The Steamship

William G. Mather

National Historic Mechanical Engineering Landmark

Cleveland, Ohio

July 30, 1995

The American Society of Mechanical Engineers

THE STEAMSHIP *WILLIAM G. MATHER*

The Steamship *William G. Mather* represents the evolution of mechanical engineering innovation. Launched as a state-of-the-art ship for her time, the *Mather* later served as a prototype, incorporating the latest advancements in technology. The enhancements extended the *Mather's* economic life and included single oil-fired boiler, steam turbine propulsion, automatic power plant control, as well as a dual propeller bow-thruster. As a result, Great Lakes shipping remained efficient, productive and competitive with other modes of transportation. The savings realized helped local iron ore sources maintain an economical edge over foreign suppliers.

THE HISTORY AND HERITAGE PROGRAM OF ASME

The ASME History and Heritage Program began in September 1971. To implement and achieve its goals, ASME formed a History and Heritage Committee, composed of mechanical engineers, historians of technology and the curator (emeritus) of mechanical engineering at the Smithsonian Institution. The committee provides a public service by examining, noting, recording and acknowledging achievements of particular significance as mechanical engineering landmarks.

Each landmark reflects its influence on society, either in its immediate locale, nationwide or throughout the world. A landmark represents a progressive step in the evolution of mechanical engineering. Site designations note an event or development of clear historical importance to mechanical engineers. Collections mark the contributions of a number of objects with special significance to the historical development of mechanical engineering.

The ASME History and Heritage Program illuminates our technological heritage and serves to encourage the preservation of the physical remains of historically important works. It provides an annotated roster for engineers, students, educators, historians and travelers, and helps establish persistent reminders of where we have been and where we are going along the divergent paths of discovery.

For further information, please contact: Public Information Department, The American Society of Mechanical Engineers, 345 East 47th Street, New York, NY 10017 (212) 705-7740

NATIONAL HISTORIC
MECHANICAL ENGINEERING LANDMARK

STEAMSHIP WILLIAM G. MATHER

1925

THE MATHER WAS BUILT BY THE GREAT LAKES ENGINEERING WORKS AS A BULK CARRIER FOR THE CLEVELAND-CLIFFS STEAMSHIP CO. TO BRING LAKE SUPERIOR IRON ORE TO THE BLAST FURNACES OF THE LOWER LAKES. DURING 55 YEARS OF ACTIVE SERVICE SHE WAS REFITTED PERIODICALLY TO REDUCE OPERATING COSTS -

1954 - COAL-FIRED BOILERS REPLACED BY A BABCOCK & WILCOX OIL-FIRED BOILER; 2,300 HP QUADRUPLE-EXPANSION ENGINE REPLACED BY A DELAVAL 5,000 HP CROSS-COMPOUND STEAM TURBINE

1964 - AMERICAN SHIP BUILDING CO. DUAL-PROPELLER BOW-THRUSTER INSTALLED TO INCREASE MANEUVERABILITY; THE BOILER PLANT AUTOMATED BY BAILEY METER CO. CONTROLS TO INCREASE EFFICIENCY

THE MATHER IS A CLASSICAL EXAMPLE OF THE MECHANICAL ENGINEER'S WORK, APPLYING NEW TECHNOLOGY TO MAINTAIN THE VIABILITY OF A MAJOR INVESTMENT.

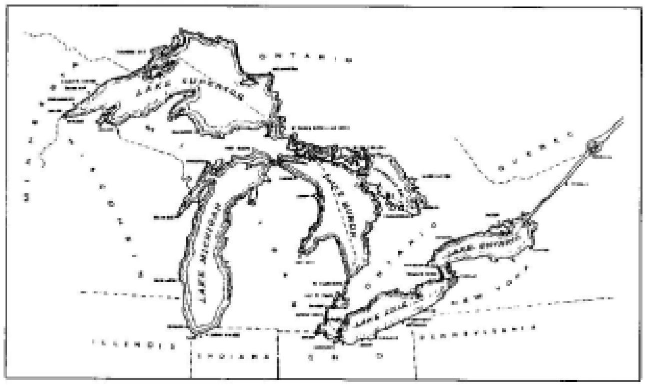
THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS - 1995

NHL115

Text of the plaque installed on the Steamship *William G. Mather* [HHNL115]

THE GREAT LAKES REGION

The Great Lakes are a distinctive geographical feature of the United States and are often referred to as the "Five Sisters." The Great Lakes Region covers around 1,200,000 square miles or one-sixth of the total area of North-America. The Great Lakes System extends from the St. Lawrence Gulf, up the St. Lawrence Seaway, through the Ontario, Erie, Michigan, Huron and Superior Lakes to Duluth,Minnesota.



It is the largest fresh water shipping network in the world, and it is shared by the United States and Canada. The Great Lakes help to define the borders of the states of New York, Pennsylvania, Ohio, Michigan, Indiana, Illinois, Wisconsin, and Minnesota. The Great Lakes Region produces about 78% of all North American steel and more than 40% of its food and feed.

Great Lake	Area (Sq. Miles)	Max Depth (Feet)	Elevation (Feet ASL*)
Ontario	7,600	802	245
Erie	9,930	210	570
Michigan	22,400	923	578
Huron	23,000	750	578
Superior	31,820	1,333	600

* ASL - Above Sea Level

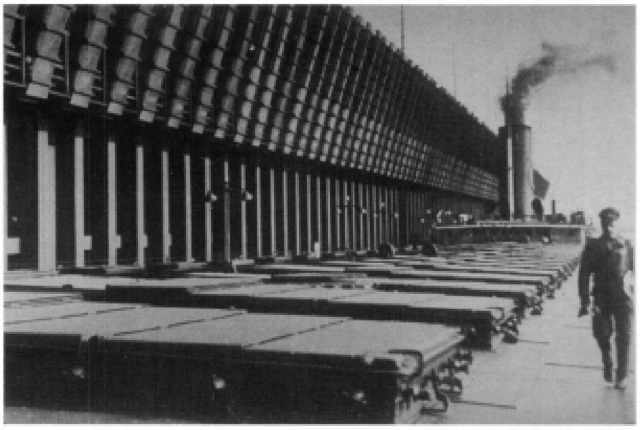
The building of canals and locks throughout the great lakes facilitated the advent of ships such as the William G. Mather. The **Welland Canal** system between lakes Erie and Ontario, completed in 1829, was the first such canalin the region. It was improved and replaced in 1845 by a Second Welland Canal, with 27 locks. The **Welland Canal** system was further modified to the present configuration, in 1932, with seven locks measuring 859' x80' and an eighth measuring 1,380'. It was complemented by the **Welland By-Pass** in 1973, which could handle any ship on the Lakes and most ocean-going ships.

The **St. Lawrence Seaway,** started in 1954 as a joint Canadian and U.S. project, , effectively opened in 1959 and made access between the lakes possible for longer and larger ships.

GREAT LAKES - THE 20TH CENTURY

The tremendous growth of the steel industry during the first half of the Twentieth Century increased the importance of shipping on the Great Lakes, particularly after the Mesabi Iron Range opened in Minnesota. Since it required **four tons of coal to make one ton of steel,** coal was needed in greater quantities than iron ore and it was also more expensive to transport. It was more economical to transport the smaller amounts of iron ore from the north to the south, and connect with the stock piles of coal located closer to the steel mills. This explained the rapid growth of towns like Cleveland, Pittsburgh, and

Detroit, which bordered the coal-producing areas in Pennsylvania, West Virginia, Kentucky and southern Ohio.



***Mather* at iron ore loading - Duluth, MN**

This explained the growth of towns like Pittsburgh, Detroit and Cleveland, which were on the waterways and bordered coal-producing areas in Pennsylvania, West Virginia, Kentucky, and southern Ohio. During the 1920s Cleveland became the sixth largest city in the United States with a population in excess of 800,000. As an industrial Midwest American city, Cleveland was second only to Chicago.

Cleveland's industries, many involving the lakes, helped to shape the city's sky line as seen from the shore of Lake Erie. Thousands of tons of Mesabi iron ore was unloaded by Hulett Ore Unloaders from ore ships in Cleveland and loaded on railroad cars for the final leg of its trip to the mills. The Great Lakes shipping industry was further stimulated by the Post-World War II prosperity. In the 1950s the U.S. registry contained over 600 U.S.-flagged ships. Opening of St. Lawrence Seaway elevated the Great Lakes system to a global level.

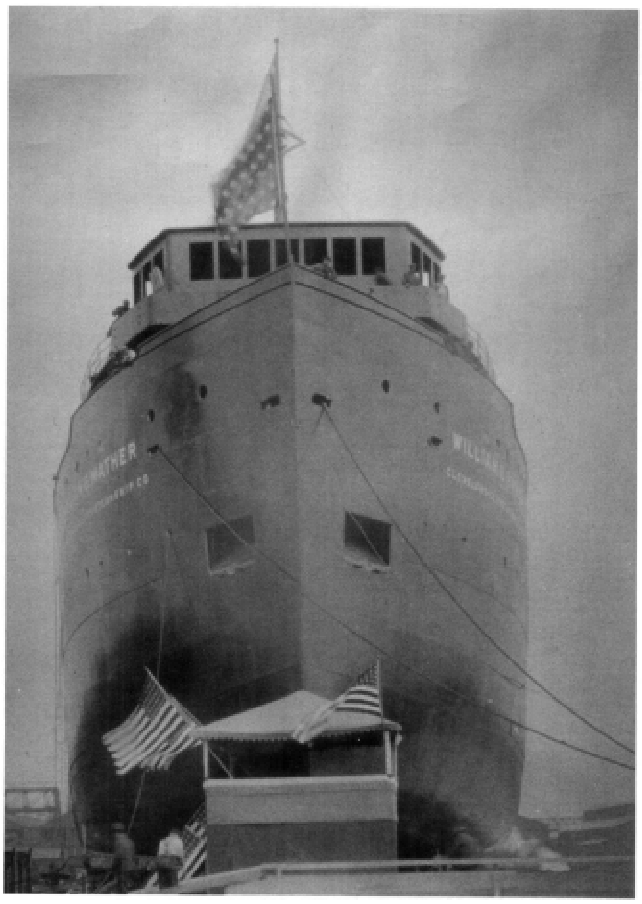
STEAMSHIP *WILLIAM G. MATHER*

One company that developed in the period between the 1890's and the 1920's was the Cleveland-Cliffs Iron Company. The Cleveland Mining Company, founded in 1850, merged with the Marquette Range and Iron Cliffs Company to form Cleveland-Cliffs Iron Company on May 9, 1891.

William G. Mather on the *Mather*

Two men were responsible for the early development of Cleveland-Cliffs Inc., **Samuel Mather** (1817-1890) and his younger son, **William Gwinn Mather** (1858-1951). These two men developed a vast iron, steel and shipping empire that is still headquartered in Cleveland. Under the **43-year presidency of William G. Mather (1890 - 1933), Cleveland-Cliffs Iron Company** grew and prospered.

As this empire grew, the company became a supplier and shipper of the raw material, iron ore. One of their greatest cooperative projects was with Cyrus S. Eaton, who formed Republic Steel by merging several steel companies in 1929. Mather and Eaton came to an agreement for Cleveland-Cliffs to transport iron ore to Republic Steel. Cleveland-Cliffs owned a large number of shares in the new company.



***Mather* at launching - 1925**

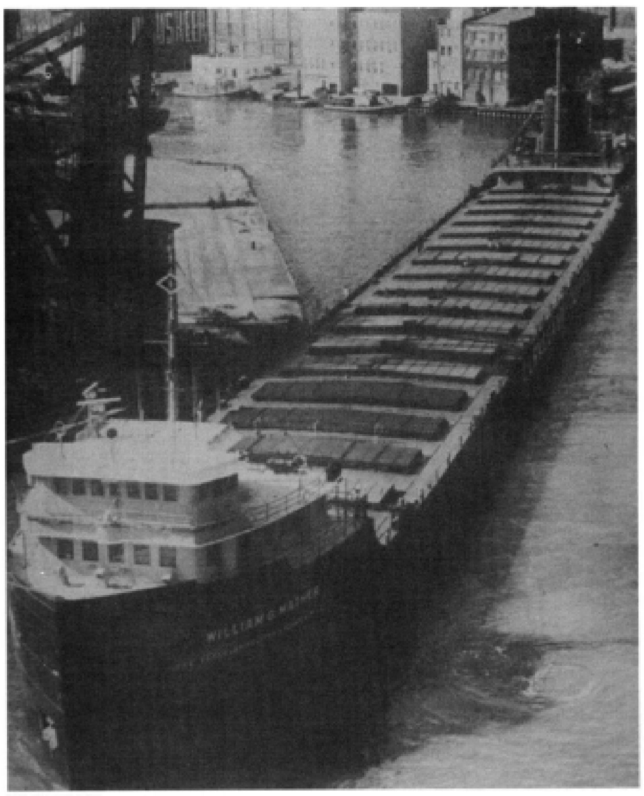
In order to help supply the steel industry, Cleveland-Cliffs developed a new fleet of ships. One of the first ships of this fleet, the *William G. Mather*, was commisioned in 1925. For her time, The Steamship *William G. Mather* was a state-of-the-art ship and it was one of the four largest Great Lakes ships in cargo capacity. As far as amenities were concerned, she had the best crew quarters and facilities of any ship on the Lakes. Mr. Mather was a frequent guest of the ship, and there were gracious -- even opulent -- state rooms and dining facilities for the guests.

The ship and Cleveland-Cliffs survived the devastating Great Depression that began in October, 1929. World War II began in Europe in 1939. In early 1941, Great Britain was standing alone against the German Blitz and was in desperate need of steel for war production. In an unprecedented event, 13 Cleveland-Cliffs ships made an early run through the ice of Lake Superior, using ice breakers and the *Mather* in the lead. Arriving at Duluth on April 8, 1941, the Cleveland-Cliffs fleet broke all records for the first arrival in a northern Upper Lakes port.

***Mather* arriving at Duluth -1941**

As the flagship of the Cleveland-Cliffs fleet, the *Mather* was the first to be equipped with the latest technology. One example was radar, which was installed on the *Mather* in 1946, making her one of the first Lakes vessels to have this technology. The *Mather* held her prestigious position as flagship until 1952, when she was supplanted by the *Edward B. Green* (now the *Kay E. Barker*).. Rather than scrapping a ship that was not yet thirty years old, Cleveland-Cliffs refitted and re-powered the *Mather* in 1954.

This re-powering was to make the *Mather* more economical, cleaner, faster, and better able to compete in the steel and iron ore market. The *Mather's* 2,300 horsepower quadruple-expansion engine was replaced by a Delaval 5,000 hp cross-compound steam turbine, and three original water tube boilers were replaced by one oil fired Babock & Wilcox marine boiler.

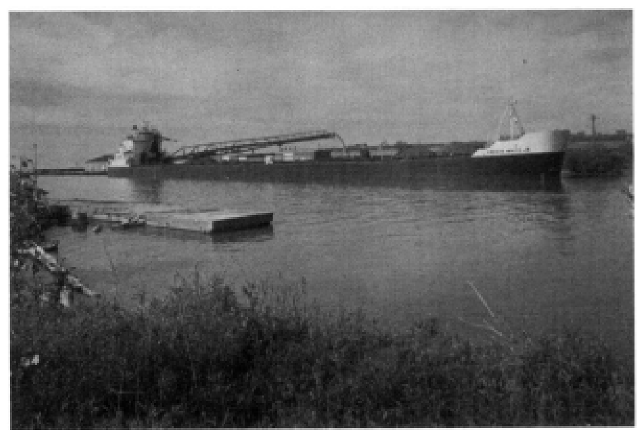


***Mather* navigating the Cuyahoga River**

In 1964, the U.S. Maritime Administration sponsored a pilot program to automate boiler controls, thereby making the boiler operate more efficiently. The *Mather* was the first Great Lakes ship to have automated boiler controls installed. The controls were developed and manufactured by Cleveland-based Bailey Meter Company (now Bailey Controls Company, a unit of Elsag Bailey Process Automation N.V.).

During this refitting, a dual-propeller bow thruster built by American Shipbuilding was also installed. It would help the *William G. Mather* navigate rivers such as the Cuyahoga and also speed up docking.

New challengers for the ore business appeared during the 1970s in the form of self unloading vessels. These and the 1000-foot versions of the ships surpassed the *Mather* and Hulett Ore Unloaders working combination in terms of economy and efficiency.



Self-Unloader Ship *Fred R. White, Jr.*

In 1980, Cleveland-Cliffs divested of all its interests outside of iron mining, including Lakes shipping. The *Mather* was retired. By 1985, Cleveland-Cliffs had sold all its ships except the *Mather.*

In December 1987, the Cleveland-Cliffs Board of Directors donated the *Mather* to the Great Lakes Historical Society for restoration and preservation as a museum ship. After $ 1.4 million in donations and over 100,000 hours of volunteer labor, the *Mather* opened in 1991 as a floating maritime museum at Downtown Cleveland's East 9th Street Pier. Over 135,000 visitors have toured the *Mather* during her four seasons of operation as a museum. In early May, 1995, the Harbor Heritage Society assumed ownership of the vessel and the Steamship *William G. Mather* Museum opened to the public for its fifth season.

***William G. Mather* at East 9th St. Pier**

STEAMSHIP *WILLIAM G. MATHER*

Specifications Summary

* (Pre = Before Upgrade - Post= After Upgrade)

Length:		618 Ft.
Beam:		62 Ft.
Depth:		32 Ft.
Gross Tonage:		8,662 Tons
Cargo Capacity:		
Iron Ore		13,950 Tons
Coal		14,000 Tons
Grain		460,000 Bushels
Bulkheads: (watertight)		4
Construction: Steel; riveted; double bottom		
Power:	(Pre)	3 Boilers - coal fired
	(Post)	1 Boiler - oil fired
Propulsion:	(Pre) Piston	2,300 Hp
	(Post) Turbine	5,000 Hp
Crew:	(Pre)	38
	(Post)	28

STEAMER *WILLIAM G. MATHER* TIMELINE

1925 S.S. ***William G. Mather*** launched.

1941 *Mather's* record breaking spring iron ore shipment.

1946 **Radar** installed on the *Mather.*

1954 New Bacock and Wilcox boiler, as well as **Re-powering** with Delaval Steam Turbine

1964 **Bailey Automated Controls** installed , American Shipbuilding dual-propeller bow thruster

1980 **Cleveland-Cliffs divests** of its Lakes shipping interests. *Mather* is retired.

1987 *Mather* donated to the **Great Lakes Historical Society** on December 10.

1988 **Restoration** of *Mather* begins at Collision Bend, Cuyahoga River.

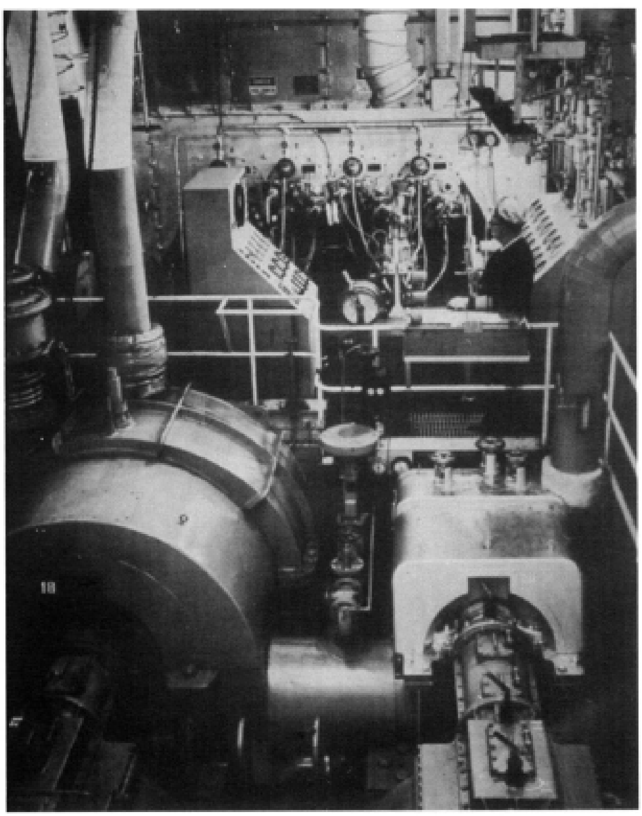
1991 ***Mather*** opens as a floating maritime museum ship at the East Ninth Street Pier on the 66th anniversary of her christening, May 23, 1991.

1994 Over **135,000** visitors tour the *Mather* by the end of her fourth season.

1995 The Harbor Heritage Society takes over ownership of the Steamship *William G. Mather* Museum. The Society undertakes a 2.5-year renovation to transform the *Mather's* empty cargo holds into commercial space to support operations.

AUTOMATIC BOILER AND BURNER CONTROLS

In 1964, the Steamer *William G. Mather* was automated by Bailey Meter Co. (now Bailey Controls) and became the first U.S. ship certified by the U.S. Coast Guard to operate without firemen. This move, it was estimated, could save up to $1,000,000 over the life of the ship. Certification from the Coast Guard came after the then 38-year old *Mather* had been refitted with a Bailey 760 Burner Control System. This along with Bailey Feedwater and Combustion Control Systems made the Mather the most automated steamer in the country.

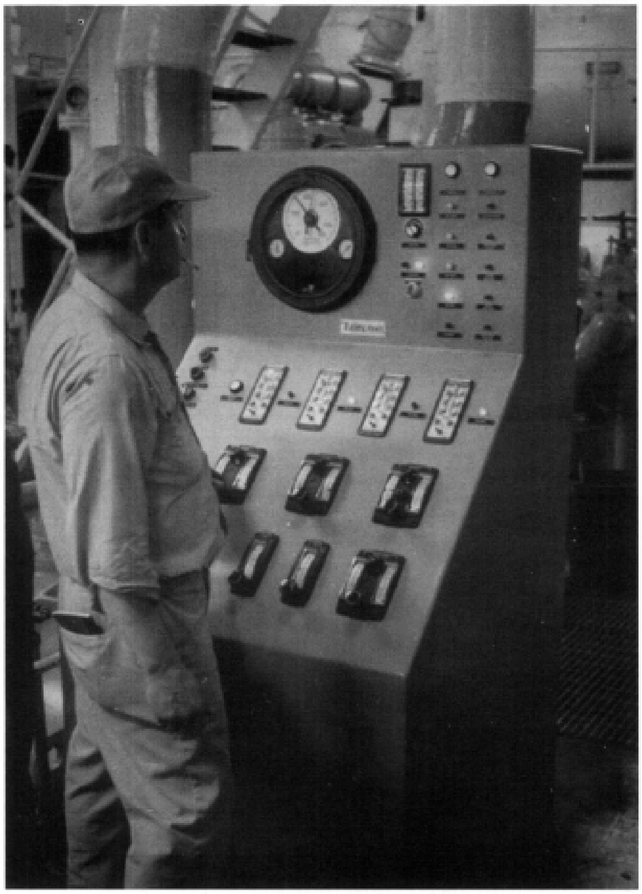


***Mather* Automated Boiler Room - 1964**

The *Mather's* automated boiler plant was especially suited to navigation on the Great Lakes. Lake vessels experience many load changes as they maneuver in the restricted rivers, canals, and harbors of port cities. At Cleveland, for example, power demand can vary rapidly from 95 percent ahead to full astern as the ship makes its way along the Cuyahoga River. As many as 30 load changes may be demanded during the two hours it took the *Mather* to travel from the mouth of the Cuyahoga river to the lower dock of Republic Steel (now LTV Steel).

The wide-range boiler and burner control systems used on the *Mather* was designed to fit in either new or old ships, including unitized plants and multi-boiler installations. The boiler control system in the *William G. Mather* included two-element, wide-range combustion control, and feedwater control. Major advantages provided by the Bailey 760 Burner Control System were safeguard against furnace explosions. A critical condition existed when a burner was being lit, or if a flame went out during normal operation. A predetermined sequence of operations had to be followed as mechanical equipment such as lighters, dampers. fuel valves, and air registers were operated in the normal start-up and shut-down cycles. All sequences were done automatically as directed by the solid-state-electronic Bailey 760 system. Two FLAMON detectors monitored the flame from each of the boiler's four burners.

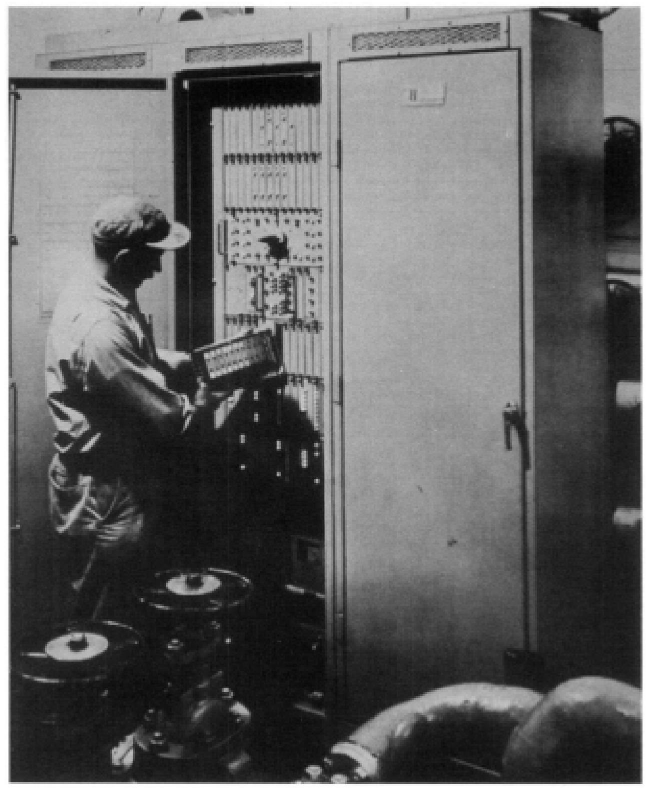
The Bailey system was installed in record time. Within six months after the "go-ahead" was given, the system was in operation. Bailey engineers literally lived with the system to see that the job was completed by the time the lakes were opened to traffic. They slept and ate with the crew of the ship throughout dock and sea trials. A few stayed with the ship during her first automated voyage until the Coast Guard certified the system and the firemen were released from duty.



Mather's **Bailey Control Console - 1964**

The operator-oriented control console was designed for one-man supervision of the marine power plant. The system was designed to automatically correct any burner fault which might cause a hazardous condition such as burners going out while fuel is flowing in. Modular construction of the system eliminated need for repair of electronic circuitry. If a fault occurred, the module was quickly identified, and replaced. The Mather installation has cabinets which house all of the solid-state burner logic panels, burner test panels, and power supplies.

During all normal operation, including maneuvering, the only manual valve adjustment required was the turbine throttle. Automatic pressure, temperature, and level regulating devices controlled conditions which would otherwise require constant or immediate operator attention.

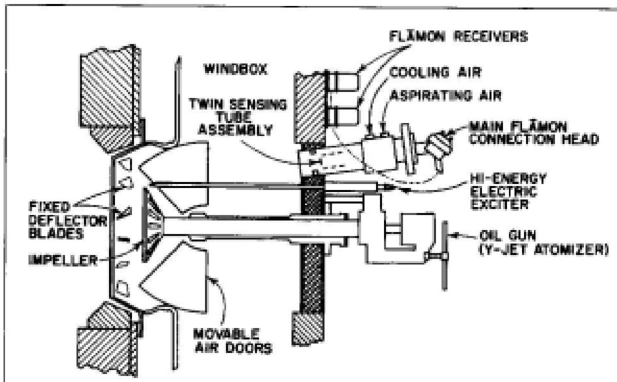


Bailey 760 Burner Control System - 1964

Safeguard against furnace explosions was the biggest advantage resulting from burner automation, not only at the start-up, but also during normal firing if loss of ignition occurred on one or more burners.

The Bailey 760 Burner Control System lighted-off or secured burners automatically as a function of load. It also permitted remote manual light-off or securing of the burners from the engineer's operating station at the discretion of the watch engineer. It also provided immediate and proper action of control devices in the event of an "off-normal" condition during any phase of the firing cycle. Complete automatic burner shut-down would occur on forced draft blower trip-out or low water level in the boiler drum.

Steam purging of the burners during the securing sequence and continuous cooling of the atomizer tip with steam, greatly decreased the need for cleaning burners.



TYPICAL FLĀMON INSTALLATION
B & W "IOWA" TYPE MARINE BURNER
OIL - FIRED

Flame Monitoring

The installation on the *William G. Mather* had a simplified burner front. It consisted of a non-retractable steam atomizing Y-jet burner, retractable high-spark igniter, air register operator, and a dual FLAMON detector for each of the four burners. This burner front design eliminated the impeller retractor, considerably simplifying the burner control system and increasing reliability. Two detectors, housed in one package, were used for each burner. Both detectors on an individual burner had to sense a main flame, otherwise the automatic shut-down sequence for that burner would be actuated.

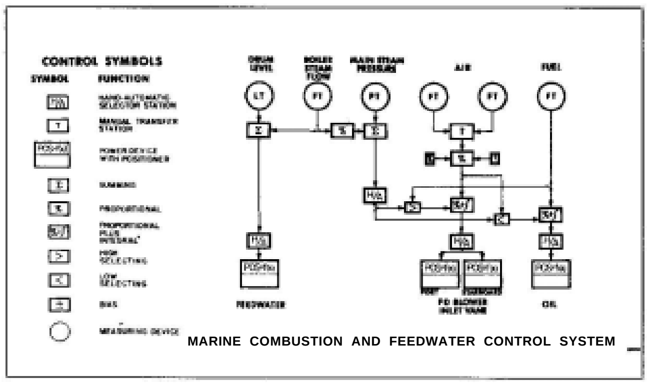
The dual flame detector was the heart of the Bailey 760 System. Properly installed and adjusted, it fulfilled the requirement of positive discrimination between the burner it was monitoring and adjacent burners. It is adjusted to prevent false trips due to the normal variations in burner operation. The detectors were sensitive to the band of ultraviolet radiation produced in the ignition and primary combustion zones of not only oil, but also gas and coal flames. The Bailey ultraviolet detector withstood reasonably high temperatures, up to 400°F.

The automatic load sequence automatically lighted and secured burners on demand from the boiler firing rate index. It eliminated the need for the operator to keep the optimum number of burners in service to meet demand. With the wide-range burners on the *Mather,* all burners were in service at about 30% boiler load. Sufficient overlap between the cut-in and cut-out points was provided to prevent hunting. The last burner was never automatically taken out of service.

Automatic load sequence provided safety and reliability since burners in service were always above their minimum firing rate to minimize the chance of flame-out due to a dirty burner. Even with the wide-range burners in the marine boiler plant, it was still necessary to secure burners at low loads and relight them as the load increased to get the overall 40-to-1 firing rate.

Automatic Combustion Control

Increased efficiency and longer runs without refueling resulted from the application of Bailey wide-range combustion control system. The Bailey two-element master control could be applied to any type of burner using any type of fuel. It overcame the disadvantages of simple pressure feed-back control and single-element master control.



MARINE COMBUSTION AND FEEDWATER CONTROL SYSTEM

The automated wide-range combustion and feedwater control system installed in the *Mather* separated the fuel-air ratio into two subloops; (1) oil flow controlling, and (2) air flow controlling.

Total oil and air flows were measured and the signals developed were used in separate closed-loop reset controllers. This made the control system independent of the number and characteristics of the burners and blowers in service.

Steam flow (available from feedwater control) and steam pressure were utilized as control indices. Steam flow provided the required reset at the exact time, rate, and magnitude of load change on the boiler, thus, providing a closer coupling between engine throttle and the boiler.

SINGLE OIL FIRED BOILER

The power boiler installed in the *William G. Mather* in 1954 was a Babcock & Wilcox design, straight-tube, single-pass sectional header, oil-fired unit with four wide-range steam atomizing burners of modified Iowa type. Design pressure is 515 psig and steaming rate is 50,200 lb. per hour, with a steam temperature at the superheat outlet of 760°F. Feedwater temperature to the boiler is about 315°F.

Furnace Design: Water cooled side and rear walls, refractory (super-duty firebrick) front wall and floor. Unit Heating Surface: Boiler 7720 sq. ft.; Air Heater 4300 sq. ft. (Circumferential area of Waterwall included). Boiler manufactured in accordance with the rules and regulations of the U.S. Coast Guard (M.I.S.) and A.B.S.

Performance

Normal (N) Overload (O)

Total steam per hr., lb., actual....
46,000 (N) 64,000 (O)

Superheated steam per hr., lb., actual.......
40,000 (N) 52,000 (O)

(de-SH) per hr., lb., actual................
6,000 (N) 12,000 (O)

Total equiv. evap. (F.&A. 212°F.) per hr.....
52,280 (N) 72,600 (O)

No. of boilers in operation................
1 (N) 1 (O)

Boiler design pressure, lb./sq. in..........
515 (N) 515 (O)

Safety valve setting, blr. drum, lb./sq. in....
515 (N) 515 (O)

Safety valve setting, S.H. outlet, lb./sq. in.
484 (N) 484 (O)

Working pressure at drum, lb./sq. in........
476 (N) 487 (O)
Working pressure at S.H., lb./sq. in...........
465 (N) 465 (O)
Total steam temperature, deg. Fahr..........
760 (N) 765 (O)
Feedwater temperature, deg. Fahr...........
300 (N) 300 (O)
Efficiency per cent.(%)......
87.6 (N) 87.1 (O)
Lb. oil per hr...................................
3,130 (N) 4,370 (O)
Air pressure at air heater inlet - in. of water.
2.8 (N) 5.6 (O)

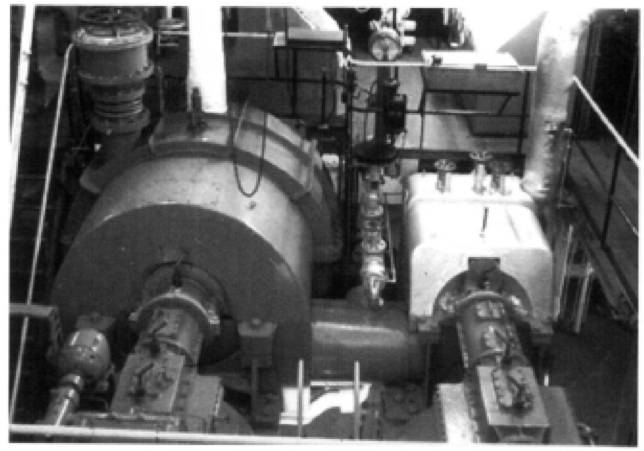
Fan Requirements: The forced draft fans were capable of supplying 73,000 lb. of air per hour at a static pressure at the air heater inlet of 5.6 in. of water and at a temperature of 100°F (no factor of safety).

Desuperheater: The unit was capable of desuperheating 6000 lb. of steam per hour from 465 psig., 760°F to 450 psig, 515°F.

Allied Equipment: Fuel Oil Pumping and Heating Set, A.W. Cash Co. Oil Control Valves; Oil Burners: Babcock & Wilcox Decagon C.D.D.F. (insulated) with Y-jet atomizer; Soot Blowers: Diamond Power Specialty Corp. G-9-B heads; Feedwater Regulator: Bailey Meter Co. Thermo-Hydraulic; Smoke indicator: Diamond Power Specialty Corp. 3 unit type; Combustion Controls, Meters & Draft Gage: Bailey Meter Company.

STEAM TURBINE

In 1954, a DeLaval (now Demag Delaval Turbomachinery Corp.) double-reduction-geared cross-compound marine steam turbine was installed as part of the power and operational equipment upgrade. The turbine had a normal rating of 5,000 SHP at 114 rpm, and maximum of 5,500 SHP at 117.8 rpm. This more than doubled the horsepower of the *Mather's* existing quadruple-expansion engine, rated at 2,300 HP.



Delaval Turbine - *Mather* Engine Room

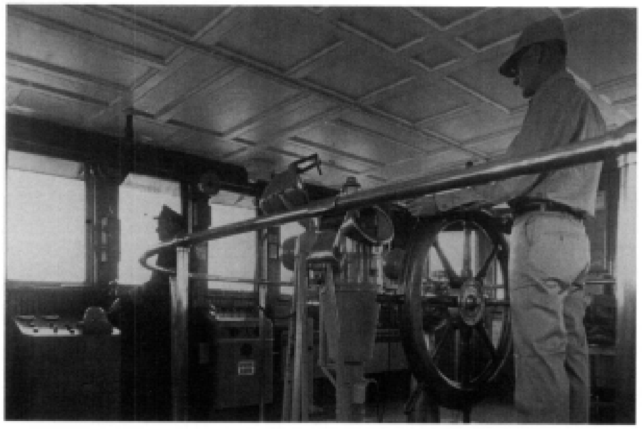
The turbine was designed for operation at 440 psig and 740°F at the turbine throttle valve inlet and to exhaust to 28.5" of Hg vacuum. It has two extraction openings in the turbine casing for the extraction of steam for feedwater heating. A valve provided low oil pressure and speed limiting control. The main reduction gears are double-reduction helical type enclosed in a gear case.

DUAL-PROPELLER BOW THRUSTER

In 1964 the Steamer *William G. Mather* was fitted with an American Shipbuilding Co. "AMTHRUST" dual-propeller bow thruster to improve maneuverability in rivers like the Cuyahoga and reduce docking times.

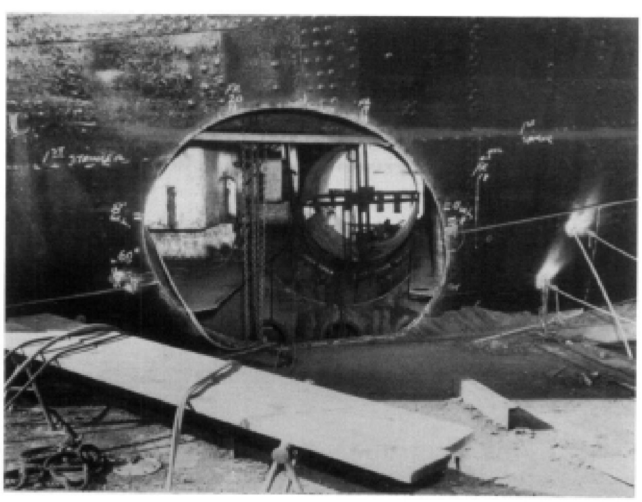
The "AMTHRUST" is a counter-rotating, tandem, fixed-pitch, solid-propeller, bow thruster unit arranged in an athwartship tunnel. The unit was designed for either diesel engine drive, as in the *Mather,* or for electric motor drive.

The control stand with instrumentation for complete operation of bow thruster was installed in the pilothouse.



Captain at *Mather's* bow thruster controls

The complete "AMTHRUST" installation consisted of the following main components: Propeller Thruster Tunnel; Propeller Unit; Power Unit with Gear and Coupling; Control System with Pilothouse Control Stand; Piping Systems for Engine Cooling, Lub, Oil, Fuel Oil; Motor Room Ventilation and Fire Extinguishers.



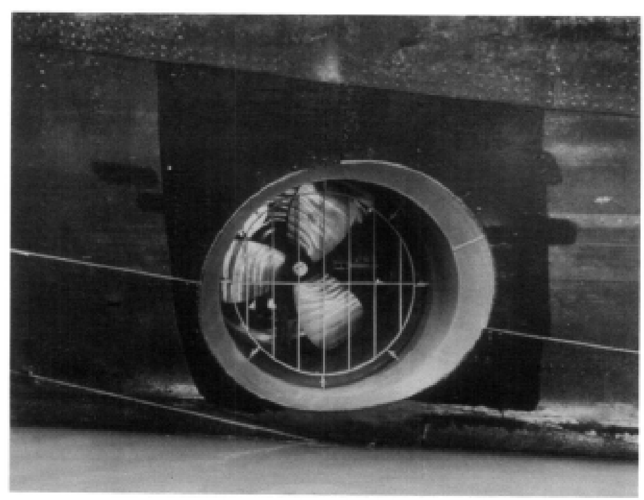
Hole in *Mather* for bow thruster
(Institute for Great Lakes Research, Bowling Green State University)

Propeller Thruster Tunnel

The tunnel has cylindrical cross sections with an inside diameter of 73.5". It is built up from three sections: The Center Section, or Propeller Section houses the propellers and the propeller gear pod. The gear pod is supported through rigid struts by the propeller section of the tunnel. This section of the tunnel was built of heavier plating than the outboard sections to guard against vibrations. The two Outboard Sections were buttwelded to each end of the center section and extended outboard to the hull of the ship. The outboard ends were attached to the hull through conical airing plates.

Propeller Unit

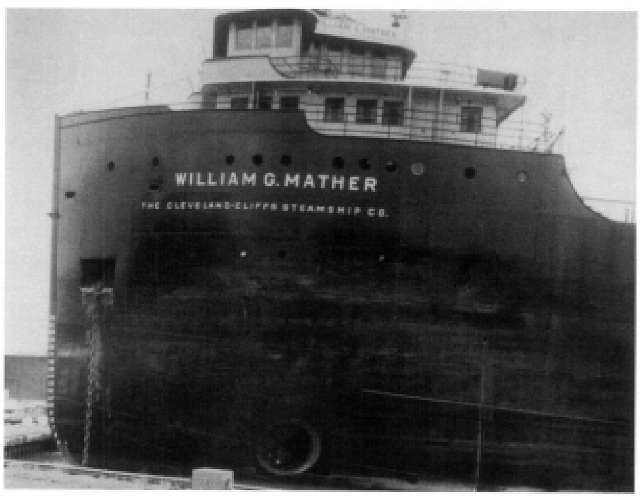
The 700 H.P. "AMTHRUST" propeller unit consists of two 6-foot diameter, counter-rotating, fixed-pitch, bronze propellers, arranged in tandem for mounting in an athwartship tunnel. The propellers are designed to produce a thrust of about 18,000 pounds to port or starboard.



Bow Thruster completed installation
(Institute for Great Lakes Research, Bowling Green State University)

The propellers are driven through a set of spiral bevel gears having a reduction ratio of

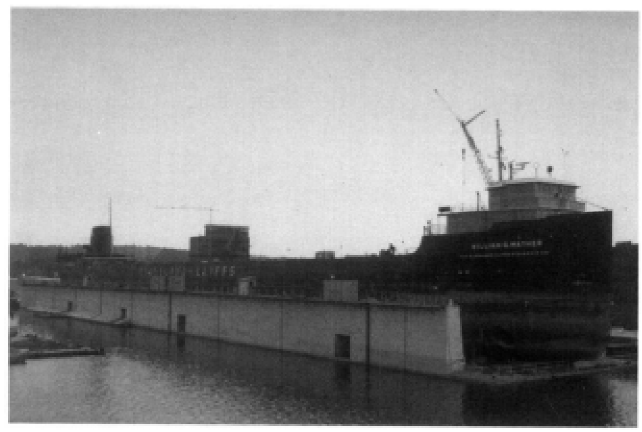
1.33-to-1. Two tapered roller bearings per propeller take the thrust in both directions and transmit it through the cast housing to the tunnel through two sets of struts. The gear pod is fastened to the tunnel both at the struts and the drive column so that it can be installed or removed from the tunnel through the port or starboard hull tunnel opening. The gear pod is completely filled with lubricating oil under a head pressure slightly in excess of the pressure of the outside water to prevent leakage of water into the lube oil system. Mechanical seals are fitted on both propeller shafts at the gear pod.



Bow Thruster on *William G. Mather*
(Institute for Great Lakes Research, Bowling Green State University)

Power Unit - Diesel Drive

Power for the bow thruster was a Cummins Model VT-12-825-M Marine Diesel Engine. The engine was rated at 700 BHP at 1900 RPM. The power unit included a hydraulically-operated Twin-Disc MG-521 marine reverse gear having a 4.08-to-1 reduction ratio. The gear was flexibly coupled to the drive shaft of the propeller unit. The engine was cooled by a closed-circuit water system with grid type water coolers located in the tunnel. The engine was fitted with a hydraulic starting system, sufficient for two starts of the engine without recharging. Lubrication of the engine and reverse gear was by means of self-contained lubrication systems. Air cleaners mounted on the engine took combustion air from the surrounding space. A spark arresting exhaust silencer was installed in the engine exhaust piping and an instrument panel was mounted on the engine.



***Mather* in Dry Dock - Lorain, Ohio 1964**

THE MECHANICAL ENGINEER

The Steamship William G. Mather is a good example of the varied industries that come together to make a product and where mechanical engineers have had a significant role.

The companies that were mentioned in this commemorative brochure are only a small fraction of those, whose components were used to built the Mather and operate it profitably.

From a bolt to a complex system, such as the *Mather* or a space shuttle which the bolt held together, the mechanical engineer’s role has been a critical element in its success. The future will demand even more of the mechanical engineer.

Acknowledgments

The Cleveland Section of American Society of Mechanical Engineers gratefully acknowledge the contributions of the following individuals and organizations:

Bryan F. Lever of EyeMusic for the cover photograph of the *Mather* entering the mouth of the Cuyahoga River. This photograph was also used on the invitations, ticket request, ceremony tickets, and programs.

William F. Taylor, Photographer, for the cover photograph of Marshall Fredericks "Fountain of Eternal Life" and Cleveland's Terminal Tower, two nationally identified landmarks with Cleveland. This photograph was also used on invitations, ceremony tickets, and programs.

Edward F. Gabrosek of Bailey Controls Inc., **William R. McDonald** of Cleveland-Cliffs Inc., and **Holly J. Holcombe,** Executive Director of the Steamship *William G. Mather* Museum, for their support in researching the *Mather's* rich history included in this document.

Rimantas (Ray) Saikus, his son **Christopher** (15) and daughter **Christina** (12) for authoring, designing, and producing this document, as well as related publications and mailings. Photographs of the *Mather* at its current site and the four Cleveland Whiskey Island Hulett Ore Unloaders, bottom right corner of back cover.

Institute for Great Lakes Research, Bowling Green State University for their detailed photographs of the "AMTHRUST" Bow-Thruster installation on the *Mather,* pages 11-12

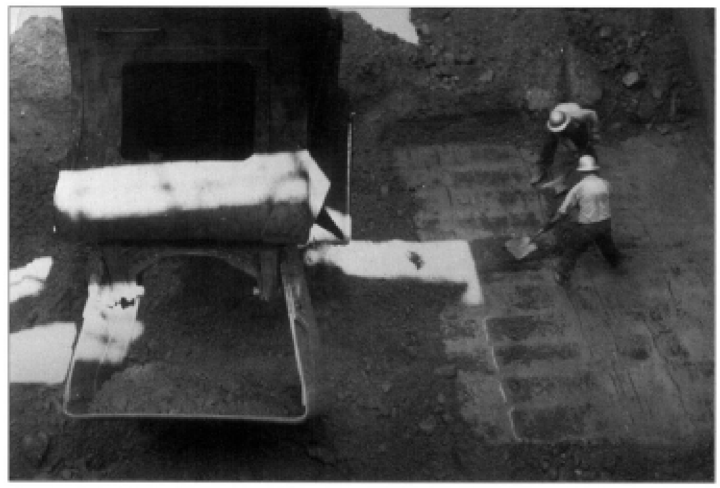
Bailey Controls Company (Elsag Bailey, Inc. a unit of Elsag Bailey Process Automation N.V.), **Babcock & Wilcox** (a McDermott company), and **Cleveland-Cliffs Inc.** for their generous support.

Foote Printing Company Cleveland, Ohio

Partners in commerce for over half a century

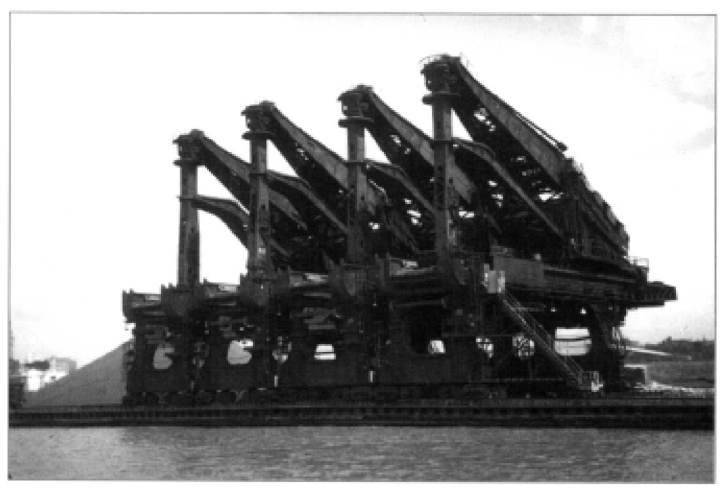
The Steamship *William G. Mather* and The Hulett Ore Unloaders at Whiskey Island

The William G. Mather being unloaded at Whiskey Island - Cleveland, Ohio



Hulett Ore Unloader bucket and men working inside bulk cargo hold

Bulldozer and men working inside bulk cargo hold



Hulett Ore Unloaders at Whiskey Island in Cleveland, Ohio