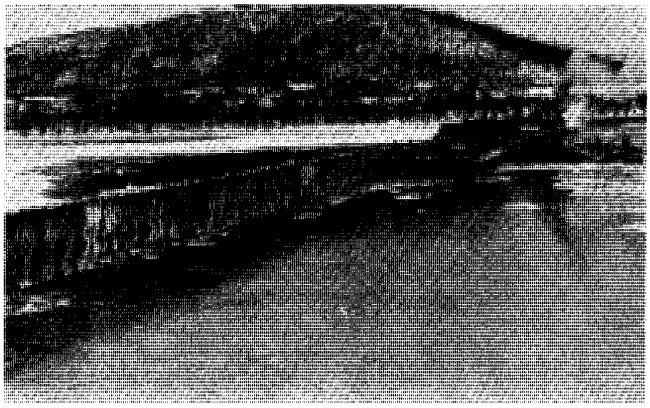
Chapter 15

RIVERS ARE HIGHWAYS THAT MOVE

The reporter nosed his Studebaker cautiously across ice patches into the parking area next to the Lock 10 operations building near Steubenville, and, heaving a sigh of relief, switched off the key. What a night to hunt a river story, but he had to have it for the Sunday supplement and tomorrow, or rather today for it was past midnight, was his deadline. His editor had heard that Pike Island Dam on the Ohio would be finished in 1965 and the men at old Locks 10 and 11 would lose their cushy jobs. Get the story, the editor had ordered.

He peered out the window through fine wind-driven snow at the light-bathed lock and saw men in orange life jackets moving carefully along ice-slick walkways as a towboat, its searchlights stabbing into the wall of snow, moved out of the chamber. Pulling on his parka, he raised the hood to cover his ears, snapped the fasteners, slipped his hands into black gloves, and reluctantly left the dying warmth of the car to dash for the door of the lock building. Zero, the radio had said at midnight, and to be minus ten before morning.

The lockhouse was empty when he entered, except for a gray government issue table and chairs, a radio squawking intermittently on the table, and maps and memento photos tacked on the walls. Unsnapping his parka, he dropped the hood and stood at the window watching the tow, twenty barges of coal probably bound for Wheeling mills, gliding out of the chamber and the lock gates closing behind. Minutes later, lockmen crowded through the door, nodding to him as one does to a stranger. They entered and quickly doffed their white hardhats emblazoned with the crimson castle, their orange life preservers, dirty parkas, and gloves to warm themselves before the next tow arrived. Recognizing the lockmaster was easy: older than the others, perhaps about fifty, solidly built, fairly tall and with an ever-present cigar in his mouth.



Ice Conditions, Lock and Dam 10, Ohio River

The reporter identified himself. "Bill Shilts sent me," he said, extending his hand and wincing when the lockmaster grabbed it with his sinewy, half-frozen paw.

"Shilts said you'd be down, but we didn't look for you tonight," replied the lockmaster, smiling as he would at any man who would get out in such weather. "Pull up a chair and have a cup," he said cheerily, plopping down at the table and unscrewing his thermos to pour two scalding coffees. "Got a tow of twenty empties upbound for Harmarville, but it'll be a few minutes."

The reporter dragged up a chair, warmed his hand on the coffee, and, anxious to get his business done, pulled a notepad and pencil from his pocket to begin his list of questions. "How long does it take you to lock a tow through?" he began.

"That last one took an hour and a half. Had to double lock it in two sections--too big for the lock--and had to fish ice chunks out of the way of the gates before we moved them." said the lockmaster, still shivering from cold misery. "If this ice gets worse, we'll have to put the dam down."

"In this kind of weather?"

"In any kind of weather. Can't let the ice pack on the wickets. Takes seven men on the maneuverboat about six hours to put it down. We open the beartraps to reduce the difference in head between the pools and draw off ice, then take the boat out to the beartrap pier. It has a capstan and cable on the stern and pulls itself back toward the lockwall four foot at a time as the wickets are dropped."

The reporter stopped his scribbling and took a swallow of coffee. "Isn't that sort of risky?" he asked.

"It is right now," the lockmaster said, waving his hand toward the snow still shuffling against the windows. "As the wickets go down, current at the head of the boat and ice pressure behind it increases. Can build up enough to break the lines and let the boat go around the end of the wickets and over the dam. And the wind freezes spray from the river, coating everything with glaze. Have to watch your step."

The reporter had done his groundwork, reading some old articles in the dead file before starting his interviews. He began to understand why John Arras had said that lockmen had to be trustworthy, reliable, and fearless. "Have you seen many accidents on this job?" he queried.

"One is too many," said the lockmaster. "Things have improved considerably since I first went to work on the river. Why, we didn't even wear life vests before 1936. Back in '42 I saw a repair boat break loose and go over a dam in rough water, but all the men aboard had preservers on and all survived. Saw a maneuverboat crew in the summer of '43 take off their vests because of the heat. Something underwater hit the catching hook and threw the man handling it into the river. He could swim but never came up. Found his body two days later at the next dam downstream."

The reporter snapped the lead in his pencil and fumbled through his pockets for another. "What would you say is the most dangerous job at these movable dams?"

"Hard to say. Who was it--Jack Paar?--that said if something can happen it will? Before we motorized the beartrap valves, we opened and closed 'em by hand. We rowed across the river above the dam, walked down to the abutment and out on the catwalk to pier 3, closed the valves on that pier, climbed in a bos'n chair hanging on a cable and pulled over the beartrap to the second pier to close those valves, and on the same way to pier 1. Crossing the open beartraps was scary, but not really dangerous. The danger was opening the valves. I've heard that men were killed doing it back around 1910, but it never happened in my thirty years on the river."

Seeing the puzzled look in the reporter's eyes, the lockmaster explained. "We use a long metal wrench to turn the valves, and if pressures are right and the lockman loses his grip on the wrench the valve closes itself, whipping the wrench handle in circles. Saw it happen about 1942 at Lock 9. Dewey McPherson sent a couple of young fellows, Lyle Cosgrove and Tommy Carrol, to close the filling valve on beartrap pier 1. The two were having too much of a good time and lost hold of the wrench. It spun around, whacking Cosgrove on the backside and catapulting him off the pier into the upper pool. Carrol dove in after him and they both swam back to the pier. But Dewey had his mouth open yelling at the two to stop their horseplay when it happened, swallowed his Mail Pouch cud and became violently ill; Leonard Martin ripped his britches and bruised his shoulder when he fell running up the catwalk, and "Bulldog" Drummond, who pulled the two out of the river and told them off, got a bloody nose from Carrol. The two fellows had to finish their shift in wet clothes."

The lockmen standing by the heater and listening were convulsed by laughter, and the lockmaster chuckled at his memories. "Super. Gaylord Watson," he continued, "gave Leonard Martin the job of leading daily safety and first aid lectures on the Quarterboat *Kiski*, and, after that, men who worked without hardhats or life vests, or who removed grease with gasoline, and such like, had to take the consequences."

Taking another swallow of coffee, the reporter scanned his question list. "What's your routine here?"

"Ain't none. If the dam is up, we tend the lock, keep drift off the wickets, take care of the maneuverboat. When the dam is down, we nurse the machinery, fire the furnaces, mow the grass, keep the weather records, and do the paperwork. Always is something that needs doing, and never know when

we'll have double work. Suppose word comes the river is falling fast and the dam is down; we work night and day to raise the wickets. If the dam is up and a big rise comes, we work around the clock to lower the dam."

"Where do your men live? I saw only two houses here at the lock."

"They're scattered about, some in Steubenville and some across the river. Would be nice to have houses for them all, but they go home and we have to call them for emergencies, always it seems at night and during bad weather. Will probably have to call them this morning before daybreak to put the dam down out of the ice."

"You make your reports to the District Engineer?"

A grin creased the lockmaster's red face. "Don't know what you mean by reports," he said. "Lots of paperwork though--it goes to different branches of the District office. Most District Engineers get around to see us before their three-year tour ends, but my boss is Whitey Whitehead, the Chief of Operations. Before him, it was Mike Harrington. But I work under Area Chief Bill Shilts up at Emsworth, who has charge of the Allegheny and Ohio. Harry Maple at Maxwell Lock runs the Monongahela. Those two, together, have worked for the Corps about a century. Used to be three Area offices. Joe Carlson and Ed Crowley ran the Allegheny back in the '30s. Howard McCullough and Lafayette Wills were before Shilts in the Ohio office; I. C. Bell ran the Monongahela Area, and there were others I don't remember right off."

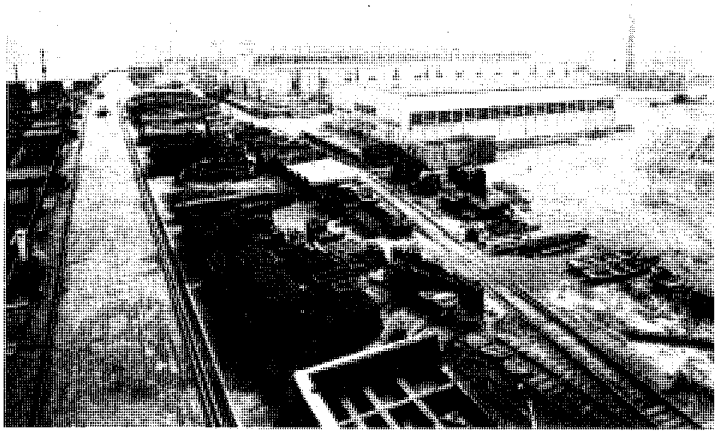
The lockmaster paused to fire up a fresh cigar, while the reporter caught up with his notes. The reporter looked up and asked, "You and your men handle the repairs here?"

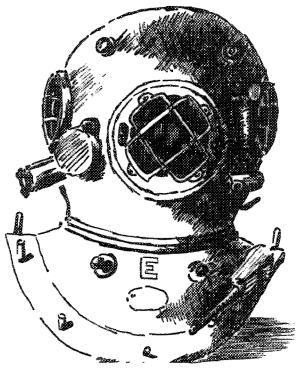
"Some, but the big jobs are done by repair parties sent down from PEWARS, that's Pittsburgh Engineer Warehouse and Repair Shops on Neville Island below Emsworth--used to come down from Lock 2 Depot years ago. They have machine, carpenter, blacksmith, and welding shops there, store spare lockgates and parts in the yard, and tie up the fleet there. Okey Sholes runs it now. Before 1946 there was a boatyard and repair shop at Charleroi for the Monongahela Area that Bill Fels ran. Had better than a hundred men working there before the war, but it was closed and consolidated at PEWARS in '46. Bobby Whigham supervises the repair party, about forty men lead by Fred Black, Ray Pike, Emil Berry, William Celli, Archie Mayfield, and others, who travel around the District with barges and derrick boats to make repairs and handle emergencies."

"You say they keep a fleet at Neville Island?"

"Yeah. People don't know the Engineers have more boats than the Navy and Coast Guard combined, but ours are mostly small work boats. We have a few derrick and workboats at Neville Island. Largest is the *Monallo II*, big enough to handle lock gates and sunken boats. Captain Walter Maund with the towboat *Chartiers* pushes the fleet where its needed. Forty years ago we had four steamboats, the *George S. Nutt*, *Swan*, *Kittanning*, and *Pennova*, a couple of dipper dredges, a dozen derrickboats, some pump boats, concrete mixer boats, and a

Warehouse and repair shops, Neville Island, Pa.





bunch of barges and small craft. There were four repair parties then, two on the Ohio and two on the Monongahela, with better than a hundred men total."

Scribbling furiously, the reporter got most of it down, then asked, "Why has repair work decreased? Because of these dams like New Cumberland?"

The lockmaster bent over a can next to the table, propelled into it the chewed end of his cigar, and replied. "I doubt it," he mumbled. "Some repair work is contracted out now. When I came to the District, we had yearly damage from ice on the Allegheny, acids on the Monongahela, and lots of trouble with these rolling lock gates on the Ohio. But everytime we made a repair, we tried to improve the damaged part so it would last longer. Back then, the wheels on these rolling gates turned on fixed axles and couldn't be greased. Had to unwater the locks and repair the wheels about every two years. They fixed the wheels to the axles, let the axles turn, and ran grease tubes from the top of the gates to the axles. That extended the time between repair jobs to four and five years. They've made more improvements so, with some work by divers, the gates now last eight or nine years between repair jobs. Stretching the repair cycle, they call it."

"You do a lot of diving?" said the reporter, and he was startled by laughter from the lockmen.

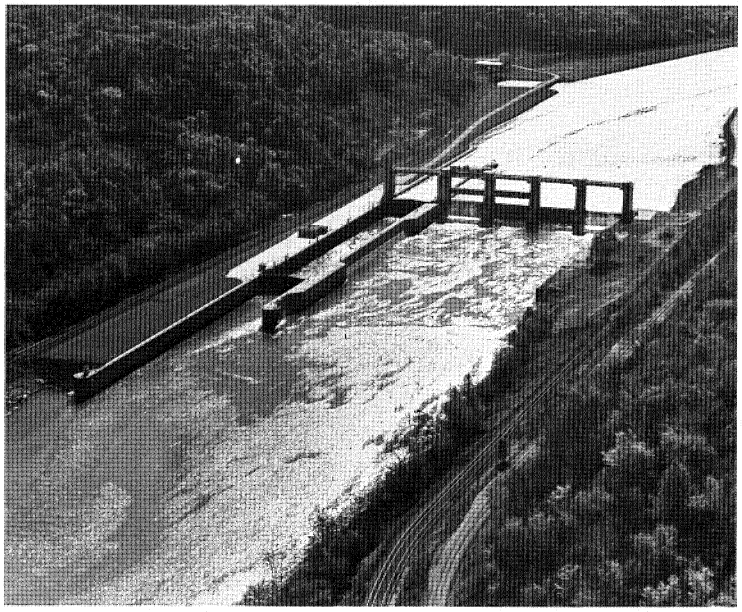
"Not me!" said the lockmaster. "Gives me a chill to think of it, but some guys like it; make extra money. Divers make underwater repairs and often save the cost of a cofferdam. Never heard of a diver drowning in this District, but I've heard some bad stories. Albert Peters was trapped in a tunnel behind a beartrap valve once when the current shut the valve behind him. The valve had a broken stem, couldn't be opened topside, so Albert had to sit down there until another diver went down and opened the valve. Harold "Pus" Lane, years ago, was working underwater on a poiree trestle and lost a finger without knowing it. Learned about it when he went topside and pulled off his glove. He went to the doctor, had the hand taken care of, went back to the job that afternoon, and got mad when the foreman wouldn't let him dive again that day."

"Lot more traffic on the river than there was when you started work before the war?"

"Sure is. Had time to do some work around here between tows thirty years ago, but no more. Don't even have time to get good and warm on nights like this. Tows are mostly too long for this 600-foot lock now; have to put them through in two sections. That's why they're building Pike Island and the new locks and dams. Same story on the Monongahela. Towboats cost something like $200 an hour to operate, and we've got to keep 'em moving."

"How about the Allegheny?"

"Well, they've more commercial traffic now than years ago, but the big thing up there, upriver from Pittsburgh mostly, is pleasure boating; you know, houseboats, motorboats, and fishing boats. Got to watch those kind carefully. They'll try to lock through without preservers, or tie their boat to a post or rail and get left hanging on the side of the lockwall when the lock empties. Over the years, I guess we've saved better than a hundred people from drowning. Back in 1950, Hull Wright at



Opekiska Lock and Dam, Monongahela River

Allegheny Lock 3 lost his own life rescuing pleasure boaters from the river."

The voice of the pilot on the upbound tow came squawking over the radio, and the lockmen began donning their gear, grumbling with good humor about the cold hours ahead of them on the lockwalls. The lockmaster stood and jammed his hardhat on his balding head.

"One more question," said the reporter. "When they finish Pike Island and tear out this lock, what are you going to do?"

"This lock was built in 1912, has been in service a half century. It's obsolete and it's time to retire it. Think I'll do the same."

The reporter snapped his parka, jammed his hands into gloves, and followed the lockmaster out into the raw wind that was blowing the snow upriver. He ran to his Studebaker, fired it up, flicked the heater and wiper switches, and eased back down the road to the newspaper office. Back at the office, he typed out his story, quoting the lockmaster almost verbatim, and, toward dawn, dropped it on the editor's desk and left for home. Next evening, he found the story back on his desk with a bluepenciled note from the boss: "No one wants to read this garbage. Get up to Kinzua and get a story on the plight of the Senecas."

Monongahela Flyover In May 1975 a distinguished group visited the Ohio River Division to inspect progress of the navigation modernization programs on the Monongahela and Ohio Rivers. The visitors included members of the Sub-Committee on Water Resources of the Senate Public Works Committee, Major General John W. Morris, Director of Civil Works at the Office of the Chief of Engineers, and Brigadier General Wayne S. Nichols, Ohio River Division Engineer. To save time, a small plane was chartered for the inspection. Colonel Scott Smith, Huntington District Engineer, served as guide to explain in detail what the dignitaries were seeing as they passed down the river at low altitude.

As the plane banked left over West Fork and approached its confluence with Tygart River, the head of the Monongahela, Colonel Smith began his description:

> *Here you are 128.7 miles above the mouth of the Monongahela at Pittsburgh. Slackwater is available on lower West Fork and Tygart rivers. Straddling the river, you see Fairmont, West Virginia, which receives cement, gasoline, and salt via the river. Sharon Steel has a small plant on the right bank, nearly opposite the mouth of Buffalo Creek. On your left at the mouth of Paw Paw Creek is Rivesville, where a Monongahela Power Company plant receives fuel by river. Prickett Creek comes in on the right; we have a recreation area there. On the left is the Mountaineer Coal Company tipple and conveyor for their Loveridge mine, which averages 13,000 tons production a day. Indian and Whiteday creeks below enter the river above Opekiska.*
>
> *OPEKISKA LOCK AND DAM 115.4 miles above the Pittsburgh Point, is the newest navigation structure on the river and replaced old locks and dams 14*

and 15. We completed the four-gated dam and 84′ × 600′ lock with 22′ lift in June 1967. Opekiska handled a half million tons of traffic in 1973, of which 70% was coal upbound for Rivesville Power Station and 20% was building cement destined for Fairmont.

As we proceed downstream, you see three coal tipples on the left bank, two owned by Christopher Coal Company for their Booth mine and the third by South Union Coal. Following the river along the left bank is the Monongahela Railroad and along the right is the Chessie Railroad.

HILDEBRAND LOCK AND DAM at Mile 108 eliminated old locks and dams 12 and 13. We finished the 84′× 600′ lock in 1959 and the dam, with six crest gates and two fixed weirs, in 1960. Eighty percent of the million tons that passed through Hildebrand in 1973 was coal moving downstream to Fort Martin Power station. We estimate this lock will have to be replaced around the year 2010.

Further downstream you see Interstate 79 crossing at Uffington. On the left bank is Morgantown Ordnance Works with a coal loading dock, and on the right is a dock used to load limestone mined locally. About half a million tons of limestone are shipped from here by river each year. The industry of Morgantown, below you, consists of glass manufacturing, coal and limestone mining, and several gasoline tank farms. Petroleum products come into here by river from New Orleans and Galveston.

MORGANTOWN LOCK AND DAM was first of our modernization structures. We built it in 1950 to replace old locks 10 and 11. It has another 84′× 600′ lock and a six-gated dam. Traffic at the lock in 1973 totaled 1.5 million tons, 70% coal and 25% limestone downbound for Neville Island on the Ohio. This lock will need replacing around the year 2000.

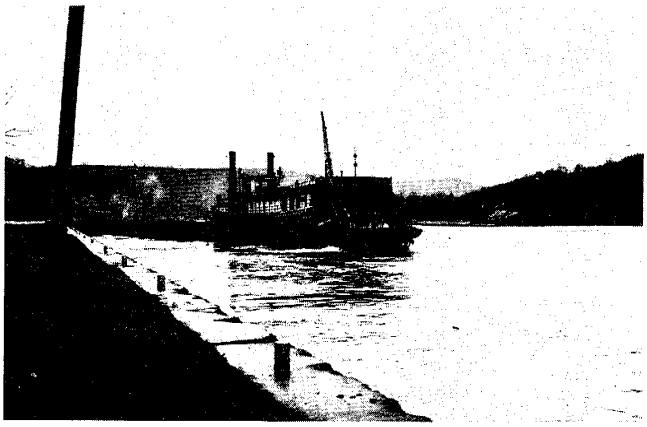
On your right is the University of West Virginia. On the left bank are loading docks for Christopher Coal's Arkwright and Purseglove mines, which have 35 year life expectancy and high production. Downriver is a tank farm on the right bank, and on the left is the loading dock for the Humphrey mine. Below is the site of old Lock 9, the first built by the Engineers on the Monongahela. As we cross the Pennsylvania-West Virginia boundary, you see the two cooling towers on the left of the Fort Martin Power Station.

LOCK AND DAM NO. 8 has a single 56′ x 360′ lock built in 1925. We rebuilt the dam with six crest gates and raised the pool four feet in 1959. We need a new and large lock here. Of the 7.5 million tons that used the lock in 1973, 70% was West Virginia coal bound downriver for steel mills and power stations.

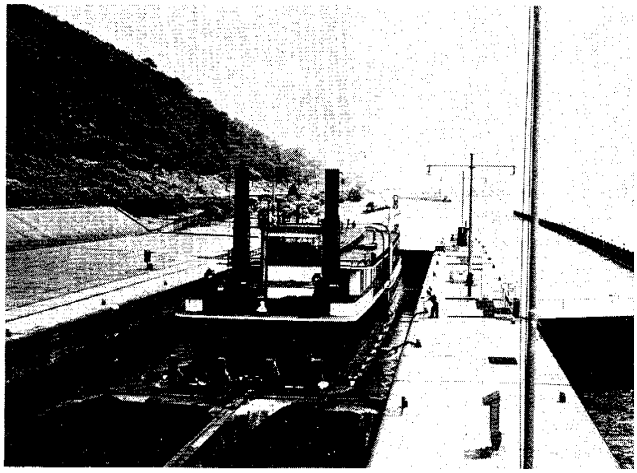
Point Marion is at the mouth of Cheat River. You can see Lake Lynn, owned by West Penn Power, two miles up the Cheat. Now, on the left bank is the mouth of Dunkard Creek and the loading dock of Jones and Laughlin's Shannopin mine, with average 4,200 tons daily output that is barged to the Vesta plant for washing and sent on to steel mills at Pittsburgh and Aliquippa.

LOCK AND DAM NO. 7 at Mile 85 is a fixed crest dam with a single small lock completed in 1926. We need a new gated dam and larger lock here. About 90% of the 9.5 million tons which passed this lock in 1973 was coal headed for steel mills and power stations. Located below the lock are the towns of Greensboro and New Geneva.

Old Lock 6, Monongahela River



Locking through Lock 4, Monongahela River



On the left bank is the Duquesne Light Company Warwick mine that ships 7,400 tons daily to power plants. There is Grays Landing, where we propose to build the lock and dam to replace No. 7. At the mouth of Whiteley Creek is U.S. Steel's Robena mine that produces 15,000 tons daily and ships to the mills and power stations. Downstream of the Highway 21 bridge is the Hatfield Power plant, fueled by river-barged coal. Nemacolin mine ships its production to Aliquippa on the Ohio, where it is transferred to rail for shipment to Youngstown Sheet and Tube Company in Ohio. National Steel Corporation's Isabella mine on the right bank ships to their Weirton steel plant on the Ohio. The old Crucible and new Dilsworth mines are on the left bank and downstream are the docks of the Gateway and Luzerne mines. Several marinas and launching ramps are located there on Ten Mile Creek. There is the town of Millsboro and Republic Steel's Clyde mine, which also ships to Aliquippa and from there by rail to Youngstown. On the right bank is Jones and Laughlin's Vesta mine that produces 5,600 tons daily.

MAXWELL LOCKS AND DAM at Mile 61.2 replaced old Lock 6 in 1965. It has double locks, each 84′x 720′, and a five-gated dam. Coal from the mines we have flown over is shipped to mills and power stations by river through this lock, accounting for 80% of the 17 million tons that passed Maxwell in 1973.

Below on the right bank is the Emerald Coal and Coke dock and the Hillman Barge Company. That's the Highway 40 National Pike bridge crossing the river at Brownsville, which was once the head of steamboat navigation on this river. Dunlap and Redstone creeks enter on the right bank. The town of California is on the left bank and across the river is an Allied Chemical plant. The complex on the left bank below California is the Wheeling-Pittsburgh Steel plant at Allenport. The Interstate 70 bridge crosses there at Belle Vernon and on the right bank below the bridge is the Wheeling-Pittsburgh Steel Corporation dock.

LOCKS AND DAM NO. 4 below us at Mile 41.5 was built in 1932 and has two 56-foot wide locks, one 360 and the other 720 feet long. We placed five crest gates on the dam in 1967 to raise the pool six feet and eliminate Lock 5. When we rebuilt the dam, we left space for locks, both 84 feet wide and 720 feet long. The larger locks will be needed in a few years, for in 1973 about 19 million tons passed through the old locks.

Downstream of Locks 4 are the docks of the Wheeling-Pittsburgh Steel's Monessen plant on the right and, on the left bank, American Oil Company has a dock at the site of old Lock 4. The towns of Donora and Webster straddle the river at Mile 36. Pigeon and Mingo creeks enter from the left and between their mouths are the town of Monongahela and the docks of U.S. Steel's

Maple Creek mine that ships coal to the Clairton plant. Below the mouth of Mingo Creek are the docks of the Mathies mine and West Penn Power's New Eagle power station that receives fuel from the Humphrey mine near Morgantown. The Mathies mine ships to Clairton and Aliquippa. At Elrama on the left bank is Duquesne Light Company's power station.

LOCKS AND DAM NO. 3 at Mile 23.8 was built in 1907 and needs rebuilding before it collapses. Traffic through it in 1973 amounted to 23 million tons, and structural failure here would be disastrous to area industry. We propose to replace the two 56-foot wide locks, one 360 and the other 720 feet long, with double locks, both 84′ x 720′. Construction should begin at the earliest possible date.

Opposite Elizabeth is Consolidation Coal's storage area. Along the left bank at Clairton are the U. S. Steel docks and marine ways. Opposite Glassport is the Ohio Barge Line terminal. Youghiogheny River enters from the right at McKeesport, and there are several docks on the lower mile of the stream. On the left bank, you see the Boswell Oil and Gateway Asphalt docks, another U. S. Steel plant, and the GM Fisher Body plant. At Duquesne is a giant U. S. Steel plant and downstream of it at the two railroad bridges is where Union Railroad transfers coal from barge to rail for shipment northward, some to Canada. Turtle Creek, where General Braddock was defeated in 1755, enters from the right.

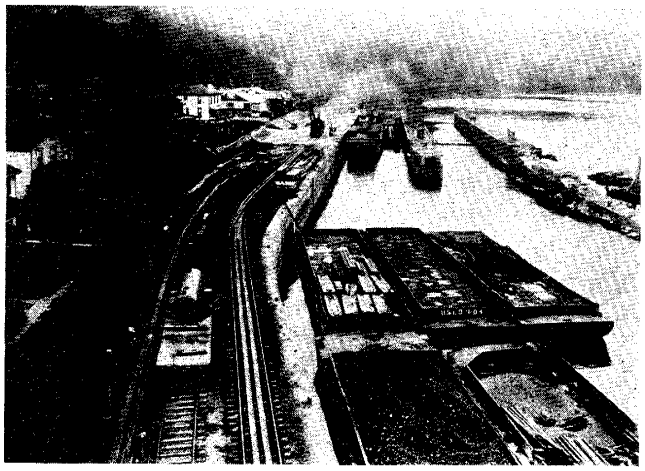
LOCKS AND DAM NO. 2 at Mile 11.2 is last on the river. We took out Lock 1 when we raised Emsworth Dam on the Ohio in 1938. This Lock 2 was built in 1905 and we reconstructed it in 1953, removing a midstream pier and improving the locks. The dam has a fixed crest, with two lock chambers measuring 110′ x 720′ and 56′ x 360′. The dam should be reconstructed in the next few years and the locks replaced around the year 2000. Lock 2 handled 24 million tons in 1973, about 60% coal.

On the right bank is U.S. Steel's Braddock works and Rankin plant, on the left their Homestead works. The American Wind Symphony that tours the river on a barge in the summers giving concerts has a dock at Rankin. American Oil Company has a tank farm at the left end of the Glenwood bridge. Jones and Laughlin Steel facilities line both banks of the river as we continue downstream. On the right bank at the Golden Triangle is the old Monongahela wharf, where the Gateway Clipper docks.

During the ten years ending in 1970, annual tonnage volume traveling the Monongahela increased 59.4%, commerce on the Ohio increased 56%, and tonnage on the Allegheny increased 31.4%. In 1973, better than 63 million tons, about 70% of it coal, passed through the port of Pittsburgh and traveled the three rivers. Modernization of the Monongahela, begun about 1948, is now approximately 50% completed. Before we continue down the Ohio, we will circle the city of Pittsburgh.

Monongahela Modernization The Monongahela carried throughout the late 19th and early 20th centuries a greater tonnage than any other inland river in America. Relatively short, 128.7 miles, in comparison with streams like the Ohio and Mississippi, it was called the "Little Giant" because of the tonnage its brawny waters transported. When long haul coal barging from the Monongahela to Cincinnati, Louisville, Memphis, and New Orleans ended in 1916, slashing Ohio River traffic by half, Monongahela commerce had not faltered and in fact increased, the coal moving to new steel mills at Midland, Aliquippa, and other ports on the upper Ohio.

Boatyard and storehouse at old Lock 4, Monongahela River



Although the "Little Giant" carried more tonnage than other streams, federal funding for its improvement was minimal and the Engineers limped along on the Monongahela until 1947, largely making do with what it had in the way of locks and dams. Planning for modernization of Locks 2 was actually initiated prior to World War II, but with delay caused by the war, it was not until October 1947 that an updated plan was approved and construction could proceed. In the meantime, when a dam threatened to wash out, the Engineers built a new dam; when a lock wall caved in, they built a new and sometimes larger lock. Monongahela slack water in 1947 was essentially a 19th century steamboat project patched up to handle 20th century barge-tow commerce, and a testimonial both to the ingenuity of engineers and the parsimony of Congress.

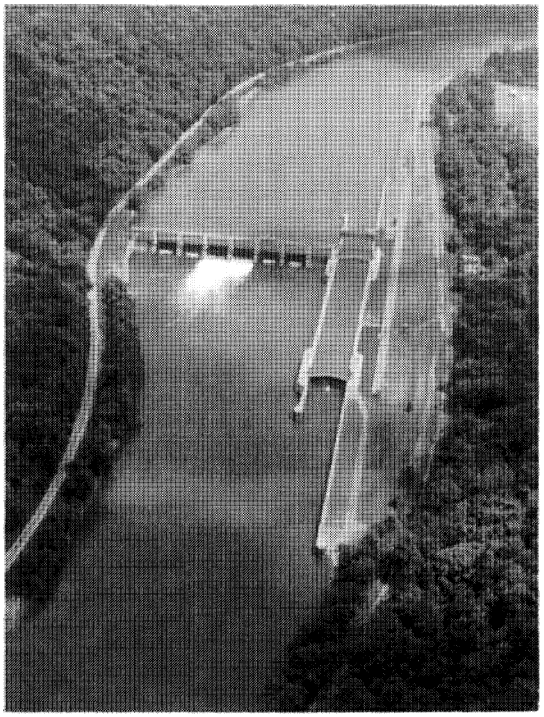
Milnor Roberts had planned canalization of the lower Monongahela in 1838, and the Navigation Company had built Locks and Dams 1 through 4 to Brownsville in the 1840's, adding 5 and 6 in 1856. No. 7, which extended slack water to the State line, was completed in 1884. Except for addition of second lock chambers for faster handling of coal fleets, the project the Engineers acquired from the company in 1897 was fundamentally the same as that planned by Roberts in 1838. Improvements the Corps made in the early 20th century, rebuilding or strengthening dams and enlarging locks, did not much alter the original project: six structures were still in service, all at or very near sites selected in 1838.

Colonel William E. Merrill planned canalization of the middle section, extending slack water from the head of the company project on to Morgantown in 1875, and he supervised construction of Locks and Dams 8 and 9 during the 1880's. Locks and Dams 7, 8, and 9 served until 1926, when major coal mining operations moved upstream into West Virginia, and the Corps removed them and built replacement structures numbered 7 and 8 at new locations with higher dams and larger locks having 56 by 360-foot chambers, then the Monongahela standard.

Colonel Merrill also recommended canalization of the upper river between Morgantown and Fairmont in 1875 to open regular steamboat navigation to the river's head, but Congress did not fund that work until 1895. The Pittsburgh District built six small steamboat locks and dams, numbered 10 to 15, on the upper river between 1895 and 1904. That project, however, provided only a seven-foot depth for steamboats, not the nine-foot channel required by fully loaded barge tows.

During the early 20th century, the Engineers extended the service of the fifteen locks and dams, planned in three sections chiefly for steamboat traffic, as long as possible. Repair and maintenance costs were very high, however, and required the continuous attention of the large repair force and workshops at Charleroi (old Lock 4). Other than structural renovations, the major changes made in the 19th century project before 1947 were relocation of locks and dams 7 and 8 to eliminate No. 9 in 1926, rebuilding of No. 4 in 1932, and elimination of Lock and Dam 1 near the mouth of the river in 1938 by raising Emsworth Dam on the Ohio.

Complex shafting and gearing systems powered by water turbines and small steam engines helped lockmen on the lower river move barges through the locks, but lockmen on the upper river maneuvered the locks and hauled tows out of the chambers by hand. It was necessary to break all tows at the six small locks on the upper river into individual units, pull a single barge at a time through the locks, and reassemble the tows above or below the dams. Superintendent Ike C. Bell directed that hard work during the late 1930's. The lockmasters and chief enginemen at each lock in 1937 were: Mike O'Hare and Frank Herrlein at Lock 1, David Longsdon and



Hildebrand Lock and Dam, Monongahela River

William Gates at 2, William Sypherd and Alfred Price at 3, Anderson Caseber and Robert Hill at 4, Charles Kerbler and Frank Marker at 5, Claude Hains and Delbert Williams at 6, John Sedgwick and Elmer Beckham at 7, Charles Boyle and Roy Martin at 8, Alva Hoke at 10, Walter Floyd at 11, David Lane and John Anderson at 12, William and Jesse Shaffer at 13 and 14, and Silas Sayre at 15. These fellows moved enough traffic through the Monongahela locks in some years to generate savings to shippers, ultimately to consumers, greater than the total federal investment in the navigation project. Historian Richard Wiley estimated that in 1937 shippers saved about $27 million through use of the Monongahela, that the total federal investment to that year aggregated about $16 million, and that operations and maintenance costs averaged less than a million a year.

With traffic swelling and the old locks and dams approaching the ceiling of their capacity and the limit of their useful life, modernization of the Monongahela became imperative at the end of the Second World War. Starting with reconstruction of Locks and Dam 2, the Pittsburgh District prepared plans to replace the thirteen remaining locks and dams on the Monongahela in 1945 with nine modern structures, beginning with replacement of the six tiny locks above Morgantown and raising the seven-foot pools to a nine-foot depth for barge traffic.

Plans prepared for the upper river in 1947 called for three new high-lift dams at the Morgantown, Hildebrand, and Opekiska sites, and raising Dam 8 to obtain a nine-foot depth to Morgantown. Construction proceeded in a regular fashion during a twenty-year period, 1948 to 1967, with few major problems, though the river lived up to its Indian name, meaning "river of falling banks," when an unstable bank slid into the lock chamber while Morgantown lock was under construction. Work began at Morgantown Lock and Dam in 1948; it eliminated old locks 10 and 11 when it opened to traffic in 1950. Second was Hildebrand Lock and Dam, built from 1956 to 1960 to replace old locks 12 and 13. Opekiska Lock and Dam, at the head of the river, was built between 1961 and 1967 to supplant old locks 14 and 15.

The new locks at all three sites were 84 feet wide and 600 feet long, able to pass a standard six-barge tow in twenty minutes. (Six-barge tows at old Locks 10 to 15 had required triple lockage.) Design of the three new locks and dams generally followed the principles being developed for the modern gated structures on the Ohio River, with lock chamber dimensions suited to the sites. This included recognition of a need for, and development of, an emergency bulkheading system capable of placement in flowing water. At Hildebrand an independent emergency bulkhead and hoist structure were permanently installed upstream of the upper lock gate. At Opekiska the closure structure was an extension of the emergency bulkhead and traveling hoist system serving the dam crest gate openings, and was also located just upstream of the upper gate. These emergency closures also served a secondary but vital function during construction of the dam when a large part of the river was obstructed by a cofferdam. The requirement to provide additional waterway opening during periods of high water for free passage of flood flows was met by using the lock chambers for this purpose, since navigation must be suspended at these river stages anyhow. Placement and withdrawal of the bulkheads in flowing water permitted simultaneous opening of both lock gates, which could be securely latched into their recesses.

At Opekiska, a procedure was even developed for early placement of a bulkhead section and its use as an upper lock gate on a rising river, to reduce time of preparation and premature suspension of traffic.

Records do not show that this procedure was ever implemented, and the requirement for a lock floodway does not now exist. The presence of the emergency closures, however, is an independent addition to dependable operation.

To provide deeper and longer pools for navigation, without increasing flood stages, the District installed movable steel crest gates between concrete piers at the three new dams. The crest gates rested on the concrete sills of the dams, holding pools of the required depth during normal and low river flows, and were pulled up between the piers clear of the water surface to allow passage of flood water and ice unobstructed through the dam. Morgantown and Hildebrand dams each had six crest gates, each sixty feet wide, while Opekiska had four 84-foot crest gates, allowing use of the same size emergency bulkheads for both the crest gates and the lock chamber.

Establishing a nine-foot depth below Morgantown Dam required the raising of Dam 8 to increase the depth of its pool by four feet. Lock 8 had been built in 1926 and had service life left, so the Engineers simply rebuilt the dam there in 1958 and 1959 by installing six movable crest gates between piers. The 1926 lock, with 56 by 360-foot dimensions, remained, but the Engineers left space for construction of a larger lock when necessary.

Modernizing the middle and lower river sections proceeded less systematically than on the upper Monongahela because available funds had to be applied to reconstruction of the old locks and dams as they approached collapse or became intolerable bottlenecks to river traffic. Work first became necessary at No. 2, lowermost lock on the river where traffic was dense.

Each chamber at Locks and Dam 2 was 56 by 360 feet, built in 1905, and the locks could handle only four barges at a time. It took forty minutes to pass the normal six-barge tow in two sections. The Engineers decided to leave the old dam in place, and in 1949 contracted with Dravo Corporation for construction of new locks, one to be the same size as the old locks and the second to be 110 feet wide and 720 feet long, the latter large enough to handle a towboat and fourteen barges in a single lockage.

Located adjacent to U. S. Steel's Edgar Thomson Works and a mainline railroad track, where the river bank was unstable, all materials for new Locks 2 had to be delivered by river and use of floating construction equipment was mandatory. Wilfred Bauknight, Chief of Construction Division, and resident engineer R. W. Comfort working with Dravo met the construction challenge at Locks 2 by mixing the 2500 cubic yards of concrete that went into the new locks aboard a barge placed next to the cofferdam. Concrete was delivered to the forms in dinkey cars running on temporary tracks laid around the site.

Two construction contracts were awarded to Dravo for this project: the first, for the narrower river chamber in December 1948; the second, for the 110-foot chamber in May 1951, a month before completion of the first. By November 1951, the District's supervisory staff had changed: Wilfred Bauknight had moved on to become Chief of Supply and Procurement Division and Jacque Minnotte had stepped up from Assistant to Chief of the Construction Division. E. P. Daugherty had become resident engineer at Locks 2. The new river chamber opened to traffic in July 1951, and the new land chamber in November 1953. First boat through was the sternwheeler *Homestead*, pushing a twelve barge tow.

The next trouble spot was at Locks and Dams 5 and 6, built in 1907 and 1916, which were in a sad state of repair and operating at top capacity. Traffic at Locks and Dam 5 often suffered six hour delays while awaiting turn to use the locks. The best site for a replacement structure was at Maxwell, 4.8 miles upstream, so in 1957 the District planned new locks at that site, plus raising Dam 4 to carry the required nine-foot depth up to the new locks. Locks and Dams 5 and 6 were thereby eliminated.

The Engineers completed Maxwell Locks, two 84 by 720-foot chambers, in 1963 and finished the dam, which had five movable crest gates, in 1966. That took out old Lock and Dam 6, and when the pool of Dam 4 was raised six feet in 1967, through construction of five movable crest gates between piers, Lock and Dam 5 was removed. Lock 4 had two 56-foot wide chambers, one 360 feet and the other 720 feet long. Those locks, completed in 1932, were still serviceable, so they were left in place with space provided in the new dam for later replacement with 84-foot locks.

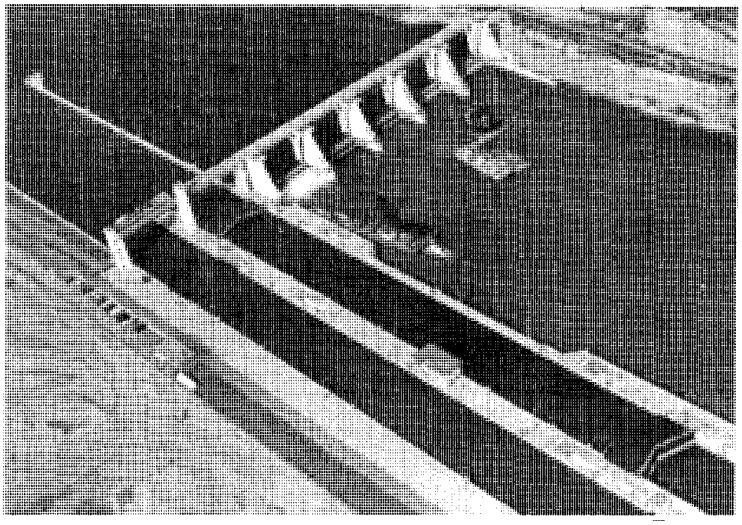
Progress on the Monongahela modernization project stopped in 1967, after twenty years work. During the Nixon-Ford administration, Congress provided no funds for completing the project, and for a decade the Engineers made the half-completed project serve as best it could.

From 1948 through 1967, the Engineers had reduced the number of navigation structures from thirteen to nine and had established a full nine-foot project depth throughout the length of the river. But only four of the nine, Morgantown, Hildebrand, Opekiska, and Maxwell, were fully modern structures. At No. 8, they had a 1925 lock and a 1959 dam; at No. 4 a 1932 lock and a 1967 dam; and at No. 2 a 1953 lock and a 1905 dam. No significant improvements had been completed at Lock and Dam 3, built in 1907, or at Lock and Dam 7, built in 1926.

Because Monongahela coal had been hauled by two 25-foot wide coalboats lashed together during the early 19th century, the Monongahela Navigation Company had made the 56-foot lock chamber width standard for the river, and that standard had forced barge tows to conform by placing two barges abreast. In planning the modernization project, the Engineers selected an 84-foot width as standard, to admit tows that were three barges wide, with 110-foot wide chambers at the lower locks, the same as on the Ohio, to allow tows that were four barges wide to move between the mills on the lower Monongahela and the Ohio without breaking and reassembling the tows. In point of fact, the only 110-foot wide chamber so far constructed was the land chamber of Locks 2. But with modernization only half finished, and some locks still in use that had the old 56-foot width, rivermen were forced either to form their tows two barges abreast to begin with, or break and reassemble their tows at the narrower locks. Considering that the Monongahela in 1977 resembled a partially completed interstate highway where traffic had to detour around old bridges that had not been raised, rivermen put up with the situation quite patiently.

The District Engineer had, in 1970, transmitted a report proposing a new lock and dam at Grays Landing (below Lock and Dam 7) and a new lock at Lock and Dam 8. The report was approved and construction authorized by the Secretary of the Army in October 1973 under the provision of the River and Harbor Act of 1909. Both projects were brought to a halt by a significant development at Dam No. 26 on the Mississippi River--some 1,000 miles distant. There the Corps' proposal for the replacement of Dam No. 26 was challenged by railroad and environmental interests who questioned, among other things, the use of the 1909 Act as authority for the replacement project. In January 1977 the District was advised that the Secretary of the Army would seek new authority from Congress for the construction, and that preconstruction planning studies must be amplified with a system-wide analysis of economic and environmental factors.

Maxwell Locks and Dam, Monongahela River



DATE	LOCKAGES (Number)						CRAFT PASSING (Number)																											
							STEAMBOATS										OTHER BOATS WITH POWER						BARGES—Standard										
							PACKET		EXCURSION		TOW				GOV'T		OIL		GASOLINE														
											DRAFT						TOW		TOW		SMALL MOTOR		DRAFT										
											3 to 5 feet		5 to 7 feet										Less than 3 feet	3 to 5	5 to 7	7 to 9	Total	Less than 3 feet	3 to 5	5 to 7	7 to 9	Total
	Large lock			Small lock																														
	Up	Down	Total	Single	Double	Total	Up	Down	Up	Down	Up	Down	Up	Down	Up	Down	Up	Down	Up	Down	Up	Down	Up	Up	Up	Up	Up	Down	Down	Down	Down	Down
1	8	7	15	4	4	8					2	1	2	4			8	3			1	1	25		3	13	41	7			45	52
2	4	6	10	3	1	4					1	2	2	2			3	3			1	1	12		5	8	25	10			28	38
3	3	7	10	4	1	5					2	2	2	4	1	1	1	1			1		23		3		26	18			28	46
4	2	3	5	2		2							2	1			1	2		1	1		6		1	6	13	4			11	16
5	5	6	11	1	1	2					1	1	4	2			2	2				1	22		3	15	40	9			28	37
6	2	2	4	2	5	7							3	2			1	4				1	8		3	6	17	14			3	17
7	2	8	10	4	2	6					2	1	1	3			4	5					18		6	6	30	10			41	51
8	8	3	11	3	3	6					1		5	3			4	2			2	1	39	4	3	8	54	3			18	21
9	3	4	7		2	2						1	3	2				3				1	17			8	25	2	2		20	24
10	5	6	11	3	1	4					2	1	1	4			4	1			2		18		7	6	31	1			36	37
11	42	52	94	26	20	46					11	9	25	27	1	1	26	22			8	6	189	4	34	76	302	78	2		258	338
12	8	5	13	2	1	3					2	1	4	2			4	2				1	32		3	11	46	8			20	31
13	3	5	8		2	2					1	1	2	2				3				1	22				22	16	2	7	11	36
14	7	4	11	3		3					1		3	3			6	1			1		19			9	8	36	5		22	27
15	4	6	10	5	5	10					1	2	2	3			5	6			1		14			5	9	28	10		33	43
16	2	3	5	1		1					1		1								1		13				13	7			12	19
17	68	79	147	37	28	65					17	13	37	40	1	1	43	38			17	8	288	4	51	104	447	118	4	7	359	488
18	2	4	6	1	1	2					1	1	1	1			1	2				1	13			1	14	5			15	20
19	8	7	15	4	2	6						1	7	5			4	2				1	41		8	12	61	14			34	48
20	5	1	6		1	1					3	1	2					1					30		6		36			1	7	8
21	1	6	7	1	2	3						1	1	4			1	3					6	1			7	11			24	35
22	8	5	13	4	3	7					2	3	4	2			5	3			1	1	31	2	4	12	49	9			23	32
23	90	98	188	47	37	84					23	20	52	52	1	1	34	47			12	10	409	7	69	129	614	157	7	8	462	631
24	4	7	11	4	1	5						1	6	4			1	2			1		29		4	1	34	18	1		30	49
25	4	6	10	3	2	5					1	1	2	3			5	3				1	5	2	2	7	16	9			24	33
26	3	10	13	2	1	3					2	2	2	5			2	2			1	1	22	1	1	2	26	1	2	2	31	36
27	4	2	6									1	3	1			1						11			13	24				13	13
28	2		2										2										9			2	11					
29	107	123	230	56	41	97					26	25	67	65	1	1	63	56			14	12	485	10	76	154	725	185	7	10	560	762
30	2	1	3								1		1	1									12			4	16	3			4	7
31	4	5	9	2	1	3							4	5			3	1					20		2	9	31	13			18	31
Through lock,	2	3	5	3	3	6						1	1	1			3	3			1	1	7		2		9	3			15	18
Through pass,	4	6	10	3	3	6					2	1	2	3			3	5					21	1	3		25	10			30	40
	5	6	11	1	2	3					1	1	4	3			1	3				1	9		5	10	24	10			17	27
	124	144	268	65	50	115					30	28	79	78	1	1	73	68			15	14	554	11	88	177	833	229	7	10	644	885
	4	4	8	1		1					1	1	3	3							1		17			6	23	6	3		21	30
	128	148	276	66	50	116					31	29	82	81	1	1	73	68			16	14	571	11	88	183	853	230	10	10	665	915

Lockmaster log

In that same year, simply because the 70 year old Locks and Dams 3 facility was on the verge of collapse, some very critical repair work was accomplished. District Engineer Max R. Janairo had declared that the deterioration of Number 3 was "of a sufficiently critical nature to warrant immediate and expedited attention". The critical rehabilitation features included provision of a new upper guard wall expansion and major repair work in the filling flume located landward of the land wall. Additional major rehabilitation of the Locks Number 3 project was scheduled in 1978.

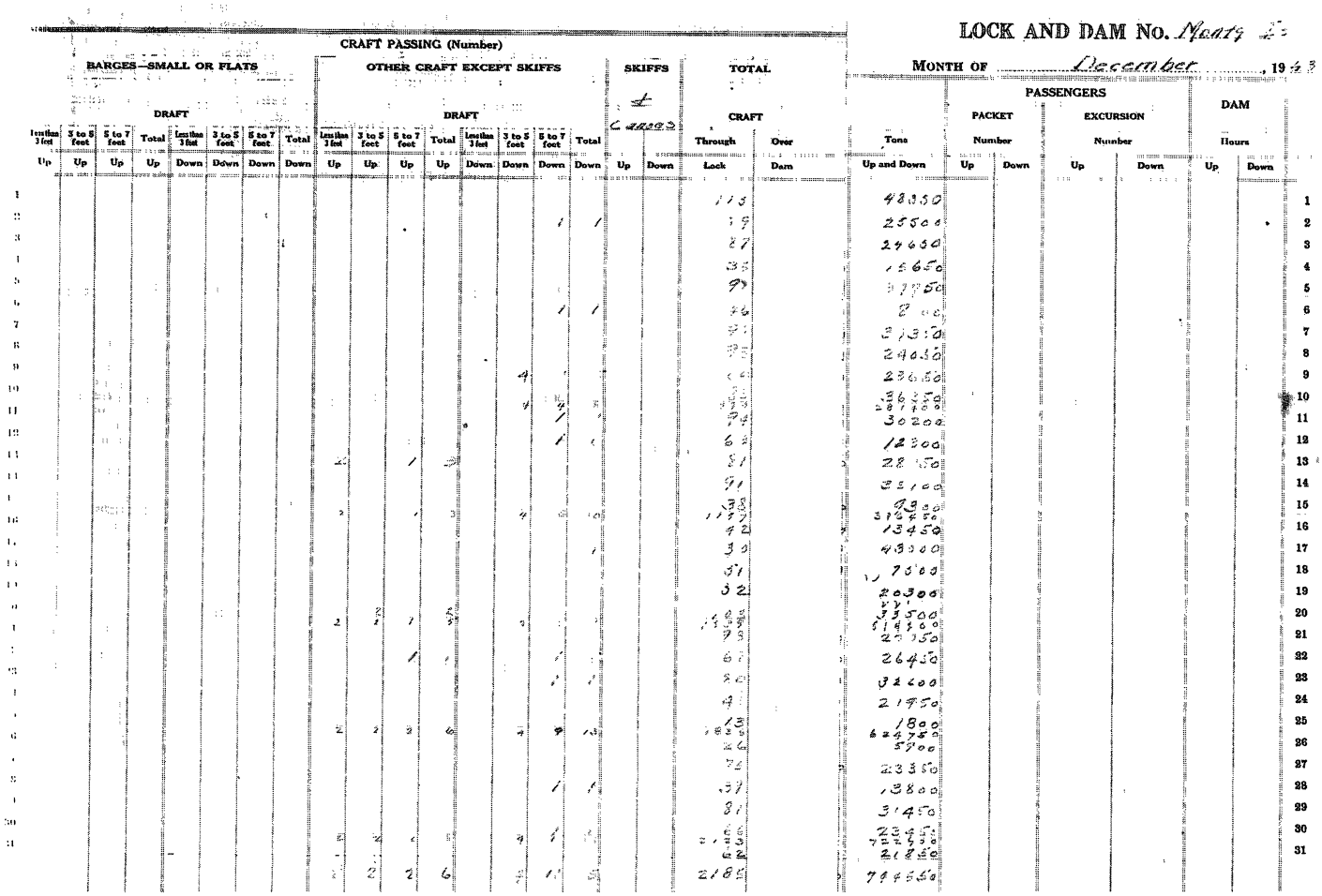
Whether Congress would fund the much needed overall modernization at a rate sufficient to finish the job by the end of the century before the first structures built reached the end of their service life was still uncertain. Morgantown Lock and Dam, for example, completed its first quarter century of service in 1975 and would reach the end of its half century estimated service life in the year 2000.

Ohio River Flyover After circling downtown Pittsburgh, the plane crossed over Point State Park, old Fort Pitt, and headed down the Ohio. Colonel Smith resumed his narrative description of points of interest along the rivers:

The Ohio is formed here at the Point and flows 981 miles in a southwest direction to the Mississippi. First island you see is Brunot Island, which contains the Duquesne power plant. In the channel left of the island is the mouth of Chartiers Creek and McKees Rocks. Next is Davis Island, where Lock and Dam 1 was built in 1885, and immediately downstream is Neville Island, which contains over two dozen major industries and the Pittsburgh Engineer Warehouse and Repair Shops. Interstate 79 is being built across the island.

EMSWORTH LOCKS AND DAM 6.2 miles below the Point, creates Pittsburgh harbor. The locks were built in 1922: the larger is 110′ x 600′ and the smaller is 56′ x 360′. In 1938, we rebuilt the dam, using the old fixed dam as an apron, closing the main channel with eight crest gates and the back channel with five gates. That allowed us to raise the pool and remove Locks and Dams 1 on the Allegheny and Monongahela. Traffic through Emsworth in 1973 was about 25 million tons. We have real traffic jams here and need larger locks.

At the toe of Neville Island on the left bank is Coraopolis and a Texas Company



dock. That's the Sewickley bridge at Mile 12 and a mile below it is Dashields Locks and Dam.

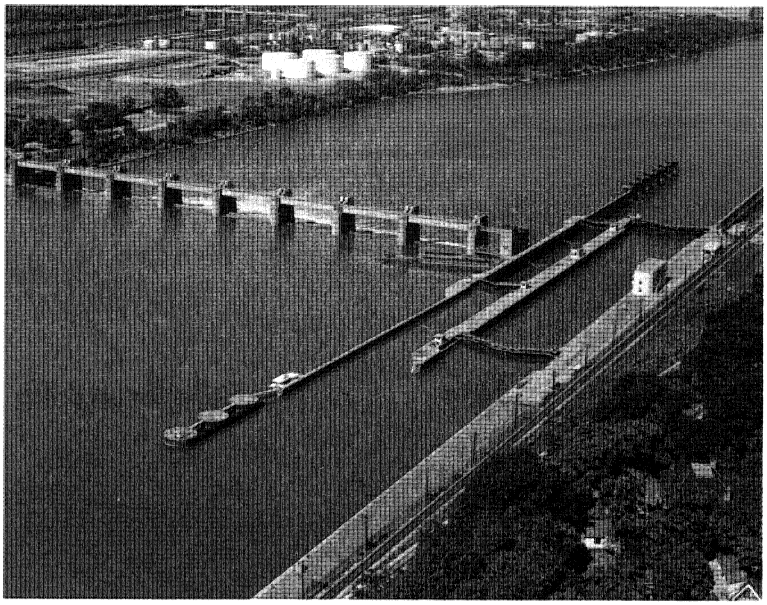
DASHIELDS LOCKS AND DAM completed in 1929, has double locks the same size as those at Emsworth and a fixed weir type dam. Dashields passed nearly 24 million tons of freight in 1973, and the structure will need replacement before long.

On the right bank opposite Glenwillard is the Bethlehem Steel dock and downstream from it is the American Bridge plant at Ambridge. Across the river is Jones and Laughlin's Aliquippa plant with several large docks.

Here at Conway, Rochester, and Freedom, the Ohio makes its northernmost bend, and we have the mouth of Beaver River. North Star Coal and the Pittsburgh and Lake Erie Railroad have docks on the left bank opposite Freedom. On the right bank below the mouth of the Beaver, are the towns of Beaver, Vanport, and Merrill, the latter named after a Pittsburgh District Engineer. In this section are the docks of the Koppers, St. Joseph Lead, Sun Oil, and Limco companies.

MONTGOMERY LOCKS AND DAM at Mile 31.7, built in 1936, has ten crest gates and two fixed weirs. Lock size is the same as Emsworth and Dashields. They handled about 23 million tons of freight in 1973.

A mile below Montgomery on the left bank are the docks of Pennsylvania Power. Other docks are at the Shippingport bridge above the head of Phillis Island. On the right bank, you see the giant Crucible Steel complex at Midland. Dravo and Campbell Barge Line have docks on the left bank at Georgetown, opposite the mouth of the Little Beaver. The Pennsylvania, Ohio, West Virginia boundary crosses at Mile 40, a half mile below the Little Beaver. Several coal and oil docks serve East Liverpool, there below Babbs Island. There is Wellsville on the right bank, where we built the pilot project for floodwalls on the Ohio River. As we approach New Cumberland, you see Cluster Islands left of the channel and Ohio Edison docks on the right at Port Homer.



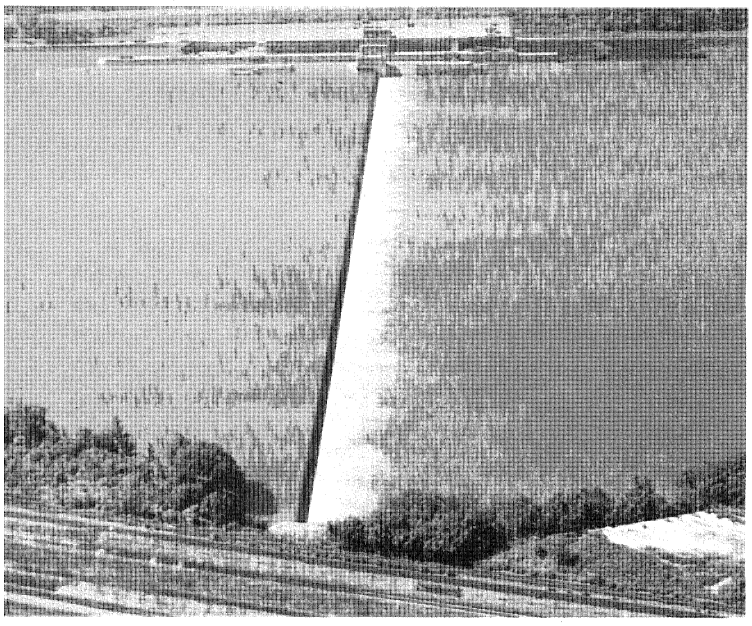
Emsworth

Dashields

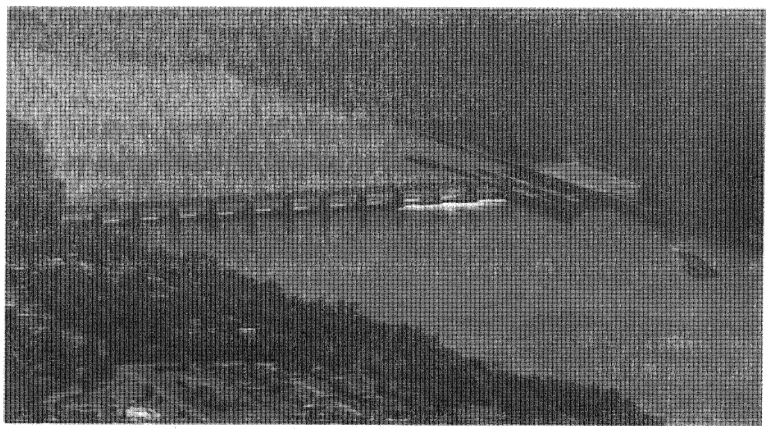
Montgomery

OHIO RIVER LOCKS AND DAMS

NEW CUMBERLAND LOCKS AND DAM at Mile 54.4, eliminated old locks 7, 8, and 9 in 1963. It was first of the new super dams we're building on the Ohio. The small lock is the same size as the large lock at Montgomery; the large lock is 1200 feet long. The dam has eleven tainter crest gates, each 110′ long, which permits use of the same size bulkhead we use for the locks. About 25 million tons of freight passed through here in 1973.



Downstream from New Cumberland, you see the towns of Empire, Toronto, and New Cumberland, and that is Browns Island, where we built our first dam on the Ohio in 1836. Left of Browns Island is Weirton and the National Steel Corporation docks, and downstream on the right is Steubenville, another steel town. The two towns have taken from Pittsburgh the dubious honor of having the worst air pollution in the nation. Mingo Junction is at the mouth of Indian Cross Creek on the right. Wheeling-Pittsburgh Steel has a dock there, and on the left bank is a Weirton Steel dock. Wellsburg, on the left, is at the mouth of Buffalo Creek. On the right bank are docks of Ohio Power and Ohio Ferro Alloys companies. Indian Short Creek comes in from the right at Warrenton. Wheeling-Pittsburgh Steel, Valley Camp Coal, and Standard Oil own the terminals you see.



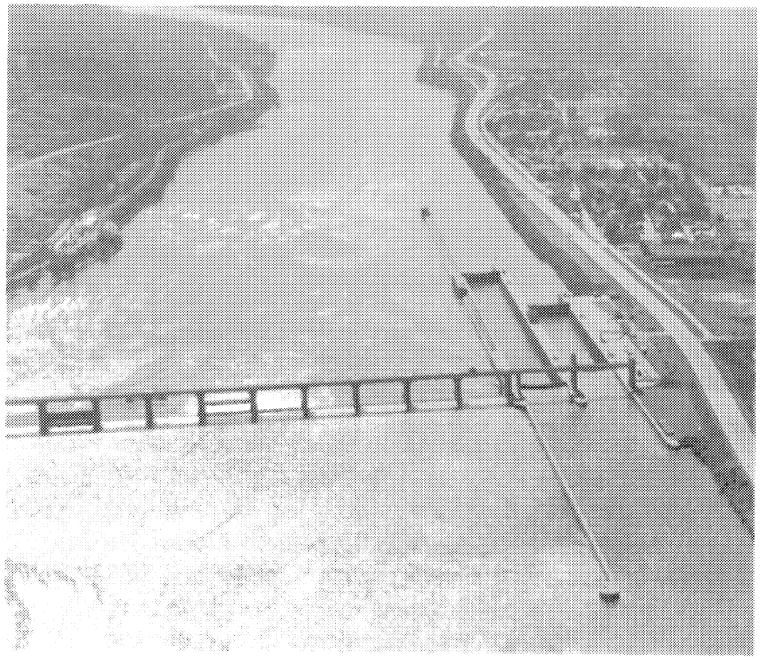
PIKE ISLAND LOCKS AND DAM at Mile 84.2 replaced old locks 10 and 11 in 1965. It's named for an island that was submerged when we built Dam 12 in 1917. It has large modern locks, nine crest gates, and a fixed weir. The locks handled around 28 million tons in 1973.

Those are Sisters Islands below the dam and Warwood on the left. You can see the U. S. Navy Training Base at Warwood

New Cumberland

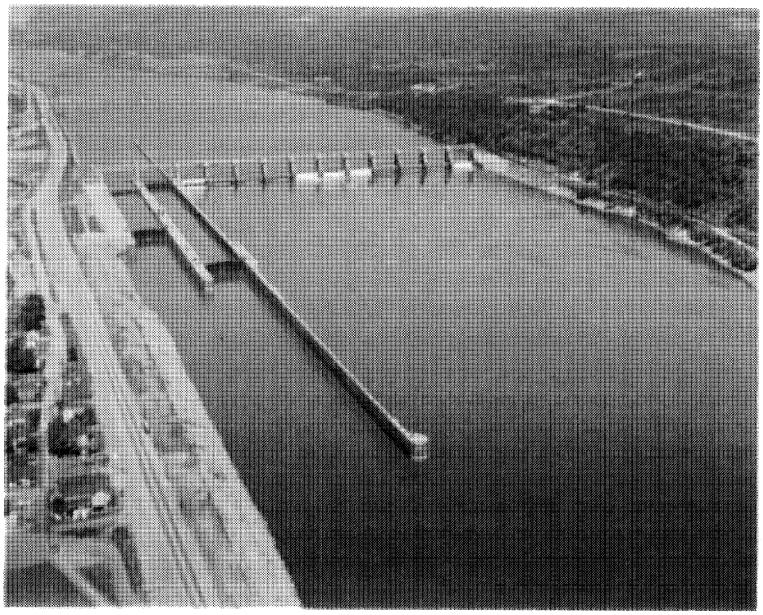
Pike Island

Hannibal



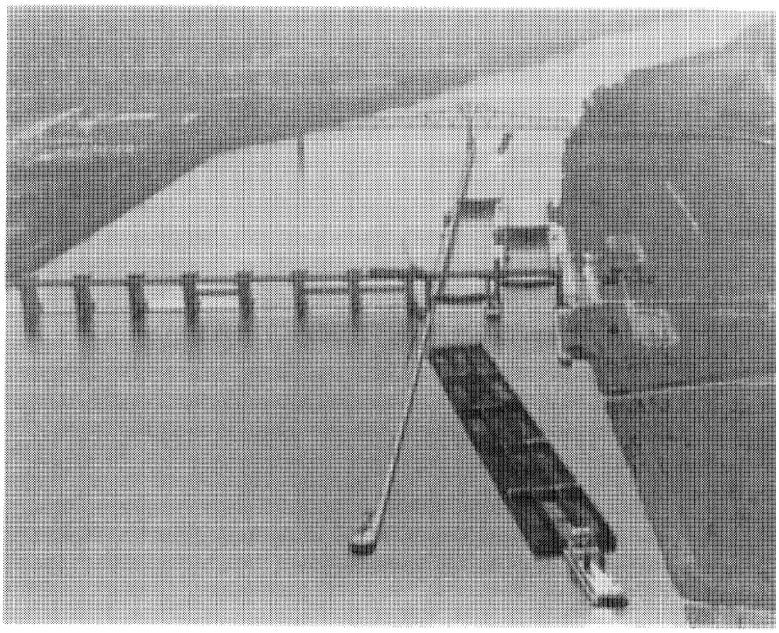
and Lock 12, one of the old single locks and wicket dams that is under contract for removal. Here, we enter the heavily industrialized Martins Ferry, Bridgeport, Wheeling, Bellaire, and Benwood stretch. That is Wheeling Island that has a large population and always suffers damages when the river floods. Interstate 70 crosses the island, and you can see the old suspension bridge next to it.

Lock and Dam 13 at McMechen is the last wicket dam in Pittsburgh District and handled 29 million tons of freight in 1973. We are getting ready to demolish it and have already removed No. 14.



Glendale and Moundsville are on the left bank. Valley Camp Coal has a dock at Moundsville, and across the river is an Ohio Edison dock. North American Coal, Hanna Coal, Riverside Coal, and Allied Chemical own some of the docks you have seen in this section above Powhatan Point and Captina. That is Fish Creek Island left of the channel, and Clarington on the right bank below the Quarto Mining Company dock. Those are the towns of Proctor, Steelton, and Rockport, and docks owned by Pittsburgh Plate Glass, Mobay Chemical, and Ormet Corporation.

HANNIBAL LOCKS AND DAM at Mile 126.4, just above New Martinsville, is the lowermost navigation project in Pittsburgh District. The cofferdam is in the third and final stage, and we expect to finish the job in 1976. The locks were completed in 1971. The dam will have eight crest gates when finished. Building the project has employed about 900 people since we began work in 1966. About 485,000 cubic yards of concrete went into the locks and about 140,000 cubic yards will go into the dam. In 1974, the locks will pass about 30 million tons, mostly coal,

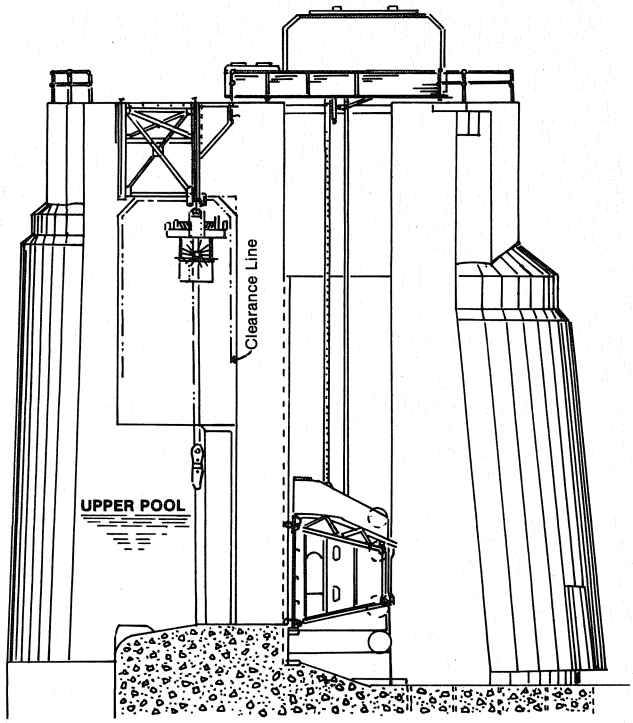


petroleum, and steel. When Hannibal is finished next year, Pittsburgh District will have finished its share of the Ohio River modernization project begun in 1954. We have urgent work ahead of us on the Monongahela, and improvements at Emsworth, Dashields, and Montgomery dams will be necessary by the end of this century.

With that, Colonel Smith ended this part of the narrative, and the pilot dropped the plane in low over Hannibal so the Washington delegation could see the third-stage cofferdam, with construction equipment and men swarming atop the steel cell cofferdam and down in the pit. The plane then crossed the imaginary line dividing the Pittsburgh from the Huntington District.

First High-Lift Dams on the Ohio "Because of the steep slope and the shortness of the pools," Acting District Engineer Harry Hill reported to Division Engineer George Spalding, "the stages are susceptible to flashing rises, so that the dams in this reach require constant maneuvering with temporary deficiency of pools. The hazards of obsolescent structures and the ill effects of temporary deficient pools are magnified in this reach because it constitutes a collecting and distributing point for large industries with a high density of riverborne traffic."

Captain Hill wrote to Colonel Spalding on September 3, 1931, to explain why the Pittsburgh District wanted to replace wicket dams 4, 5, and 6 on the Ohio with a high-lift dam to modernize navigation on the upper river. He told Spalding the best site for the new dam was at Montgomery Island, two miles downstream of Lock 6 and 31.7 miles below Pittsburgh. A fixed dam at that site, high enough to maintain a nine-foot channel to Dashields dam, would cause flood damages at Bridgewater, New Brighton, Rochester, and Freedom, but the engineers at Pittsburgh had devised a solution. They had planned placement of a concrete foundation and low sills with movable crest gates, about fifteen feet high, atop the sills to form the dam. At normal and low water stages, the metal crest gates resting on the sills would dam the river and form the pool, but at the approach of floods or ice they would be hoisted up between piers to allow passage of flood waters and ice gorges without damage. Double locks, like those at Emsworth and Dashields, would pass the river traffic.



Vertical lift gate

After a week's study, Spalding approved construction of Montgomery Locks and Dam. General Lytle Brown, Chief of Engineers, stamped his approval on the project designs a week later, and the following day, September 18, 1931, the Secretary of War approved. Fifteen days from the desk of the Pittsburgh District Engineer to the desk of the Secretary of War and full approval; a record not likely ever to be surpassed by any navigation project.

Booth and Flinn Company won the contract for building Montgomery Locks and Dam and began work in May 1932 under local inspection of resident engineer Don P. Keelor. The contractors had used towers and cableways to build George Westinghouse bridge at Pittsburgh and adopted the same system at the Montgomery project for handling excavated spoil, erection of forms, and placement of concrete. A deep gravel bed overlay foundation rock at the Montgomery site, so the contractors adopted the old Ohio River box cofferdams, double rows of wooden sheeting held together with metal tie rods, and had few problems with them, except overtopping by floods. With experience as bridge contractors, they chose to erect the eleven piers of

the dam on open caissons sunk to rock with steel sheetpiles driven across the spaces between the caissons.

While the old chanoine wickets had been dropped under the river surface against the dam foundations at the approach of floods or ice gorges, the new Montgomery Dam had ten 100-foot long and 16-foot high vertical-lift gates which were pulled straight up clear of the river level to pass flood and ice flows. Vertical-lift gates, which were steel bulkheads rectangular in shape weighting ninety tons, were raised by chains in concrete piers at the ends of each gate, powered by electric hoisting machinery mounted atop the piers. Damtenders and a gasoline-driven locomotive crane moving along a steel service bridge connecting the piers at the top handled emergency bulkheads and serviced the gates.

Some people worried that Montgomery Dam, with piers in the river channel, would block passage of ice and create great ice gorges. When a huge gorge occurred on the Ohio between Vanport and Sewickley in February 1936, the media blamed it on the new dam. Senator James J. Davis of Pennsylvania complained to Congress that the dam had caused the gorge, resulting in suspension of river traffic, unemployment at closed mines and mills, and some property damages. In fact, the gorge had grounded on a shoal at Vanport, three miles above the dam, and when it broke free on February 26 it smashed apart on the dam piers. Had the dam been finished, its deep pool would have prevented formation of the gorge at Vanport and moved it on south without serious problems. In the end, District personnel, especially Superintendent R. C. McCullough, received commendations for their hard work during the ice gorge at saving boats and equipment carried away by the ice.

Montgomery Dam was finished in the summer of 1936 and the Pittsburgh District began building a second high-lift dam at Emsworth, to permit removal of the lowermost locks and dams on the Allegheny and Monongahela with resulting enlargement of Pittsburgh harbor. Contractors Seeds and Durham and American Bridge Company under direction of resident engineer Ralph Patt built the new dam at Emsworth, which actually was two dams, one on each side of Neville Island. The crest of the old dam, built in 1922, was cut down sever feet and it became an apron directly below the new structure, and the contractors had the new concrete foundation in place and the steel crest gates suspended between the piers by January 1938. The 967-foot main channel dam was closed by eight vertical-lift gates, each 100 feet long and 12 feet high. The 750-foot backchannel dam was closed by five crest gates; four were vertical-lift and the fifth an experimental crest gate invented by William E. Sidney.

Sidney's invention arose from the experimentation with movable crest gates for dams that was underway during the Depression years. The Corps of Engineers tried three different types of crest gates, roller, tainter, and vertical-lift, at its projects; and the Sidney gate was a hybrid of the tainter and vertical-lift types.

Huntington District and its senior engineer Harry Pockras thought roller gate dams superior, and built four of them, three on the Kanawha River and Gallipolis Dam on the Ohio, to replace chanoine wicket dams. Roller gates were metal cylinders or drums that were rolled by chains and hoists up and down inclines in concrete piers to open and close the dams. German engineers had built the first roller gate dam in 1902 at the Main River near Schweinfurt, and the Krupp and Maschinenfabrik Augsburg-Nurnberg firms held the patents.

Tainter gates, sometimes called sector gates, had an upstream face formed of sheet metal shaped in the sector of an arc and supported by girders connected to an axle or trunnion fixed between two piers. They did not slide or roll up piers to get out of the way of floods or ice; instead, the trunnion stayed in place between the piers and the upstream metal sheet rotated upwards until it cleared the water surface. French engineers had used crude tainter gates as early as 1853, but Wisconsin lumberman Thomas Parker, who also invented the Parker beartrap that was tried at Ohio River Dam 13, independently in-

vented the American sector gate for use in splash dams on Wisconsin logging rivers. The invention became known as the tainter gate because Parker sold his rights to Jeremiah B. Tainter, who patented the device in 1886 and collected royalties for its use. William L. Marshall (Chief of Engineers, 1908-10) installed the first tainter gates used by the Corps on Fox River in Wisconsin in 1890. By 1939, the Corps was using massive steel tainter gates on the spillways of its flood control dams.

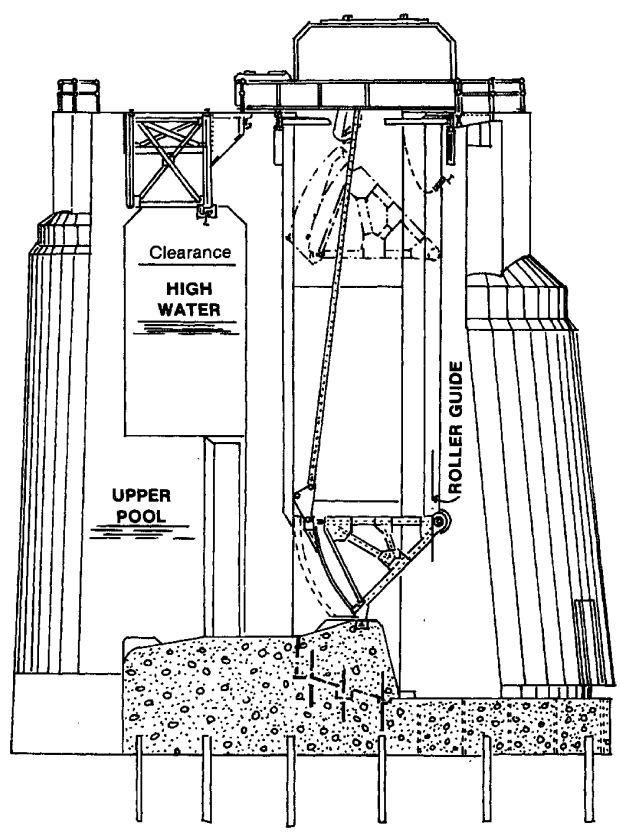
The vertical-lift gates Pittsburgh District installed at Emsworth and Montgomery Island dams in 1936 and 1938 were simply modern and large-scale versions of a crest gate for dams used by engineers since ancient times. They were steel bulkheads, rectangular in section, placed in slots in concrete piers and raised up and down from concrete sills by chains and hoisting machinery.

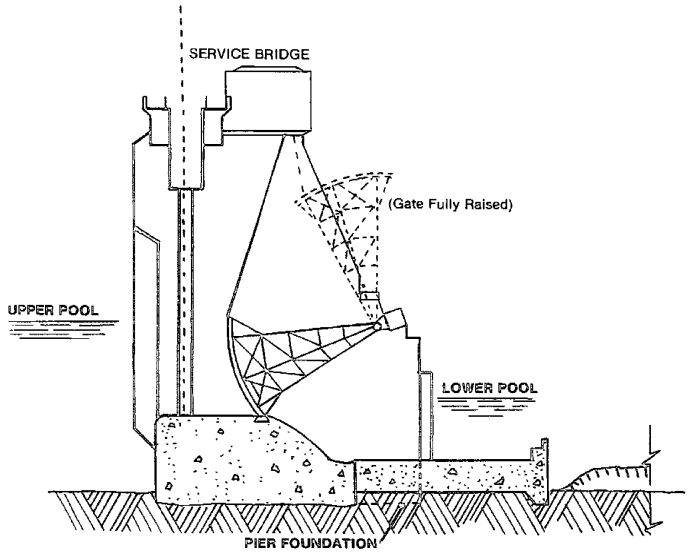
The Pittsburgh District began experiments in 1935 with the movable crest gate invented by William Sidney, the self-trained mechanical expert who joined the District in 1925 and became head of the Design Branch. His invention combined the advantages of the tainter and vertical-lift gates. It was a tainter gate that opened and closed by rotating on a trunnion to maintain normal pool levels, but which could also be hoisted up piers at flood times like the vertical-lift gates.

The District installed a one-fifth scale model of the Sidney gate at Allegheny Dam 3 in 1935, and Wilfred Bauknight reported it worked fine. Because it was light-weight, it could be raised from piers smaller than those needed for vertical-lift gates, and, because it lifted out of the path of floods instead of rotating on fixed trunnions like tainter gates, it needed less metal and smaller piers than did tainter gates. The District therefore installed a full size Sidney gate in the back channel dam at Emsworth in 1937 to continue experiments.

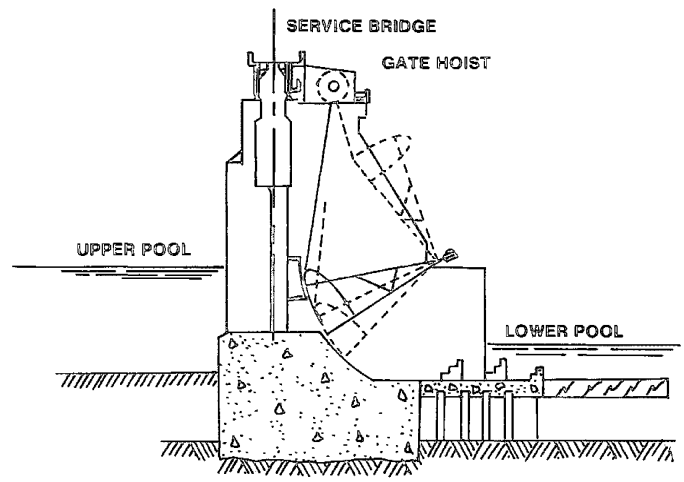
The engineers at Pittsburgh began studies of replacing the wicket dams and single locks below Montgomery Island dam in 1936, and District Engineer W. E. R. Covell reported in January 1937 that replacement of the old structures would become necessary about 1945. The Division Engineer assigned Pittsburgh responsibility in 1938 for replacement studies of old locks and dams 7 through 14, and on May 10, 1941, District Engineer Ludson Worsham recommended building three high-lift dams with double locks, similar to the Montgomery Island project, at the New Cumberland, Pike Island, and Opposum Creek sites. The present Hannibal Locks and Dam site, about six miles downstream, was later substituted for Opposum Creek. Thus, just as federal work on the inland rivers in 1824 and the Ohio River canalization project in 1874 had begun at Pittsburgh, the Ohio River modernization project, replacement of the chanoine wicket dams, also began at Pittsburgh before the Second World War.

Sidney gate





Tainter gate



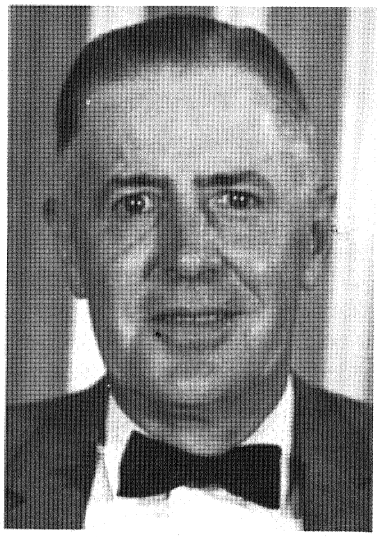
Submergible tainter gate

Ohio River Modernization "Even though the war emergency stopped all construction but the most urgent maintenance work, we have continued to plan for better structures, hoping for that day when our fully prepared plans could be made a reality," said Division Engineer Douglas L. Weart, shortly after the defeat of the Axis powers. "The largest of these proposed projects," he continued, "is the new dam within the Pittsburgh District, planned for construction near New Cumberland."

At a public hearing at Pittsburgh on December 1, 1943, Colonels Lacey Hall and Gilbert Van B. Wilkes had heard rivermen's opposition to the New Cumberland project, proposed to replace old locks and dams 7, 8, and 9. John Howder of Hillman Transportation, speaking for rivermen, said that pilots actually feared passing high-lift dams like those at Emsworth and Montgomery, because of dangerous currents in the approaches to the locks. Colonel Wilkes had assured rivermen, however, that the Pittsburgh District would devise safer approaches to the locks at New Cumberland.

On May 2, 1944, William McAlpine from the Chief's office and Colonel Robert G. West and Ralph Bloor from Division met Charles Wellons, Jack Dodds, Ike English, William Sidney, Jim Neill, and Harry Anderson of the Pittsburgh District at the New Cumberland site to seek solutions to the lock approach problems. They boarded the *Tennessee* and rode it upriver to Neville Island to inspect lock approaches at the old locks, and at Montgomery and Dashields, then returned to the District office to discuss the problem. They concluded the hazardous lock approaches resulted chiefly from locating double lock chambers in the river, where they actually damned the river and created currents setting out away from the upper lock gates toward the dam and caused eddies below the lower lock gates. They agreed the hazardous currents could be reduced by indenting the locks into the river bank, excavating space for the locks and their approaches from the bank and thereby leaving the river the same width it was before the locks were built. They also agreed that the main locks at the modern navigation structures should be 110 feet wide and 1200 feet long, same width as the old locks but double the length and adequate for handling the optimum size barge tows on the river. They were not certain, however, whether the auxiliary lock should be 56 by 300 or 56 by 600 feet in the chamber. (After study of traffic projections, the larger 110 by 600-foot size auxiliary lock was selected.)

Traffic on the Ohio River during and following the Second World War, especially long-haul petroleum barging, increased so rapidly that by 1949 tonnage on the middle and lower Ohio surpassed the tonnage moving on the three rivers within the Pittsburgh District. In that same year, however, Pittsburgh, handling about 12% of all



James A. Neill

waterborne commerce in the United States, was still the inland river port with the most tonnage, following Houston and New Orleans on the seacoast; but big shipments of West Virginia coal from Huntington to Cincinnati and other traffic was increasing the importance of those ports. In 1953, Huntington actually surpassed the Pittsburgh Port as then defined.

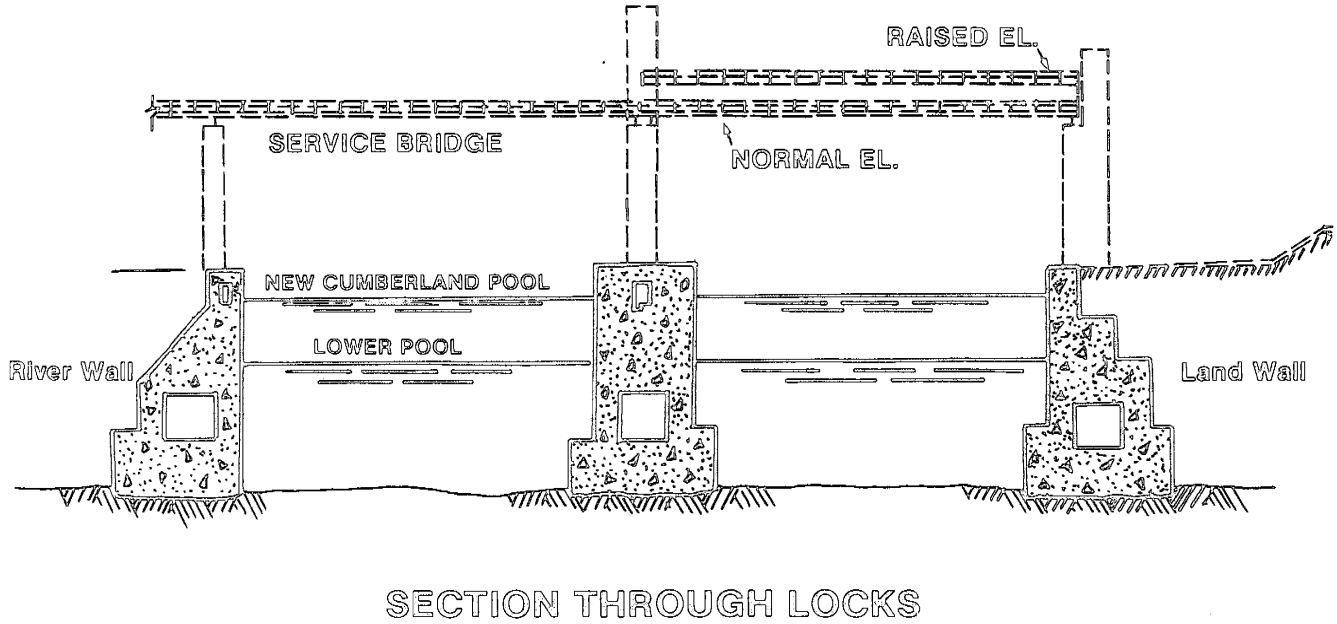
Because of skyrocketing traffic all along the Ohio during the postwar years, the Ohio River Division made planning for the New Cumberland, Pike Island, and Hannibal locks and dams in the Pittsburgh District part of overall plans for modernizing the river, replacing the chanoine wicket dams with 19 new structures. Emsworth, Dashields, Montgomery Island, and Gallipolis locks and dams in the Pittsburgh and Huntington Districts would remain in service and fifteen new "super" dams would be constructed. The Pittsburgh District would build New Cumberland, Pike Island, and Hannibal on the upper river; Huntington District would build Willow Island, Belleville, Racine, Greenup, and Meldahl dams on the middle section; and Louisville District would build Markland, McAlpine, Cannelton, Newburg, Uniontown, Smithland, and Mound City on the lower river. Because of high traffic density, the first three constructed would be New Cumberland, Greenup to serve the port of Huntington, and Markland to serve Cincinnati.

Modernization was needed because maintaining and repairing the old wicket dams would be very expensive in the long run. With an average 23-foot lift at the new dams, as compared with 9.5 feet at the wicket dams, each new dam would eliminate two or more wicket dams, reducing operating expenses and cutting the number of lockages necessary to pass the length of the Ohio by more than half. The high-lift dams with deeper pools would permit barge loading to a full nine-foot draft and speed the movement of tows, provide a more stable water supply, allow recreational development, and have other benefits. Jim Neill, successor to Charles Wellons as senior engineer at Pittsburgh, explained the need for modernizing the Ohio to members of Congress in 1953:

> *I suggest we consider the Ohio River as a highway--an industrial highway comparable in importance to some of our interstate highways. Fifty years ago we were designing and building highways which to the best of the designer's ability were laid out to provide for the needs of traffic far into the future. I wonder how many of those highways are adequate for present day needs? I wonder if there are any of the really important ones which have not been rebuilt and perhaps rebuilt again in the past 50 years? Yet, it is widely recognized that our highway system falls short of our needs. I think our Ohio River situation is similar.*

Tonnage passing through Lock 7 nearly doubled, from 6.8 million tons to 12.3 million tons, between 1945 and 1951, and in early 1952 Chief of Engineers Lewis A. Pick visited the river and asked accelerated planning for New Cumberland, Greenup, and Markland dams so construction could begin in 1954. Just after the Chief's visit, the senior engineers from the Districts--Jim Neill from Pittsburgh, Harry Pockras from Huntington, and Sam Bailey from Louisville--met at Cincinnati on March 12, 1952, with William McAlpine and Ralph Bloor and the Ohio River Division staff: Ed E. Abbott, F. R. Jones, James W. Bruce, Dwight W. Keller, and C. F. Michaels.

The Division office wanted plans for the new "super" dams standardized as far as possible for



Converted lift span - New Cumberland locks

economy and speed of design and construction and wanted project plans to aim at the goal of slashing operation and maintenance costs to the bone. The Division staff wanted Pittsburgh District to devise standard crest gate and hoisting equipment designs for the entire Ohio. "I objected," Jim Neill said, because Pittsburgh had plans for the New Cumberland project well in hand and the other Districts were just beginning at Greenup and Markland, "but Division will probably do it anyway." Division did.

In a series of conferences from 1952 through 1957, Jim Neill, P. G. Quedens, and other engineers from Pittsburgh met frequently with Ed Abbott, senior engineer at Division, and engineers from other Districts to iron out design details for the modernization structures. They agreed upon a culvert system to permit filling and emptying of the locks in eight minutes without undue turbulence in the lock approaches, a hydraulic piston system for opening and closing the steel mitering lock gates in about a minute and a half, and a hundred other details. Their goal was operation of the locks by one man from a central control panel, though an assistant would be on the job for reasons of safety. With that goal in mind, the engineers adopted floating mooring bits that moved up and down with the water level in the lock chambers, ending the need for lockmen on the walls to handle mooring lines. And they even planned such items as elevators and kitchenettes at the new locks and dams for the comfort and convenience of the lockmen and damtenders.

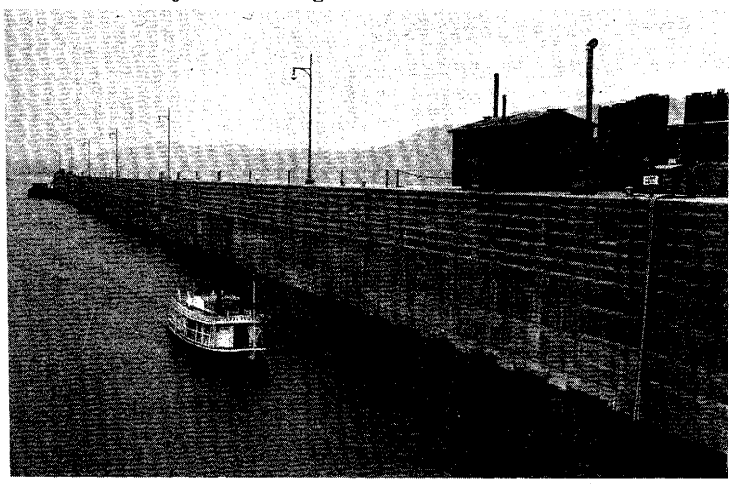
The engineers disagreed, however, about the type of crest gates to be used at the new dams. Ed Abbott and the Division staff wanted tainter gates with fixed trunnions because such gates, with fewer moving parts than other types, would need less maintenance. Division also proposed use of some submergible tainter gates, that would go several feet under the river level, to pass drift and heavy ice. The Pittsburgh engineers preferred the Sidney gate, which had worked well at Emsworth, because it would cost less to construct. Pittsburgh also opposed submergible tainter gates, which might be subject to "pulsating hydrodynamic forces" that could cause damaging vibrations.

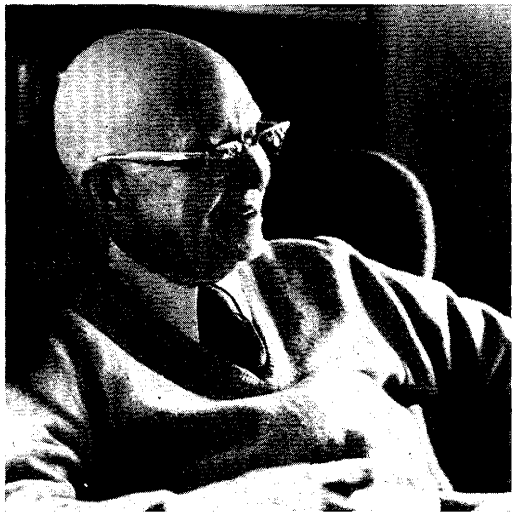
The crest gate question was still unresolved when Chief of Engineers Samuel Sturgis broke ground on November 1, 1955, for construction of New Cumberland Locks. Division had assigned design of tainter gates for Markland Dam at Cincinnati to the Seattle District, which had used such gates on dams in the Columbia River basin. The Pittsburgh District had, through contract with its retired engineer Charles Wellons, come up with a design for a divided Sidney gate, which had a lower section that would remain in place on the concrete sill to serve as fixed weir for passage of ice flows after the top half of the gate was raised up the piers.

The question was referred to the Chief of Engineers in 1957. Division Engineer R. E. Smyser contended the Sidney gates planned for New Cumberland would not pass heavy ice flows, such as had occurred during the winter of 1917-18.

Captain Frederick Way, Jr. (1978)

The *Lady Grace* through New Cumberland





Pittsburgh District Engineer H. E. Sprague warned that submergible tainter gates would be damaged by vibrations. When the Division office agreed to study solutions to possible vibration problems, the Chief of Engineers approved use of tainter instead of Sidney gates at the new dams on the Ohio.

Savin and Dravo corporations under a succession of resident engineers, E. P. Daugherty, Charles Wagner, and Roy Klingebiel, built New Cumberland Locks and Dam between 1955 and 1961. On October 22, 1959, Captain Fred Way and his *Lady Grace* had the honor of the first lockage at New Cumberland.

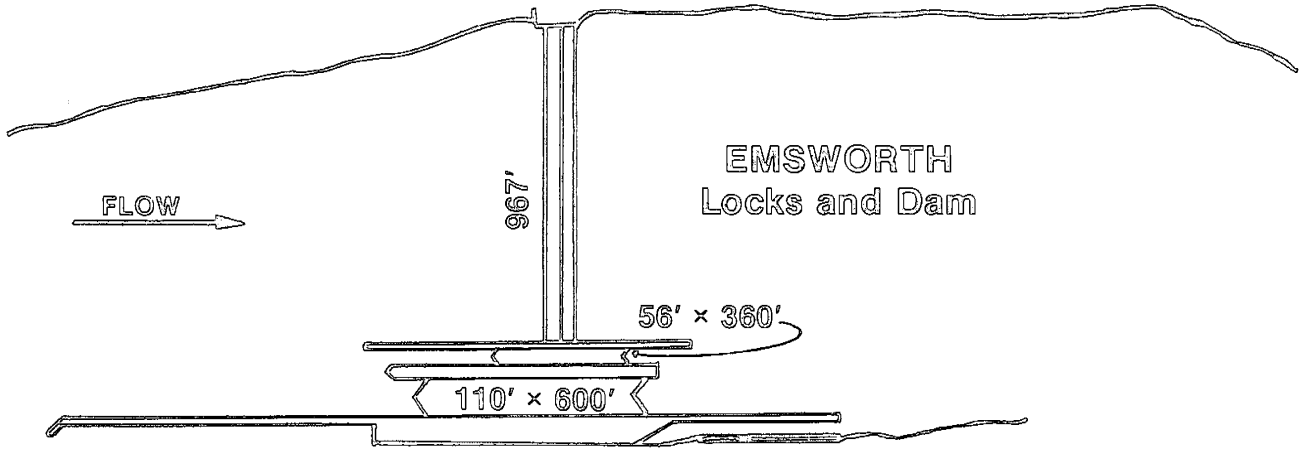
A challenging redirection was encountered as the New Cumberland project neared completion. The service bridge over the locks, with a 57.5-foot clearance over normal pool elevation exceeded the American Waterway Operators' requirement for 55-foot clearance, but other organizations, chiefly the Ohio Valley Improvement Association, wanted a greater clearance. A 68-foot clearance was designed for the Pike Island project, and the same clearance achieved at New Cumberland by converting the span over the auxiliary lock to a lift span with a vertical movement of 10.5 feet. This bootstrap operation was undertaken and completed by Dravo Corporation.

The submergible tainter gates vibrated from the time they were first put in service, tearing away part of the concrete sill at New Cumberland. The engineers at Pittsburgh repaired the sill and stiffened the gate to reduce vibrations, but the problems persisted. At a September 1964 conference, Ed Abbott of Division concluded that the prospect for solving vibration problems was poor, and, "inasmuch as vibration-free operation of submergible tainter gates as presently designed cannot be assured, no further installation of this type of gate should be made."

Pike Island Locks and Dam, built between 1959 and 1965 by Dravo Corporation under local inspection of Leo Wilsbacher, Everett M. Thompson, and Russel W. Comfort, was named for a low island at the site that resembled the shape of the pike fish. The structure appeared quite similar to the New Cumberland project to laymen, though engineers would recognize differences. After a towboat parade, lead by the *Louis Fiore*, from Wheeling, Chief of Engineers William F. Cassidy and Senators Jennings Randolph and Robert C. Byrd dedicated the Pike Island project to replace old Locks 10 and 11 on September 3, 1965.

On April 16, 1966, ground was broken for Hannibal Locks and Dam, the replacement for locks 12, 13 and 14. Blount Brothers built the locks and Arundel-Dixon the dam. The resident engineers in succession were R. W. Comfort, James B. Lloyd, Carl S. Mallow, John J. Speaker, and C. R. Orr. Senator Jennings Randolph, Assistant Secretary of the Army Victor Veysey, and Division Engineer E. R. Heiberg III spoke to a crowd of about 3,000 gathered on September 27, 1975, to witness dedication of the Hannibal Locks and Dam, the last element of Pittsburgh's share of the Ohio River modernization project. The dedication lacked one day of being exactly fourteen years after completion of the New Cumberland project.

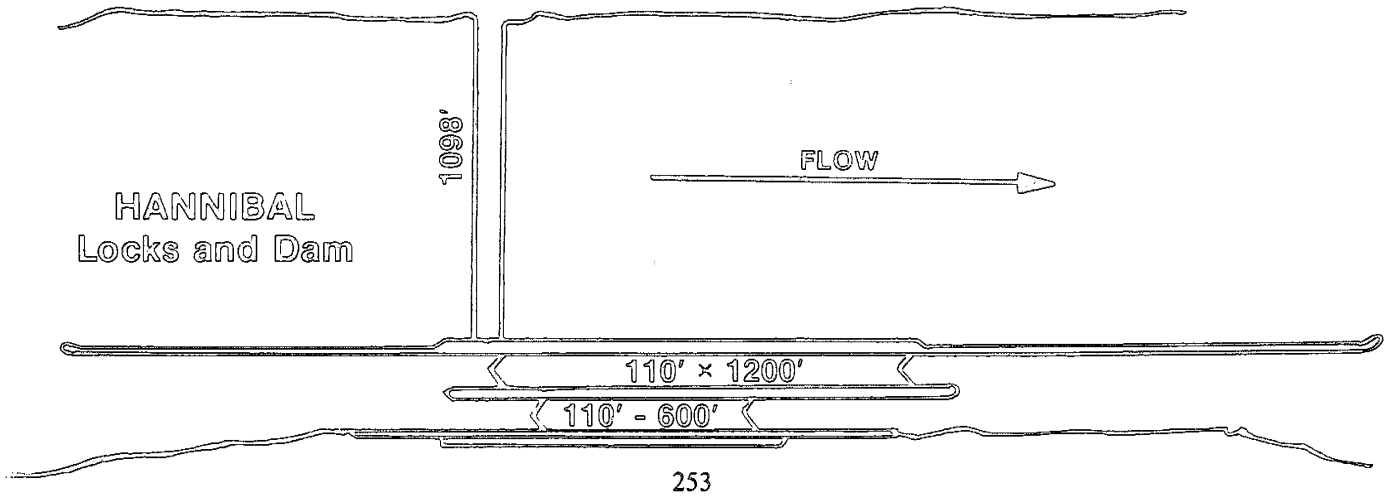
"With their passing an era in the history of navigation will come to a close," Colonel Janairo said of the closing of old locks and wicket dams at completion of the Hannibal project. Lockmaster William Campbell put down the wickets of Dam 13 on July 10, 1975, and demolition of the old structure, long cursed by operations personnel as the most cantankerous dam on the river, began. Lock 15 in the



Huntington District continued in service until 1976 and was the last wicket dam in operation on the upper Ohio.

Twelve of the fifteen new locks and dams planned in 1952 to modernize the Ohio were in operation in 1976, and construction of Willow Island and Smithland Locks and Dams was well along toward completion. While further study was made of the fifteenth, Mound City Locks and Dam on the lower river near Cairo, temporary 1200-foot locks, resembling a steel cell cofferdam in construction, were installed at Dams 52 and 53 to handle traffic, and thus two of the old chanoine wicket dams remained in operation.

By the time Hannibal Locks and Dam was finished, Emsworth, Dashields, and Montgomery Island Locks and Dams at the head of the Ohio had been in service for an average of nearly 50 years. Maintenance costs at those structures were increasing and their locks, 56 by 360 feet and 110 by 600 feet, were inadequate for a burgeoning commerce that had adapted to 1200-foot locks.

Displaying a riverman's impatience with overage facilities, Leonard Martin, Chief of Operations at the Pittsburgh District, commented in 1976 that traffic projection planners really blew it at Emsworth, where monumental delays, sometimes as long as 36 hours, occurred when the 600-foot lock closed for repairs. At those times, tows were locked through in three sections and the District towboat *Chartiers* hauled the sections out of the chamber.

When Emsworth Locks were planned in 1917, Ohio River traffic was at its nadir and few men could have predicted a time when 1200-foot tows would string up and down the river minutes apart. It appeared in 1977, nevertheless, that both the Pittsburgh District and river commerce would have to live with the conservative projection made in 1917 for years to come and extend the life of the old locks to the limit. It is worthy of note that the Pittsburgh District in May 1971 transmitted a report containing the replacement studies for Emsworth, Dashields, and Montgomery Locks and Dams. The plans contemplated installation of double locks at each facility, 110 by 1200 feet and 110 by 720 feet.