How Can Disappearances Within the Triangle Be Explained?

Science is a process for finding answers to questions and solving mysteries. This investigation includes three activities leading to a consideration of fact and speculation about the disappearances of planes and ships in the Great Lakes Area. The activities are an example of how scientists work, and they can serve as a practical application of your Earth systems knowledge and skills as well.

Your class should first study the locations of missing craft and personnel in the activity titled, "What is the Great Lakes Triangle?" Like scientists, you should examine the data for trends and indicators; in this case you examine concentrations of the disappearances and speculate on their causes.

The present investigation is actually three activities that are to be performed by different classroom groups simultaneously through cooperative learning. If time permits, all three activities could be done by the entire class. The activities treat the wreck of the *Edmund Fitzgerald* as example of a Great Lakes Triangle tragedy. When all three topics have been considered, there will be a discussion to consider whether the wreck of the *Edmund Fitzgerald* was an accident resulting from natural causes or whether other supernatural or extraterrestrial forces might be at work (as proposed in Berlitz' *The Bermuda Triangle).*

Objectives

Upon completion of this investigation you should be able to:

- Discuss the values of using several data types and sources to solve a science problem.
- Demonstrate how bathymetric charts are used and constructed.
- Demonstrate how weather information is mapped and interpreted.
- Give an example of how scientists use multiple working hypotheses to solve complex problems.

Source

Activity B of OEAGLS EP-17, *The Great Lakes Triangle,* by Rosanne W. Fortner and Daniel W. Jax.

Earth Systems Understandings

This investigation focuses on ESU 3 and 4, with data analysis related to interacting subsystems. ESU 7, careers, is also introduced.

One of the last photographs taken of the *Edmund Fitzgerald*.

Procedure

Your expert group will be assigned to investigate one of the following hypotheses:

1. Great Lakes bulk carrier design could be responsible for the wreck of the *Edmund Fitzgerald*.

2. The severe lake storm was responsible for the wreck of the *Edmund Fitzgerald*.

3. Lake bottom features (either unknown or unavoidable) were responsible for the wreck of the *Edmund Fitzgerald*.

Materials

- Navigational chart of eastern Lake Superior, #14962.
- Cardboard tube 45-55 cm long.
- Dry beans, rice or aquarium gravel.
- Transparencies of outline maps of Lake Superior.
- Transparencies of weather maps.
- Pencil or pen.
- Blank transparency.
- Washable markers.
- Tape.

After your investigations have been completed, your teacher will conduct a class discussion. Findings from all three topics will be brought together. The discussion will help you answer the questions below. It may be helpful to read the questions before you begin work, but do not try to answer them until all the investigations have been completed and reported.

1. Could ship design be responsible for the loss of some vessels?

2. How bad is a severe storm on the Great Lakes in terms of wind speeds, wave heights, duration (how long the storm lasts), and visibility?

3. What kinds of areas in lakes and oceans may be safer when a storm is in progress?

4. How are bathymetric measurements made and interpreted?

5. Is it possible that there are features on lake and ocean bottoms that mariners don't know about?

6. Consider the *Edmund Fitzgerald* as an example of a Great Lakes Triangle disaster. Are there natural forces that could explain the sinking? What are some possible explanations?

7. Considering the storm, the water depth and temperature, and what possibly happened to the *Fitzgerald*, why do you think the bodies of the crewmen were never found?

Hypothesis 1: Great Lakes bulk carrier design could be responsible for the wreck of the Fitzgerald.

Introduction

The *Edmund Fitzgerald* sank in the Great Lakes Triangle area on November 10, 1975. The Coast Guard and the National Transportation Safety Board both decided that the wreck was caused by a hatch cover that let water enter the hold. If you examine the general shape and parts of the *Fitzgerald*, you may be able to point out to your classmates some ways that ship design could have been at least an important factor in the sinking.

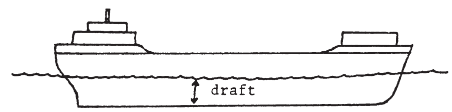


Figure 1. Draft of a vessel.

The ships that carry iron ore (taconite pellets) on the Great Lakes are designed to haul huge loads with very little draft. *Draft* is the depth of water necessary to float a vessel. If a ship "draws" (has a draft of) 30 feet, it can only go in water that is more than 30 feet deep. Because of underwater rocks and the need to go through locks from one lake to another, most lake vessels draw 25 feet or less when fully loaded. This means that a large load must be spread out in a thin layer. If a ship is designed for use on one lake only, it can have a larger draft, because it doesn't have to go through any locks.

A bulk carrier is a ship that carries a large amount of unpackaged material like grain or minerals. Great Lakes bulk carriers are usually about 10 times as long as they are wide. The *Edmund Fitzgerald* was the biggest ore carrier on the lakes when she entered service in 1958. The *Fitzgerald* was 727 feet long, 75 feet wide, and drew (had a draft of) 25 feet of water.

Procedure

Materials

- Cardboard tube at least 45 cm long.
- Tape.
- Dry beans, rice, or aquarium gravel.
- Marking pen.

A scale model is a small version of anything, with all sizes cut down by the same proportion. Architects, car designers, and such make scale models to see how a product is going to look before they invest in the real thing. The model of a 30 x 20 meter house might be 3 x 2 meters, or 30 x 20 centimeters. For each of the model sizes given, the original measurements have both been divided by a certain number.

1. Build a scale model of the *Edmund Fitzgerald* using the dimensions given in paragraph 1 above. Use a cardboard tube that you flatten on one side to form the deck. Draw hatch

covers on the deck and outline the positions of other deck structures.

2. Seal one end of the "hull" with tape and pour beans, rice, or aquarium gravel into the hold until it is about three-fourths full. Seal the open end so that none of the "ore" can get out.

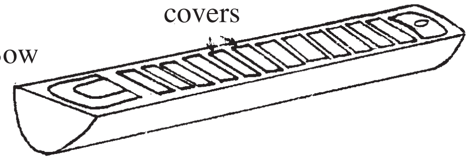


Figure 2. Example of a constructed scale model of an ore carrier.

This simulates the cargo of an ore carrier like the *Fitzgerald*. The hold of the ship is not really a single open chamber. It has dividers or "bulkheads" to separate one section from another. The *Fitzgerald* had three compartments for cargo inside its hold. Ore pellets were loaded through the hatches on deck.

3. Experiment with your model to find the answers to the following questions.

   A. Balance the model on the side of a pencil. What do you have to do to find the balancing point (center of gravity)?

   B. Suppose the ore is loaded and the ship is balanced for its trip across the lake. A storm comes up. Wind and high waves cause the ship to <u>roll</u> (rock from side to side) and <u>pitch</u> (rock from end to end). Which motion, roll or pitch, is more likely to shift the cargo out of balance?

   C. Waves break over the ship one after another. The water from one wave doesn't even clear the deck before more water piles on. How could this affect the ship's balance?

   D. A hatchway caves in or comes unsealed, letting water enter the hold. How could this affect the ship's balance?

   E. A series of waves raises up the stern and rolls under the ship toward the bow. If the cargo shifted strongly toward the bow, what could happen to the ship?

   F. The *Fitzgerald* was 727 feet long. She sank in 530 feet of water. What could happen to the ship if it suddenly took a nosedive to the bottom?

4. Prepare to explain to the class how ship design could be at least partly responsible for the loss of some vessels.

5. Share with the class the meaning of these terms: draft, scale model, hull, bulkheads, center of gravity, pitch, and roll.

Hypothesis 2: The storm was responsible for the wreck of the *Fitzgerald*.

Introduction

Weather conditions on the water can sometimes create freak accidents that appear to be more supernatural than natural. Sightings of "ghost ships," sea monsters, and the like often occur during periods of unusual weather. Natural forces and a good imagination are probably responsible for many of the unexplained phenomena of the Great Lakes and Bermuda Triangles.

The mariners of the world's oceans and the Great Lakes are always watchful of the weather. Their lives depend on how prepared they are for conditions on the water. Regardless of their preparedness, however, accidents happen. A storm may build up far more strength than weather predictions forecast, and the tremendous force of a raging sea may be more than a ship can take. Such an accident occurred on November 10, 1975, with the sinking of the ore freighter *Edmund Fitzgerald*.

Procedure

Every six hours, at 1 P.M. and 7 P.M. and 1 A.M. and 7 A.M. Eastern Standard Time, observers all over the world report weather conditions at their location. Wind speed and direction are noted. Precipitation for the previous six hours is measured. Temperature, visibility and any other weather conditions are also recorded. The information is then put into an international code, sent to collection centers within each country and exchanged internationally. In this country, the information is collected and analyzed by the U.S. Weather Bureau.

At the centers receiving the coded weather information, weather maps are prepared. The messages are decoded, and the conditions reported are translated into figures and symbols. These are grouped around a small circle drawn on a map at the position of the station reporting the information. The circle on the map, with the figures and symbols describing the weather conditions at that location, is called a station model. The method of construction of a station model and an interpretation of its information are shown in Figures 3 - 5.

Materials

- Transparencies of Lake Superior.
- Wax pencils or washable markers.
- Overhead projector.

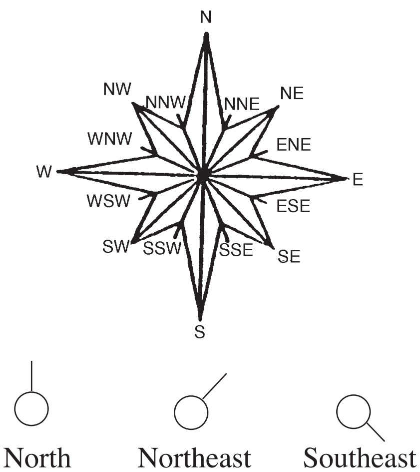


Figure 3. Method for showing wind direction. Circle is placed at location of station, and bar points to where wind is coming from.

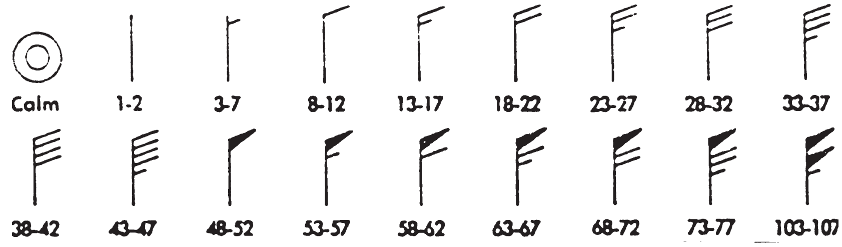


Figure 4. Symbols used to indicate wind speed (in knots).

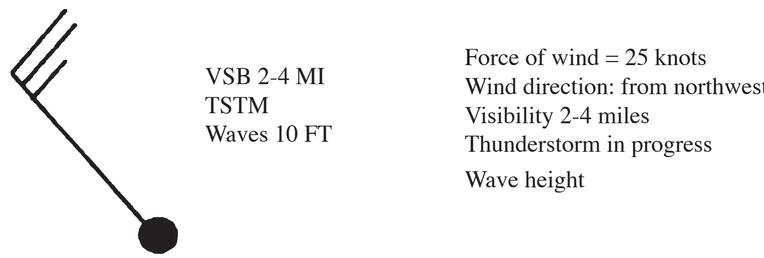


Figure 5. Interpretation of a Station Model.

You are to examine and report data (information) on weather conditions during the storm that caused the *Fitzgerald's* sinking.

Figures 6 and 7 show the weather data for 1 A.M. and 7 A.M. (Eastern Standard Time) on November 10, 1975. The abbreviations used stand for ships that reported in as weather stations. This information was taken from the actual transcripts of hearings following the sinking of the *Fitzgerald*. Look carefully at Figures 6 and 7. Notice how the low pressure center is moving and where the *Fitzgerald* (FTZ) is at each time.

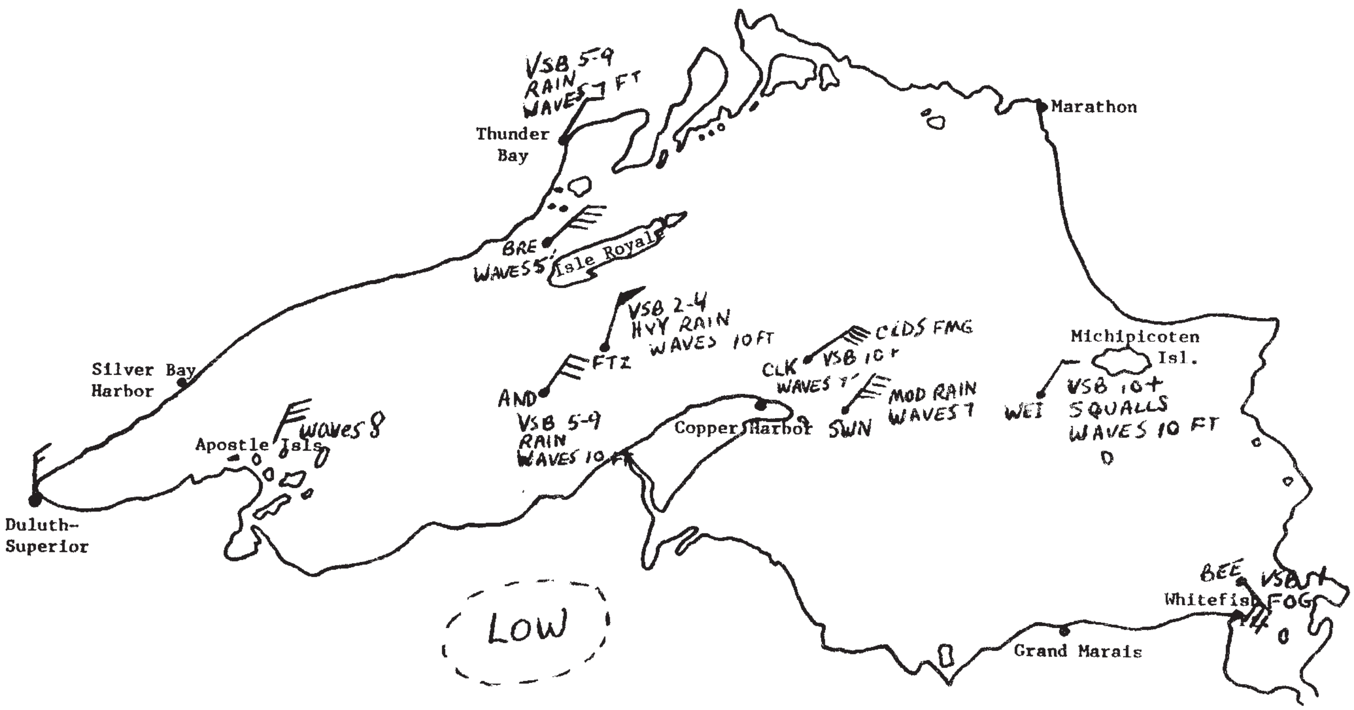
Divide your group in half. Each subgroup gets one transparency of Lake Superior (Map 3 or 4) and records on it the following information, as was done in Maps 1 and 2.

A. Date and time (plot a new map for each different time).

B. Wind, wave, precipitation, and visibility data for the stations listed. (Some stations are on land; others are reports from ships at the positions given.) The information to be plotted is listed for Maps 3 and 4.

MAP 1

Date: 10 November 1975
Time: 0100E

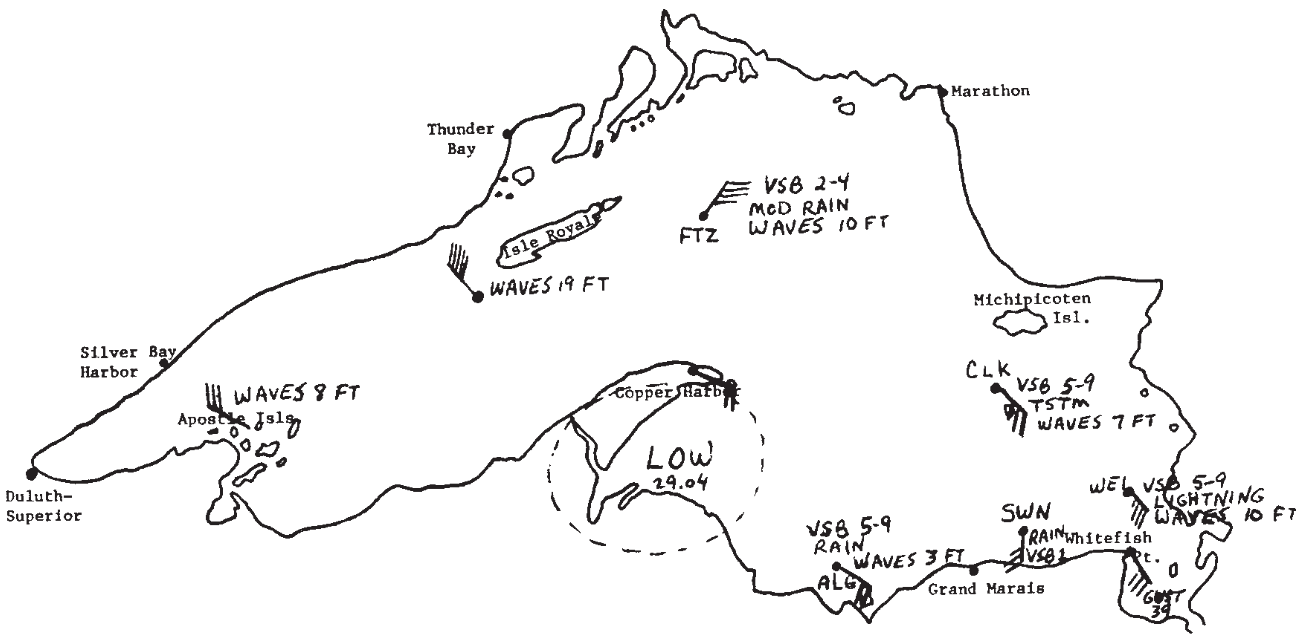


Location	Wind Speed (knots)	Wind Direction	Wave Height (feet)	Precipitation	Visibility (miles)
Anderson (AND)	32	NE	10	Rain	5-9
Fitzgerald (FTZ)	52	NNE	10	Heavy rain	2-4
Duluth	15	N			
Apostle Isls.	30	NNE			
Thunder Bay	10	NE	8	Rain	5-9
BRE	38	NE	7		
CLK	42	ENE	5	Clouds forming	10+
SWN	40	NE	7	Moderate rain	
WEI	30	NE	7	Squalls	10+
BEE	30	SE	10	Fog	1

Figure 6. Weather data from 1 A.M., November 10, 1975.

Map 2

Date: 10 November 1975
Time: 0700E



Location	Wind Speed (knots)	Wind Direction	Wave Height (feet)	Percipitation	Visibility (miles)
FTZ	35	NE	10	Moderate rain	2-4
Apostle Isls.	30	WNW	8		
WS of Isle Royale	45	NW	19		
Copper Harbor	20	ESE	6		
ALG	20	SE	3	Intermit. rain	5-9
CLK	26	SE	7	TSTM	5-9
SWN	25	S		Rain	1
WEI	35	SE	10	Lightning	5-9
Whitefish point	30 gust 39	SE			

Figure 7. Weather data from 7 A.M., November 10, 1975.

Weather Data for Maps 3 and 4 (transparencies)

Map 3

Date: 10 November 1975
Time: 1300E

Location	Wind Speed (knots)	Wind Direction	Wave Height (feet)	Precipitation	Visibility (miles)
AND	20	SE	10	Clouds forming	10-24
Duluth	25	NW			
Silver Bay	20	NW	5	Clds. dissolving	10-24
SW of Isle Royale	40	WNW	10		
BEE	49	NW	7	Moderate snow	1
TAD	53	NW	15	Heavy snow	1/2
Copper Harbor	60	WNW	8		
Slate Island	25	NNW	7		
SIM	44	W	7		10-24
Caribou Island	40	WW	6		
CLK	41	S	13	Moderate TSTM	5-9
Whitefish Point	20	SW	15	Light snow	2-4

Map 4

Date: 10 November 1975
Time: 1900E

Location	Wind Speed (knots)	Wind Direction	Wave Height (feet)	Precipitation	Visibility (miles)
Duluth	10	WNW			
Copper Harbor	40	NW	10		
Grand Marais	55	WW	13		
ARM	25	NW	8	Clds. dissolving	10+
NE of Isle Royale	40	NWW	5		
off Marathon	25	NW	5		
FTZ (sank)	49	NW	16	Drizzle & snow	10+

When both maps are finished, bring your group back together. Answer the following questions based on the sequence of maps 1-4.

1. In what direction was the storm moving? (Note the movement of the low pressure center.)

2. Do the winds around a low pressure center blow clockwise or counter-clockwise? Toward or away from the center? Are wind speeds greater or less as they get closer to the low pressure center?

3. On weather maps 1-4, check the station models for coastal weather and mid-lake weather. Which areas, coastal or mid-lake, had higher wind and waves?

4. Which areas had higher wind and waves, island areas or mid-lake areas?

5. Which side of the lake, Canadian or U.S., had more severe weather conditions?

The map below shows the courses taken by the *Fitzgerald* and a following ship, the *Anderson*.

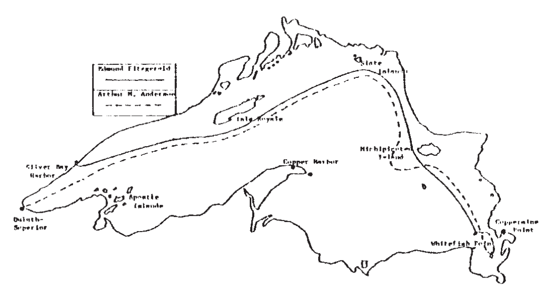
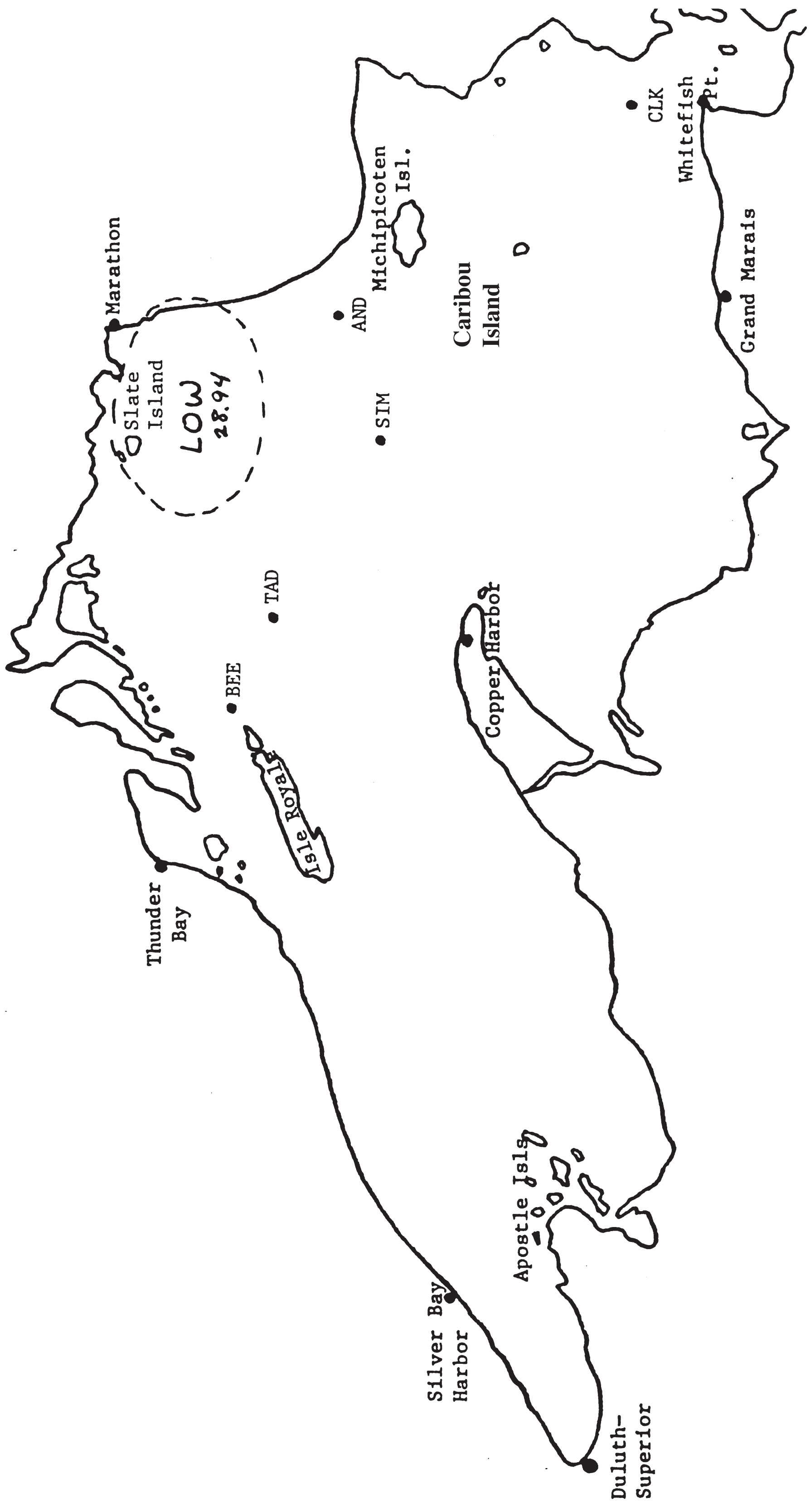


Figure 8. Courses steered by the *Arthur M. Anderson* (AND) and the *Edmund Fitzgerald* (FTZ) on the night of November 10, 1975.

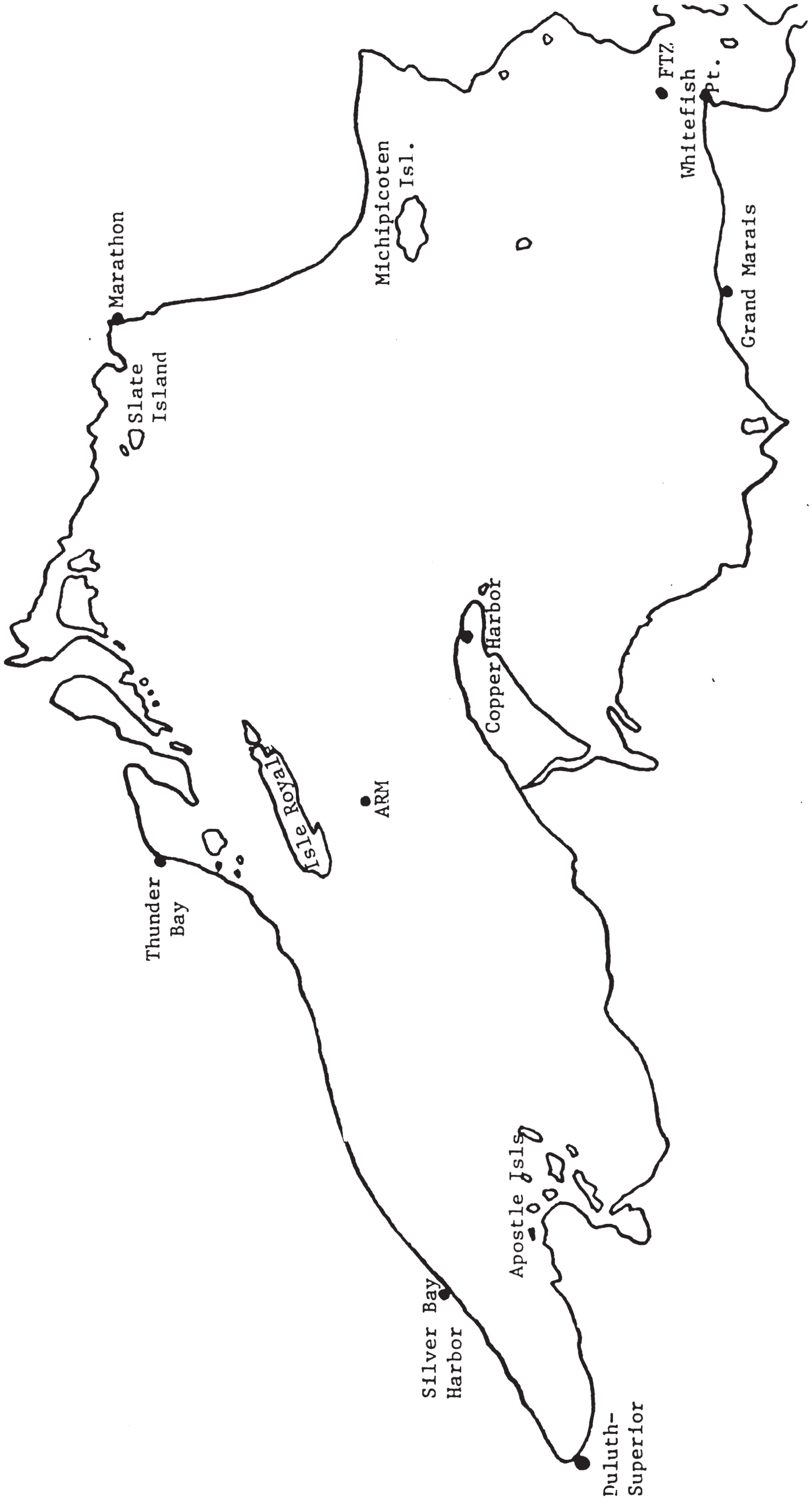
6. Was this the best possible course in view of the weather conditions?

7. Plot a recommended course for the *Fitzgerald* on a third transparency. You will want to consider the storm's path, the wave heights, and wind speeds along the way. Be prepared to defend your choices for the rest of the class.

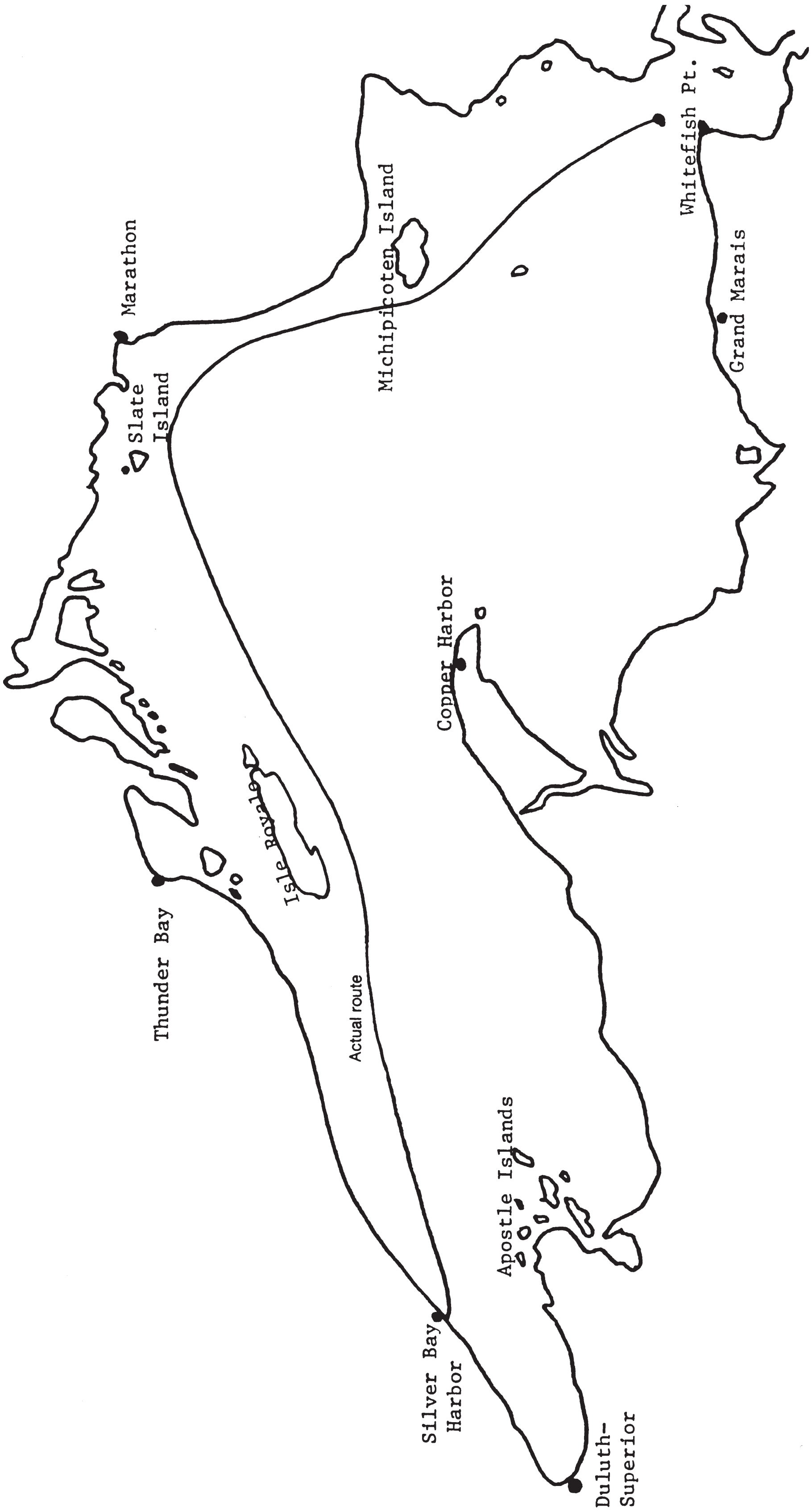


Map 3
Date:
Time:

Map 4
Date:
Time:

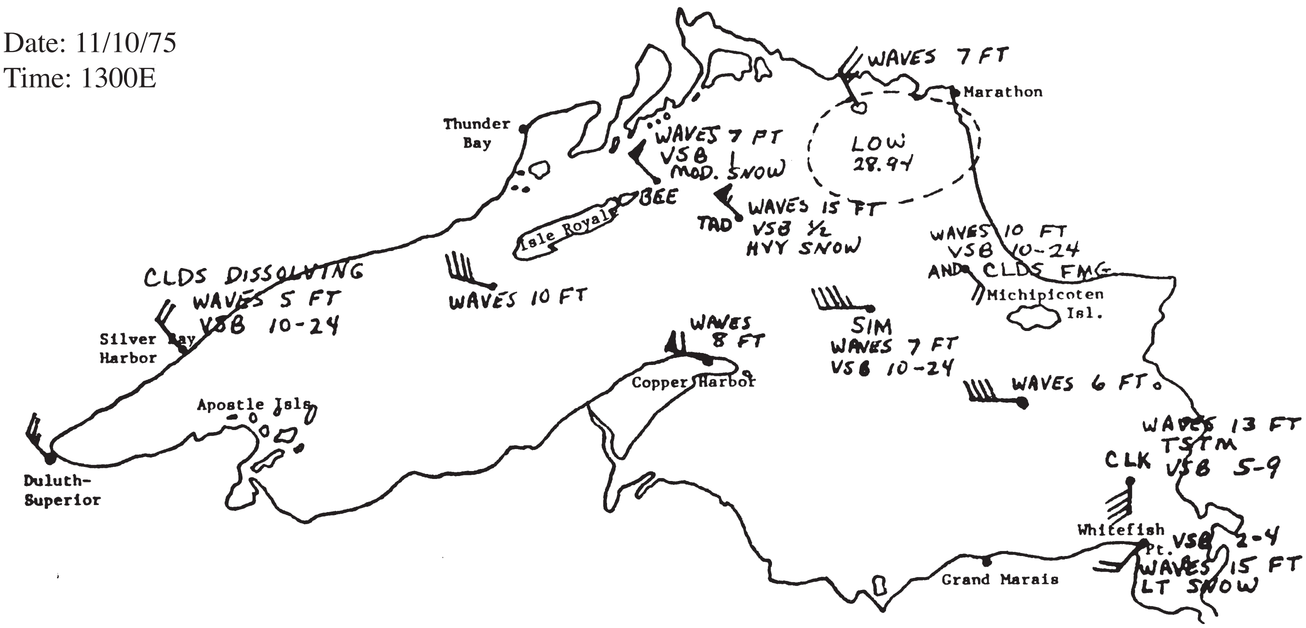


Map 5

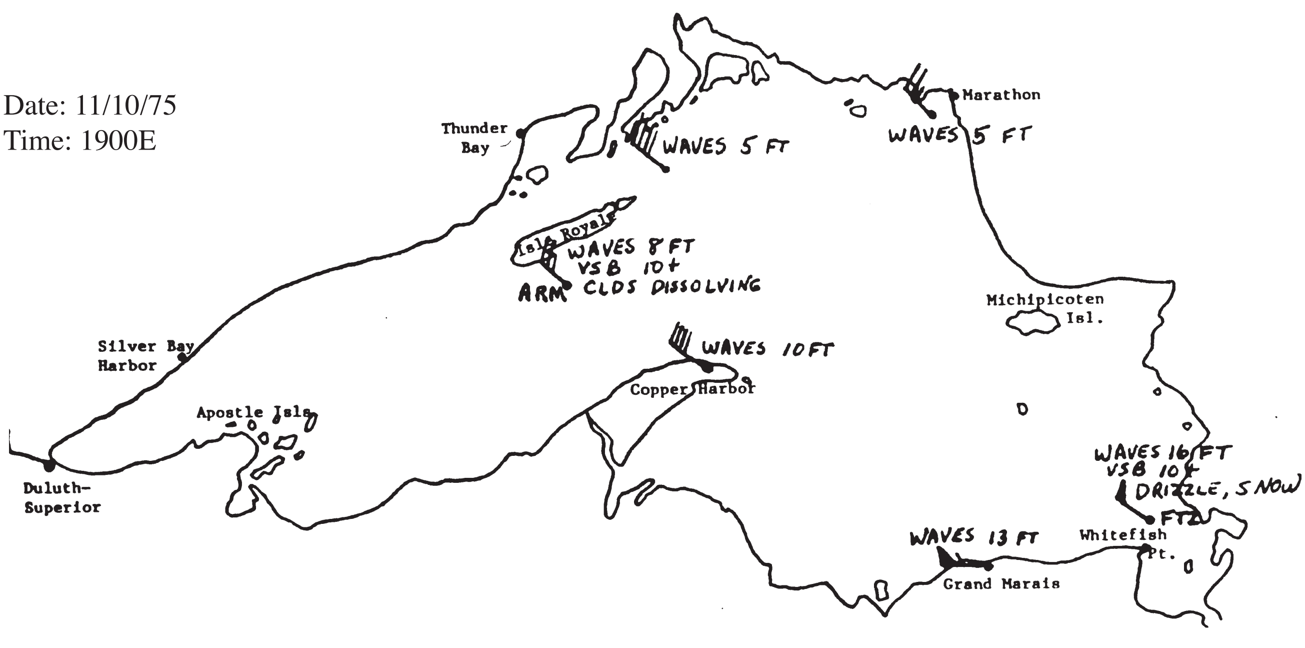


Actual route for the *Edmund Fitzgerald.*
(Mark "Best Route")

Date: 11/10/75
Time: 1300E



Date: 11/10/75
Time: 1900E



To the Teacher: Correct station models for students' map 3-4.

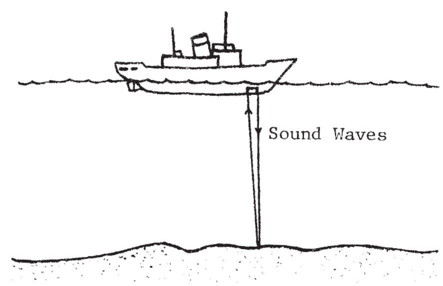
Hypothesis 3: Lake bottom features were responsible for the wreck of the *Fitzgerald.*

Introduction

How deep is the water? Every mariner must be aware of water depth in order to know if his or her vessel will float without bumping the bottom.

Exploring water depths began with crude lead-weighted ropes on wires lowered from ships. Knots or marks on these sounding lines were recorded as depth measurements. "Mark Twain," for example, meant that the water came up to the second mark on the line and was two fathoms (about 4 meters) deep.

In World War I, the echo sounder was developed. A sound sent out from an instrument aboard a ship bounces off the sea floor or lake bottom. SONAR (SOund Navigation And Ranging) uses the same principle. When the echo returns to the ship, depth is calculated. Sound waves travel through water at a speed of 5,000 feet per second. If the sound takes 1 second to reach the bottom, its echo takes 1 second to return and the water is 5,000 feet deep. Using the results of echo sounding, scientists can draw a bathymetric chart. ("Bathy" means deep, and "metric" means measured.) Such a chart shows the characteristics of the sea floor or lake bottom.



A ship using an echo sounder.

Procedure

Materials

- Nautical chart of eastern Lake Superior (St. Mary's to Au Sable Point).
- Transparent sheet.
- Wax pencil or washable marker.

A contour line is a line connecting points of equal elevation or depth. We can construct bathymetric contours in the following way.

The numbers on the nautical chart are the soundings at various locations in a small lake. The larger the numbers are, the deeper the water. The zeroes indicate shoreline areas, where the water depth becomes zero. All the zeroes around the edge of the map have been connected to show the shape of the lake.

1. Are there other zeroes besides the lakeshore ones? What kind of a feature has been drawn at Point A?

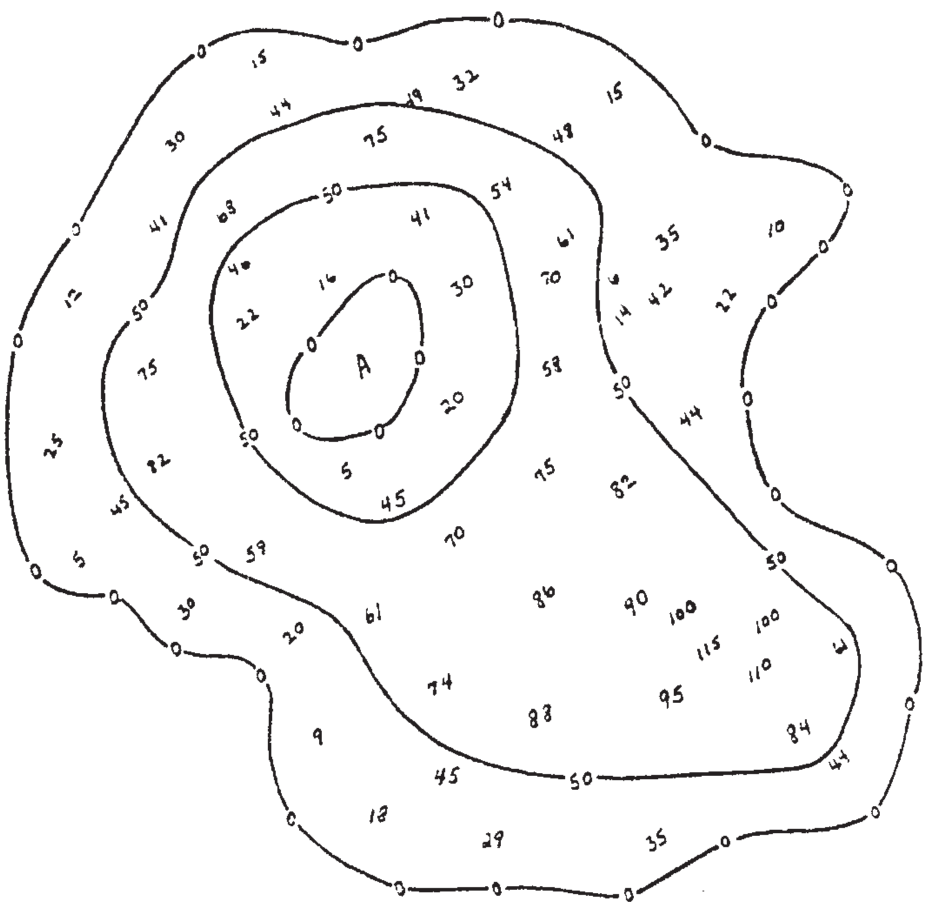
2. Now find a line that roughly shows where the water is 50 feet deep. (U.S. mapmakers do not use the metric system to any great extent yet.) The line goes between the numbers

greater than 50 and the numbers less than 50. Contour lines do not end unless they go of the edge of the map, so the ends of the 50-foot line are connected.

There are two 50-foot bathymetric contours for this map. One surrounds the feature at A and another is around the inside of the entire lake. Be sure you understand why these lines were drawn where they are.

3. Put a Y on a part of the lake that has some very shallow areas close to the 50-foot line. This is a place where there is a rocky area or a shoal underwater. Sailors would have to be very careful not to bump their boats into this.

4. Draw a 100-foot contour line in the lake. Put an X on the deepest point in the lake.



Practice Map: Soundings in a Small Lake.

5. On the nautical chart showing the eastern end of Lake Superior, place a transparent sheet so that its short bottom edge is on the line labeled $46^0 50'$ and the long left hand edge is on the $85^0 00'$ line of longitude. Trace the shoreline onto your paper.

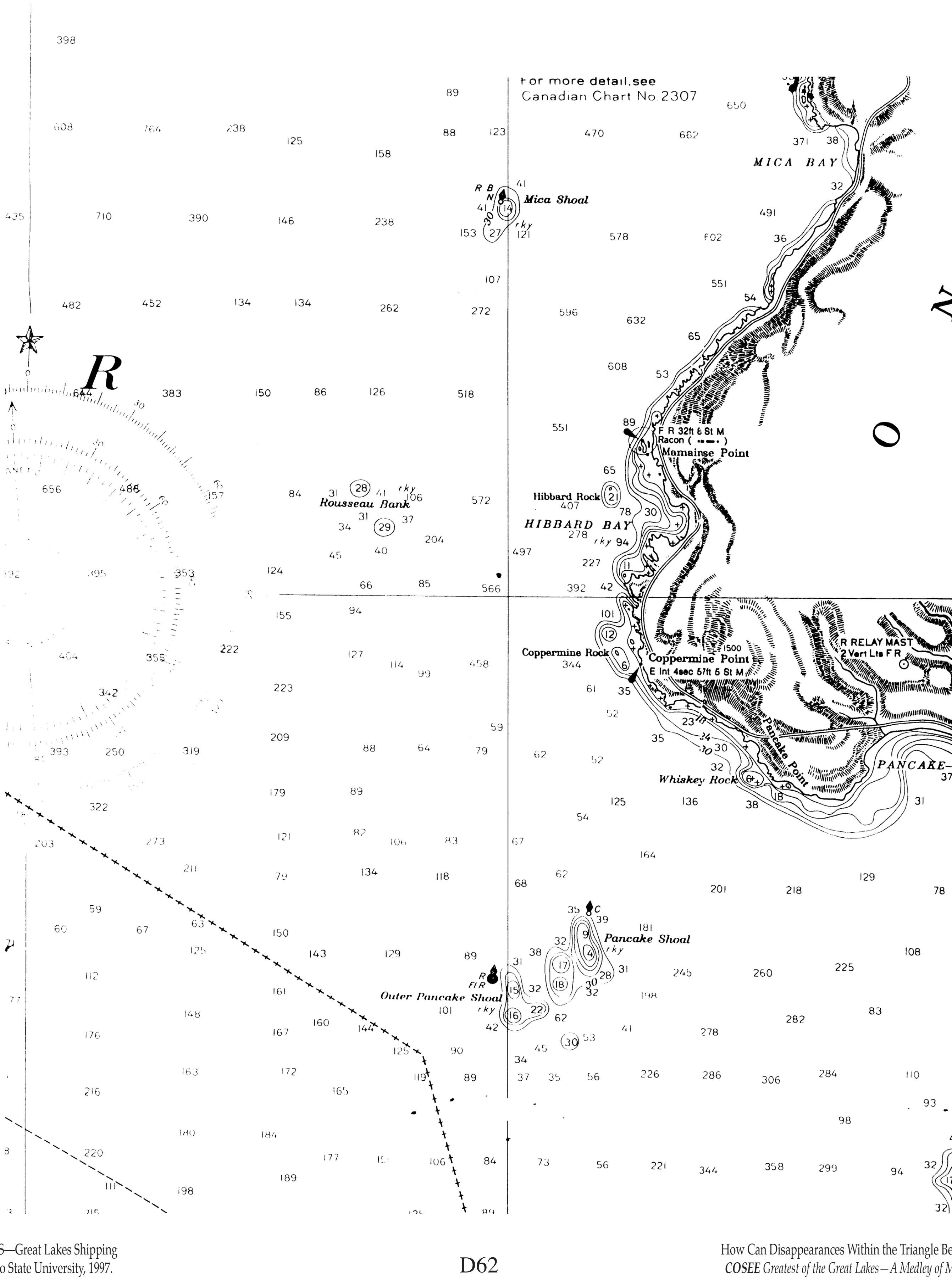
6. In the area covered by the tracing paper, draw 50-foot bathymetric contours. Be sure to look around for the depths far out in the water that may need to be enclosed in such lines. (Contour lines cannot cross each other. Why?)

7. Also draw a 75-foot contour. Your map should now show places of shallow water that are surrounded by very deep water.

8. Label the town of Coppermine Point on your transparency. On November 10, 1975, the *Edmund Fitzgerald* sank off Coppermine Point in 530 feet of water. The ship was coming from the northwest. Put an X on the place where the sinking probably occurred.

9. The *Fitzgerald's* hull was 37 feet deep. In a storm with large waves, the hull might dip down to a depth of about 50 feet. Locate areas where hidden shoals might be (depth of 50 feet or less, and areas where few depth measurements have been made). Be prepared to show the class where the *Fitzgerald* could have struck bottom.

Note: The critical section of this chart is reproduced on the following page if a complete chart is not available.


For more detail, see
Canadian Chart No 2307
MICA BAY
Mica Shoal
R B N
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Racon
Mamainse Point
Hibbard Rock
Rousseau Bank
HIBBARD BAY
Coppermine Rock
Coppermine Point
E Int 4sec 57ft 5 St M
R RELAY MAST
2 Vert Lts F R
Pancake Point
PANCAKE
Whiskey Rock
Pancake Shoal
Outer Pancake Shoal
C
R
FlR

Base Group Leader's Guide

The following sequence is recommended for bringing out the major points (topics are addressed as if they were done by separate teams):

Leader
We have noted that many ships and planes have disappeared in the Great Lakes area. Does this indicate that some unusual forces are at work in the area, causing vessels and people to vanish into thin air, or could natural causes explain the losses? (No pause for answer.) Let's examine some things that might cause a ship to sink in the Great Lakes. Team 1, show us what you discovered about the balance of such a ship.

Team 1
Presents a model of the *Fitzgerald*. They explain what a scale model is and tell what is meant by draft of a ship.

Leader
When you experimented with your model, Team 1, show us what you discovered about the balance of such a ship.

Team 1
Tells what was done with the model and how they answered questions A to F.

Team 1 Answers

A. Cargo must be positioned exactly right to balance the ship.

B. Pitch will shift the cargo out of balance more.

C. Waves pile up water on deck and weight the ship down more. (They could also cause it to have a greater draft temporarily, so it could strike an obstacle underwater.)

D. Water sloshes as the ship rolls and pitches. The water makes the cargo shifting even more likely.

E. The ship could dive to the bottom.

F. It could snap into pieces or the front part could be buried in the lake bottom.

Leader
(Show picture of *Fitzgerald* wreck, Figure 9.) Could this have happened in the way you described? (Answer depends on Team 1's previous answers.) If E and F were well considered, answers here should be "yes."

Leader
Team 2 has investigated the weather conditions on the day the *Fitzgerald* sank. Team 2, please explain when and how a station model is constructed.

Team 2
Gives the requested information from its activity.

Leader
What was the weather like on November 10, 1975?

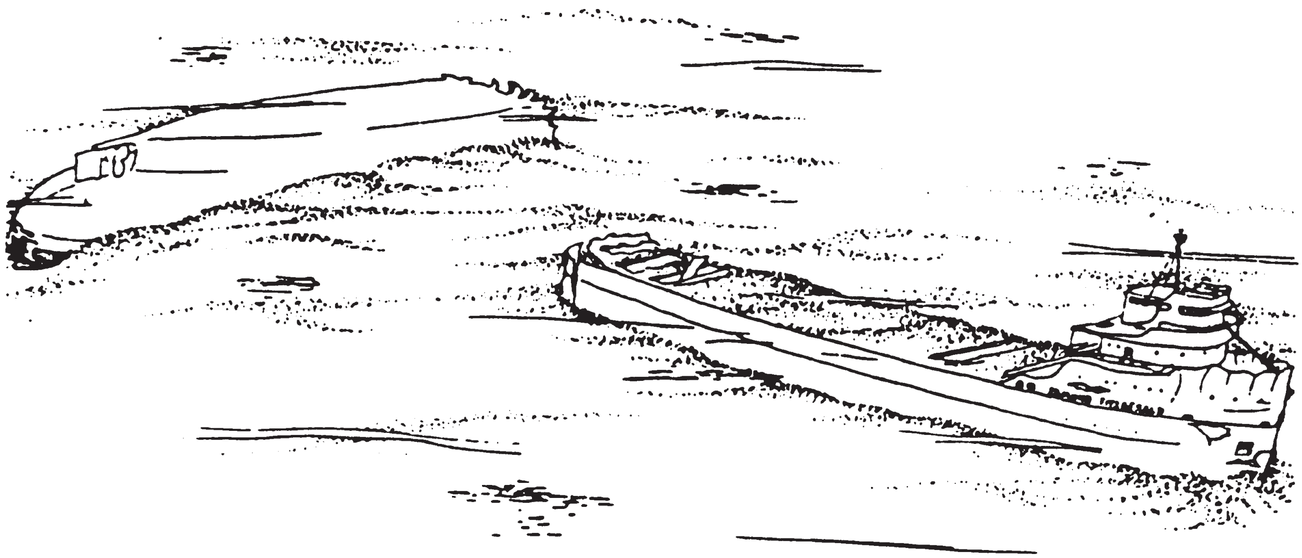


Figure 9**.** The *Edmund Fitzgerald* as it appears on the bottom of Lake Superior. (Artist's conception based on Coast Guard data)

Team 2
Shows Maps 1 and 2, then transparencies they constructed for Maps 3-4, pointing out the general direction in which the storm was moving.

Leader
When a low pressure center is on the map, it generally means unsettled weather. How do winds blow around a low pressure center?

Team 2
Gives answer to question 2.

Leader
On your transparencies, show us what types of areas have higher winds and waves.

Team 2
Gives answers to questions 3-5 and shows transparency sections to illustrate:

Leader
Team 2, do you think the *Fitzgerald* chose the safest route, or could you plot a safer one?

Expected Responses

The storm was moving toward the northeast, as shown by movement of the LOW.

Counter-clockwise flow toward the center, with stronger winds near the center.

Wind and waves:
Higher in coastal areas than mid-lake (Map 1)
Mid-lake and islands about the same (Map 1)
Canadian and U.S. sides about the same (Map 3)

Answers will vary.

Team 2
Shows transparency with a "better" *Fitzgerald* route and explains the reasons for choosing the route. General discussion of Team 2's choices. There are no correct answers.

Leader
Team 3 has information about the bottom of Lake Superior and how the uncharted features could cause ships to wreck. Team 3, how do we know what's on the floor of a lake or ocean?

Team 3
Responds according to the introduction of its activity . Shows map done as practice.

Leader
Let's look at the area where the *Fitzgerald* sank. Team 3, what do the bathymetric contours tell us about the lake bottom in this area?

Team 3
Shows tracing of contours and points out shallow areas.

Leader
Tells about the "Three Sisters" waves described in the article attached (a fourth explanation of what might have happened).

Conclusion

At this point, the Base Group leader should pull together the information from all teams and emphasize the following:

- A combination of natural forces and possible human error could account for the sinking of the *Fitzgerald*.

- Many disappearances within the lakes triangle are in heavy traffic areas (narrow stretches of water, busy airports, etc.). Compare this with the accident rate on the busiest street in your community and the accident rate on a little-travelled route.

- There is probably no single explanation for all the accidents in the Great Lakes triangle, but it is likely that logical reasons for the losses could be found.

- This investigation has been a piece of scientific detective work – the putting together of pieces to reach a logical conclusion.

The Sunday Journal

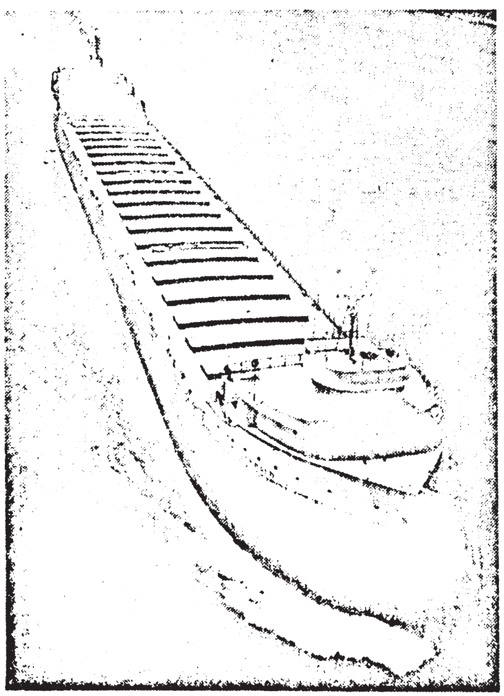
First Section

Marquette, Michigan

25 cents

Did 'three sisters' pull it down?

Fitzgerald: Another theory



THE EDMUND FITZGERALD

EDITOR'S NOTE: Lyle McDonald, who now lives in Laurium, is a former commercial fisherman on eastern Lake Superior at Grand Marais. His family has been in the commercial fishing business for years. Some of the shoals and reefs in the area of the Fitzgerald sinking were discovered by and named for his ancestors. An uncle was keeper at the Caribou Island light for many years.

By LYLE MCDONALD
Special to the Sunday Journal

Seafaring men and their families throughout the world waited almost two years to learn the findings of the U.S. Coast Guard board of inquiry regarding the sinking of the freighter Edmund Fitzgerald.

The statement released recently by the board that the ship probably sank because of seepage through the hatch covers was somewhat of a disappointment. One hesitates to dispute the judgment of such a group of knowledgeable people who spent so much time and money to come up with their findings, but they certainly did not release any information as to how the disaster could have been avoided or how future similar situations could be avoided.

It seems to be the consensus among sea-going men that seepage could have been somewhat of a contributing factor. However, the lip-seal design of hatch covers on freighters is such that very little seepage could occur.

The Fitzgerald was a relatively new ship. We should give the captain, crew, owners and designers some credit. No captain and crew would leave a Lake Superior port at that time of year without first insuring the hatch covers were properly secured and battened.

My license to make the above statements and offer my explanation of this traumatic disaster has been earned through many years as a captain of commercial fishing tugs on Lake Superior, primarily out of Grand Marais—very close to the *present location of the Fitzgerald.*

Throughout the years, the greatest battles with Lake Superior have been waged by commercial fishermen. Personally, I have waged many such battles. Knowledge of the sea's actions, the size and capabilities of the ship, courage, judgment and the Grace of God have enabled me to win all of those battles and respectfully submit my version of the tragedy.

The Fitzgerald went to the bottom of Lake Superior by means of submarining, due to excessive water weight on the decks of her forward section, immediately aft of the pilot house.

THREE SISTERS

The absolute key to this tragedy lies in the Three Sisters—or three big seas! I am amazed that this phenomenon has not been considered. Commercial fishermen, and all men who have spent considerable time on Lake Superior during storms, know that at irregular intervals, three larger waves appear. Fishermen, throughout the years, have timed and utilized these three big waves to successfully gain entrance to dangerous harbors when the wind is blowing off the lake.

To further understand this phenomenon, stand on the beach when the wind is blowing off the lake, and periodically, three waves will come higher on the sand than the others. This phenomenon of the three big waves is much more pronounced during a big storm, in the middle of Lake Superior, and in the fall and winter months.

Although the three big seas was the key to the disaster, many other elements have to have been precise to conquer this gigantic, magnificent ship. Some of the factors that have to be considered are: Wind direction and velocity, speed of seas, distance between seas, direction of ship, speed of ship, weight of cargo, buoyancy-displacement ratios, depth of water, contour of ship bow and inertia.

We know the wind was blowing approximately 70 mph out of the northwest. The speed of the ship would have been approximately 16 mph. A look at the chart will show that the course to Sault Ste. Marie, at the point where the ship was found, would have been approximately southeast.

Fitzgerald: Another theory

(Continued from page 1)

Importantly, note also that it had become necessary to change course after clearing Crisp Point, shortly before the tragedy. Consequently, the ship was traveling almost directly before the seas.

On Lake Superior, in November in deep water when the wind is blowing at 70 mph, the seas travel at approximately 25 mph and are spaced between 100 and 150 feet apart. We know that her decks had been awash previously. When the captain changed course, it enabled the three big seas to sweep up the full length of her decks, and the back-wash from the first sea was met by the second, and the backwash from both were met by the third. Since the seas were traveling almost twice as fast as the ship, this permitted a tremendous fluid weight to remain on the forward section.

The actual time lapse from the time the first big sea hit aft of the pilot house until the third one hit would have been approximately 10 seconds. Because of her great width, these three seas would have remained on her forward deck for approximately 20 seconds.

The ship was 729 feet long and had an 80-foot beam. The area of the forward 325 feet of the ship would be 26,000 square feet. If those three big seas massed on this section of the ship for 20 seconds, the adding water weight would be 10 million pounds at an average depth of six feet. During this time the ship would have moved forward approximately 50 feet.

HEAVILY LADEN

She was laden with 52 million pounds of iron ore pellets. This additional 10 million pounds of water for 20 seconds, and a travel distance of only 50 feet, caused the entire plane of the ship to depress from horizontal to from 5 to 15 degrees below horizontal. At this point, her decks were under or almost under the surface. Because her bow and sides were perpendicular to the water, her buoyancy-displacement factor became decreased to a point where inertia prevailed and she continued her course to the bottom.

With the terrific weight, speed and the forward force of the propellor, it is doubtful if the angle of descent would have increased much during the relatively short distance of 350 feet to the bottom. This angle would increase somewhat as the ship descended, because water pressure increases with depth. When the bow plowed into the clay bottom of the lake, the stern section would have been close enough to surface to permit time and space for the stern section to capsize after she snapped.

Were we to believe the findings of the Coast Guard board of inquiry, whereby she sunk because of seepage through the hatches, she would likely have seeped water through hatches both forward and aft, and would have settled to the bottom on a horizontal plane, and the aft section would not have had space or time to be upside down.

WHY IT HAPPENED

We have dealt with how this tragedy occurred, now let us consider why it happened, how it could have been prevented and what lessons it can teach people who put out to sea in boats.

The Edmund Fitzgerald lies on the botom of Lake Superior today, with it's full crew of 29 men trapped inside her, because the captain did not realize he was in danger. Prior to this tragedy, the Great Lakes ships had become so large, so well constructed, so fast and so completely equipped that the captains thought they were unsinkable.

Had the captain realized the storm could sink his ship, he could have gained shelter on the south side of Michipocoten Island or, later in the day, sought shelter under the north shore, on the Canadian side of the lake.

Had he known the ship could sink, he could have reduced his speed or utilized the old sailboat tactic of "tacking" before the wind. Had his speed been half, that massive body of water would have dissipated twice as fast.

Those of us who operate ships, regardless of size, should have learned many things as the result of this tragedy in which Lake Superior was able to swallow a ship of the magnitude of the Fitzgerald. Books have been written, and probably should be revised because of the tremendous number of relatively small pleasure craft, on water safety.

The cardinal lesson to be learned from the Fitzgerald tragedy is that one should never underestimate the ferocity and power of Lake Superior. Conversly, never overestimate the capabilities of your craft. A good operator does not get caught in a storm greater than the capabilities of his boat. However, if it does happen, common sense should prevail.

Any ship will survive a storm much better if the speed is reduced. If the situation gets to a point where shelter cannot be reached, any ship will weather a storm much better if she is held into the wind, with just enough propulsion to maintain steerageway.

Fitzgerald Hit Reef, Latest Report Says

DULUTH, Minn. (AP) — The Lake Carriers' Association says the ore carrier Edmund J. Fitzgerald sank after striking a shoal, or underwater reef, nearly two years ago in storm-tossed eastern Lake Superior.

The association rejected the theory of the U.S. Coast Guard, which found that the "most probable cause" of the disaster was loss of buoyancy and stability resulting from massive flooding of the cargo hold through ineffective hatch closures.

The association, composed of 15 domestic bulk shipping companies operating 135 vessels on the Great Lakes, filed its position paper Wednesday with the National Transportation Safety Board, asking that it be considered in the board's deliberations in the case.

The paper was written by Paul E. Trimble, a retired Coast Guard admiral who is association president.

Trimble cited 40 years' experience with the type of hatch covers and closure clamps in use and said if they were ineffective there would have been many watery cargoes to unload.

This would have been a "costly problem that vessel and cargo owners would not tolerate," he said.

Testimony about improper hatch closure procedures on other vessels in other than heavy weather conditions "should under no circumstances be assumed to have been the case on the Fitzgerald in the weather she was experiencing," Trimble said.

He cited testimony before the board about the Fitzgerald's course shortly before it sank Nov. 10, 1975. Some of it was presented by the captain and a mate of the ore carrier Arthur Anderson, which was providing navigational assistance to the Fitzgerald after radar failure.

While no plot of the Fitzgerald was maintained, the captain of the Anderson said the Fitzgerald was close to SixFathom Shoal north of Caribou Island.

Trimble's other arguments in opposition to the Coast Guard's findings included:

—MINUTES after passing Six Fathom Shoal, the Fitzgerald reported a list and said two tank vents had been carried away and that two ballast pumps were operating.

—THE CAPACITY of the ballast pumps—14,000 gallons per minute—was adequate to handle the volume of water that could enter through the eight-inch diameter vents.

—THERE SHOULD have been no list, particularly in 10 to 15 minutes, from water from this source.

—THE FITZGERALD'S report of listing in such a brief period "can only be readily explained by holing of the vessel's ballast tanks caused by striking Six Fathom Shoal."

—THERE WAS NO REPORT of hatch damage or hatches opening.

—IT IS QUESTIONABLE that water in the cargo hold would have resulted in a list since it would not have been restricted to one side of the vessel.

—THE FITZGERALD'S MASTER reported the pumps were operating and "we are holding our own" minutes before the ship disappeared from view on the Anderson's radar.

—THE QUANTITY of water needed to sink the Fitzgerald "could not have seeped through the hatch covers."

Trimble said the Fitzgerald "labored in heavy, quartering seas for over three hours" after the initial damage caused by shoaling.

When buoyancy became marginal, a large wave or series of waves could have raised the stern, starting the bow's dive under water, Trimble theorized.

He said hatch covers could have been blown off by compressed air in the cargo compartments as water entered from the sides or bottom, or they could have sprung from the weight of taconite pellets cargo as the vessel dove in 530 feet of water.

Underwater photographs of the wreckage, he said, do not support a conclusion that the hatch clamps were not properly closed, he said.