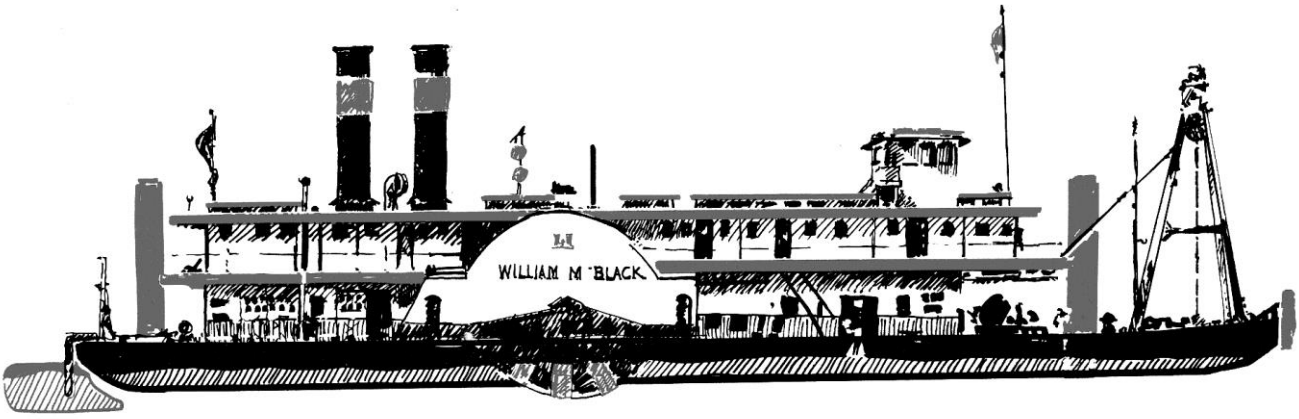
All Hands on Deck!
Exploring the
William M. Black



National Mississippi River Museum & Aquarium

History Education Curriculum

Target Grades:	3rd – 7th grade
Key Words:	U.S. Army Corps of Engineers, dredgeboat, river navigation
Subject Areas:	Dredging, steam power, river depth, river transportation, river channelization
Duration:	45 minutes

Title: ***All Hands On Deck! Exploring the William M. Black***

Summary:

This hands-on program gives students a look at the life of a river boatman working on a steam dredgeboat. Students will learn a few important skills of boatmen such as taking river depth soundings, knot tying, duties of the crew and officers, and how steam powered the boat.

Objectives:

To learn about river life from hands-on experiences shared by boatmen working on a United States Army Corps of Engineers dredge boat.

Group Size: 15 – 20 students

Background for Educators:

Dredging is an important occupation on navigable river. As we read stories from Mark Twain or other writings from a time before locks and dams on the Mississippi and Missouri Rivers, we learn about boats getting stuck on sandbars, getting caught on submerged logs and snags, and encountering rocky rapids or falls that made boat travel dangerous and sometimes impossible.

To alleviate some of the navigational hazards on river the U.S. Army Corps of Engineers has been charged with making the Mississippi and Missouri rivers more navigable to large boats and barges. The building of locks & dams, construction of wing dams to channel the water flow, and dredging of the river bottom to maintain a nine foot navigation channel have all helped to make boat travel safe and possible even during low water levels.

The William M. Black dredgeboat, located in the Ice Harbor at the National Mississippi River Museum & Aquarium, is a National Landmark.

Background information and history on the William M. Black

(This material gleaned from archival material and interviews with former officers and crew from the William M. Black and the Meriwether Lewis by former museum educator, Roger Thiede. Original written April, 2002; revised and updated - October, 2002; post script added June 12, 2003; reviewed, corrected and updated January, 2006. All the material is or can be documented with the exception of any reference to the 21 day work shift that may have been followed in the 1930's.)

The boat

When built – The WMB was built in 1934 and was commissioned in November, 1934, following Coast Guard inspection and licensing. Construction took 210 days from laying the keel to commissioning. She began dredging the next year, 1935. The WMB operated from the spring of 1935 until the fall of 1973, 39 seasons in all.

Where built – The WMB was built at ship yards at Point Pleasant, West Virginia by the Marietta Mfg Co. Today little remains of what was, for many years, a very active ship building industry at Point Pleasant. Point Pleasant is on the Ohio River at the confluence of the Kanawha River, about 40 miles north of Huntington, WV.

Boat data – The WMB is 277 feet from headlong to stern and 85 feet abeam at the wheel boxes. The hull is 8.5 feet deep, 50 foot wide and was originally made from hot riveted steel plate 5/8ths of an inch thick. The original hull was replaced by a welded steel hull in the 1960's. The boat has a displacement of about 1700 tons (3,400,000 pounds), dry and draws between 4.5 and 5 feet of depth when working. From the waterline to the top of the stacks is about 70 feet. The stacks are hinged and will tip so she could get under some of the bridges on the Missouri river. 15 feet is gained by tipping the stacks, giving her clearance for all the bridges from St. Charles, MO to Sioux City, IA.

Engines – Like most boats of that period almost everything was steam powered and there were more than 50 steam engines and steam turbines on board, most operating at 120 psi steam pressure. All of the engines were condensing engines. Several of the engines and turbines were removed when the boat was decommissioned in 1973.

The engines range in size from the 1300 HP triple expansion dredge pump engine to the two 600 HP tandem compound propelling engines to some of the small reciprocating piston engines and turbines used on oil pumps and oil injectors.

The triple expansion engine, the propelling engines, the jet pump and fire pump turbines and generator turbines operated at a working pressure of 220 psi. The triple expansion dredge pump engine is similar to the engines used to propel ocean going steamboats, such as ocean liners like the Titanic (although the Titanic was propelled by quad expansion engines), the Liberty ships of WW II and various cargo ships. The pistons vary in size from the small, high pressure piston with a diameter of 18" to the middle piston with a diameter of 29" to the low pressure piston with a diameter of 47.5 inches. Even though steam pressure drops from 220 psi at the small piston intake to atmospheric pressure at the large piston discharge because of the increasing piston surface area the total force per piston remains about the same. The triple expansion engine was capable of rotating the dredge pump turbine at 160 rpm. The stroke is 20 inches. There is no clutching system to connect the triple expansion engine to

the dredge pump so when the engine is running the pump is turning. The triple expansion engine was built by the American Shipbuilding Company.

There are two identical propelling engines, one for each of the paddlewheels. These are tandem compound (compound engines have steam pressure driving the pistons in each direction) reversing engines with a 20" diameter and a 40" diameter piston that share a common connecting rod and have a stroke of 84 inches. These engines are attached to the paddlewheel cranks by the 29 foot long pitman arms. These engines operated at 220 psi on the high pressure piston and were rated at 600 HP each. The propelling engines could turn the paddlewheels at a maximum rate of 17 rpm which would drive the boat at about 10 mph on the water. The two propelling engines were not linked and each was operated by a leverman when the boat was underway on orders from the pilot through the speaking tubes and the mechanical telegraphs.

Steam turbines operated the jet pump, sea water pumps and electric generators. These large turbines operated at 220 psi. The jet pump is located on the starboard side of the triple expansion engine and it pumped hundreds of gallons per minute of water at 60 psi pressure through the hydraulic jets at the bottom of the dustpan. The jet pump turbine is rated at 275 HP. The water jets cut and suspended the sand and silt in front of the lowered dustpan at the river bottom. Water from the jet pump was also used to jet in the pilings used to anchor the boat during dredging, and to remove them at the end of a dredge cut.

Reversing reciprocating (piston) steam engines were used to operate many machines on the WMB. These small engines resemble the engines used on railroad locomotives, except for the difference in size. A pair of these engines was used as the power source for the gypsy winches on the fore deck as well as the dustpan hoist and the forward and aft spud hoists. Single reciprocating engines were used to operate the capstans and were used to operate the various low pressure water and fuel pumps. Several of these engines operated fuel pumps to move the bunker oil among the bunkers and to the pre-heater for use in the boilers. These small engines operated at a pressure of 120 psi.

Condensers

Aft of the triple expansion engine is a large Ingersoll Rand condenser that converted steam from the triple expansion engine, the propelling engines and the jet pump back into water. It used water from the river as the cooling agent. You can see the cooling water intake pipe on the starboard side at the front of the condenser. It is made of copper, which does not rust or corrode as does iron pipe. Since some oil would be scavenged as the steam passed through the engines it was necessary to remove that oil before the water was reused in the boilers. This is done in the rectangular tank called a hot well aft of the I-R condenser. A material called "monkey wool" was used to absorb the oil that floated to the top of the hot well. Monkey wool was actually made from the fibers of the flax plant and was akin to the fibers used to make linen cloth. Once it was oil saturated it was disposed of, although we don't know just what was done with it. I doubt it was pitched over the side although that may have been an option. When we got the boat in 1979 the hold immediately forward of the hot well was packed with oil soaked "monkey wool."

Electrical System

The boat was originally equipped with two 20 KW DC generators, each operated by a steam turbine. The electricity was used to power the floodlights used for nighttime dredging

operations as well as running lights and compartment lights on the boat and motors in the shop. The generators were replaced with two 40 KW DC generators when the boat was in for its winter overhaul in the early 1950s. Each of the 40 KW_generators could produce 325 amps of current. All electrical power was hand switched through the switching panel at the back of the engine room. Note that there is a wooden "bumper bar" in front of the panel to protect the operators from being accidentally thrown into the panel by pitches and rolls of the boat. All voltage was 120 V DC. Two AC current alternators were installed sometime in the late 1960s or early 1970s and may have been used in some applications before the boat was decommissioned in 1973.

Water System

Besides the jet pump and the fire pumps, which used river water that had been screened but not filtered, there was a treatment process to create pure water for the boilers and for drinking and cooking. There are four “sea chests”, covered with brass plates with half inch holes to screen the incoming river water. The sea chests, two on each side of the hull forward of the paddlewheels and about two feet below the water line, are small tanks inside the hull that measured about 2’ by 5’ by 1’ deep. Depending on where it was to be used the incoming water either went to the jet pump or fire pumps or to the vertical sand filters that were located to the starboard side of the rear part of the engine room. Today this would be considered “grey” water and it is not potable. This filtered water was used for most other applications on the boat from flushing toilets to showers to the laundry. If the water were going to be used for boiler water replenishment or for cooking and drinking then it was distilled to make it very pure. The capacity of the distilling condensers was 325 gallons per hour.

Waste Water

Until environmental regulations forced changes in the way that waste water was handled in the mid-1960s, all waste water including sewage was discharged into the river. A waste water holding tank was then installed in the middle hold with a capacity of several thousand gallons and it was pumped out at dumping stations at ports on the river. There were problems, especially with odor, from the stored waste water and a power venting system had to be installed to discharge the gases into the air high enough so that they did not stink up the boat too much. You can see this vent stack on the starboard deck ahead of the wheel box and back of the ladder.

Boiler Room

The WMB is equipped with two Babcock and Wilcox water tube marine boilers, each capable of producing 22,500 pounds of steam per hour at a pressure of 250 psi. Each boiler had a heat exchange surface area of over 4600 square feet. The boilers are oil fired and when dredging the WMB could burn up to 7000 gallons of #6 bunker oil every 24 hours making steam. Number six bunker oil is sometimes called “black oil”, or “bunker C”. There are four fuel oil injectors on each boiler and they could be controlled individually to match the amount of heat needed to make steam, depending on what the boat was doing. There are four fuel bunkers, two on each side, of the boiler room. Each bunker can hold up to 12,000 gallons of oil. Because the oil is too viscous at room temperature to be pumped through the burner injectors the fuel is preheated to at least 140 degrees F to make it fluid enough to go through the injectors. Normally the bunkers were only filled from 20,000 to 25,000 gallons to keep the boat drafting a little higher in the water. There were two fuel barges assigned to the WMB that could each hold 75,000 gallons of fuel. These were shuttled back and forth from fueling

ports to the WMB. When not dredging the boilers are kept on standby and one or the other had steam pressure up. Steam pressure was necessary to operate the electrical generators, pump water and do other tasks. Even on standby the boat burned 1200 gallons of fuel in 24 hours. All the engines and turbines on the WMB are condensing, meaning that the steam is recovered and condensed back to water for reuse in the boilers, but a certain amount of the boiler water is lost in the cycle so the water levels in the boilers were constantly monitored by the striker or boilerman on duty to be sure that there was plenty of water available in each boiler. Even though the boiler water feed was automatic I doubt that there was ever a fireman or striker living that did not check the boiler water sight gauges regularly. Even in the winter when the boat was in for its annual overhaul steam pressure would be maintained, either by operating one or both of the boilers or by bringing in a steam line from a stationery plant at the boat yard. If the boat was completely cold it could not be started without bringing in steam from an outside source, such as another steamboat or from a stationery plant on shore, so that oil could be pumped and preheated, water pumped into the boilers and so forth. Once one of the injectors was going and there was some pressure being generated then the rest of the injectors would be hand lit by using a long wire with cotton waste at the end that was oil soaked, lit, then extended into the boiler as successive injectors were brought online. The lighting devise was called a q-tip and there is one located in a pipe on the starboard front corner of the aft boiler.

There is a large air compressor located on the starboard bulkhead at the back of the boiler room, just to the left of the door into the shop. It is black and looks like the air compressors used on railroad steam locomotives (and, in fact, is made by the same company that made compressors for locomotives). Compressed air lines run throughout the boat and the compressed air was used for air powered tools, among other things.

Shop

Because the boat was away from its winter quarters at the USACE boatyard at Gasconade, MO for most or all of the dredging season it was necessary to have the tools and the skilled operators on board to facilitate repairs on most of the systems on the boat. There are grinders, vises, anvils, welders, pipe cutters, threading machines, radial drills, an eight foot lathe that had a compound bed that could be extended to 12 feet, a shaper, a forge and many hand tools. Besides the metal working shop there was a carpenter's work area on the aft deck where wood could be worked to build or repair sounding poles, furniture, paddle wheel buckets, or whatever was in need of repair or rebuilding. There is a hold compartment outside of the starboard shop doors that contained storage space for hardware used to repair the paddlewheels.

Forward deck

The dredge pick-up unit, called the dustpan, was raised and lowered by a leverman operating the dustpan hoist. The dustpan could be lowered to a depth of 20 feet at the front. It hinges at the forward bulkhead with a swivel joint for the high pressure water line in the center and a ball and socket type slip joint for the two intakes. The port and starboard gypsy winches were used to pull the boat forward when dredging. The winches are two speed winches and each has a pulling force of 120,000 pounds. They are wrapped with 3600 feet of 1-1/8 inch wire rope that would be tied to pilings that had been jetted into the river as anchors to pull against. A piling or anchor that was used to pull against was called a "deadman". In the 1950's the USACE purchased navy surplus anchors left over from WW II and then used these anchors instead of the pilings to pull against when dredging. It was easier and much quicker

to set and move anchors than it was to jet in and then jet out pilings. The anchors weigh about 8000 pounds each and are made of cast iron. The half round loops welded to the bottoms of the anchors were necessary to hook onto when lifting the anchors as this type of anchor will dig in deeper and deeper the harder you pull against them.

The forward spud is used to anchor the boat. The spud is hollow steel, 20 inches square and 40 feet long and is raised and lowered by the steam powered spud winch. The fore and aft spuds remain set on the river bottom while the boat floats up or down according to the river stage. In the Ice Harbor they anchor the boat so well that we never feel wave or wind action aboard the WMB.

The port and starboard "A" frames were used to raise and lower the pilings used when dredging. Note that the high pressure water lines run part way up the A frame structures.

The head log is the 36 inch square steel bumper, of sorts, at the very front of the boat. It has two towing knees attached that were faced with 10" X 11" oak beams to prevent barges that were being pushed from damaging the boat. It also has several pulleys that were used to cross the gypsy winch cables in front of the boat.

There are two capstans on the fore deck that were used to tighten the ropes to barges that were tied along side the WMB, or to snug the lines when the WMB was docked at a pier. They are operated by small reciprocating steam engines in the holds below the capstans.

The pick up unit, or dust pan, is 36 feet wide and has 38 water jets across the lower face of the pan. Dredging was normally done at a depth of 18 feet. The high pressure water from the jets breaks up and suspends the sand and the silt at the river bottom. Heavier material, such as rock or water soaked logs usually will not be picked up in the suspension, however the jet pipes form a bar grate that keeps anything larger than about 10 inches from entering the intakes. The dredge pump could handle most materials that would pass through the bar grates into the intakes. When the dredge was doing bank dredging them often encountered tree roots and it would be necessary to raise the dustpan periodically to clean it by hand and with high pressure water. Working in dense clay could also cause problems that could usually be flushed out with high pressure water. Sometime when raising the dustpan it come out of the water with a snake or two in it! A former deckhand from the Dredge Lewis told me that he saw his first cottonmouth water moccasin when they were doing some bank dredging below Brownvil1e, NE back around 1955. Although that is too far north for the normal range of the cottonmouth he was sure that's what it was. Sometimes when cutting a new channel the dredge would work across what had been a strip of dry land, usually flood plain, to make the new channel. At times the dredges worked in conjunction with bulldozers that stripped off as much vegetation as possible before it could be sucked up by the dredge pumps.

Rear or aft deck

There is an aft spud, similar to the forward spud that was used as an anchor. It was also possible to set one or the other of the spuds and use them as pivots to turn the boat in tight quarters.

There are four rudders, two starboard, two port. The rudders were operated from the pilot house and were steam activated.

There is a single capstan on the rear deck. It was also used for securing lines to barges or to piers. It's operated by a small reciprocating steam engine below the capstan.

The dredge spoil discharge line comes out in a goose neck and is attached to a floating pipeline of 14 fifty foot sections of dredge line discharge pipe floating on pontoons. The discharge pipe was able to be steered from the "doghouse" which was located on the final pontoon. The discharge pipe was 34 inches inside diameter and made of cast iron. It was rotated 90 degrees every few years to insure that it would wear uniformly.

The doghouse contained a movable vane or baffle that could deflect the discharge spoil to drive the whole pipeline to the port or to the starboard side of the boat during dredging. There was an actual shack, complete with a small stove, to warm the operator in cold weather. This was a dangerous job because of the distance from the dredge, usually 700 feet, and the fact that when the dredge was not pumping there was no way to control the position of the pipeline. There was a telephone that connected to the pilot house on the WMB but at night, especially, it was a risky place to have to work. This was definitely not a job that was much sought after. The discharge pipe was sometimes called the "stinger"" because the pipeline would undulate in the river current until pumping was started again. Also, because tow boats continued using the river during dredging operations, there was the danger of being run over by a down-bound tow if the dredge's master did not get the pipeline out of the way in time. It was necessary to stop the dredging operation and pull out of the channel to let down-bound and up-bound tows pass at times when there was not enough water or enough room to accommodate both the dredge and the tow in the channel. The *William M. Black's* tender, the *Tavern*, could also be used to help position the discharge pipeline.

Below Decks

There are 25 separate compartments, or holds below the main deck. At least six of these holds were used for parts storage. Several are equipped with shelving and bins for parts and all are lit so they can be worked in. When the boat was in operation the holds were kept clean and were painted every few years. They are isolated one from the other to prevent flooding of the boat if a leak were to develop in any one of the holds. Each hold had a siphoning system, or pumping system to remove any water that might leak in.

Second Deck or boiler deck

The forward area, forward of the galley, is "officer country" and that is where the officer's staterooms are located. There are 12 staterooms, six on a side, with the master or captain and the chief engineer having their own quarters and their own heads (bathrooms). Between the captain's quarters and the chief engineer's quarters is the office with a desk for the captain and one for the chief engineer. The chart table is at the back of the office and the map trays contained river charts from the lower Missouri river. There could be two officers assigned to each stateroom and, if there were dignitaries on board, they were usually assigned to the staterooms immediately aft to the captain's or the chief engineer's staterooms. That way they could share the heads between the staterooms and had a bit more privacy than was afforded for the officers, other than the master or captain and the chief engineer. The WMB was by no stretch a pleasure boat but politicians and Corps of Engineers dignitaries occasionally came on board to "check up" on the dredging operations. The other officers shared a common head, or bathroom, that was located on the starboard side at the back of the dayroom, or lounge off the officer's mess.

The galley was located amidships and was divided into three areas. The forward area was the officer's mess, the aft area on the starboard side was the crew's mess and between them is the galley. The original galley had two oil fired cook stoves and food was served family style to both officers and crew by mess boys. In the 1950s the boat's electrical system was upgraded and some time in the 1960s the electric stove replaced the oil fired stoves and the steam table was added. After that people went through the line to get their food. The cook's quarters were on the port side just behind the galley. The only pieces of original equipment in the galley are the work table on the starboard side, just forward of the crew's mess, and the Hobart electric mixer attached to that same wall. Refrigerators were located in the pantry at the back of the galley. These refrigerators were open and crew members could raid them if they so desired. There was always coffee available in the galley for the crew. There is a large walk-in freezer on the main deck to the port side of the shop. Next to that freezer is a walk-in refrigerator. Both of the walk-in units were locked and not accessible to the crew. There is an ice maker next to the walk-in refrigerator that was installed when the boat was built. It appears in the original blueprints for the boat.

Aft of the galley was the laundry room. In the early days of operation, through the 1930s, 1940s and into the 1950s there was a crewman assigned as a laundryman and it was his job to wash sheets, towels and he would wash clothes for the officers and crew. It was normal for the officers and the crew to tip the laundryman for doing their personal laundry. A pair of socks, for instance, would be $0.02; a shirt may cost a nickel. There were ironing boards and mangles so that if something needed pressing, it could be done on board. Later, starting sometime in the early 1960s, the boat's laundry, including towels, sheets and other flat ware was sent to commercial laundry facilities in nearby river towns. Officers and crew could, if they chose, do their own personal laundry on board or send it out. The drying_room on the port side was located above the boiler room and heat rising from the boilers would be used to dry the clothes as they hung on lines in the drying room.

There is an alleyway between the laundry room and the aft section of the boiler deck. On the forward bulkhead (wall) on the starboard side of the alleyway is a wood slat bin that was used to store potatoes for the galley.

The crew's quarters are in the aft compartment of the second deck. There are two heads, or bathrooms, one on each side of the compartment. Normally there would be six to ten people sleeping in the crew's quarters on any given shift. The others would either be on their work shift, between shifts or on their days off. There are 32 bunks and lockers for the crew.

Also on the boiler deck were a number of Adirondack style deck chairs. Some of them were located in front of the staterooms and office under the canopy, and others were located on either side of the starboard and port wheel boxes. Among the crew's favorite activities when they were not working was to sit and lounge on the deck in those chairs when the weather was fit.

The pilot house was located on the top deck. It was from this position that the pilot guided the boat when it was underway on the river. Normally there would not be anyone in the pilot house, other than the pilot. When the boat was dredging it was controlled from either the office below the pilot house or from the main deck. The only controls that the pilot had direct handling of were the rudders which were controlled by the twin sticks. The WMB (and the Mitchell) was never steered by a wheel, such as the dredges Clark and Lewis were originally. The paddle wheels were operated from the main deck according to directions from the pilot,

given through the mechanical telegraph system and the speaking tubes. The pilot also had control of the whistles and the boat's bell.

Dredging History

The United States Army Corps of Engineers was and is in charge of maintaining the navigability of the inland waterways, including the Mississippi, the Missouri, the Illinois, the Ohio, the Tennessee, the Arkansas and the other navigable inland waterways. There are over 25,000 miles of navigable rivers in the lower 48 states. In the mid 1800s the US Congress authorized the Corps of Engineers to maintain a minimum channel depth of 3 feet in these rivers but as railroads began to take away much of the transportation of goods and freight from the steamboats an effort was made to keep the steamboat industry competitive so Congress authorized the 6 foot channel in the very early 1900s so steamboats could be larger and more heavily loaded than those that were limited by the 3 foot channels that existed in places on some of the rivers. But the die was cast and the movement of freight and goods continued to move to the railroads, which were not limited by winter or the location of rivers and river ports, such as Dubuque or St. Louis or St. Paul.

The steamboat industry was forced to change due to the loss of freight hauling and in the early 1900s many of the steamboats were either scrapped or converted from packets into excursion boats, used for special outings. My father used to tell of taking a steamboat from Dubuque to Potosi for a day outing in the summertime during the 'teens. It would cost a $1.00 for the round trip. The steamboats did continue to haul some goods and freight, though. The Potosi Brewing Company used to ship kegs of beer aboard some of the boats and, so the story goes, when they could not pull in to a dock to unload a keg or two they would simply push the correct number of kegs over the side and the purchaser would pick them up in a small boat.

The barge industry began to emerge as a new force on the rivers in the 1920s and with it came the need for larger and more powerful towboats and a deeper navigable channel. In 1930 Congress authorized the Corps of Engineers to maintain all of the inland waterways at the new depth of 9 feet. At first the towboats were pushing a few barges but as the towboats became more powerful the number of barges they could push was increasing so that down bound tows could push dozens of barges if the water was high enough.

As a point of information a single barge is called a "load" and the assembly of anywhere from two to 15 or 16 barges and the towboat is called a "tow." So a down bound of up bound "tow" may contain anywhere from one or two to 15 or 16 loads" plus the towboat, which is actually pushing the barges. And the towboats are designated as motor vessels, or MV's. Empty barges as "MT's." A "light" boat is a towboat without barges. Steam powered boats are designated Str.

And that brings up the reason that the USACE had four steam powered side-wheel hydraulic dustpan dredges built in the early 1930s for service on the Missouri river.

One of the rivers that has been navigated by steamboats from the early 1800s on was the Missouri river. The Missouri river presents a much different problem in channel management than does the Upper Mississippi or the Ohio or Illinois. It carries and through history has carried a much larger bed load of what a geologist would call "fines" – mostly very fine silt

and sand – than some of the other river systems. Some of the old timers described the river as being “too thin to plant corn on and too thick to steamboat on." Because of the volume of the bed load the sand and silt would shift around with the current and it was not uncommon for sand bars and shoals to build then degrade all within a few hours or days. The early steamboats would try to limit their trips upriver to the army forts to high water in the spring of the year but more than a few of them were left stuck on sand bars over the winter months when they were caught by low water on their return trips to St. Louis. On their up bound trips if they got stuck on a sandbar it was sometimes necessary to unload the boat in an effort to free it. Sometimes just waiting a few hours or even a few days was long enough for the river channel to change sufficiently to allow movement again. There was a saying among the Missouri river pilots that the men were separated from the boys at the mouth of the Missouri. The “boys” continued up the Mississippi and the “men” turned up the Missouri.

The Missouri also carries a large volume of water. As much as 60% of the volume of the Mississippi river between St. Charles, MO, where the Missouri flows into the Mississippi, to Cairo, IL, where the Ohio River enters the flowage, is made up of water that flows out of the Missouri River.

The upper Mississippi flows through a lot of limestone rock and in general the river bed is not as soft and movable as the sand and silt in the Missouri so the frequency of dredging on the Missouri was greater than on the Upper Mississippi. To handle the type and volume of materials effectively huge dredges were needed. The Corps ordered four dredges, all very similar, in the early 1930s. The William Clark and the Meriwether Lewis were built and commissioned in 1932, and the William M. Black and the William Mitchell were built and commissioned in 1934. The Clark and the Lewis worked out of the Omaha, NE division of the USACE and the Black and the Mitchell worked out of the Kansas City division.

Each of these dredges was capable of moving from 80,000 to 100,000 cubic yards of spoil every 24 hours and in the 1930s and 1940s they worked most of the time during the shipping season to keep the Missouri navigable between St. Charles and Sioux City, IA. The dredging season usually began when the spring rise was dropping in late April or early May and would continue through October and even into late November some years. 100,000 cubic yards of material is about the amount of material it would take to fill 10,000 of today's tandem axle dump trucks. If stacked on a football field by the end of a 24-hour day there would be a stack of sand and silt that would be about 40 feet high, reaching to the top of the fourth floor of most buildings. Another way to look at that amount of dredge spoil is that the dredges could pump the equivalent of almost seven dump truck loads of material per minute!

In the 1940s the first of the five flood control dams was completed on the Missouri River at Pickstown, South Dakota. Others followed in the 1950s and 1960s. The dredging mission was also changing from channelizing to channel maintenance because the water level of the navigable river could be controlled by holding back or releasing more water from the dams. Dredging the river to provide a navigable channel provided a narrower, deeper, and straighter river and also increased the velocity of the flow which made it partially self-scouring. In the 1950s the dredge Clark was first moved to the USACE Memphis district and then later sold to a private operator and moved to Texas, where it still dredging in the Houston ship canal in the late 1990’s. The Clark was converted from a hydraulic dustpan to a cutter head and the intake was lengthened so that it could dredge to a depth of 45 feet. The headlog was moved to allow this. The Meriwether Lewis was decommissioned in 1969, the William M. Black in 1973, and the last of those four dredges, the William Mitchell, was decommissioned in 1981.

Port and starboard paddlewheels

The paddlewheels are 25 feet in diameter, 15 feet wide, weigh about 45,000 to 50,000 lbs each. Buckets and framing are made of white oak which resists water togging and rotting. The paddlewheels are out of round slightly because by being slightly oval shaped they “bite” the water better when underway. Some of the paddle buckets have two planks, some have three.

The Crew

The full crew aboard the WMB was 63 men. No women ever worked aboard the four Missouri river dredges. No blacks ever worked on the WMB, either, according to a mate that worked on the WMB from the spring of 1940 until the boat was taken out of service in 1973. He did say, however, that blacks were hired as cooks aboard some of the USACE boats in the St. Louis area after the 1950s. Some of the crew and officers were from the south; states like Louisiana, Arkansas, Mississippi, Tennessee. They would work for the USACE during the dredging season, usually May through October, and then work on the southern rivers during the winter months. But most of the crew and officers were hired from the areas where the dredges worked. Many of the crew on the WMB, for instance, were from the Gasconade, MO area and other Missouri River towns nearby. Crewmen were considered temporary employees and were hired by the season. Officers, which included anyone licensed by the US Coast Guard, such as the captain, engineers, pilots, mates, and so forth, were considered to be federal government employees and were assigned GS ratings and were afforded benefits according to their ratings. It's interesting to note that the crew received room and board as part of their compensation but officers had to pay for their own room and board. The Corps of Engineers, like many government organizations, kept volumes of records in quadruplicate documenting the average costs of meals and the cost of each "man night” of boarding.

It took a minimum crew of about 12 people to operate the dredge but there were usually about 15 to 16 officers and crew working on any given eight hour shift. The day shift was usually staffed with the most people. It was normal to have about 48 people aboard when the boat was dredging. Because dredging was a 24 - 7 operation time off for crew and officers was staggered to assure that there were enough people aboard to staff the three shifts.

When the boat was standing by waiting for a call the crew had to be available to be on board within a few hours. The boat usually tied up in Kansas City when it was standing by.

Some Frequently Asked Questions

How much did they get paid?

In 1935, the first dredging season on the WMB, a deckhand was paid every two weeks. He was paid $27.50 each pay period and also received room and board. In 1946 a cook’s helper would be paid $0.75 per hour. Their wages still included room and board. Prior to the work rule changes the deckhands and officers worked a twenty-one day period and were then given 32 hours off the boat. Shifts were changed every week so that during any three week period a deckhand would work at least three different eight hour shifts. The shifts were broken down into 8 AM to 4 PM, 4 PM to midnight, and midnight to 8 AM - so when you received your day off, 24 hours, you were given an additional eight hours and then started back to work on the

next shift instead of the one you were working before your 32 hours off. By 1964 a deckhand was earning a minimum of $1.25 per hour and by 1967 that minimum had increased to $1.40 per hour. Shifts were still changed weekly. A differential was paid for working second shift, an extra $0.10 per hour; or for third shift, and extra $0.15 per hour. In 1967 the wages ranged from the minimum of $1.40 per hour to as much as $3.19 per hour, depending on your job and your years of service. These jobs were considered to be good jobs and many of the deckhands and officers came back season after season to work for the Corps of Engineers on the dredges.

What did they do when they were not working?

When the boat was on the river and not close to any of the river towns on the Missouri men stayed aboard most of the time between their work shifts. There was not much to do, other than to talk, play cards, read, or write letters. There was a radio in the day room, or lounge, off the officers' mess and in the late 1950s a TV was added in the laundry room but reception was limited by the location of the boat. One of the deckhands that I talked with in 2001 said that he really would have liked to have worked more hours as it got too boring between shifts with 16 hours off. If the boat was near a landing or in an area near one of the ports, such as Kansas City, the men could leave the boat with the only requirement being that they be back on board in time for their next shift and be sober enough to work it safely.

How did they dredge? How fast did the dredge go? What did they do with all that dredge spoil?

The usual procedure was to use a motor launch to survey where dredging was needed, then to map it out and establish the cuts needed to accomplish the job. A surveyor went out with a poleman in the launch and they crisscrossed the river, sounding every 25 feet to determine what the bottom looked like. After the area was mapped the dredge would pull up to the top of the cut to be made – the dredge always worked heading into the current and moved upstream during the cut – and at the top of the cut two pilings (or later, the two anchors would be placed) would be set into the river, one on the port and one on the starboard side. The gypsy winch lines would be crossed in front of the headlog and attached to the pilings. Then, using the paddlewheels, the boat would reverse to the bottom of the cut, usually a distance of from a few hundred feet to as much as 1200 to 1400 feet. Then the triple expansion engine would be turned on and the dredge pump would be primed and would start turning, the jet pump would be activated and the dustpan would be lowered into the river and dredging would commence. When it was at depth, usually 18 feet, the levermen would start the gypsy winches and the boat would be pulled forward at about 150 to 200 feet an hour. Because the lines were crossed in front of the boat by operating the winches at different speeds it was possible to sweep sideways as the boat moved forward. It would take about fifty feet per cut doing the sweep as the boat dredged. Normally the channel was supposed to be 300 feet wide. When the boat reached the top of the cut one of the pilings would be pulled and reset to the port or starboard, depending, and the process would be repeated until the cut was wide enough and long enough to meet standards.

The dredge spoil would be piped from the pump through the boat in a 34 inch diameter pipe that ran the length of the hull. At the back of the boat the discharge line was attached to the 14 pontoon pipes and doghouse and the spoil was usually discharged along the shoreline, if possible. Sometimes it was discharged behind wing dams or on islands. Since the dredge was moving forward as it dredged it was necessary to continually reposition the end of the line with the baffle in the doghouse section at the end of the line.

Did they really put men down inside that pipe in front of the pump?

According to deckhands and officers I've talked with men were not put into the pipe to clean it out. If the turbine blades on the pump were damaged or blocked, however, it was always easier to try to fix it by going into the man hole than to disassemble the pump housing. But down in the pipe? Probably not. When there were problems with blockages it was usual1y at the dustpan and it was cleared with high pressure water hoses. Man in the pipeline does, however, make a good story for 4th graders.

Why was the boat made with steam power instead of diesel engines?

One probable answer is that a huge amount of power was needed to operate the dredge pumps and diesel technology was just beginning to develop whereas steam technology was highly developed and there was experience with these boats that showed that they could do the job they were constructed to do, move extremely large amounts of silt and sand from the Missouri River. Also, fuel was cheap so the fact that the WMB could burn up to 7000 gallons of fuel a day was not considered a problem.

Why side paddles instead of propellers or a stern paddle?

Again it was probably experience that decided that the dredges should be side paddle boats. Side paddle boats are very maneuverable because the paddles can be operated independently one from the other. That way if the boat did get up on a sand bar it could usually be "walked" off by using the paddles. It's interesting to note that the USACE Dredge Thompson was built only three years after the WMB, in 1937, and is powered by diesels and propelled by propellers and also has about half the dredging capacity that the WMB had because its pipeline is only 24 inches in diameter. It is also a "cutter head" dredge instead of a hydraulic suction head dredge. Hydraulic suction dredges require very large engines to operate the dredge pump that creates the suction to do the dredging.

So the era of the WMB is now "history." Dustpan dredges are few and far between these days as modern technology has replaced steam with diesel power and cutter heads have replaced the hydraulic dustpan pick up units. The Corps of Engineers are still operating a few much newer hydraulic dustpan dredges on the lower Mississippi. In their time, these old dredges did what they were intended to do. They "tamed" the Missouri River by converting it from a meandering prairie river into a navigable channelized river so that it would be a reliable waterway for barge traffic. And, some would add, at the expense of the natural flora and fauna of the lower Missouri River system.

Post Script: On Thursday, June 12, 2003, I had an interesting visit with Bunny (Buena) Ryan, widow of the late Ed Ryan. Ed was instrumental in obtaining the William M. Black for Dubuque in 1979 with the aid of Senator John Culver. The boat was obtained from the General Services Administration and there was a keen competition between Kansas City and Dubuque as to who would be awarded the boat. It also helped that Dubuque had a protected harbor for the boat and would be able to incorporate the boat into the Dubuque County Historical Society exhibits as part, of the Mississippi River Museum.

Some of the things I learned during our visit was that the Black was tied up at the USACE boatyard in Gasconade, not Kansas City as I had previously thought. Newt Marine Services

of Dubuque towed the Black to Clinton, where the starboard overhang deck was cut off and the paddlewheel removed. There was some difficulty in finding a crane at Clinton that could lift the paddlewheel and place it on a deck barge but eventually the lift was done by two cranes working together. The boat arrived in the Ice Harbor sometime during the summer of 1979.

Materials Needed:

- River depth sounding pole (located on rack on the port side of the boat)
- Activity tub with knot tying supplies (located in the laundry room closet)
- Model steam engine (in boat building shop)
- Role playing assignments for students

Role Playing Assignments:

Captain
Chief Engineer
1st Assistant Engineer
2nd Assistant Engineer
Clerk
Carpenter - stationed on the stern of the first deck
Machinist - stationed in the machine shop
Dog-House Man - stationed at the stern
1st Mate - stationed in the pilothouse
Fireman-water tender -stationed at the steam boilers
Tender Operator - stationed on or near the *Tavern* tender
Marine Oiler - stationed near the steam pistons of main engine and pump engine.
Cook-Steward - stationed in the galley
Cook - stationed in the galley
Cook - stationed in the galley
Laundry -
Mess Attendant - stationed in the officer's mess
Mess Attendant - stationed in the crew's mess
Cabin boy - stationed in the crew cabin
Leverman - stationed on the fore deck
Deckhand
Deckhand
Deckhand
Deckhand
Deckhand
Deckhand
Deckhand
Deckhand

Procedure:

Assign each student a role that they will be responsible for while on the *William M. Black* (This may be done in the classroom prior to your visit). Students may want to wear period clothing from the 1930's or 40's, such as bib overalls, jeans, "newsboy hat" , flannel shirt, leather shoes, etc.

This will be a training cruise to learn about the *William M. Black* operations and to practice some of the operating and safety procedures.

A tour will be given of the William M. Black dredge boat with all assigned roles taking their positions as the class progresses through the boat. Nautical terminology will be used while on the Black and demerits will be handed out to any student, teacher, chaperone, or educator who used a non nautical term.

The knot tying tub will be gotten from the laundry and can be used on the deck, in the crew's quarters, or in the crew mess room. Some basic knots to be learned include a square knot, half-hitches, taught-line hitch, sheet bend, bowline, clove hitch, and timber hitch.

Optional- Set up steam engine (located in the boat shop) in the galley of the *William M. Black*, make sure there is water and fuel in place to be able to light the engine fuel.

Evaluation:

Additional resources:

- *William M. Black* brochure
- *"Bread and Quicksilver"* overnight role playing activity

Extensions:

- *Boat Building, Steam Power, and Rivet Toss*
- *Steam Power and Steamboats*

Credits:

Mark D. Wagner, Director of Visitor Experience for the National Mississippi River Museum & Aquarium, *William M. Black* education staff and docents.
Dubuque County Historical Society Archives
Boy Scout Handbook (knot tying)
This curriculum segment was written through a Resource Enhancement and Protection Conservation Education Program Grant (REAP CEP), December 2007

Captain

Chief Engineer

1st Assistant Engineer

2nd Assistant Engineer

Clerk

Carpenter - stationed on the stern of the first deck

Machinist - stationed in the machine shop

Dog-House Man - stationed at the stern

1st Mate - stationed in the pilothouse

Fireman-water tender - stationed at the steam boilers

Tender Operator - stationed on or near the *Tavern* tender

Marine Oiler - stationed near the steam pistons of main engine and pump engine.

Cook-Steward - stationed in the galley

Cook - stationed in the galley

Cook - stationed in the galley

Laundry - stationed in the laundry room

Mess Attendant - stationed in the officer's mess
Mess Attendant - stationed in the crew's mess

Cabin boy - stationed in the crew cabin

Leverman - stationed on the fore deck

Deckhand

Deckhand

Deckhand

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