

Introduction:
Ice and Ice Breaking



When the Toledo, Ann Arbor and North Michigan Railroad first announced its intention to ferry railcars across Lake Michigan there were two major obstacles cited by those who felt the idea was unworkable. First, it was not possible to secure railcars so they would not roll back and forth or tip over in a storm, and, second, it was not possible to consistently cross Lake Michigan in winter. The railroad solved the first problem very quickly, but the second—crossing the lake during winter storms and entering harbors filled with ice—took a while longer. Indeed, it could be argued that it was never “solved.” Eighty-five years after the line began operations a car ferry was denied entrance to Frankfort Harbor for nine days due to ice. To fully understand what the boats and their crews were up against it is helpful to have some knowledge of ice in its various forms, as well as how the boats broke ice, how they became stuck, and how they broke each other out.

The freshwater ice of the Great Lakes is dense and very difficult to break up—much more so than sea ice. Sea ice contains salt, which depresses the freezing point and lessens the density. Over time, as the ice remains frozen, the salt leaches out and the ice becomes more dense. It takes sea ice a year or more to become as dense as freshwater ice.¹

Depending on who is doing the categorizing, there are anywhere from a few to twenty or thirty different forms of ice. There is some over-

lapping of definitions, and it is unlikely that any two captains will identify all forms the same way. The same is true for institutions such as the U.S. Coast Guard, the Canadian Coast Guard, and the National Weather Snow and Ice Institute. The U.S. Coast Guard and the Canadian Coast Guard have adopted definitions that do not closely relate to the terminology the car ferry captains used throughout most of their service. Since our interest is in car ferry history, we will follow the definitions that were commonly used by car ferry captains even though they may not fit some current definitions. Fortunately, we only need to be familiar with a few forms of ice to appreciate the challenges the car ferries faced and the stories of how they met those challenges over the years.

Sheet ice is formed when the water is very calm; it skims over and then gets thicker and thicker, depending on how long the temperature stays below freezing. Sheet ice can be anywhere from a fraction of an inch to several feet thick. The early car ferries, such as the *Ann Arbor No. 1*, *No. 2*, *No. 3*, and *No. 4*—those built through 1906—could plow through sheet ice about one and a half feet thick without having to stop. That was considered very good for the time. Later boats, such as the *Ann Arbor No. 5*, *No. 6*, *No. 7*, and the *Wabash*—those built through 1927—could plow through about three feet of sheet ice without having to stop.² The Ann Arbor's best icebreaker was the *Viking*, the 1965 rebuild of the *Ann Arbor No. 7*. When she was rebuilt, she was given a diesel-electric power system that produced 6,120 horsepower—over twice that of the *No. 5*, previously considered the best icebreaker in the fleet. The *Viking* was capable of forcing her way through four feet of sheet ice without having to stop. Variations of sheet ice include *ice floes*, which are made up of sheet ice that is not attached to something, such as the shore, and *ice fields*, which are made up of sheet ice that is attached to the shore.

Many newspaper articles in the 1890s referred to *blue ice* of various thicknesses. They were referring to sheet ice that was nearly transparent, made up of ice crystals very closely packed together with few impurities. Blue ice is very dense and difficult to break through compared to *white ice*, which is usually older and contains large quantities of air.

Anchor ice is so called because it is attached (anchored) to something such as a pier. Anchor ice often formed around the slips where the boats tied up and was difficult to break up because the normal method of simply ramming into the ice was not possible due to the damage the boat might do to the slips.

Pack ice is much like anchor ice in that it is attached to something, but



Sheet ice on Crystal Lake, an inland lake about three miles north of Frankfort. (*Photo from the author's collection.*)



Anchor ice lines the piers as the *Ann Arbor No. 2* enters Frankfort Harbor in the mid-1890s. (*Photo from the A. C. Frederickson Collection.*)

it forms differently. Ice is piled up against something—a pier, a breakwater, the shore, a harbor entrance—by a prevailing wind and becomes thicker with the passage of time. The ice at the harbor entrance in the following picture is not sheet ice even though it appears to be flat on the surface. It is attached to the two piers, extends to the bottom, and has



Pack Ice at the entrance of Frankfort Harbor. (Photo from the A. C. Frederickson Collection.)

been formed by wind pushing more and more ice into the harbor entrance. Because of the way it was formed, it should be called pack ice.

Windrows are formed when the wind shoves pieces of sheet ice together under pressure. Where there is a crack, the ice breaks into chunks that are forced up and down, forming a “wall,” usually along a relatively straight line. That wall of ice, or windrow, may rise ten to fifteen feet in height and extend even farther below the surface, often to the bottom in water less than twenty-five feet deep. Windrows can be several feet across and extend for miles. Car ferries always had difficulty with windrows and often became stuck trying to break through them. Many times when they were stuck for hours or even days windrows were involved.

Slush ice is defined as “snow which is saturated and mixed with water on land or ice surfaces, or as a viscous floating mass in water after a heavy snowfall”—tiny ice crystals suspended in water.³ Slush ice was often a problem in the basin between the breakwaters of Frankfort Harbor.

The standard method of breaking ice was for a car ferry to plow into it under full power until the ship could go no farther, back off, and try again. There were various recommendations on how far to back, but most car ferry captains liked to back off as far as they could in order to work up more speed before they rammed the ice again. While this was an



Ann Arbor No. 5 opposite a large windrow. (Photo from the A. C. Frederickson Collection.)

acknowledged method, it was (and is) not for everyone. Vessels not designed for some level of ice breaking can suffer serious damage.⁴

Another good method of breaking ice was backing. The backing method used the wash of the propellers to break up the ice and was particularly effective on anchor or pack ice, where ramming into it full speed ahead might damage whatever the ice was attached to. To break ice by backing, both engines were put in reverse to bring the boat close to the ice to be broken up; then one engine was put ahead and one astern to create a circular current, which acted on the ice and tore it up. Sometimes both engines would be put ahead to vary the direction of the current. The boat alternated having both engines in reverse and then one or both engines ahead. An advantage of backing was that a boat was less likely to get stuck due to the fact that it was always clearing space ahead of the stern. There was, however, a disadvantage. Because one engine was often ahead and the other astern, the turning force on the boat tended to swing the bow to one side or the other unless there was sufficient ice pressing against it to keep it in line. In some cases that was not a problem, but at times it could be.

Car ferries became stuck in ice due to surface friction, which resulted when:

1. They plowed into heavy ice, such as pack ice or windrows going all the way to the bottom, and found they could not back off

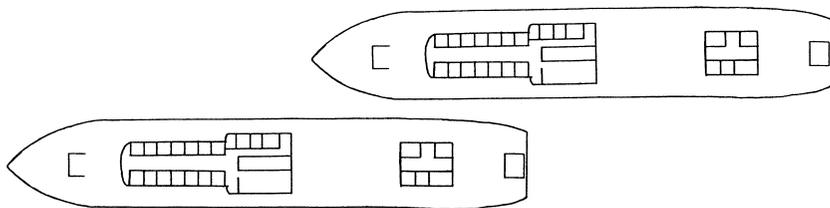


Ann Arbor No. 5 backing in ice on Green Bay. (From the Roger Griner Collection. Photo courtesy of the Marinette Eagle Herald.)

2. They found themselves under pressure from ice pressing against their sides
3. They got caught in slush ice

The boats became stuck while plowing into windrows or pack ice in an effort to break through. They found they had the power to ride up onto the ice but not to back off. The longer they stayed, the more the ice closed in around them. Often they needed the help of another boat to break out.

Pressure exerted by ice is best understood with an example. Picture an ice field extending from the Michigan shore several miles into Lake Michigan. Add to this picture a strong west wind pushing the ice against the beach. The ice is being pushed against the beach, but it is not moving onto the beach and inshore because the beach is pushing back with equal force. Now imagine a car ferry somewhere between the shore and the western extremity of the ice. The ice, pushed by the wind, exerts tremendous pressure on the sides of the ferry, as does the resistance



Car ferries passed very close aboard to break each other out of the ice. (*Drawings from the author's collection.*)

from the shore. Thus, the ice squeezes the ferry from both sides, developing a surface friction that it cannot overcome. The ship will remain stuck until the wind changes, relieving the pressure.

Slush ice presented more of a problem for car ferries than one might expect. It seems logical that a ferry could simply plow through the relatively soft slush ice, but that was not what happened. Instead, the ice stuck to the sides of the ferry, changing its effective shape to one that became very unstreamlined and creating a drag the ferry could not overcome. Slush ice blown into the harbor entrance at Frankfort was particularly difficult on occasions when it extended to the bottom. A boat could plow into the ice, but as it neared the piers the ice beneath it would be compacted, causing the ship to ride up as though there had been solid ice on the bottom. Before long, the ship would become stuck, much as it might if it had run onto a sandbar.

At times when a car ferry got stuck it required the help of another ferry to free itself. The standard method of breaking a boat out was to run alongside the boat that was stuck for its entire length, keeping the boats about ten feet apart. Ten feet seems very close for two ships 360 feet or more in length, but former captains say that unless they were that close the method would not work. Also, they say that the operation was not as dangerous as it sounds because once the pass was started even a foot or two of ice between the boats was enough to keep them apart. The skill was in starting the pass. Over the years, there were some accidents. Log entries such as “Ran into boat 4 near the stern. No damage done” or “Hit boat 3 near the bow” occurred from time to time. The boats were solidly built and could take considerable abuse, though there were times when they required repairs.

A second good method of breaking boats out was backing. A boat could use the circular current created by putting one engine ahead and



Spudding around the *Ann Arbor No. 1* at the entrance to Frankfort Harbor in the early 1900s. (Photo from the A. C. Frederickson Collection.)

one astern near the boat that was stuck to break up the ice around it. This method was effective but not always practical because of the potential to lose control of the bow.

A third method in use from the early days through the 1930s was spudding. Crew members went out on the ice and used spuds (long poles with a wide blade at one end) to create cracks in the ice. In some cases, they used ice saws to remove blocks of ice in an attempt to loosen the ice around the boat. Modern captains say that spudding could not have worked as the forces pressing against the boats were too great. One can easily see the merits of their view, particularly in situations involving boats under pressure from the ice, but, correct or not, the Ann Arbor used the method as late as 1940. Perhaps the best view is that of Arthur Frederickson, an Ann Arbor captain and the author of three excellent books on the company's history, who said, "Sometimes this worked, and others it was necessary to wait for a wind shift."