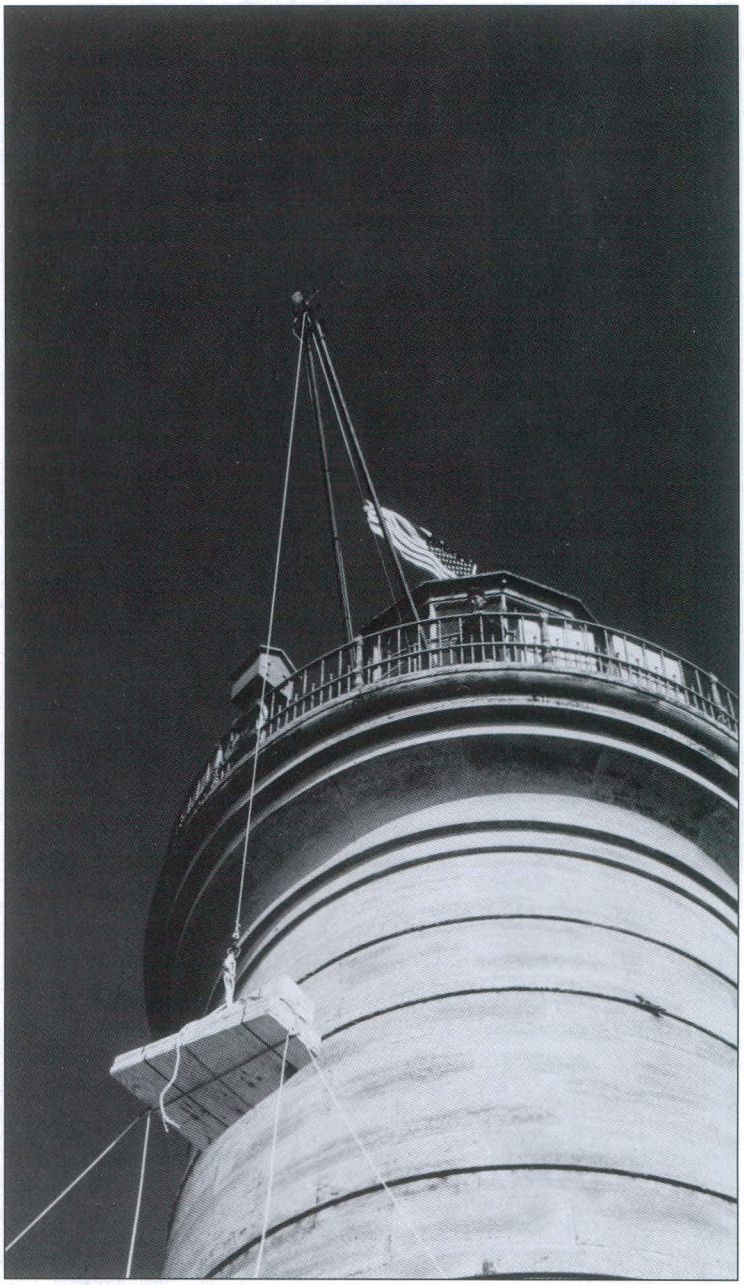
Lens Removal

by Mike Van Hoey



Right— A crated section of lens being lowered from the Spectacle Reef lighthouse lantern. Photo by Mike Van Hoey.

Late in the autumn of 1829, a small but important light began to glimmer over the waters at the eastern entry to the Straits of Mackinac. Sitting atop a lighthouse erected on Bois Blanc Island by Cleveland contractor Philo Scovill, it was the first of many lights built by the U.S. government to safely guide mariners through the treacherous straits.

Whale oil fueled the reflector lamps in that first light. Each night the keeper, Eber Ward, climbed the sixty-five-foot tower and lit thirteen separate lamps; each had its own fourteen-inch parabolic reflector. This catoptric (reflecting) system, known in the United States as the Winslow Lewis patent system, was used in all government lights until the 1850s. It was not without its drawbacks. The reflectors were easily bent, and the silver on their surfaces came off with frequent polishing. Whale oil, shipped to the lakes through the Erie Canal and distributed under contract, was a costly fuel.

In 1822, Augustin Fresnel, a French physicist, had developed the dioptric (refracting) system for use by the French Commission of Lights. This system surrounded a single flame with ground and polished glass. It bent or refracted essentially all the useful light and focused it toward the horizon, where it was of most use to mariners. The Fresnel system was not adopted by the United States until 1852, when the newly formed Lighthouse Board mandated that all lighthouses using the old reflector lamps be refitted with Fresnel lenses.

The Fresnel lens offered obvious savings in fuel since a single lamp could light the whole horizon. Moreover, the Fresnel lens could easily exhibit different characteristics—fixed, flashing or fixed varied by flashes—that allowed a mariner to easily determine which light he was observing. The lens was available in several different sizes. The largest, or first order, was used on the ocean coasts to mark major landfalls. It was approx-

imately six feet in diameter and over eight feet tall. The smallest, or sixth order, was just under a foot in diameter and less than sixteen inches high. The first Fresnel lens used in the Great Lakes was a fourth-order installed in 1851 at the Waugoshance Lighthouse at the western end of the straits.

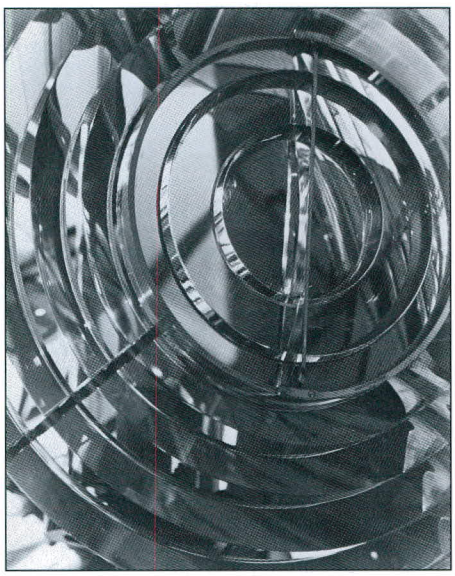
Fuel remained a problem. By the mid-1850s the cost of whale oil exceeded $2.00 a gallon. The Lighthouse Board began experimenting with alternate fuels, mostly vegetable oils such as rapeseed and colza. The fuel finally adopted was lard oil, which was inexpensive and readily available. It was in regular use by the late 1860s. By the 1880s kerosene was in extensive use. First burned in wick lamps, after the turn of the century it was used in more intense incandescent oil vapor lamps.

The development of acetylene in the early 1920s marked the beginning of the end for the lighthouse keepers. The flow of acetylene to a lamp could be regulated by a "sun-valve" that essentially turned the light on and off when required. More advanced acetylene burners automatically varied the size of the flame to create different characteristics. Two lights in the straits, St. Helena Island and Bois Blanc Island, became "unwatched" in 1923 and 1924 respectively.

Electricity powered the major offshore lights in the straits by the early 1930s. With a generator at each individual station, these lights remained manned well into the 1960s and 1970s. In the mid-seventies the United States Coast Guard (USCG) began building redundancy into these lights. Dual generators, dual lights, dual fog signals and multiple lamp changers could all be radio-monitored and controlled by a central control at St. Ignace. When a piece of equipment failed, its backup functioned until a crew was dispatched to correct the problem. Routine preventative maintenance included changing the lamps regularly and overhauling the generators. Diesel fuel tanks were kept full, and the automated stations ran themselves. A single crew based in St. Ignace cared for Detour, Martin Reef, Poe Reef, 14 Foot Shoal, Spectacle Reef, White Shoal, Gray's Reef and Lansing Shoal. Batteries powered the lights at Skilligallee, St. Helena Island and Bois Blanc Island.

Advances in technology brought further automation in the early 1980s; solarization. At solarized lights, a solar panel charges a bank of long-life batteries by day. At night the batteries power a small lamp with an acrylic lens. The lens, though made of plastic, is a precision optic that uses Fresnel's principles. Where necessary, these lights can be fitted with flash panels and rotated by small electric motors. In most cases the effective range or distance from which the light can be seen is the same or greater than with previous systems.

The simple solar packages reduce the environmental hazards of storing fuel and refueling offshore structures and offer the advantage of standardized parts. Unfortunately, they also spell the end of the classical brass and glass Fresnel lens.



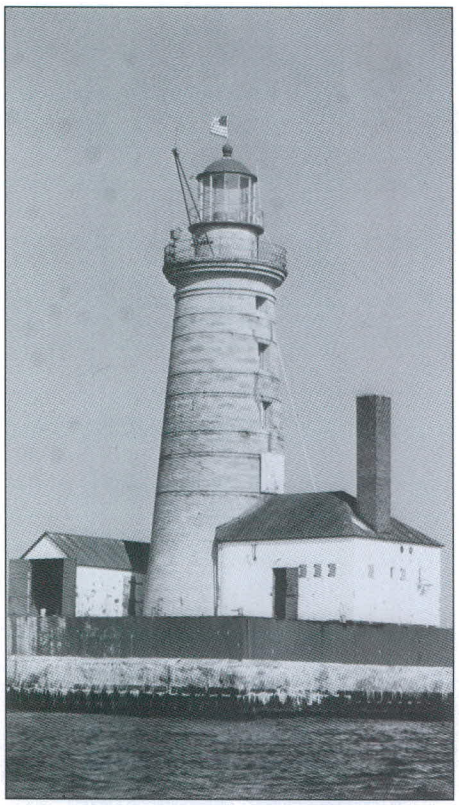
Early in 1982, the Great Lakes Historical Society (GLHS) in Vermilion, Ohio, learned that the second-order Fresnel lens at Spectacle Reef would be removed and replaced with a solar-powered light. Realizing the importance of such an artifact, the society requested that the lens be loaned to the museum. Officials in Washington approved the request with the provision that the society pay the cost of removing and transporting the lens to the museum in Vermilion. The society's board appropriated $1,800 for purchasing tools and materials required for the project.

Jim Woodward and Tom Meakin, both GLHS members who live in Cleveland, volunteered to carry out the project. After a midsummer inspection of the lighthouse, the two men built a crane to raise and lower materials seventy feet from the crib deck to the lantern room above. They cut lumber for packing crates and assembled it in marked bundles. They checked and rechecked lists of tools and made countless trips to the local hardware supply for clevises, slings, winches, line, straps and every other imaginable type of rigging equipment. Once on the light station, ten miles from land, they would have to make do with what they brought with them.

I first learned of their project at the Days of the Ships Festival in Cleveland that summer. It took a few weeks, but I finally convinced the pair that I could make a valuable contribution to the project as a photographer. Since I lived so far from Cleveland, there was little to do but wait. Arrangements had been made with the USCG to transport us and our equipment to and from the light. Fall is a busy time for the Aids to Navigation crew at St. Ignace, but 2 October was finally set as the departure date.

The lens at Spectacle Reef was manufactured in Paris by Henry LePaute, one of three major French lens manufacturers. The lens itself is five feet in diameter and nearly seven feet tall. It comprises sixteen brass-framed sections of prismatic glass. The glass prisms were cast in iron molds and carefully ground and polished to refract and reflect the light at the proper angle. They were then set in the brass frames with a compound called litharge. Small assembly numbers stamped in the corners of the frames assured their proper placement when they were assembled at their destination.

The Spectacle Reef light alternated red and white flashes. This was accomplished by attaching panels of ruby glass over every other bulls-eye panel and over the upper and lower sections of the lens. A clockwork mechanism rotated the lens to create a thirty-second interval between flashes. The keeper wound up a weight every four hours to keep the lens turning on the eight chariot wheels that



Above—Spectacle Reef Lighthouse in northern Lake Huron displays an alternating red and white flashing light 85 feet above the water. The building at left is the boat house, at right the generator and fog signal building. Right—The partially disassembled 2nd Order Fresnel lens. Photos by Mike Van Hoey.

supported it. After automation, the lens was turned by an electric motor.

The pedestal that supported the lens and housed the rotating apparatus was made of eight-foot-tall cast-iron pieces, making the overall assembly more than fifteen feet high. The challenge was to dismantle the entire lens and pedestal, package the fragile pieces and lower all of the parts from the lantern room to the crib deck.

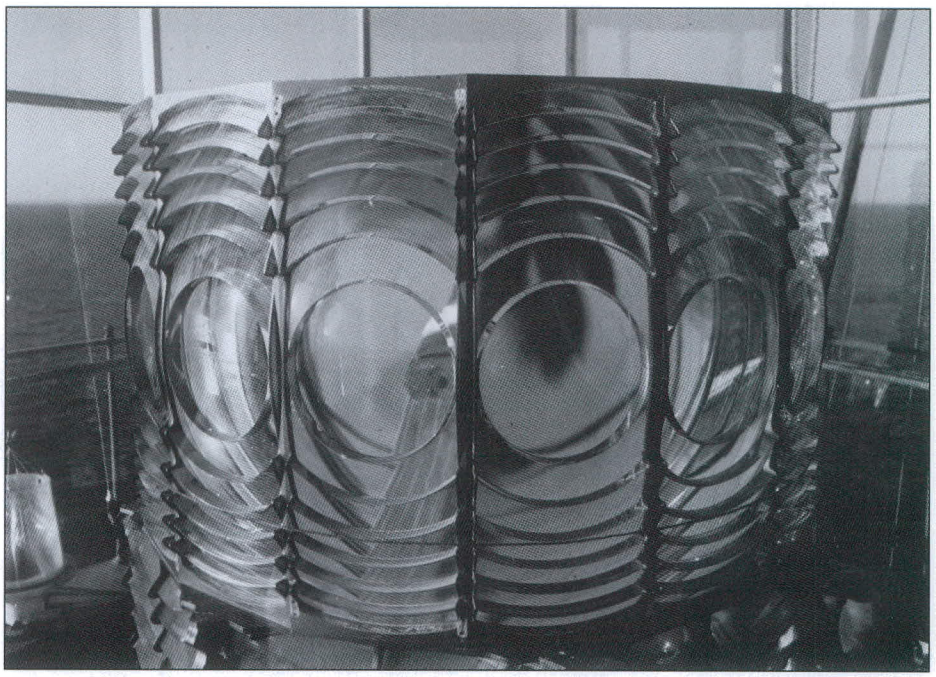
I met Tom and Jim at a rest stop along I-275 at 3:30 A.M. on 2 October. Tom's van and a U-Haul trailer were full of equipment. On top of the van were the two twenty-foot pipes that would form the legs of the crane. After a final stop at a hardware store in Mackinaw City, we crossed the bridge and arrived at the St. Ignace Station.

It took an hour and a half to transfer the equipment to the boat and secure it. A brisk autumn wind had stirred up six-foot waves, and the trip to Spectacle Reef took nearly three hours.

One of the reasons the lighthouse was being solarized was that its generator was unreliable. I began to appreciate Tom's mechanical abilities when he jerry-rigged the equipment to provide us with electricity. I ran temporary wiring to provide lights and heat for the meals planned by Jim's wife, Anita. Then we slept.

In the days that followed, we alternated handling galley chores and housekeeping. During our meals we discussed our progress and planned the next few hours of work. Unexpected problems called for a coffee break, time to pool our individual talents.

Most of the preplanning worked well. We started by videotaping the lens's final rotation in the tower that has been its home for 109 years. Once we had hoisted the individual pieces of the crane to the lantern gallery and assembled it, we set to work, alternating the loads coming up with those coming down. Each one-way trip took nearly ten minutes.



As we carefully loosened screws that had not been turned in over a century, the brass and glass pieces were easily dismantled. First came the ruby colored panels, then the upper belt, the bulls-eyes and the lower belt. The unusual shapes of some of the sections became apparent only after the pieces had been removed, and we had to recut much of the lumber for the crates. We carefully packed each panel with styrofoam and numbered the crates to identify their contents.

The pedestal, however, was not so easily taken apart. The lens sat upon a large cast-iron circular table called a platen. The platen, seven feet in diameter, fit on a shaft of iron, and the whole assembly rotated on chariot wheels. The platen refused to separate from the shaft, perhaps held only by a century of habit. Unassembled, the pieces were too large to be moved to the gallery to be lowered. We sat up until 1:30 A.M. discussing alternatives. The lantern room windows could be removed, but the risk of breakage was far too high. Moreover, we did not have enough rigging to lift the platen and shaft and swing them to the lower gallery. The frame of the lantern room door could be removed, but the opening would still be too small.

Discouraged, Jim and I headed for our sleeping bags. But Tom went back to the lantern room. We fell asleep to the sound of steel tools systematically beating against the old cast iron.

Suddenly, we awakened to a mighty crash. Tom had separated the parts by using a large quantity of penetrating oil and placing them in tension using a come-a-long and a hydraulic jack. Responding to Tom's repeated tapping with a large ball-peen hammer, the platen finally separated from the shaft, tipping slightly. The crash was the sound of an open

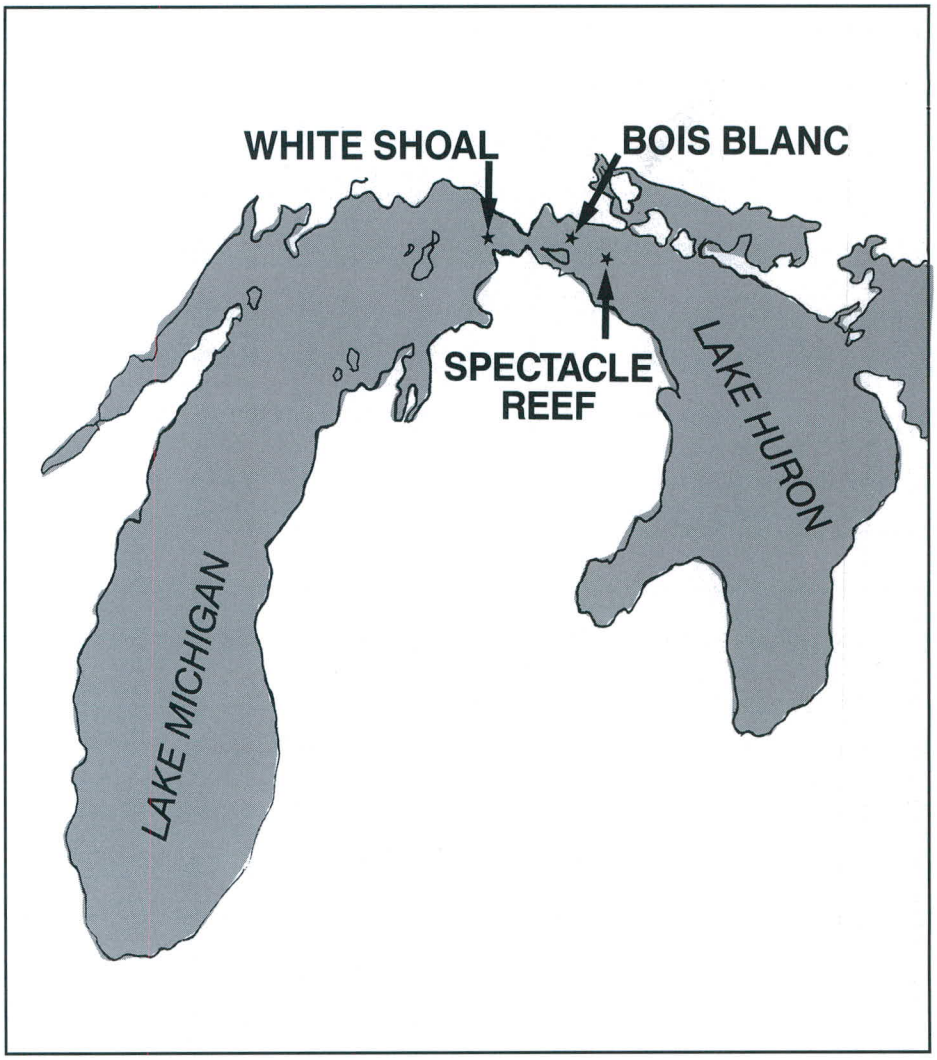
tool box, which had been sitting on the platen, hitting the lantern room's iron floor.

With this hurdle overcome, we agreed to sleep in and clean up the mess in the morning. That day a crew from USCG Base Soo joined us and began removing other parts of the station that would not be needed once the light was solarized. Our work for the day was to lower the platen to the lantern-room floor and roll it out onto the gallery. The other iron parts were placed on the gallery in order of size so that the heaviest, the platen, would be the last lowered to the crib. During this process our next problem appeared.

Our old drawing of the lens was not terribly clear. It seemed to indicate that the base of the pedestal was in two pieces. It was not. There seemed no way to remove it short of cutting it in half. The Coast Guard crew's acetylene torch was ineffective because the old cast iron dispersed the heat too quickly. Then we thought of the obvious. A few quick measurements confirmed that the base could be taken down the spiral stairs that connect the seven stories of the tower. Tom rigged some line, and after dinner we enlisted the help of the Coast Guard and began to lower the base. The greatest effort was expended in pulling upwards to keep the base from crashing down the staircase.

We were to be picked up by the *Buckthorn*, the Sault Ste. Marie buoy tender used in the St. Marys River. Due to her shallow draft and the rough weather, she was to pick us up on Friday at first light. On Thursday we lowered the rest of the lens parts, crated up miscellaneous small parts and dismantled and lowered our crane. We also lent the Coast Guard a hand as they removed the electronic gear, fog signals, fuel tanks and the old generator. We thought we would have time to round up our personal gear on Friday morning, so we set a leisurely pace for most of the day.

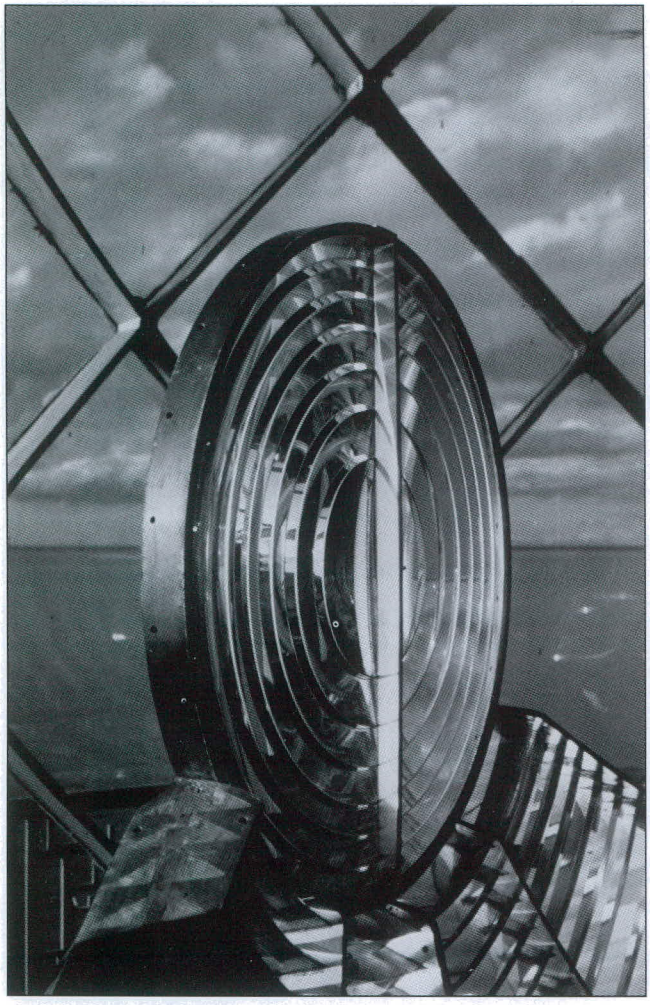
Just as we were preparing to get some sleep, the radio crackled to life. Weather conditions were deteriorating, and the *Buckthorn* was underway. It would arrive around midnight. With only flashlights we began in the lantern room and worked our way down, packing personal gear, tools and galley supplies.

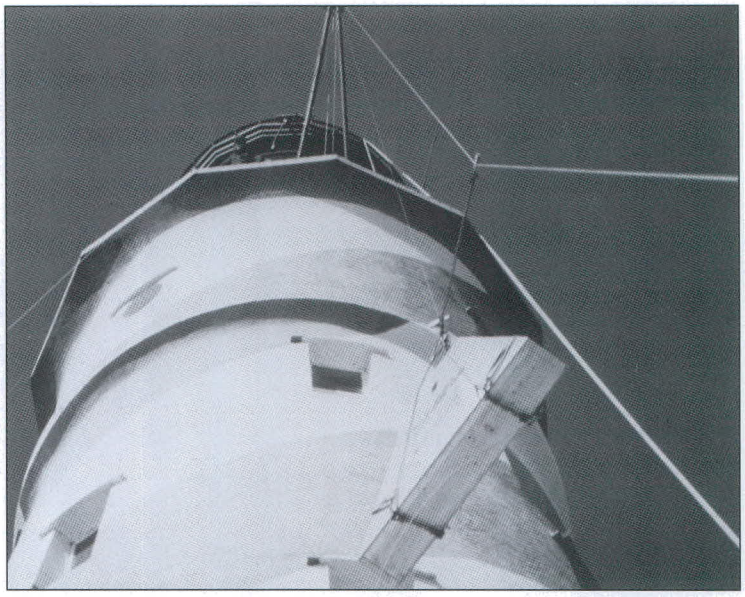


The cutter arrived at 12:30 A.M., bathing the lighthouse and crib in floodlights. First we loaded the lens onto the buoy tender. Then we loaded all of the equipment removed by the Coast Guard team. By the time we were underway for DeTour VIllage, it was 4:00 A.M. There, we unloaded our equipment and the crates containing the brass and glass panels. The ironwork would be taken to Base Soo and shipped by lake freighter to Cleveland. The Coast Guard had driven our truck from St. Ignace to meet us. When we reached St. Ignace, Chief Pat Henry offered welcome showers and a brief rest before we headed for home.

The project had taken a week, and we had become a team. The next year, 1983, we turned our attention to the lighthouse on White Shoal. It, too, was to be solarized. White Shoal's second-order lens is quite different in design from the one at Spectacle Reef. Called a "bivalve" lens, it looks like a clam. Two opposing bulls-eye panels, over nine feet in diameter, make up the optic portion. The manufacturer—Barbier, Benard, and Turenne of France—began providing lenses for the U.S. Lighthouse Service in the 1860s and is still in business.

The rotating assembly for the White Shoal lens rested on a float suspended in a large circular iron bowl containing mercury. Four hundred pounds of dense liquid mercury provided a near frictionless bearing in which the lens could easily turn. Keepers wound a clockwork mechanism every two hours to keep the lens turning at a speed that produced a flash every eight seconds.



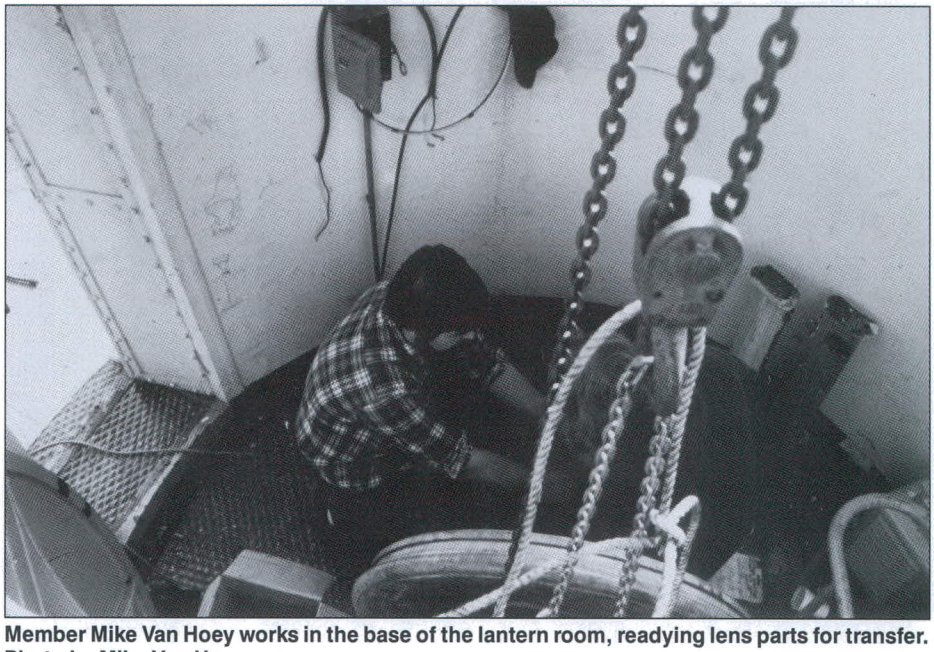




Above—the partially disassembled 'bi-valve' lens of White Shoal lighthouse. Above right—a section of the 2nd order Fresnel bi-valve lens being lowered to the deck of the lighthouse. Right—Keeper Jim Woodward works to remove a section of the huge optic. Photos by Mike Van Hoey.

Our crew, now known as Ohio City Engineering & Drayage Co., Ltd., with a new member, Bob Lieblein, began to remove the lens on 10 September. The USCG buoy tender *Mesquite* took Bob, Tom and the tools from Charlevoix to White Shoal. The men of the Aids to Navigation Team at St. Ignace used a smaller boat to take Jim and me to the station.

White Shoal's crib is much smaller than the one at Spectacle Reef, and its tower has a gallery around the first level. To adjust the crane to these new circumstances, we attached a separate cable to a corner of the crib and used a pulley on it to pull each load clear of the gallery. An additional winch on the crane adjusted the new cable. A light installed outside the tower allowed us to work after dark.



Member Mike Van Hoey works in the base of the lantern room, readying lens parts for transfer. Photo by Mike Van Hoey.

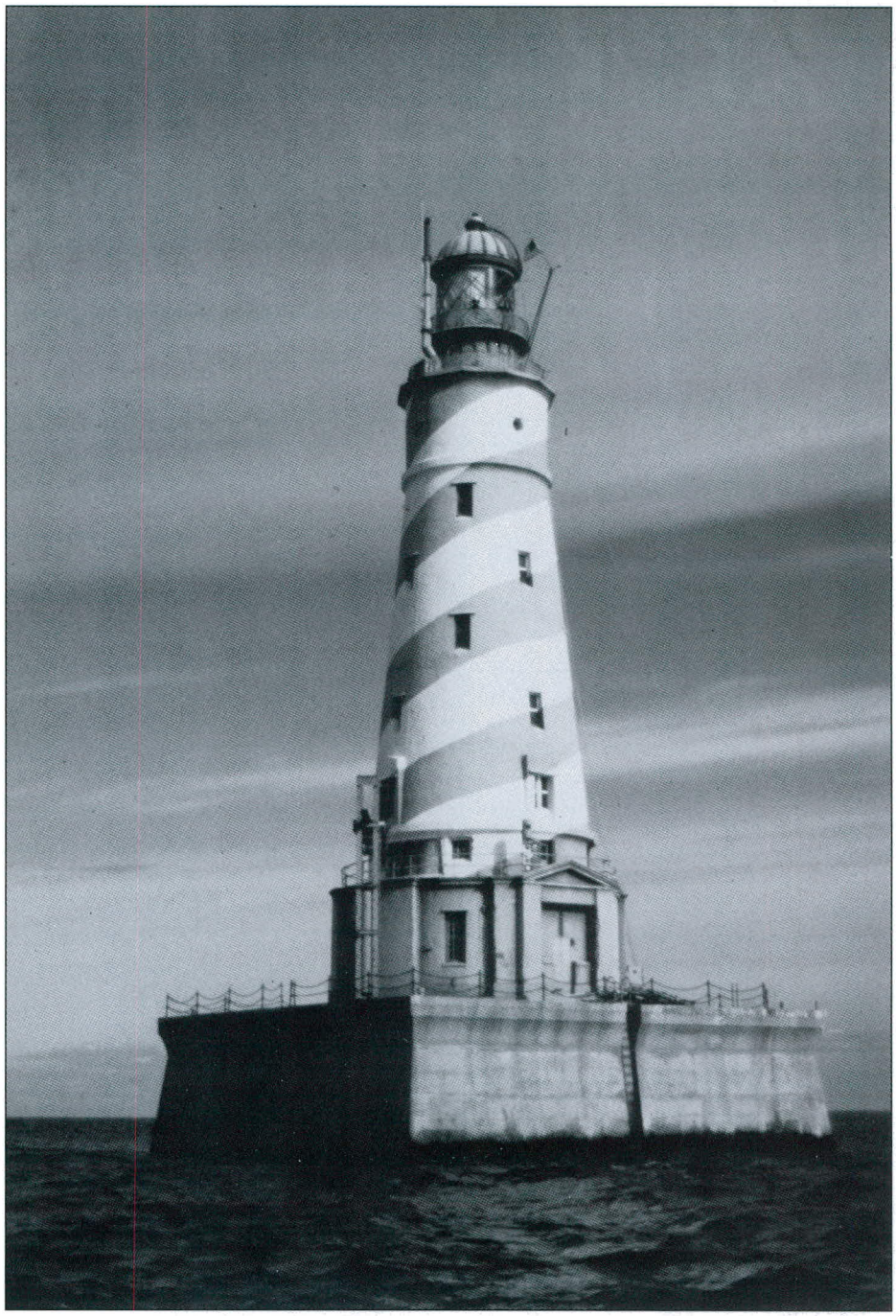
We brought with us full lengths of lumber for the crates and cut them to size as necesssary. The bivalve lens had only fourteen sections, but they were of much greater size and weight than those at Spectacle Reef, so the crates were larger and more difficult to manage. As the first segment of the lens was removed, we discovered that the gallery was too small for the crates to lie flat. We had to stand them on end, with the top open, and lower the pieces directly into them, much as one places a letter in an envelope. High winds that made it impossible to lower the fragile lens segments delayed the project for nearly two days.

The Mercury float mechanism also presented special problems. It was more sensititve to loading than the chariot wheels had been. We had to remove the lens segments symmetrically to maintain the balance required to freely rotate the platen. Moreover, mercury is a hazardous substance. We carefully drained it into tightly capped tubes that were disposed of by the USCG.

Once again, one piece was too large to fit through the gallery door. This time, we had to sever the part by drilling a sequence of small holes and breaking the cast iron at the perforation. Fortunately the break will not be visible when the lens is displayed.

We had hoped to remove the lens from the site and bring it ashore aboard the ice breaker *Biscayne Bay*. But ice from the previous winter had rearranged the rocks around the crib so that a large vessel could not land broadside. (All of the equipment landed by the *Mesquite* had been passed over the bow.) Since the weather was bad and no lighter vessel could carry the larger iron pieces, we decided to store the lens and pedestal at the light for the winter. The following spring, the shallow draft *Buckthorn* brought the lens ashore.

Removal of the beautiful Fresnel lenses is always controversial. Purists argue that they should remain in their original homes. But as long as technology continues to change and improve aids to navigation, the new will replace the old. Careful removal of the lenses, with the cooperation of the USCG, ensures their preservation for the future.

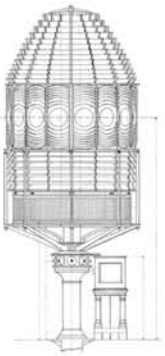


White Shoal, constructed in 1910, displays a light 125 feet above the water. White Shoal, now automated, welcomes ships into Lake Michigan.

By the summer of 1987, the White Shoal lens is to be a major exhibit prepared by the Great Lakes Shipwreck Historical Society at the Whitefish Point Light Station in Michigan's Upper Peninsula. A smaller lens, removed from Lansing Shoal in 1985, will be exhibited in the new Michigan Historical Museum in Lansing. The Spectacle Reef lens is now displayed without its pedestal at the GLHS museum in Vermilion. That museum plans to create a complete exhibit, with the lens lit and rotating just as it did for over a century in Lake Huron.

The author, Mike Hoey, is a lighthouse historian and our District Superintendent for the Great Lakes. He is also President of Lighthouse Properties, a non-profit research and technical organization.

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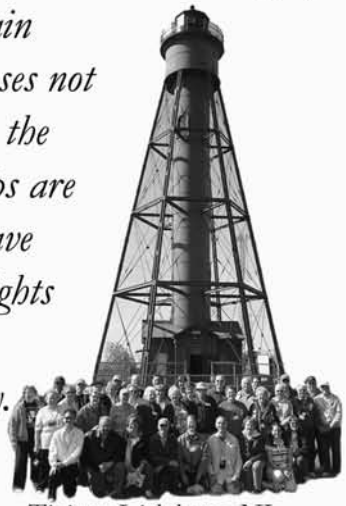
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