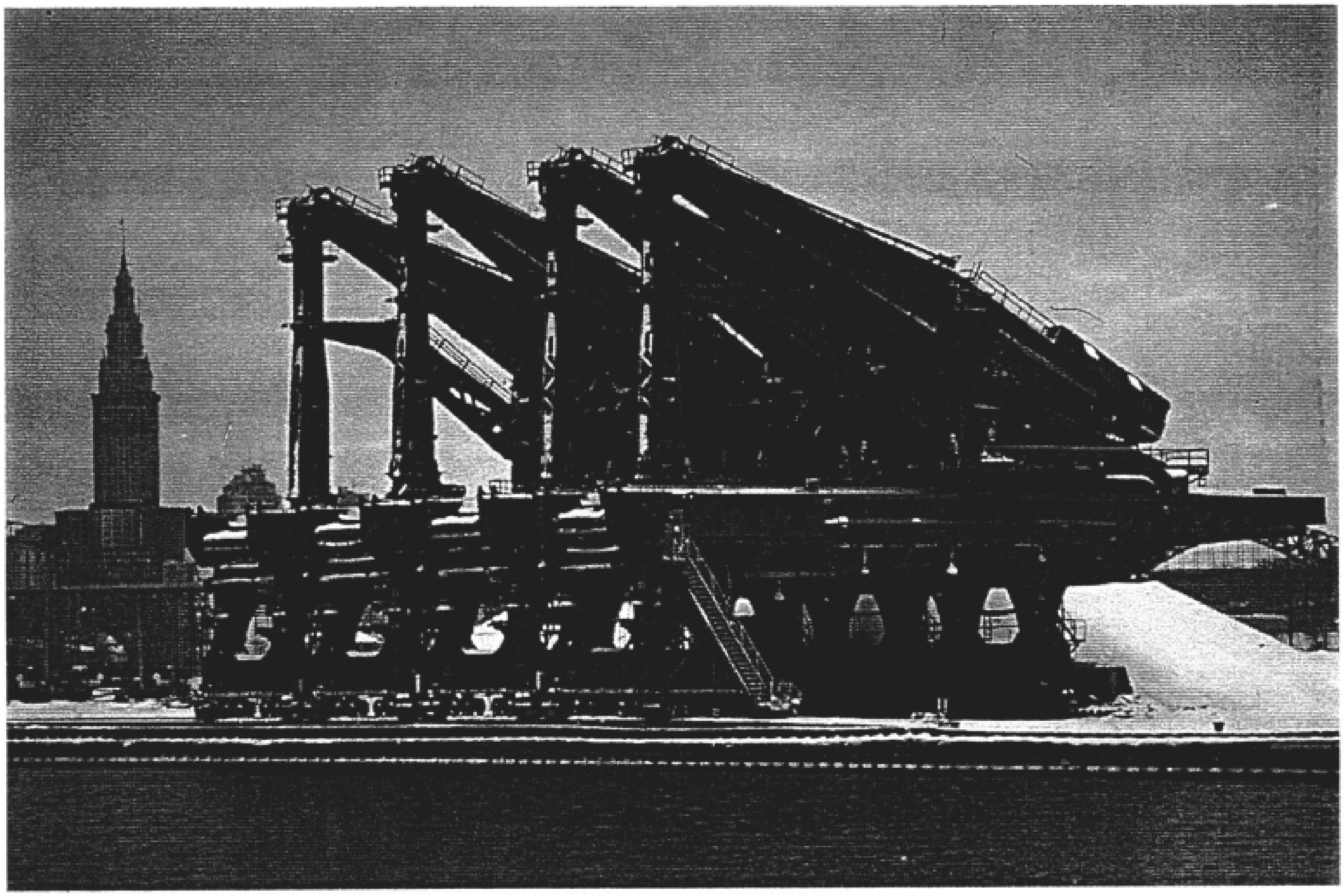
Hulett Iron-Ore Unloaders

Historic Mechanical Engineering Landmark



Celebrating the 100th Anniversary of the Hulett Iron-Ore Unloader Invention

Cleveland, Ohio

August 2, 1998

ASME **International**

THE HISTORY AND HERITAGE PROGRAM OF ASME INTERNATIONAL

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HISTORIC MECHANICAL ENGINEERING LANDMARK

HULETT IRON-ORE UNLOADERS

1912

THE "HULETT," A HIGHLY EFFICIENT MATERIALS-HANDLING MACHINE UNIQUE TO THE GREAT LAKES, WAS INVENTED BY CLEVELANDER GEORGE H. HULETT (1846-1923). THE FIRST, STEAM-POWERED AND WITH A 10-TON-CAPACITY GRAB BUCKET, WENT INTO SERVICE AT CONNEAUT, OHIO, IN 1899. IT COULD UNLOAD AN ORE BOAT AT THE RATE OF 275 TONS AN HOUR.

LIKE LATER HULETTS, THESE WERE ELECTRICALLY POWERED. THE VARIOUS MOTIONS OF THE 17-TON BUCKET WERE CONTROLLED BY AN OPERATOR RIDING IN A SMALL CAB IN THE VERTICAL LEG JUST ABOVE THE BUCKET. EACH MACHINE COULD UNLOAD 1,000 TONS AN HOUR.

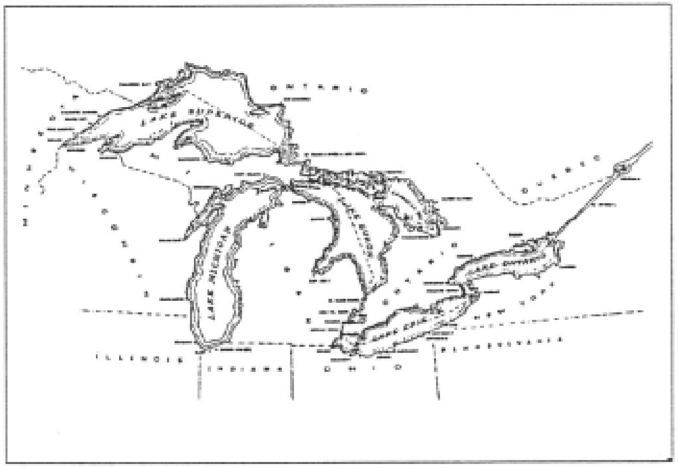
THE HULETT'S CLEAR SUPERIORITY OVER EXISTING MECHANICAL UNLOADERS REVOLUTIONIZED ORE HANDLING AND LED TO ITS RAPID ADOPTION THROUGHOUT THE LOWER-LAKE ORE PORTS. THROUGH 1960, MORE THAN 75 WERE BUILT BY CLEVELAND'S WELLMAN-SEAVER-MORGAN CO. AND ITS PREDECESSOR AND SUCCESSOR FIRMS. WITH THE ADVENT OF SELF-UNLOADING ORE BOATS, MOST HAVE BEEN DISMANTLED. THIS BATTERY IS THE LARGEST AND OLDEST OF THOSE THAT SURVIVE.

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS - 1998

Text of the plaque installed on the Hulett Ore Unloaders at the C&P Ore Dock on Whiskey Island - Cleveland, Ohio

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." They extend from the St. Lawrence Gulf, up the St. Lawrence Seaway, through the Ontario, Erie, Michigan, Huron and Superior Lakes.



The Great Lakes Region covers around 1,200,000 square miles or one-sixth of the total area of North-America. It is the largest fresh water shipping network in the world, and it is shared by the United States and Canada. The lakes help define the borders of the states of New York, Pennsylvania, Ohio, Michigan, Indiana, Illinois, Wisconsin, and Minnesota. This region produces about 78% of all North American steel and more than 40% of its food and feed.

IRON ORE[1]

Iron ore, discovered in 1844 in the Lake Superior region, was not shipped in any significant amount to the lower Great Lakes until 1852. That year, the first shipment to arrive in Cleveland, consisted of about two tons of ore and was transported in barrels. From the ore mines, the barrels were moved by horse teams then loaded unto a boat. They were then unloaded at the Sault Ste. Marie rapids, moved by horse teams again, and then reloaded unto another boat. In 1855, with the opening of the Sault Ste. Marie canal, the true beginning of ore shipping and the challenge of ore unloading commenced.

The annual production of the Lake Superior mines rose from 1,449 tons in 1855 to 1,908,745 tons in 1880. Loading, shipping capacity, and unloading became significantly more important to maximize the quantity of ore and number of round trips the lake boats could make during the short shipping season on the Great Lakes. The increasing demand for ore by the blast furnaces, coupled with a need to keep the price of the ore down, fueled the improvement as well as the development of various unloading methods and mechanisms. The building of more canals and locks throughout the Great Lakes accelerated also.

Since it required four tons of coal to make one ton of steel and the volume of coal was almost double per ton that of iron ore, it was more economical to transport the smaller volumes of 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.

Iron-ore loaded into hold of ore boat

The Great Lakes Historical Society, Vermillion, Ohio

PRE-HULETT ORE UNLOADING[1,3,4]

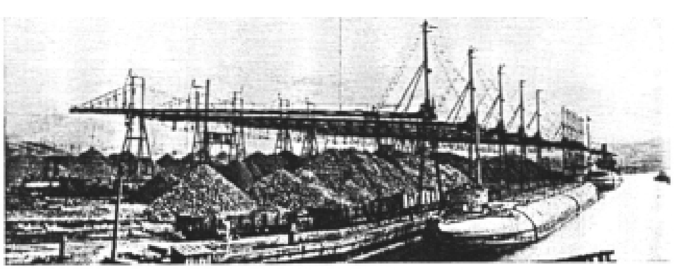
Starting in August of 1855, after the Soo canal and locks were built, iron ore was carried by schooners. The loading and unloading was done by hand, using wheel barrows. To improve the loading of ships, an elevated trestle dock was built in 1858 at Marquete, having gravity assist the loading of the heavy iron ore. Brigantine-rigged sailing vessels, with no boom between masts, were the choice for shipping iron ore. The ore was placed in the hold or on the deck. Because of unloading difficulties, most schooners chose the deck, in great risk to their seaworthiness.

This led to the introduction of ships like the *R. J. Hackett,* built in Cleveland in 1869. It had large holds with a pilot house at the bow and the engine and boiler at the stern. Shipping ore by depositing it in the hold became the standard. To unload the ore, it was shoveled in stages up to intermediate temporary platforms, then to the deck, and loaded wheelbarrows were then run over a plank to the dock. It is said a 300 ton load took a week to unload.

The next method had men shoveling ore into metal tubs, which were hoisted onto the deck using horses and block-and-tackle. Wheelbarrows and planks still used to carry ore onto the dock. A steam-hoisting engine, designed by J. D. Bothwell, replaced the horses in 1867, and later a hoisting and swinging motion was combined that prevailed into the early 1880's.

The next significant improvement in ore unloading was Alexander E. Brown's "Tom Collins" rig, basically a cable tramway that could traverse the length of the dock. It would bring the hand filled tub from the hold over the iron pile, and dump it via a trip line. Several tubs were placed in the hold, so that the shovelers could fill one tub, while the Brown unloader delivered a full one directly to a red car or to the stockpile. The first Brown unloader was installed on the New York, Pennsylvania & Ohio (NYPANO) dock at Cleveland during the season of 1880-1881.

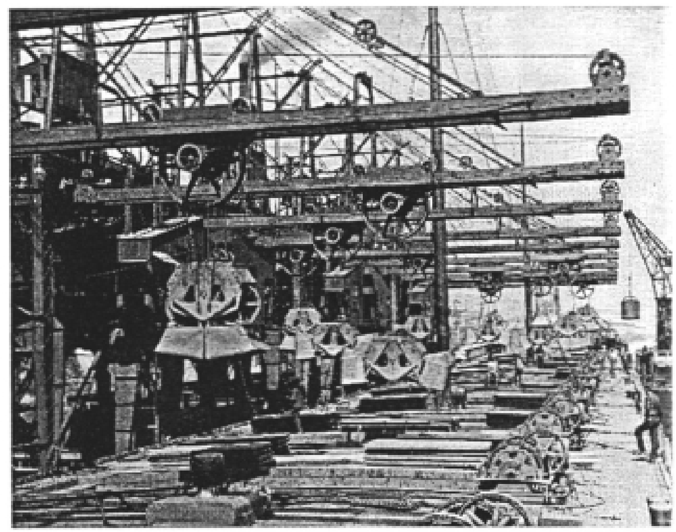
Brown brought forth the next major improvement, the "Brownhoist", with a rigid bridge structure replacing the cable tramway. It was electrically powered and had a self-filling 1.5 ton grab bucket or "clam". Another concurrent design, yet inferior to the Brownhoists design, was Robert



Brownhoists & whale-back ore boats
The Great Lakes Historical Society, Vermillion, Ohio

Aspin's "Champion Ore Hoist", a fixed timber structure with a tilting "A" frame boom and a tipple bucket on a rope fall, that remained in service until 1908.

Alexander Brown also developed the "Brown Electric Fast Plant" a box-shaped mechanism supporting a rigid rail tramway, with the Brown self-filling grab bucket. The ore could be deposited in two places on ore piles to the rear, or in traveling

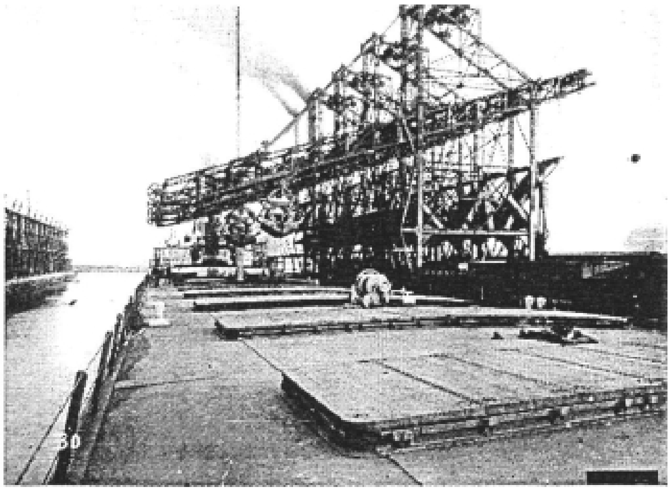


Brown Electric Fast Plant
The Western Reserve Historical Society, Cleveland, Ohio

hoppers spanning rails below. The ore piles to the rear could be redistributed by a single traveling transfer bridge of the conventional Brown hoist type. These "Fastplants" could traverse the entire dock, and were the fastest unloading machinery on the Great Lakes in their day and many were still in service up to the 1930s.

Other unloader designs included the McMyler Manufacturing Company's revolving steam-driven derrick fitted with a grab bucket, known as "whirlies" because of their spinning motion. Smaller fixed "whirlies" were placed on bulk carriers on their starboard sides but had limited use as the first ore self-unloaders.

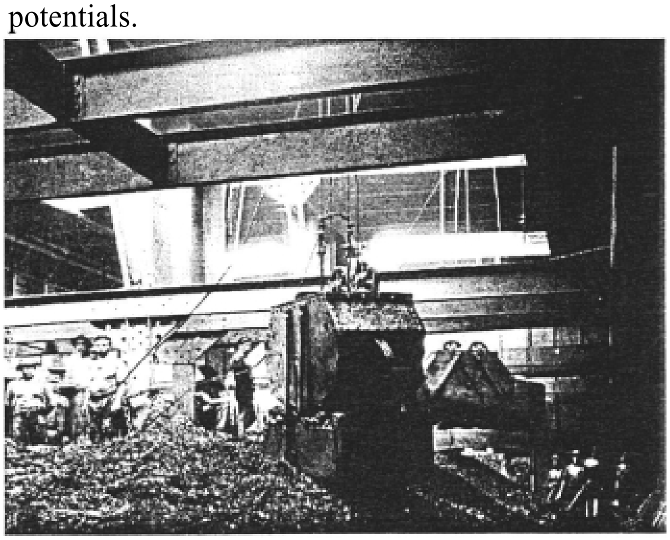
Another concurrent unloading machine was the traveling bridge crane, manufactured by the Hoover & Mason Company of Chicago. It had a heavy automatic grab bucket capable of filling itself with any grade of ore and had a spread of eighteen feet. The closing motion was very peculiar with first a downward biting motion of the blades to affect penetration, then a horizontal scraping travel to complete closure. Also in this class of unloader was the Mead Morrison rig, a much taller version of the traveling bridge crane with a history of its dangling clam bucket impacting the ship's frames and bulkheads.



Hoover & Mason traveling bridge crane
The Western Reserve Historical Society, Cleveland, Ohio

The direct handling of ore from vessel to rail car or stockpile reduced the cost of unloading a ton of iron ore from 30-50 cents to about 18 cents. It has been estimated that, by 1893, 75% of the iron ore unloaded at Lake Erie ports was handled by Brown hoisting machines. All of these technologies required a large labor force to shovel the ore into tubs or to move the ore piles in the hold to allow the clam or grab buckets to pick it up.

The photograph below depicts the men in the holds of ships and the cargo that they had to handle, a bucket could only come in straight down, so the ore had to be moved towards the opening's center. All these machines could lift substantial amounts and at sustained rates, but their reliance on manual labor limited all of their potentials.

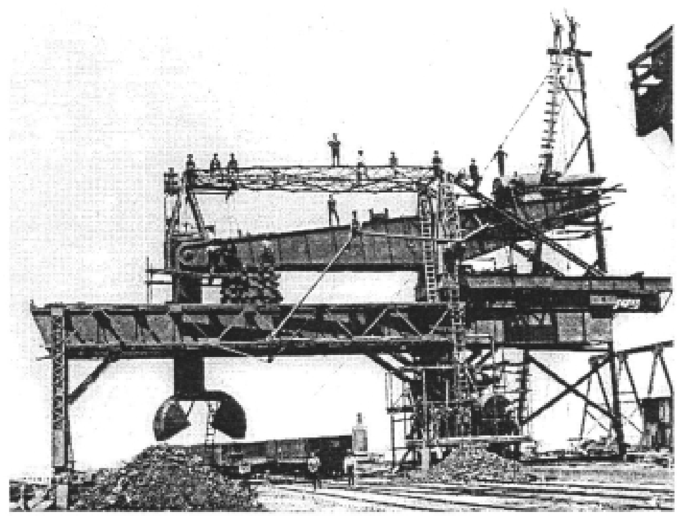


Brown Fast Plant bucket and men in hold
The Great Lakes Historical Society, Vermillion, Ohio

GEORGE H. HULETT[1]
The man and the idea

George Hulett was born on September 26, 1846 at Conneaut, Ohio, the son of pioneer settlers who had emigrated from Vermont in 1831. The family moved to Cleveland in 1860. Hulett attended the local schools and was graduated from the Humiston Institute in 1864. He conducted a general store at Unionville, Ohio, until 1881, when he returned to Cleveland and entered the produce and commission business.

Patent records show that, between 1887 and 1906, Hulett secured over two dozen patents for a variety of hoisting and conveying machinery. On April 5th, 1898, Hulett, along with John McMyler, secured a patent for an improved "loading and unloading apparatus." Hulett and McMyler's invention provided "means for reaching under the decks of vessels and unloading (cargo) rapidly and cheaply." According to the patent:



1899 - First Hulett iron-ore unloader, Conneaut
The Great Lakes Historical Society, Vermillion Ohio

> ... it consists of a suitable framework for the support of the mechanism, a leg supported thereby and depending therefrom, and a scoop or bucket connected with the lower end of the leg and capable of being turned completely around relative to its support.

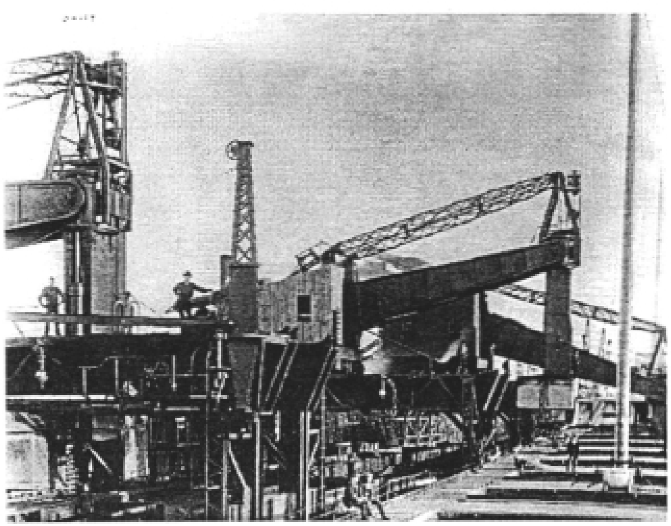
The new machine was designed to operate hydraulically, although "other means, such as steam or electricity, could be employed as well as water." Hulett soon perfected the new machine and secured subsequent patents in his name alone.

He died on January 12, 1923 in Daytona,

Florida and an obituary in the Iron Trade Review noted that, for thirty years, Hulett was "actively engaged" as a construction engineeer for a number of manufacturers of heavy machinery, including the Variety Iron Works and the McMyler-Interstate Company, both of Cleveland, and the Webster, Camp & Lane Company of Akron. When Webster, Camp & Lane later merged with the Wellman-Seaver-Morgan Company of Cleveland, Hulett, a member of the American Society of Mechanical Engineers, served as vice-president and director of the combined companies until 1918. During this period he worked to perfect the design of the Hulett with Samuel T. Wellman, also a member of the American Society of Mechanical Engineers and a past- president (1901).

HULETT IRON-ORE UNLOADER
An Overview

The first Hulett ore unloader, steam powered, rated at 275 tons per hour and with a 10 ton bucket, was placed into service at Conneaut, Ohio in 1899. The Webster, Camp, & Lane Company built it at its own expense on the contingency that if it didn’t work, they would not get paid and they would have to remove it. The first Hulett was a success and additional units were added in Conneaut.



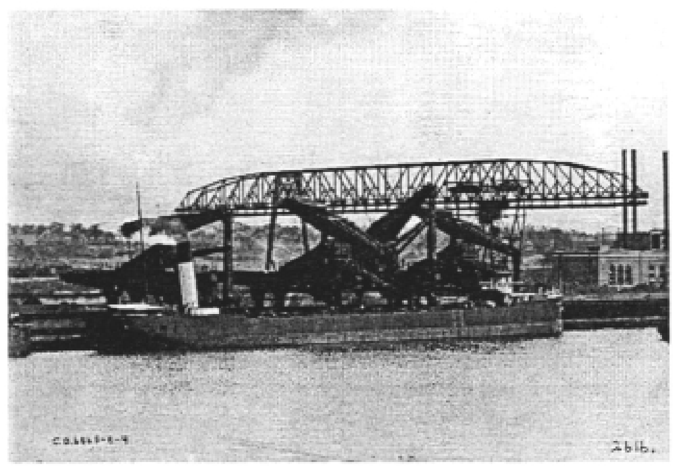
Battery of original Hulett ore unloaders, Conneaut
The Great Lakes Historical Society, Vermillion, Ohio

Over 75 Hulett ore unloaders were built between 1898 and 1960, with bucket capacities of 10 tons, 15 tons, 17 tons, 20 tons and 22 tons. Nearly 45 operated at docks on the shores of Lake Erie and the Cuyahoga River. They revolutionized vessel design and ore shipping on the Great Lakes.

The Hulett ore unloaders at the C&P Ore Dock were built in 1912. These unloaders (with 17 tons buckets, electrically powered, and rated at 1000 tons per hour) and the men operating them, set many ore unloading records, and made the City of Cleveland the largest iron ore terminus in the world. They remained a dominant factor in ore unloading for over 75 years, ceasing operation in December of 1992.

THE C&P ORE DOCK[1]

The Cleveland & Pittsburgh ore dock, now called Cleveland Bulk Terminal, was designed by engineers of the Wellman-Seaver-Morgan Company, and the Pennsylvania Railway. Built on forty acres of reclaimed land on the Lake Erie side of Whiskey Island. Slag and refuse served as fill and the dock was built of a double row of 40-foot reinforced concrete piles supporting a concrete superstructure heavily reinforced with 85-pound rails, strong enough to support the giant Hulett ore unloaders, weighing in at ~ 550 tons each. The face of the dock is 1,000 feet long.



Hulett unloaders & ore bridge, C&P Ore Dock
The Western Reserve Historical Society, Cleveland, Ohio

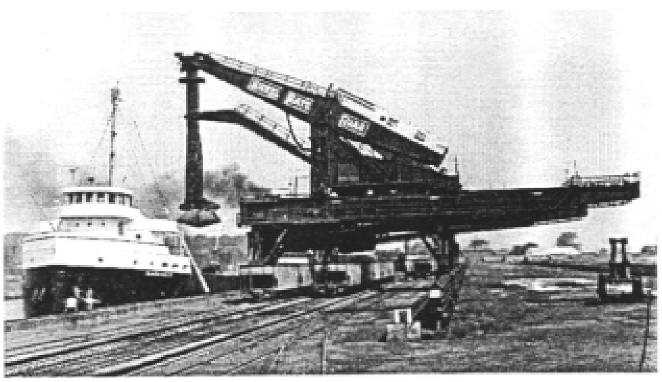
As built, the dock was equipped with four Hulett ore unloaders (each with a 17 ton capacity bucket); a stocking and re-handling bridge with a 15 ton capacity bucket; an electric power house to provide electric power for the Hulett ore unloaders, the stocking bridge, and the electric locomotives, referred to as “shunt cars”; and a one-million-ton capacity ore storage yard. An office and machine shop were added later. Except for the stocking bridge, knocked down in 1978 during a storm with winds of over 100 mph, all artifacts and buildings remain at the site today.

The C&P Ore Dock on Cleveland's Lakefront at 5400 Whiskey Island, including the Hulett ore unloaders and all the artifacts and buildings, was designated a Cleveland Landmark under ordinance No. 816-93, passed by the Council of the City of Cleveland on June 14, 1993. The C & P Ore Dock, artifacts, buildings and the Hulett iron-ore unloaders were placed on the National Register of Historic Places in 1997. The Cleveland-Cuyahoga County Port Authority owns the dock.

HULETT IRON-ORE UNLOADER[2]

W-S-M Automatic Ore Unloader

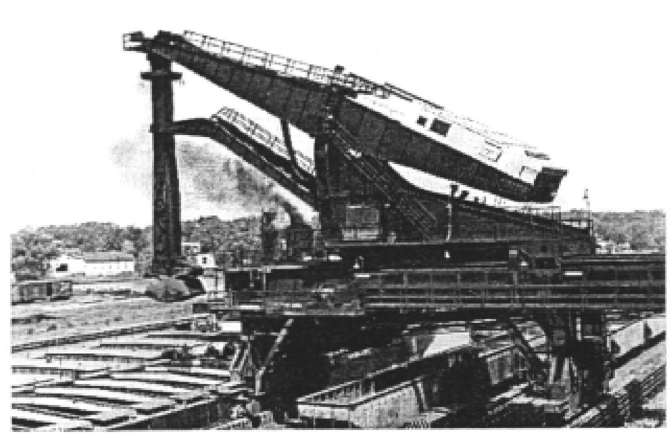
The automatic unloader shown below is unique in design and has proved through many years of service to be one of the most successful devices for unloading ore cargoes from lake



Hulett iron-ore unloader
The Great Lakes Historical Society, Vermillion, Ohio

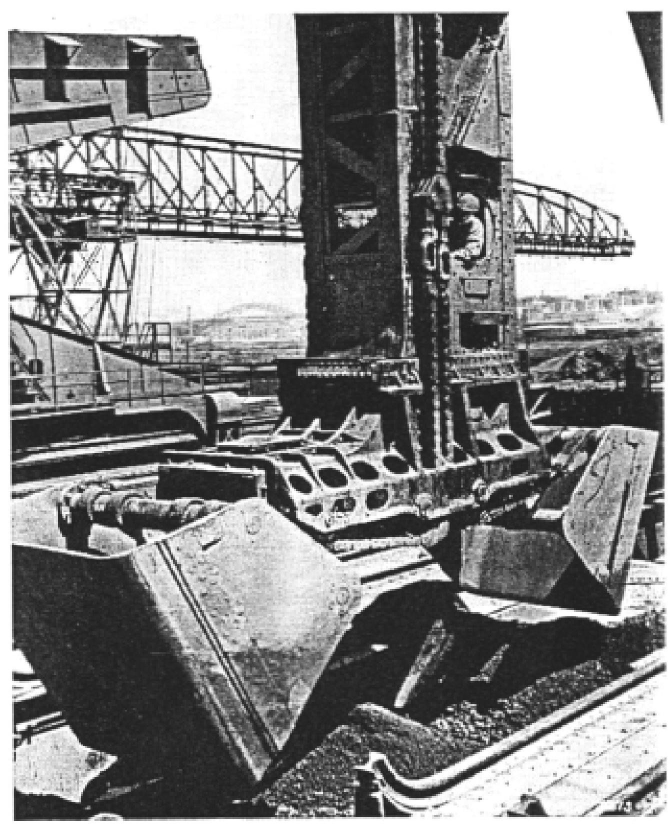
steamers that has ever been devised. Although of immense proportions, the design has been simplified and the control perfected to such a point that the machine is the last word in delicacy of control and operation.

The unloader consists of a main framework mounted on trucks which travel along the run-way rails which are located approximately as shown in the photograph. The main framework extends back to the rear runway over a temporary storage pile where the ore can be discharged if desired. Between the front and rear runways, space is provided for railroad tracks where ore carrying cars are placed under the machines and loaded with ore for transportation to the furnace plants. The girders of the main framework form a support for runway rails, on which a trolley travels. This trolley supports a balanced walking beam, from the outer end of which a stiff bucket leg depends. At the lower end of this leg is the bucket, which is



Hulett ore unloader at work
The Great Lakes Historical Society, Vermillion, Ohio

operated by machinery located on the walking beam. All horizontal movements of the bucket are accomplished by means of moving the trolley backward and forward on the girders. The vertical

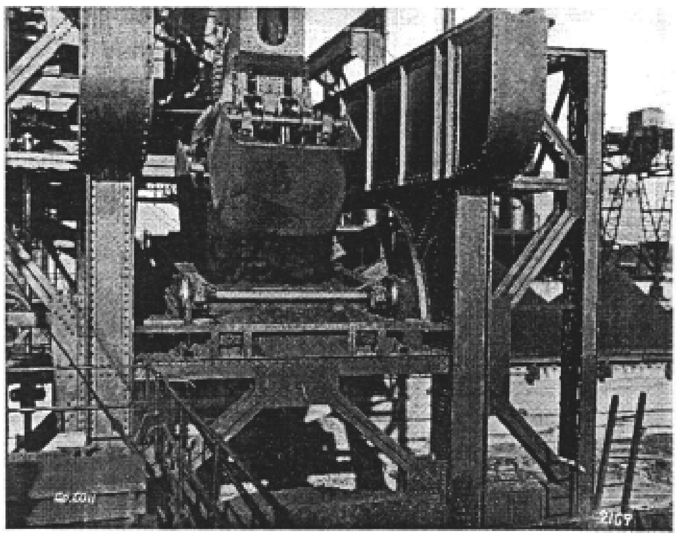


Leg & buckct of C&P Ore Dock Hulett
The Western Reserve Historical Society, Cleveland, Ohio

movements of the bucket are accomplished by the operation of the walking beam. The forward portion of the beam being out of balance, the bucket descends by gravity as soon as the brakes of the hoisting mechanism are released.

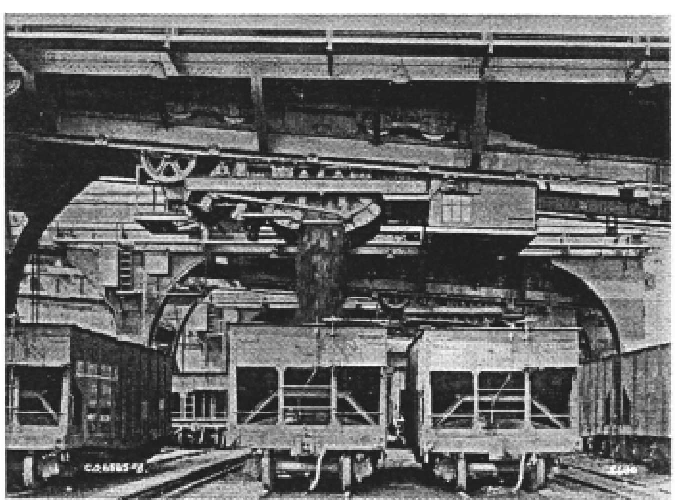
The hoisting mechanism controlling this operation is located in the enclosed house at the rear end of the walking beam. Ropes from the winding drums of this mechanism pass around sheaves located in the rear end of the trolley and are anchored to the rear end of the walking beam.

In addition to the main parts of the machine



Bucket discharging into hopper
The Western Reserve Historical Society, Cleveland, Ohio

which we have described, there is also a receiving hopper located at the forward end of the main framework and between the main girders, provided for the purpose of receiving the ore discharged from the bucket. The capacity of this hopper is about three full bucket loads and its



Larry discharging into railroad cars
The Western Reserve Historical Society, Cleveland, Ohio

purpose is to act as a balancing point for the ore between the bucket and the cars or storage as the case may be. The bottom of the hopper is provided with outlet gates and the contents is discharged as required into a larry which runs on an auxiliary track suspended from the under side of the main girders.

Larry discharging into temporary storage area
The Western Reserve Historical Society, Cleveland, Ohio

The larry, after receiving its load from the main hopper, moves to a point so that its contents can be discharged either into the cars standing on the railroad tracks beneath the main span of the girders or into a temporary storage pile under the cantilever at the rear of the machines. The ore so placed in this temporary stock pile cannot be reclaimed by means of these machines as their function is solely one of unloading the cargo from the ships.

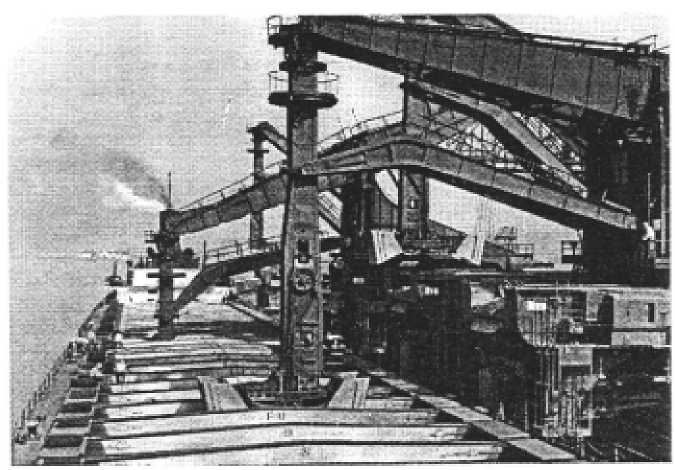
Machines of this type have been made in two sizes, the smaller size having a capacity of ten tons and the larger size having a capacity of seven-teen tons in the bucket shells. The machine shown here is electrically operated throughout and its speeds are regulated so as to operate through a complete cycle in about 50 seconds.

Some idea of the capacities of unloading by this method may be derived from a record which was made in Ashtabula by eight machines of this type having a capacity of fifteen tons each, unloading seven boats having a total capacity of 70,000 tons in 22 hours, actual time. At other points, four machines working in boats having capacities up to 13,000 tons have unloaded these cargoes in about three hours and twenty-five minutes.

The operation of the machine is as follows:

After the boat has been placed along side of the dock, the machine is moved opposite one of the hatches and the bucket is lowered through the hatch into the ore. After filling the bucket, the walking beam hoist mechanism is put in operation and the bucket hoisted out of the boat. At the same time, the trolley is traveled back so that the bucket is brought over the main hopper between the girders in the main framework and its contents is discharged into this hopper. The bucket is then immediately returned to the boat for another load. The ore in the main hopper is discharged into the larry which has been brought to a point directly underneath the discharge gates of the hopper. The larry hopper is filled and the larry is moved over the desired discharge point and the gates of the larry hopper are opened discharging the ore as required. The larry hopper is provided with scales so that the contents is accurately weighed and recorded. In this way, a car can be loaded to its allowable capacity and an accurate recod kept of the amount of ore so discharged into the car thus eliminating the necessity for the use of track scales.

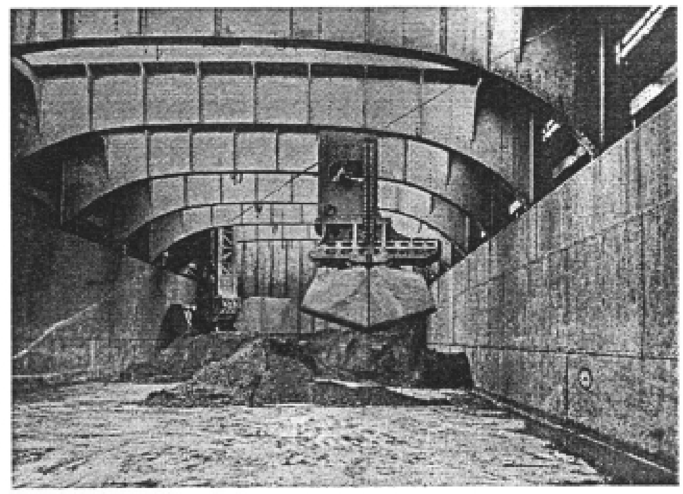
If railroad cars are not available for immediate shipment, the larry is traveled to a position on the rear cantilever and its contents discharged into a temporary storage pile, from which it is usually re-claimed for shipment or storage by means of a bridge, located on the runway at the rear of the unloader.



Battery of Hulett ore unloaders, C&P Ore Dock
The Great Lakes Historical Society, Vermillion, Ohio

Only two operators are required for the entire operation of one of these machines. One of the operators, whose station is in the bucket leg directly over the bucket shells, controls all of the motions of raising and lowering the bucket, of traveling the trolley back and forth, and moving the machine along the dock from one hatch to another. The second operator is stationed in a cab on the larry and from this station he controls the movement of the larry, the operation of the larry gates, and the weighing of the ore.

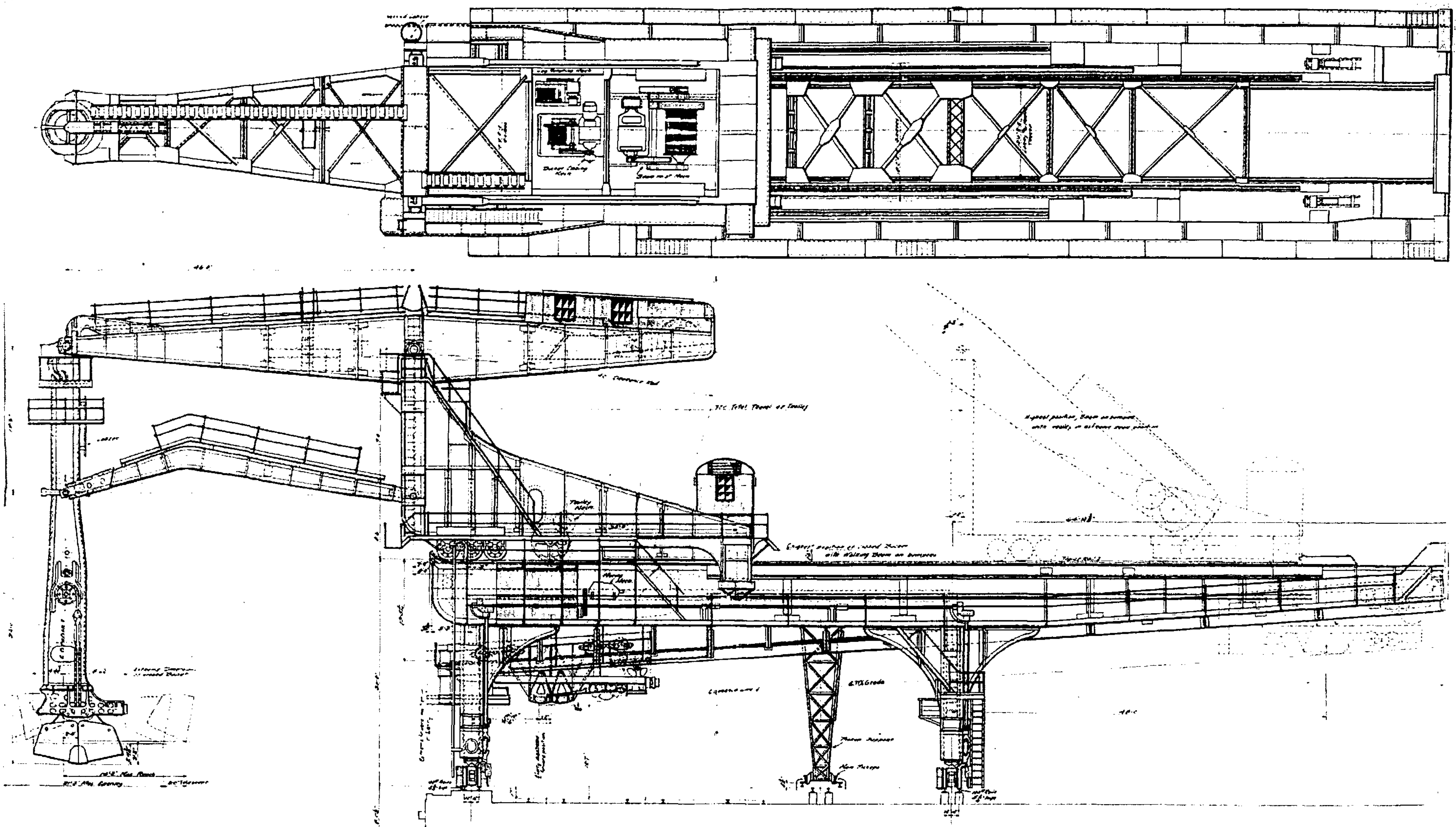
An idea of the arrangement of the bucket is given by the illustration above. The bucket shells are each made of a single piece of plate



Hulett buckets inside hold of ore ship
The Great Lake Historical Society, Vermillion, Ohio

formed to the shape as shown on this photograph. These bucket shells are usually provided with manganese steel cutting lips which are essential to resist the abrasive action of the ore. The bucket shells themselves are carried on heavy cast steel arms mounted on rollers traveling in guides in the fixed portion of the lower end of the bucket leg. The position of the operator who controls the operation of the bucket, etc., as previously described, is also shown on this photograph. The view shows the bucket in operation in the hold of the modern ore carrier after most of the ore has been removed and the balance of the ore has been scraped into position so as to be handled by the bucket.

The motor for operating and closing of the bucket is located in the machinery house at the back of the walking beam. Ropes from this bucket closing mechanism are carried through the walking beam and the bucket leg and attached to a power drum in the bucket leg directly over the operator. This power drum is geared to the closing chain drums, one of which is shown on this photograph. The bucket is closed by rotating the



Reference Drawings

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THE WELLMAN-SEAVER-MORGAN CO.
CLEVELAND, OHIO U.S.A.

CONTRACT No. 7178 PROPOSAL No.

SUBJECT 17 Ton Hulett Ore Unloader

General Drawing

DRAWN BY J.T.B. CHECKED BY R.E.S. APPROVED BY

SCALE DATE DRAWING No. 52630

52630

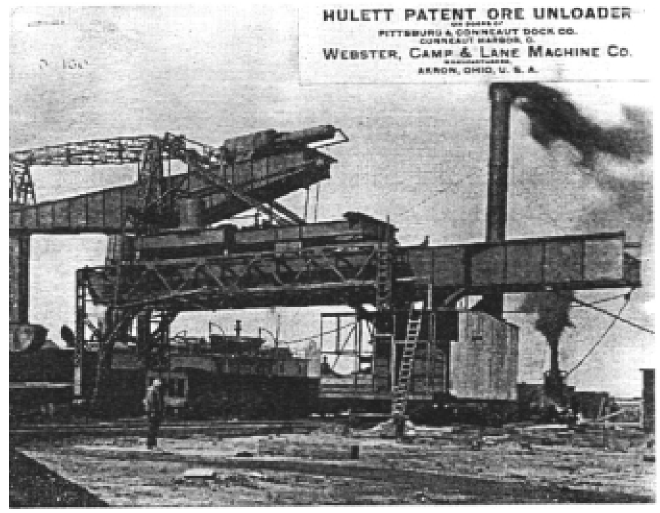
drums in the proper direction. The bucket is opened by reversing the motor and the bucket shells are forced open by means of an opening chain located in the center of the bucket leg between the two closing chains.

In addition to the vertical movement, which is given to the bucket leg by means of the walking beam, it also has a motion of rotation around its vertical axis. This is accomplished by means of ropes attached to a segment on the bucket leg itself, the ropes being carried back in the walking beam to a rotating mechanism which is located adjacent to the bucket closing mechanism. The bucket leg itself is carried on a roller bearing which is attached to the top end of the leg. This motion is introduced for the purpose of turning the bucket at right angles to the hatch-way in order to secure as great a reach lengthwise of the boat as possible, thus the bucket is enabled to reach out under the hatches and remove ore which is not directly beneath the hatch opening. The distance from point to point of the bucket shells when open is approximately 21 feet.

The scale tarry, into which the main hopper discharges, has a capacity of between 35 and 45 tons and two larry loads are intended to constitute a full carload of ore. The arrangement of the discharge gates of the larry is that they are suspended from the sides of the larry frame and operated by con-necting rods which attach to cranks, also connected to the main larry frame, these gates being operated by means of a small motor which is carried at the rear of the larry. The gates are so arranged that all or a portion of the contents of the tarry may be discharged. The hopper of the larry is suspended in the larry frame on scales so that the contents of the larry may be wholly or partially discharged and be accurately recorded.

The mechanism for moving the larry back and forth on its track is also located on the larry and consists of winding drums upon which ropes are wound, the end of the rope being attached to the rear end of the cantilever on the main framework. The larry track is inclined and the larry is pulled up the incline by means of these ropes and descends by gravity.

As previously stated, these machines are usually electrically operated throughout. In some cases, however, machines of the same general type have been made to operate by steam and hydraulic cylinders, water being supplied to the operating cylinders by means of a steam accumulator which furnishes water at a pressure of 1,000 pounds per square inch. The machine shown below was steam operated.



Original Steam Hulett ore unloader, Conneaut

The Great Lakes Historical Society, Vermillion, Ohio

The electrically operated machines are usually designed for a 220 volt direct current. Alternating current is never used. The motors required for the equipment of one of these machines are as follows:

Beam Hoist	1	motor	275 HP
Bucket Closing	1	"	120 "
Bucket Rotating	1	"	25 "
Trolley Travel	1	"	120 "
Hopper Gates	1	"	100 "
Longitudinal Travel	1	"	100 "
Larry Travel	1	"	150 "
Larry Gates	1	"	40 "

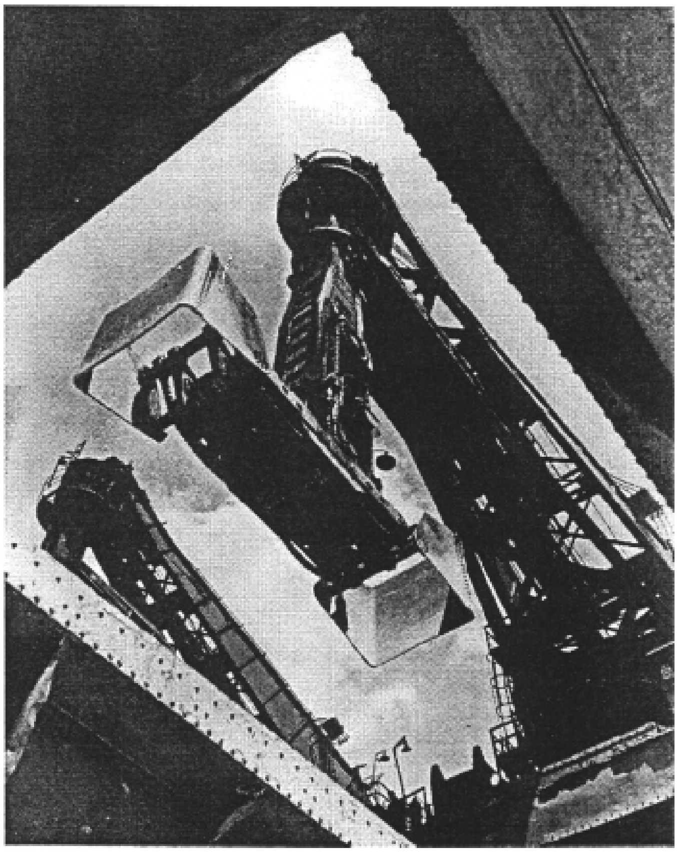
The control equipment for these motors is of the magnetic switch type throughout, having master controllers in the operators' cabs in the bucket leg and on the larry.

Electric current is supplied to these machines by means of insulated conductor rails running the length of the main runways. The current is collected from these rails by means of pickup shoes and distributed to the various portions of the machine. A similar collecting device is also employed for supplying the main current to the trolley. Conductor rails are attached to the main framework of the machine and the current collected from these rails by means of pickup shoes attached to the trolley.

Many points of superiority are presented in the Wellman-Seaver-Morgan Ore Unloader, which are not found in other systems of unloading.

The design is very heavy; there is little to get out of order, resulting in low maintenance cost per ton of material handled.

The control is accurate and positive, and manual labor is reduced to a minimum.



Hulett bucket configurations
The Great Lakes Historical Society, Vermillion, Ohio

The bucket is positively guided in passing through the hatches of ships, thus eliminating the danger of damage either to the boat or to the machines, arising from the use of rope suspended buckets.

The operator travels with the bucket into the boat, and can always see exactly what he is doing.

The bucket is of extremely large capacity, hut is so suspended from the walking beam that the weight resting on the tank top of a boat is less than one-third of the weight of a rope suspended bucket of equal capacity. In fact, it is impracticable to use a rope operated bucket of anything like the size attained on these unloaders.

One particularly important point to be considered is the extremely low cost obtainable with these machines. Records extending over long periods show unloading cost ranging from 2-1/2 to 4-1/2 cents per ton, which includes superintendence, labor, repairs and materials on the machines, as well as the cost for power and light

On account of the high capacity of these machines, the number of units required is less by a considerable margin than of a smaller type lighter machine, which results immediately in a decreased cost of operation, for the reason that a fewer number of skilled operators is required.

Again, on account of the extreme reach of the bucket, it is possible for the machine to discharge a very much higher percentage of a ship's cargo than can be accomplished by ordinary rope operated buckets. The bucket can be rotated at right angles to the hatch and reach out for ore which would be entirely inaccessible to an ordinary bucket.

It can be conclusively shown in plants where large tonnages are to be handled that there is a distinct saving in first cost, as well as a yearly saving in the cost of operation, over any other type of machine.

This unloader is not a combined machine. It is an unloader,--pure and simple, and it does its work well.

End W-S-M Co. Bulletin No. 27

HULETT IRON-ORE UNLOADER [4]

Technical challenges

The most serious mechanical problem associated with the first unloader was with the clamshell bucket. It was a completely enclosed half shell. Iron ore had a tendency to pack into the bucket which slowed unloading operations or stopped them entirely. A square bucket was then tried. though it too had the same problem.

Finally, a dock foreman cut the top off each side of the bucket and it worked fine. Instead of perching ore into the bucket it could now heap up. The concept was further developed by having only sides and a bottom to the bucket.

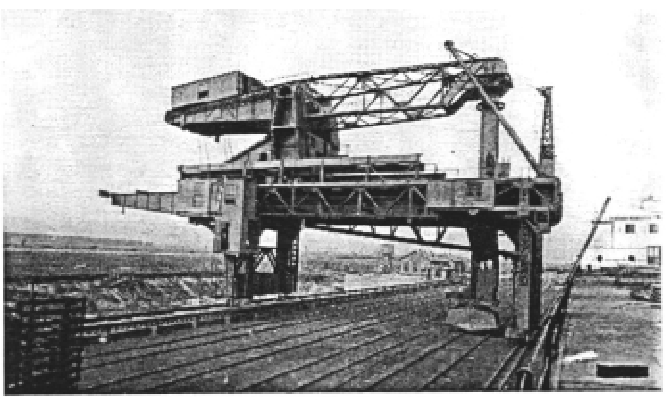
About the time the final Conneaut Huletts entered service the Lackawanna Steel Company of

Lackawanna (Buffalo), New York. ordered four similar machines. However, their walking beams were bent at the pivot point. They also had long conveyors mounted behind them so ore could be placed into a stockpile. Another significant difference was they were electrically powered.

Two machines, steam powered, almost identical to the Conneaut Huletts were erected for the Buffalo. Rochester & Pittsburgh Railroad in Buffalo about 1901.

The most important change was to redesign the manner in which the leg was mounted on the walking beam, on the first machines the top of the leg was mounted in a rotating. hinged collar on the walking beam. A light truss above the walking beam stabilized the leg by means of an extension leading to it. This probably worked adequately though one must suspect the support truss/leg extension was under a lot of stress when the machine was operating.

To solve this problem Hulett placed the walking beam at the top of a lengthened leg and added a horizontal stabilizer midway. This greatly



Hulett open grid walking beam, direct loader
The Western Reserve Historical Society, Cleveland, Ohio

reduced stresses in the machine. Another change was to use crude hoppers, then conveyor belts to load cars. The first machines apparently loaded cars by dropping down between the main girders and carefully dumping into the car. This isn't surprising since other unloading systems were little better. Using a hopper and/or conveyor belt not only simplified the loading process but also greatly accelerated cycle time.

These second generation machines were readily identifiable by an open truss on the forward half of the walking beam. Several of these 10-ton machines were installed at docks in Cleveland, Gary, and Lorain. Electric motors replaced the steam cylinders. The walking beam was operated by cables and counterweights at its rear. The bucket, now perfected, was opened and closed by a heavy chain on the side of the leg rather than levers as on the first Hulett.

In 1908 the third generation Hulett came on the scene. In addition to a radically increased

Huletts 15 ton bucket
The Western Reserve Historical Society, Cleveland, Ohio

capacity. 15 vs. 10 tons, it resembled the original machines rather than the second generation Hulett because it had a solid girder walking beam, The first battery of four 15-ton Huletts was built at the Superior (later A&B) dock in Ashtabula, Ohio.

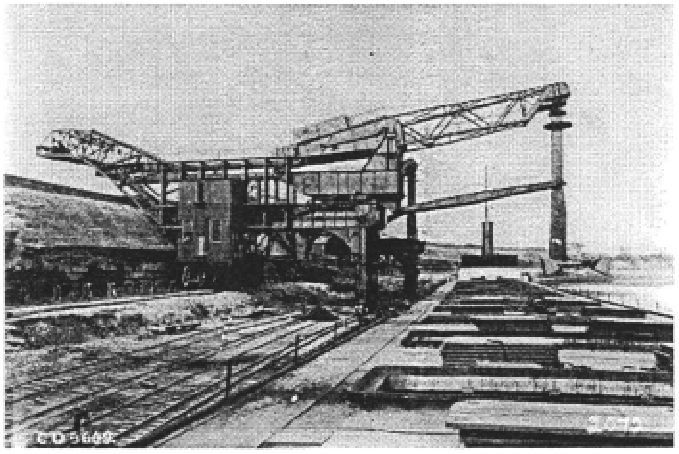
An idea of the productivity of the new 15-ton Hulett becomes apparent by studying Table I. Note the significant cost differential per ton for the Hulett compared to the Hoover & Mason machines.

Table I

Type	Capacity	Tons/Hr.	Cost/Ton
1905 Hulett	10-Ton	278	$ .088
1908 Hulett	15-Ton	475	$ .058
1906 Hoover & Mason	6-Ton	253	$ .108

Hulett with stocking conveyor
The Western Reserve Historical Society, Cleveland, Ohio

The cost/ton figures were based on results during the 1909 season. The 1905 Huletts were at Lorain: the 1908 at the Superior dock in Ashtabula: and the Hoover & Mason wire rope machines at the PLEA dock in Ashtabula. It is readily apparent why the Hulett became the king of the lower lake docks.

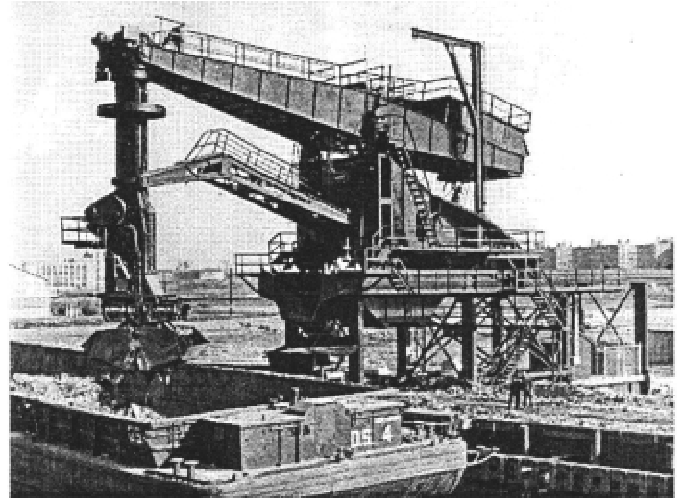


Extended trolley travel Hulett, Lorain
The Great Lakes Historical Society, Vemillion, Ohio

Despite their many advantages Huletts weren't used at all docks. In some cases, often at steel mills, the owner wanted a machine that could load cars, put ore into a stockpile, and later take it out of the pile for use in the blast furnace. Huletts at Lorain and Lackawana were specially equipped with rear extensions for this reason but still needed an ore bridge. The result was most steel mill docks used ore bridges which could perform all the necessary functions.

As with almost everything, there were variations on a theme. The Lorain and Lackawanna Huletts have already been discussed, though the former had a particularly unique aspect to them. Because the dock was built on a bend in the river they were designed so the trolley could move out beyond the main base.

Other oddballs were a pair built for the Wheeling & Lake Erie Railway in 1914. They were steam powered because the railroad didn't want to build a powerhouse. Reportedly some of the early electric Hulett installations drew their power from city power plants. Whenever they were operating. the electrical drain dimmed the town's lights. As a result almost all docks constructed their own powerhouses, in later years the utility companies had power plants large enough



Hulett unloading garbage, New York City
The Great Lakes Historical Society, Vemillion, Ohio

to meet the Huletts' needs.

A unique installation was in Fort William, Ontario, where a pair of Huletts was built for the Canadian Pacific Railway. They were the only Huletts on Lake Superior. However the odd thing about them was the fact they were used to unload coal. Because of the low cubic weight of coal they were rated at only eight tons.

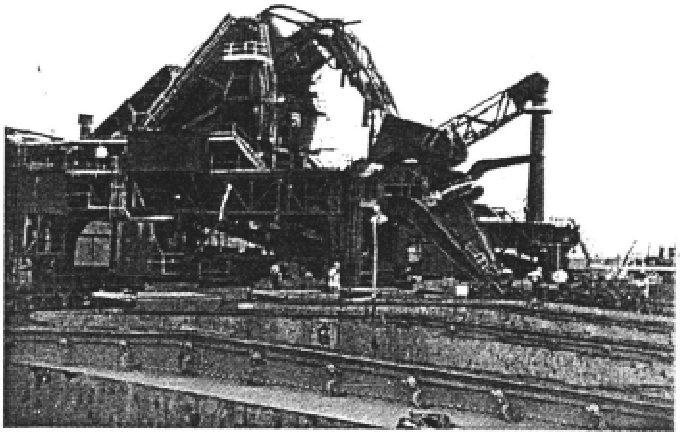
Then there was the single Hulett in New York City used to unload garbage from scows!

The only other Hulett on saltwater was at Sandy Hook. New Jersey. Huletts were not suited for use there because they cannot adjust to the tide.

Last Hulett Built - 20 ton bucket, Lorain
The Great lakes Historical Society, Vermilion, Ohio

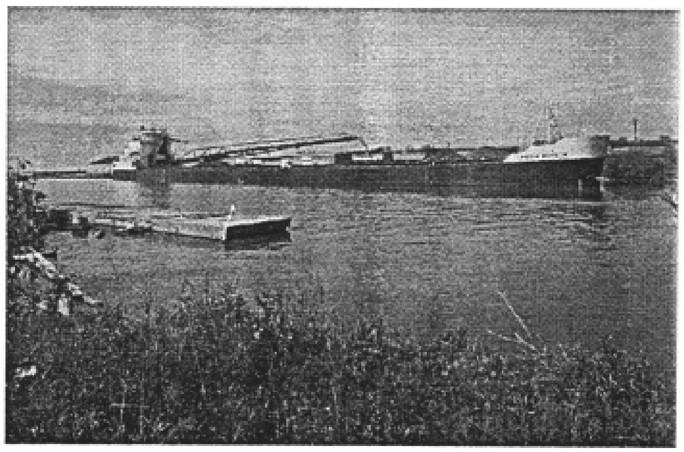
The Last Hulett

The last Huletts were built at Lorain. Ohio



Damaged Hulett
The Steamship *William G. Mather* Museum, Cleveland, Ohio

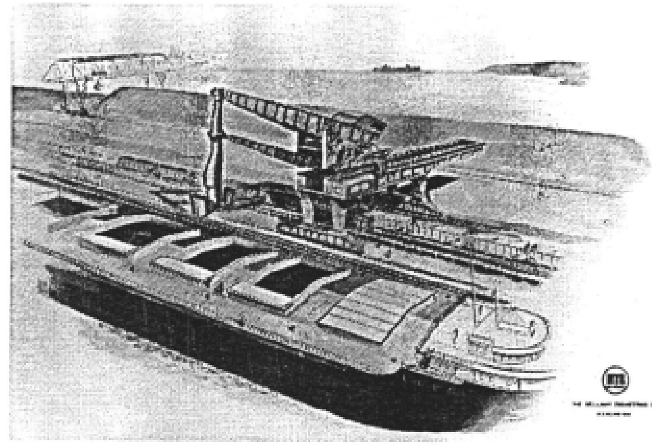
in 1960. Like their predecessors at that dock they were a special design in which the trolley moved beyond the front of the traveling base. These machines represented the final version of the design comprising all the many improvements and they had a 20 ton capacity.



Self-Unloader Ship *Fred R. White, Jr.*
The Steamship *William G. Mather* Museum, Cleveland, Ohio

Huletts were sometimes involved in unusual accidents. Several were tipped onto their side when a boat's bow fouled them. In a few cases the walking beam buckled, and in others the bucket and leg free fell into the cargo hold when the cables at the rear of the walking beam broke. Sometimes the leg caught on the side of a hatch and broke off.

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 Hulett Ore Unloaders and the Steamship *William G. Mather* working combination in terms of economy and efficiency. There were plans in the conceptual stage to build 50 ton



Concept - 50 ton bucket Hulett
The Great lakes Historical Society, Vermillion, Ohio

bucket capacity Hulett ore unloaders but they never materialized.

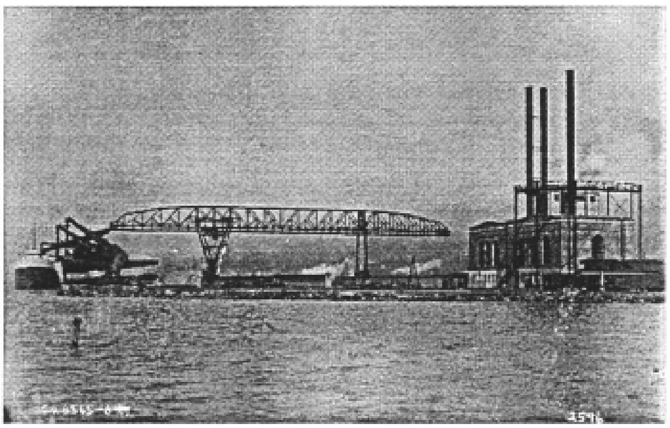
HULETT IRON-ORE UNLOADER
C&P Ore Dock Hulett
Specifications

Length:	~	108 ft.
Width:	~	19 ft.
Height: (leg retracted)	~	*96* ft.
Gross Tonage:	~	550 tons
Bucket Capacity: (Iron ore)		17 tons
Power: (Electric Motors)		220 V DC
Operators: (Unload ship)		2

HULETT IRON-ORE UNLOADER
Timeline

1844 - Iron Ore discovered in the Lake Superior region
1852 - First Iron Ore shipped to Lower-Great-Lakes
1854 - The Marquette Range in Michigan's Upper Peninsula begins ore production
1855 - Lock at Sault Ste Marie Canal, Michigan opened - 1450 tons iron ore pass through it
1881 - Alexander Brown develops Brownhoist unloader, dramatically increases efficiency
1892 - Extraction begins - hematite ore from Minnesota's Mesabi Range
1896 - Wellman-Seaver-Morgan Co., a Cleveland manufacturer of heavy equipment, is founded
1898 - George H. Hulett patents first ore unloader
1899 - First Hulett unloader built by Webster, Camp & Lane Co. goes into service at Conneaut, Ohio
1903 - Wellman-Seaver-Morgan Co. acquires assets of the Webster. Camp & Lane Co.
1904 - The *Augustus P. Wolvin* is launched, the first ore boat with continuous arch, hopper hold construction, built to accommodate the new Hulett ore unloaders
1907 - The *Wyandotte,* first steel ship with a continuous self-unloading apparatus, goes into service
1912 - New C&P Ore Dock, equipped with four 17 ton Hulett unloaders begins operations
1925 - The Stemship *William G. Mather,* another ASME Historical Mechanical Engineering Landmark, is launched
1930 - The Great Depression virtually brings steel industry to a standstill
1939-1945 - WW II results in an unprecedented demand for iron and steel. In 1942, C&P Ore Dock Huletts unload 8,744,139 tons of iron ore from 1081 ships

1955 - First commercially viable taconite processing facility, operated by the Reserve Mining Co., opens in Silver Bay, Minnesota
1959 - The St. Lawrence Seaway opens
1960 - The last Huletts to be built go into operation at Lorain
1968 - The Poe Lock at Sault Ste Marie opens. 1200 ft. long, 110 ft. wide, and 32 ft. deep
1971 - First 1000 ft. vessel, the *Stewart J. Cort,* Bethlehem self-unloader, goes into service
1976 - Interlake's *James R. Barker,* prototype for 1000 ft. self-unloader vessels, goes into service
1992 - Hulett unloaders at C&P Ore Dock unload their last cargo from Canadian freighter *Lemoyne* on December 18th
1993 - Cleveland City Council designates the C&P Ore Dock, including the four Hulett ore unloaders, a Cleveland Landmark
1997 - C&P Ore Dock, including the four Hulett ore unloaders, are listed on National Register of Historic Places
1998 - Hulett ore unloaders at C&P Ore Dock designated ASME Historic Mechanical Engineering Landmark



C&P Ore Dock - early operation
The Western Reserve Historical Society, Cleveland, Ohio

C&P ORE DOCK OPERATION[1]

The ore stocking and rehandling bridge consisted of a truss bridge supported by a shear leg (toward the rear of the dock) and a main tower (closest to the Hulett machines). The bridge had a main span of 266 feet, with 173-foot cantilevers at each end. The main tower and shear leg were mounted on trucks that travelled on rails atop concrete walls. A 1.5-ton grab bucket, suspended from a trolley mounted on trucks on the underside of the bridge, transferred ore from the ore trough to the storage yard and, later, loaded it into railroad cars for shipment. Two 75 h.p. motors feared to the trolley axles drove the trolley. Like the Huletts, the action of the grab bucket was regulated by opening and closing ropes wound on separate drums and operated by separate motors in the trolley. The lateral movement of the ore bridge across the face of the dock was controlled from a house mounted on the maintower. Separate 75 h.p. motors drove the tower and shear legs of the bridge. The bridge operator's house was located so that the trolley operator could position the trolley opposite the house and step into it whenever the bridge had to be moved to a new position along the dock. Under favorable conditions, the stocking bridge handled about 1,000 tons of ore each hour.

The track system at the dock was arranged as follows: Empty cars were stored in a yard at the east end of the plant, from which they could be switched to one of four tracks beneath the unloaders or to a single track that ran along the north wall of the storage bridge. Loaded cars were assembled into trains in a large yard south of the storage yard. Thus the movement of cars at the dock was continuous.

Electric locomotives, called "shunt cars," moved the rail cars about the dock. These locomotives, made by Baldwin-Westinghouse, ran on narrow-gauge (42-inch) tracks and were equipped with "side pusher arms" designed to push, or "shunt" the cars along adjacent standard-gauge tracks. Conductor rails between the narrow-gauge tracks supplied power to the locomotives. The shunt cars handled both single cars and trains.

When the boat arrives, electric "shunts" shuttle the empty rail cars into place beneath the Hulett unloaders. There are four unloading tracks, one for each Hulett machine. The shunts run on narrow-gauge tracks between each two unloading tracks. The shunt's "side pusher arms," powered by compressed air, may drop on either side to engage the end sills of the rail cars, thus enabling them to move cars on two tracks at the same time. During unloading, the shunts keep the cars in proper position under the Huletts for even loading. There are six shunts at the C & P Dock, including two formerly employed at Cleveland's Erie Dock, now abandoned. Each shunt is able to handle from 10 to 12 empty cars or 6 loaded cars at a time.

With the empty cars in place below, the Huletts begin the work of unloading the ore. Each machine requires three persons to operate: the Hulett operator, the "larryman," and an oiler. The Hulett operator sits in a cab in the leg above the bucket, he controls the movements of the walking beam and bucket, as well as the lateral movement of the entire machine along the face of the dock. When the bucket has taken its 17-ton bite of ore, it is raised out of the hatch and run back until it is in position to empty its load into dual receiving hoppers supported on the main framework of the Hulett. The larryman discharges the ore in the receiving hopper through dis-type gates into a "scale larry." The larryman, seated in a cab inside the scale larry, records the weight and then moves the larry horizontally until it is in position above an empty rail car. He discharges the ore through a hopper into the car, then returns to the receiving hopper for another load. The process is repeated until the rail car is full. The shunt shuttles empty cars beneath the hopper as they are needed, and meantime pushes loaded cars to the east end of the yard, where they are made up into trains. Trains dispatched from the C & P Dock usually consist of 80 to 85 loaded cars plus caboose.

The operation of the Huletts is coordinated by a foreman stationed on the deck of the vessel. It is his job to see that the ship is unloaded efficiently and that it is kept at an even keel to avoid undue stress to the hull. To accomplish this, the Huletts are frequently shifted laterally along the dock during unloading. Another foreman keeps watch over the operation on the dock.

When the majority of the cargo has been unloaded, tractor scrapers assisted by gangs of shovelers "clean up" in the hold. The Hulett machines act as cranes, lowering the tractors into the hold. The ore that has scattered to the corners of the vessel or otherwise out of reach is gathered together in piles for the final few grabs by the Huletts. The tractor scrapers were first introduced for "clean-up" about 1952; previously only shovelers did the job.

If the ore is not to be shipped immediately, the larryman moves his car along the cantilever at the rear of the Hulett and deposits the ore into the storage yard. About 90% of the ore arriving at the C & P Dock is shipped immediately, however, and the storage yard at the dock does not grow appreciably large until fall, when many mills store surplus ore at the dock for shipment durng the winter months, after dock operations have ceased. The ore bridge that formerly transferred ore within the storage yard was destroyed by a blizzard in January 1978, and the work of the bridge has since been taken over by front end loaders equipped with scales. The concrete walls of the ore storage through have been removed. Since the 1930s, power has been purchased commercially rather than manufactured at the dock's power house. The dock's original offce is still in use.

Boats tying up at the C & P Dock generally were in the 6,000- to 8,000-ton class, although some carried as much as 32,000 tons. With all four Hulett machines working, an average of 3,000 long tons were handled each hour. Approximately 80 men working two 8- to 12-hour shifts, six days a week, were required during the shipping season. The shipping season ran eight or nine months, usually beginning in April and ending in late December or early January. The majority of ore unloaded at the C & P Dock was shipped inland to furnaces in Ohio, Pennsylvania, and West Virginia.

One-thousand-foot self-unloader boats, which carry their own conveyor systems, eventually led to the replacement of the Huletts. The first such boat to tie up in Cleveland arrived at the C & P Dock on the evening of 12 August 1979. The "George A. Stinson," carrying 57,000 tons of iron ore pellets, was part of Conrail's experiment to see what changes Will be needed at the dock to accommodate the huge vessels for regular commercial service.

REFERENCES

Most of the information that follows (with substitute images) at these referenced points is a direct excerpt from:

1 - Citation for HAER Report:
United States Department of the Interior, National Park Service, Historic American Engineering Record, **"The Pennsylvania Railway Ore Dock (Cleveland & Pittsburgh Ore Dock)."** prepared by Carol Poh Miller, October 1979

2 - Wellman-Seaver-Morgan Co.'s
Bulletin No. 27 May, 1919
"W-S-M Automatic Ore Unloaders"

3 - The Great Lakes Historical Society
Inland Seas Volume 31 - Winter 1975 - Number 4
"Barrels to Barrows, Buckets to Belts: 120Years of Iron Ore Handling on the Great Lakes" by John A. Burke

4 - The Great Lakes Historical Society
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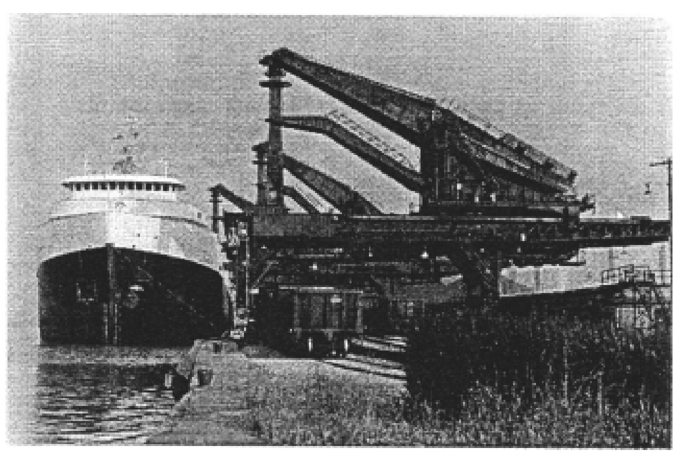
"The Hulett Story" by Eric Hirsimaki



Last ship unloaded, the *Lemoyne,* December 1992
Carol Poh Miller, Cleveland, Ohio

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

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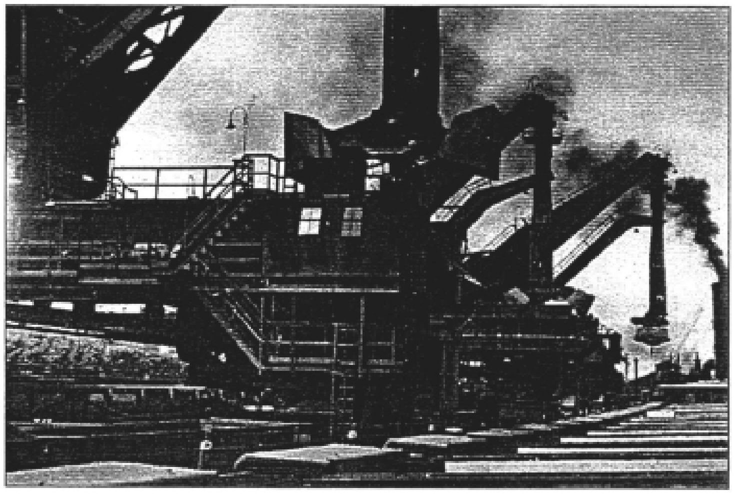
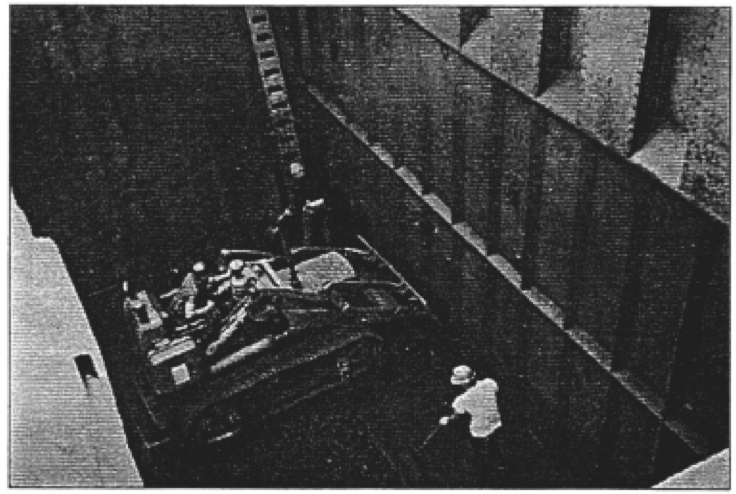
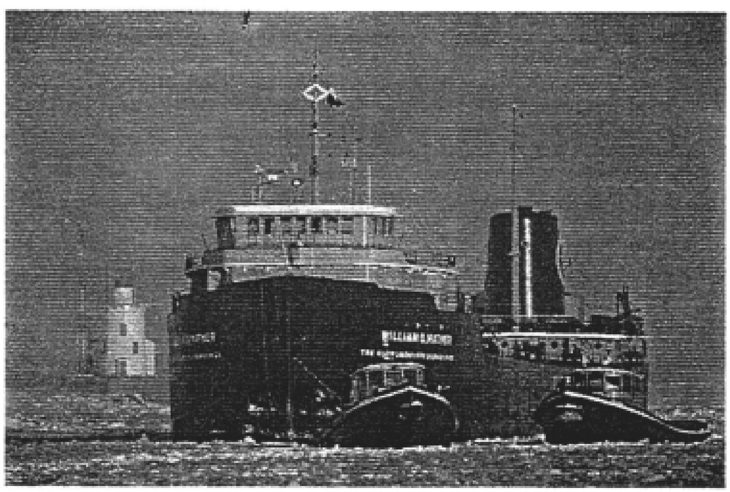
The Hulett Ore Unloaders at Whiskey Island and the Steamship *William G. Mather*



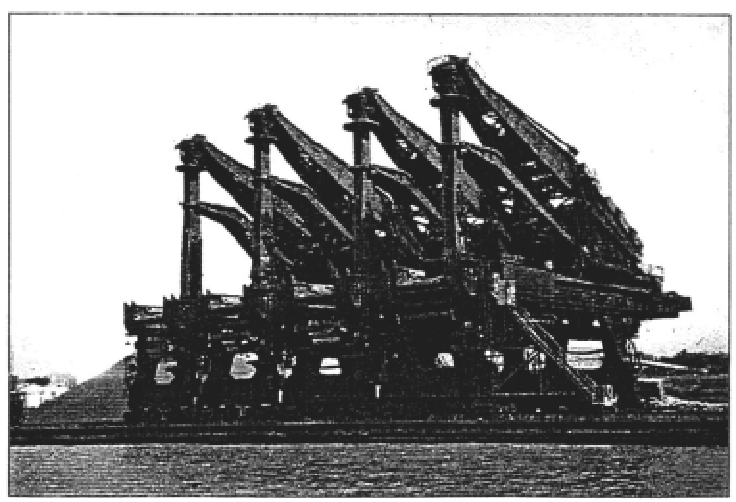
The William G. Mather being unloaded at Whiskey Island - Cleveland, Ohio



Bulldozer and men working inside bulk cargo hold



Steamship *William G. Mather* at the mouth of the Cuyahoga River



Hulett Ore Unloaders at Whiskey Island in Cleveland, Ohio