Colonel F. R. Shunk (cadet photograph)

Chapter 13
WATCHDOGS AT THE HEADWATERS

After shuffling wearily through the letters from Sharon, New Castle, Warren, Niles and Beaver River basin towns piled a foot high on his desk, Colonel Francis R. Shunk read again the letter from Youngstown. "For many years the Mahoning River has been encroached upon by railroads, manufacturing plants and private individuals, narrowing the channel which has greatly increased the possibilities of floods, until at the present time the situation has become serious," wrote Youngstown city clerk M. H. Hyland. On behalf of the city council, Hyland begged the Army Engineers to prevent more encroachments on the stream.

The Colonel abruptly dropped the letter on the desk, asked his secretary to bring the Beaver River file, and called John Arras and Thomas Roberts to the office. When the two senior engineers arrived and were seated next to the desk, he read them the Youngstown letter and asked what they knew of the Beaver basin.

John Arras smoothed his mustache bristles with one hand while he pondered the question. "Colonel," he said, clearing his throat, "the March 1913 storm center came from Cincinnati up the Miami River, across central Ohio, and through the northern sector of this District. Dayton, Columbus, Zanesville had record floods and every town on Beaver, Mahoning, and Shenango rivers were flooded. Water was four feet higher at New Castle than ever before and took out a railroad and three highway bridges. Flood damages in Beaver basin exceeded $2 million, which was only about 1% of the total damages in Ohio. The flood killed about 400 people."

Flipping through the Beaver River file, the Colonel found an old report, looked up, and asked, "Roberts, you were at Youngstown in 1909, weren't you?"

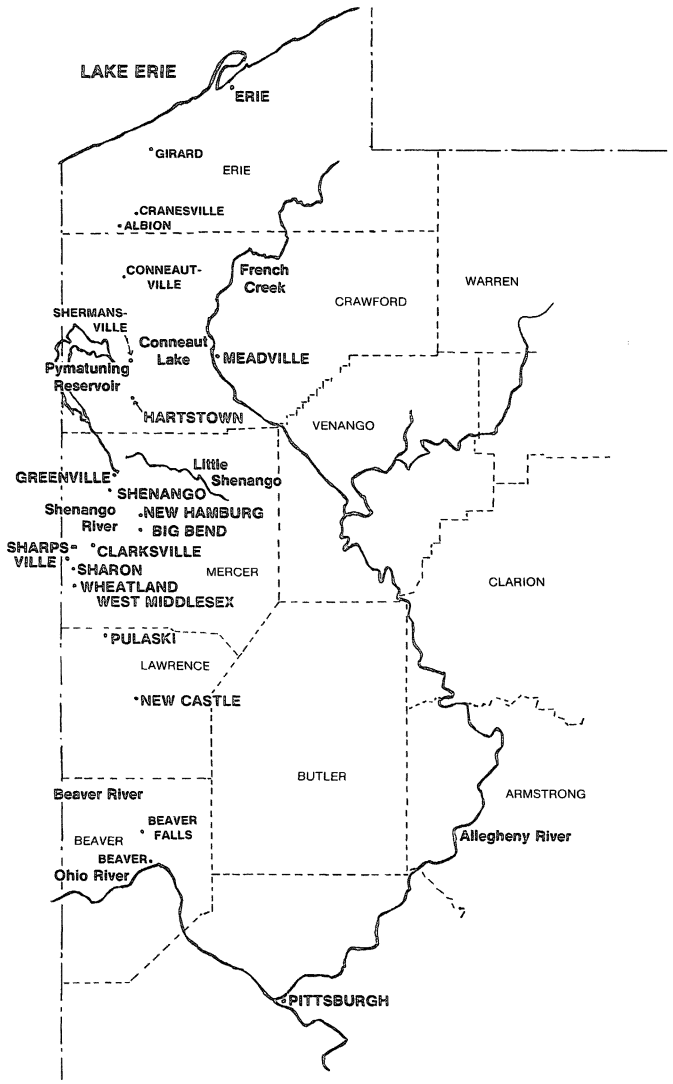
"Yes. Senator Theodore Burton and Congressman Aubrey Thomas arranged to send me there to inspect navigation."

"What did you see?"

"Mayor John Naylor of Niles told me they wanted snags cleared from the pools of Girard and Leavittsburg milldams. Seems the state stocked the river with fish, but fishing boats were hitting the snags. Turned some boats over and nearly killed the fishermen."

The Colonel smiled and asked, "Was that the only trouble?"

"No. Like the letter said, people are filling the banks, they have flooding problems and need help. But their big problem is low flow. River discharge at Girard milldam is less than 20 cfs, and Youngstown mills circulate the whole flow two or three times. Makes the water hot. Owners of the Girard milldam once closed it, cutting off Youngstown's water. Made people at Youngstown so mad they went to Girard at night and cut holes in the dam. Carnegie Steel at Youngstown, in self-defense, bought control of the millpond."



Route of the Beaver to Lake Erie Canal

Shunk nodded that he understood. "Did you make any recommendations?"

"I landed in hot water on the Mahoning, Colonel," said Roberts with a chuckle. "I found some fine reservoir sites there when I surveyed canal routes in 1895, and I told the people there they should build reservoirs to solve their water problems. Since I found no river commerce, nor prospects for any unless the Lake Erie and Ohio Canal is built, I told the people at Niles they should clear the snags out of the way of fishing boats themselves, with horses and blocks and tackle, then burn the snags so they wouldn't float to the Ohio and interfere with navigation. Senator Burton didn't like it; you've his letter in the file."

The Colonel turned through the 1909 correspondence and found the Senator's letter. Burton wrote, "I am frank to say that this stretch of river could be used for small launches and would probably develop more traffic than any stream now under improvement." Shunk found that amusing, for he knew the Senator and recalled the reputation he had as an opponent to "porkbarrel" projects. Apparently the Senator's scruples had not extended to projects in his own district.

"I went back up there in 1912," said John Arras. "James Getty and I boated 13 miles of the Mahoning above Warren. Saw a few canoes and motor launches on the millponds, found a hundred snags and some boulders, and estimated about $1300 would clear that 13-mile stretch. But I agreed with Roberts: there is no commerce on that river and not likely to be any."

"How can we help these people?" asked Colonel Shunk, pointing to the stack of letters on the desk.

"Don't know how we can," replied Arras. "The nearest commercial navigation is at the mouth of the Beaver, a long way from Youngstown."

"What about the Beaver and Erie Canal?" Roberts asked. He explained his father had been engineer on the canal, built between 1831 and 1844 up Beaver and Shenango rivers to Conneaut Lake and on to Erie, Pennsylvania, with connections by feeder canal to French Creek and by the Cross-Cut Canal up the Mahoning past Warren and Ravenna to the Ohio Canal at Akron.

"Sounds like a big project," the Colonel commented. "Did it carry much traffic?"

"It was 136.5 miles long from Beaver to Erie and had 133 locks. Fifty-ton canalboats pulled by three horse teams made the trip from Erie to Beaver in 36 hours. The boats carried farm produce, pig iron from Youngstown and Sharpsville, and up to 400,000 tons of coal a year. My father planned enlargement of the canal in 1869 to handle 300-ton boats, but it was sold to a railroad in 1870 and abandoned. Was still profitable when it was sold."

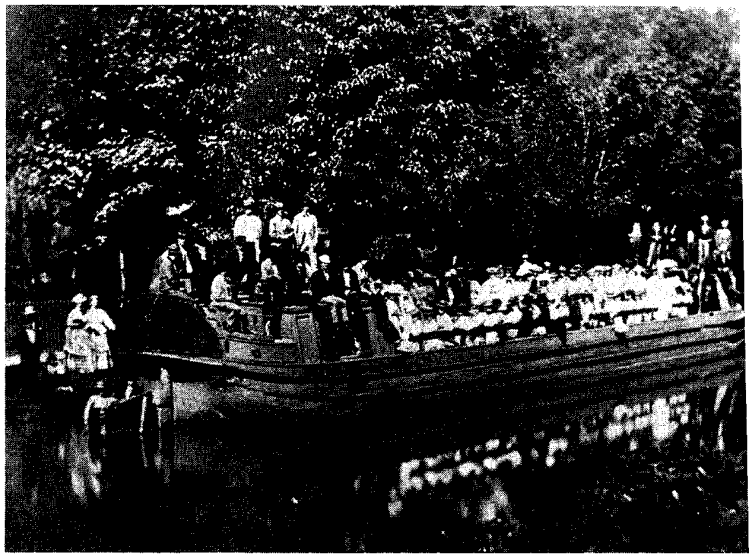
"I doubt traffic on the canal would make the river itself legally navigable," said the Colonel. "Have either of you ever heard of any interstate commerce on the Mahoning or Beaver?" Neither man had ever heard of any, so the Colonel dismissed them and prepared his reply to the City of Youngstown.

"Encroachments of the kind mentioned in your letter," he wrote, "are covered in the River and Harbor Act approved March 3, 1899, but whether these laws are applicable to the Mahoning River is open to doubt since it appears that neither it nor the Beaver River into which it flows is navigable except for short distances on isolated pools formed by power dams, where light draft boats may be operated." He explained his decision was administrative, not legally binding, for river navigability had to be determined in the end by the courts. He suggested Youngstown should seek to end stream encroachments by enforcing laws of the State of Ohio.

Mahoning River Navigation The Pittsburgh District Engineer's decision that the Mahoning River was not navigable and therefore not subject to federal jurisdiction stirred up a storm of protest from people in the Beaver basin, who remembered that grandpappy had floated the river in a flatboat, and from the Lake Erie and Ohio River Canal Board. In 1915, Pittsburgh industrialists, through the Canal Board, were seeking construction of a new canal between the Ohio and Lake Erie to move iron ore from the Great Lakes south to Pittsburgh and Monongahela coal north to Youngstown, Cleveland, and Chicago steel mills. More low bridges and channel encroachments on the Mahoning and Beaver rivers could increase costs of the proposed canal.

To secure federal protection for the rivers, it was necessary to prove they had supported an interstate commerce. Even commerce in flatboats, the craft that navigated the rivers when the authors of the Constitution gave the Federal Government power to regulate commerce, would do. Leaders of Youngstown, Warren, Niles, and New Castle and William A. Magee, chairman of the Canal Board and mayor of Pittsburgh, began collection of state laws, historical records, and notarized statements from oldtimers to prove the Mahoning and Beaver rivers had once been navigated by interstate commerce.

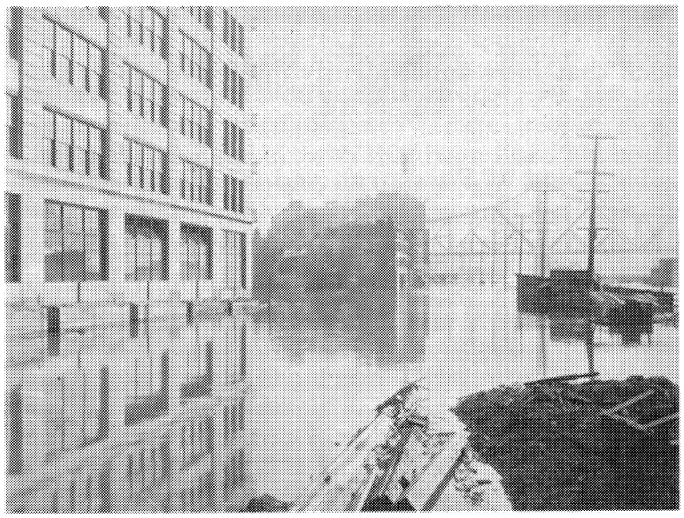
State legal records showed that the Beaver River and its tributaries had been navigable public highways by law. Local histories mentioned that Moravian missionaries had ascended the Beaver during April 1770 in sixteen canoes to a camp a few miles below New Castle, that James Hillman had canoed up the Beaver regularly from Pittsburgh to trade with Indians from 1788 to 1796 and had joined with John Young in 1796 to found Youngstown, and that James Caldwell in 1801 supplied the settlers at Warren by poling a canoe up the Beaver and Mahoning rivers once a fortnight.



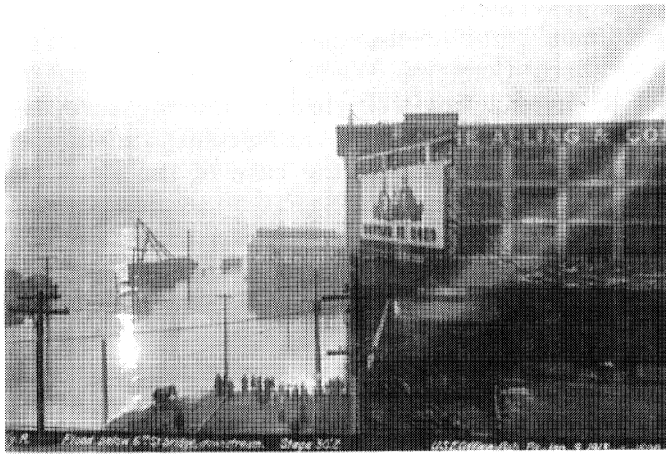
Beaver River packet *John L. Graham (1875)*

Oldtimers remembered flatboats carrying pioneers down the Mahoning, Shenango, and Beaver rivers to new homes on the Ohio and Mississippi. It was known that Joseph Antrim and six men had built a flatboat on Shenango River two miles above Sharon in 1810, loaded their families and household goods aboard, floated downstream on a spring flood, and continued down the Ohio and up the Miami River to settle in Champaign County, Ohio. The pioneers had also rafted logs down the rivers from points as far up the Mahoning as Newton Falls and had marketed their farm produce in flatboats.

Erwin Ladd, born at Warren in 1828, swore he had seen flatboats, 70 feet long, 14 feet wide, with 2.5-foot gunnels hewed from poplar logs, built on the



Monongahela River at foot of Liberty Avenue, Jan. 9, 1913



Allegheny River below Sixth Street Bridge, Jan. 9, 1913

Mahoning at the Market Street bridge in Warren. He had seen fleets of seven boats, loaded with hay, pumpkins, potatoes, cheese, and cider, leave Warren for ports on the Ohio and Mississippi. He recalled that flatboat merchants had been Herman R. Harmon, Ira and Elijah Hull, Charles W. and Randa Simmons, and Cyrus Spencer, and that his father, Isaac Ladd, had been one of the flatboat captains. "On account of the dams at the grist and saw mills," he said, "the best men ran the boats as it required great skill to navigate at these places and at some of the sharp bends." Flatboating from Warren had ended when the Cross-Cut Canal opened about 1840.

John Boles and John Graham had owned boatyards at Bolesville and Bridgewater that turned out many flatboats, keelboats, and canalboats. They also built some of the steamers, the *Rhuamah*, *Fallston*, *Beaver*, *Itaska*, and *Rodney*, that plied the lower Beaver from Beaver Falls, New Brighton, Fallston, and Bridgewater to Pittsburgh during the late 1830's.

At least one steamboat, the *Isaphena*, was built on the Shenango River at New Castle in 1840, and records showed three steamboats built at Warren, Ohio. The listing of two, the 21-ton *Seagull* built in 1833 and snagged on Arkansas River in 1834 and the 30-ton *R. H. Barnum* built in 1862 and burned in 1864 on the Big Sandy River, could have resulted from errors in the records--confusion between Warren, Pennsylvania, and Warren, Ohio--but there was no question about the 34-ton *Warren Packard*, built in 1861. Named for its owner, a prominent Warren businessman who was ancestor of the builder of Packard automobiles, the *Warren Packard* had operated as an excursion boat on the Mahoning out of Warren for a year before its owner gave it up as a losing proposition.

William A. Magee of the Lake Erie and Ohio River Canal Board sent all the evidence collected to the Chief of Engineers in February 1915, convincing the Chief that the Beaver River and its major tributaries had been navigable in fact in the past. The Chief chided Colonel Shunk for overlooking the historical records of Beaver and Mahoning River navigation, reversed the Colonel's decision, and directed the Pittsburgh District to exercise jurisdiction over streams in the Beaver River basin as navigable waters of the United States. Thereafter, encroachments on stream channels in the Beaver River basin were regulated.

Ohio River Flood Board "We are spending millions for relief of flood victims, but not one cent to solve flood problems," thundered Theodore Roosevelt, while the flood of March 1913 was still receding. He declared that it was imperative for the Federal Government to build reservoirs to conserve flood waters to use for irrigation, hydroelectric

power generation, and improving dry-season flows. "All this might be done," he asserted, "by one act of the Federal Congress. We can lift the rivers out of politics by enacting a single adequate measure, establishing a policy, and providing continuing funds, exactly as was done in the case of the Panama Canal."

There were many who disagreed. Colonel Charles Townsend of the Corps warned the attractive idea of multipurpose reservoirs might be the "voice of a siren luring the people to an open pork barrel for every stream in the United States." Editors of the influential *Engineering News* feared a federal flood control program might cause cutthroat competition among congressmen for appropriations. "Each would aim," the editors warned, "to get the largest possible appropriation for his district, and, most unfortunate of all, the voters of his district would judge his usefulness as a legislator by this standard."

Public outcry after the March 1913 flood forced the Chief of Engineers to change from a passive to an aggressive approach to flood problems. The Chief sent a confidential letter to all District Engineers directing that they begin studies of multipurpose water uses, and on April 12, 1913, he issued a carefully worded order appointing an "Ohio River Flood Board" to report upon the "most practicable and effective measures for prevention of damage by floods to works constructed for the improvement of navigation, of interference with interstate commerce, and of other disastrous results thereof." The Secretary of War assured Senator Theodore Burton of Ohio that the study by the Flood Board would have wide scope. The Flood Board was chaired by Pittsburgh District Engineer Francis Shunk, and his deputy, Captain Harold C. Fiske, served as recording secretary. "The tendency of proposed legislation seems to indicate that the public wants a solution of these problems," commented Captain Fiske, "and that if this Board does not attempt to solve them someone else will and others may not solve them as well as we might." Captain Fiske later served as District Engineer at Chattanooga, Tennessee, and developed plans for multipurpose water resource development in the Tennessee River basin that were subsequently implemented by the Tennessee Valley Authority.

Beginning at Pittsburgh and Wheeling, moving on to East Liverpool, Wellsville, New Castle, Youngstown, and Warren, and traveling west across the Muskingum, Scioto, Miami, and Wabash basins, the Flood Board visited some 52 cities that had suffered damages during the 1913 flood. The wreckage they saw indicated that most flood damages had been caused by encroachments that had reduced stream flood-carrying capacity. The encroachments had occurred because control of rivers was in a twilight zone between federal, state, and local governments and no one had exercised effective authority. "What was anybody's business became nobody's business," the Board reported, and it made the radical proposal that federal jurisdiction over rivers, limited to navigable waters, be extended to all streams, whether navigable or not. That recommendation, opposed by state governments that were jealous of their prerogatives, was shelved and quietly ignored for more than a half century after 1915.

Because conditions varied from basin to basin, the Board thought all feasible flood protection measures, including levees, flood walls, dredging, channel rectification, reservoirs, and floodplain zoning, would be used, but it could recommend no specific plan because data was insufficient. "Our first duty," the Board reported, "is to obtain definite and precise information on all these subjects, so that the people may know what can be done and what it will cost." Needed were complete drainage area maps, stream profiles and cross sections, water discharge curves, and precipitation records, collected systematically on the Ohio and all its tributaries; studies that would best begin in the Pittsburgh District where the Pittsburgh Flood Commission had made a start. Then a definite federal flood control policy should be established, "based not on uncertain and indefinite benefits that may accrue to navigation, but on the certain and positive benefits that will accrue in the protection of life and property from loss."

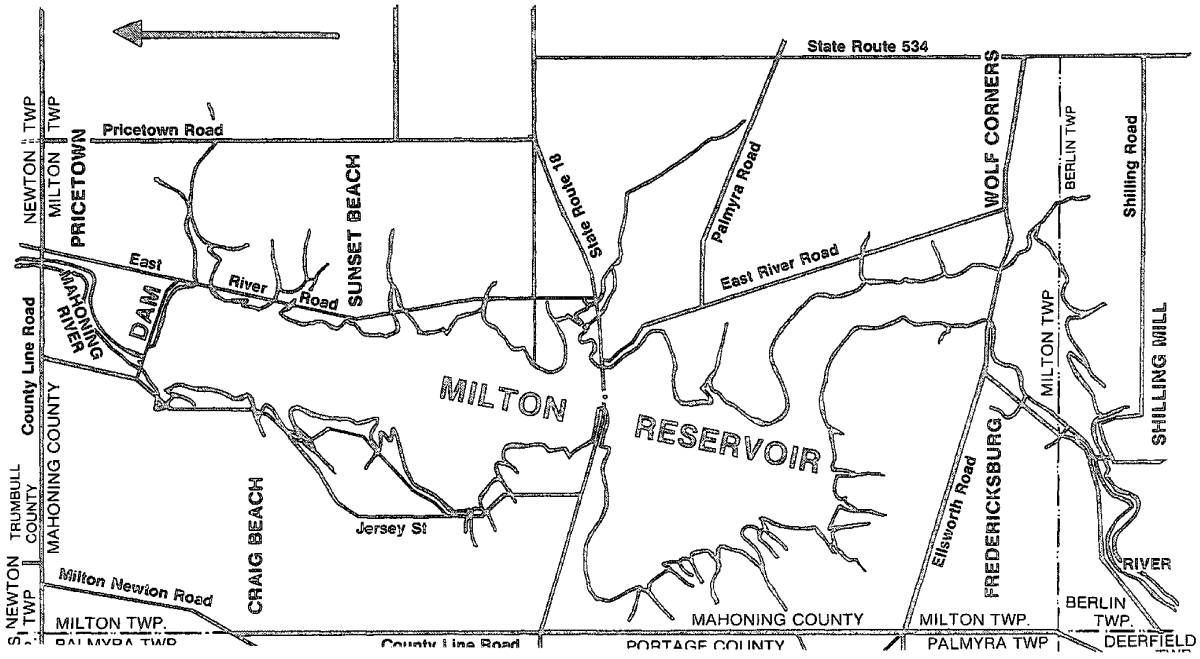
Mahoning and Shenango River Reservoirs The long range plans outlined by the Ohio River Flood Board did not please people in the Beaver River basin, who had been hard hit by the 1913 flood and who were desperate for improved water supply. Through studies of historical navigation, they obtained federal jurisdiction over stream encroachments in 1915, and in the same year they began construction of their first reservoir.

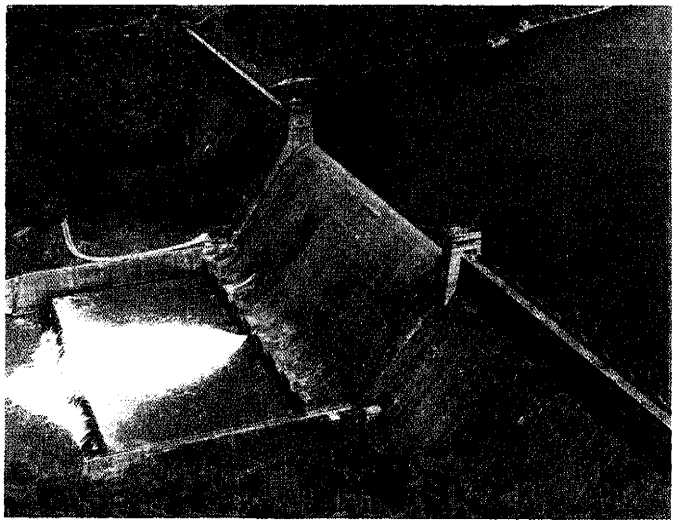
Youngstown city engineer Frank M. Lillie and consulting engineer J. W. LeDoux studied reservoirs for flood control and water supply upstream of Youngstown in 1912 and found several excellent reservoir sites: the Berlin and Milton sites on the Mahoning between Newton Falls and Alliance, two sites on Meander Creek and a site on Mosquito Creek, both tributaries that joined the Mahoning at Niles. Youngstown funded construction of the Milton Dam on the Mahoning after the 1913 flood. It was the first multipurpose reservoir in the Beaver River basin and first in the Pittsburgh Engineer District.

Because the 2,840 feet long and 40 feet high compacted sand and clay dam at the Milton site was to be located in a glacial valley, with fissures in the foundation rock, engineers Lillie and LeDoux adopted the then novel techniques of grouting the foundation and building a cutoff wall. After drilling holes into the foundation rock, they forced cement grout down pipes to fill and seal the fissures. Steel sheetpiles were then driven to rock just upstream of the dam axis and a 30-inch wide concrete wall was then poured in a trench excavated behind the piles. With the foundation thus protected from leakage, the earthfill was rolled into place to form the dam. Completed in 1917 at a cost of $1.2 million, Milton Dam stored 10 billion gallons of water during floods for release during droughts, increasing the minimum flow past Warren to 77 cfs (fifty million gallons a day).

Storage behind Milton Dam was insufficient, however, to meet the needs of industry sprouting along the banks of the Mahoning, and in 1921 consulting engineer Alexander Potter recommended building more reservoirs: at the Berlin site on the Mahoning, on West Branch of the Mahoning between Newton Falls and Ravenna, on Eagle Creek near Phalanx, on Meander Creek south of Niles, and on Mosquito Creek north of Niles. The Mahoning Valley Sanitary District was organized and in 1922 built a dam with 32,400 acre-feet reser-

Lake Milton reservoir





Tygart Dam

voir capacity two miles up Meander Creek south of Niles. Industrial and population growth continued at such a pace, however, that even augmented river flow was insufficient. By 1941, the river between Warren and Lowellsville was used and reused so many times that water temperatures sometimes reached 130° F.

Sharon and New Castle on Shenango River had problems similar to those of communities on the Mahoning. Floods caused heavy damages and flows past Sharon were sometimes as little as 8 cfs. New Castle city engineer C. H. Milholland, in a letter describing 1913 flood damages to Colonel Francis Shunk, said, "in my opinion, the construction of reservoirs, in suitable locations, will be the remedy for floods in this section." The Pennsylvania legislature passed an act that year approving a dam closing the outlet of Pymatuning swamp at the head of the Shenango to be operated for flood control and water supply. Because part of the reservoir would be in Ohio, legal complications delayed land acquisition until 1921, and construction did not begin until 1931 when federal funds for Depression work relief became available. Finished on January 23, 1934, Pymatuning Dam and its spillway cost $368,139, but land acquisition and relocation costs drove the total price up to $3.7 million. Pymatuning Dam reduced damages at Sharon and New Castle during the March 1936 flood and that summer maintained a 175 cfs flow past Sharon when natural flow would have been less that 40 cfs. "We feel that the dam has already paid for itself," said people at Sharon.

Watchdog on the Tygart *Between flanking hilltops in the Tygarts Valley of Northern West Virginia a sentinal stands--silent and strong. Broad of beam, its long arms reach across the valley and anchor themselves deeply in the towering hillsides. Firmly planted in the rock and soil below, it stands guard over the tumbling waters of the Tygart River--and against their uncontrolled flow during seasons of extreme rain.*

So Tom Cummings, editor of *Grafton News*, described the dam he tagged as the "Watchdog of the Waters." A massive concrete and steel block plumped down in the riverbed just upstream of Grafton, at its completion in 1938 Tygart Dam was the largest concrete dam east of the Mississippi and first link in the chain of reservoirs and dams the Pittsburgh District was forging for protection of the headwaters district.

Planning for Tygart Dam and the reservoir chain, begun in 1849 by Charles Ellet and renewed in 1908 by the Pittsburgh Flood Commission, had been continued by the Pittsburgh District after 1913. Just as federal power to improve navigation had once been questioned, so federal power to undertake flood control projects was questioned during the early 20th century, but ever since Thomas Hutchins began his surveys of the Seven Ranges in 1785, the performance of surveys and planning studies had been accepted as a legitimate federal function.

Congress had approved the studies of flood problems and remedial measures begun in 1913 by Colonel Francis R. Shunk and the Ohio River Flood Board, but took little action on the findings of that board. Through lobbying in Congress and in the Pennsylvania legislature, the Pittsburgh Flood Commission secured a matching federal-state grant in 1924 to fund studies by the Pittsburgh Engineer District of multipurpose water resource development, including navigation improvement, flood control, low flow augmentation, and hydroelectric power generation, in the Allegheny and Monongahela basins.

Inspector James C. Getty had served for years before 1924 as practically a one-man survey branch for the Pittsburgh District. A touchy, independent fellow, highly critical of John Arras, Anson B.

McGrew, or any other superior who issued orders for field surveying from the comfort of an office, Getty commonly loaded his survey instruments into a horse and buggy to travel to survey sites. He scrambled through the brush, climbed bluffs, and waded creeks alone, though sometimes hiring local men to hold the ends of tape measures and the rods while he sighted through his theodolite.

To handle the expanded survey program in 1924, the District purchased a Peerless sedan, a Buick touring car, and saddle horses for transportation. The home office dispatched to the furthermost ends of the District several survey parties of young and vigorous men, including Cliff Morrison, Bob West, Ben Walker, Paul Atkinson, Louis Yough, and Tommy Saddam, under command of Hugh Casey, an engineer officer who later became Ohio River Division Engineer and military governor of the Philippines. When that survey group finished preliminary fieldwork in 1929, a separate Survey Branch headed by Payson A. Perrin was established. It began using airplanes, cameras, and more sophisticated methods for performance of survey and mapping work.

As a result of intense lobbying by the Flood Commission and financial cooperation from the State of Pennsylvania, the Pittsburgh District had its first comprehensive river basin report ready by 1928, the year Congress approved similar studies throughout the nation. Known as "308 Reports," because proposed in House Document 308, 68th Congress, 1st Session, the basin studies, begun in 1928 and mostly finished by 1935, represented the complete commitment of the Army Engineers to the multipurpose water resource development concept.

"In these studies," said General Lytle Brown in 1930, "we seek to answer the questions: what are the ultimate possibilities of a certain river in terms of navigation, irrigation, power, flood control, and other possible uses of its water? How can this ultimate development be achieved—by what works, at what costs, and by what compromises between the different interests involved?" Limited by law to planning studies and navigation projects, however, General Brown faced a difficult task in attempting to achieve some measure of flood control; he saw hope, nevertheless, in the "308 Reports." "The entire design may not be worked out in our lifetime or in our children's lifetime," he said, "but the entire design will be known to us now."

The District's 1928 report on the Allegheny and Monongahela basins was extremely conservative. Based on 1907 flood damages and low flood frequency rates, planning full development including 99% flood protection for Pittsburgh, estimating costs of multipurpose reservoirs high and their benefits low, the report found that costs of the program outlined would exceed benefits. The Pittsburgh Flood Commission, engaged in a fight to secure federal funding for flood control, attacked the 1928 report as too conservative and hired engineers Harold A. Thomas and Ross Riegel to prepare an alternate plan. By eliminating some of the more costly project features planned by the Engineers, reducing flood protection at Pittsburgh from the 99% proposed by the Engineers to about 87%, and estimating higher benefits, Thomas and Riegel produced an economically feasible plan in 1930. During the early Depression years, Pittsburgh District studied that plan, and a third, and a fourth, and more, but all planning studies were pointless unless some means of funding the proposed project were devised.

Bound by law to undertake only projects that would benefit navigation, General Lytle Brown cast about in search of ways to achieve flood control and came up with the idea of cooperative funding, allocating construction costs to those interests that would be benefited. That was the way it was done in Europe. The federal government could contribute funds proportionate to project benefits to navigation, local and state governments would pay for flood control features, and industry would pay for increased water supply or for hydroelectric power.

There were major obstacles, however, to cooperative funding for flood control. The economic depression that began in 1929 made business reluc-

tant to invest in new ventures and eroded the tax receipts of local government, thereby reducing their ability to participate in flood control projects. Legal tangles could be resolved where projects lay within a single state, and that was accomplished in the Miami River basin in southwestern Ohio, but flood control in the Pittsburgh District involved construction of dams and reservoirs in three or more states, which would provide benefits to people living as far away as New Orleans. West Virginians might well ask, and they did, why they should help fund construction of reservoirs in the upper Monongahela basin whose benefits would accrue to people living in Pennsylvania, Ohio, and even in Louisiana.

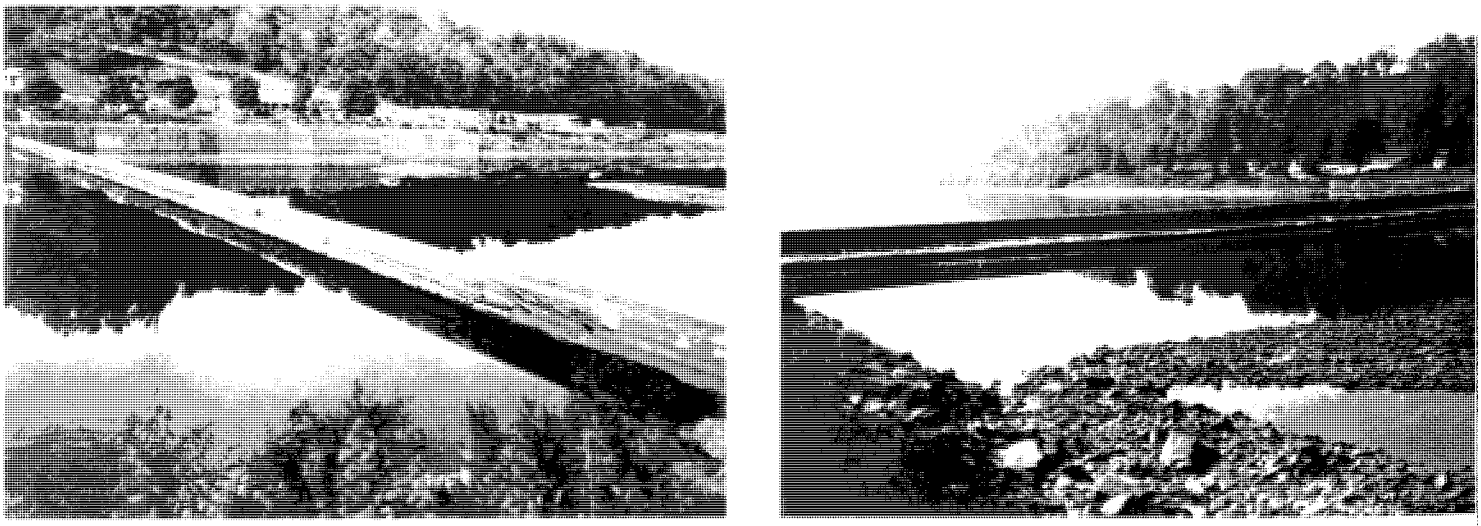
An opportunity for cooperative flood control arose in 1933 when President Franklin D. Roosevelt signed the National Industrial Recovery Act, providing funds for Depression work relief and economic recovery through construction of public works. Building flood control projects could employ thousands, even millions, of workers. The Federal Government could pay for benefits to navigation and loan money to local and state governments and conservancy districts to pay for flood control and water supply features. Agencies such as the Muskingum Watershed Conservancy District and the Pittsburgh Flood Commission jumped at the opportunity.

In December 1933, the Muskingum Watershed Conservancy District in central Ohio arranged construction of a fourteen dam system for flood control and other purposes, funded by assessments on property owners and grants from the state of Ohio and from the Public Works Administration (PWA). The PWA required that the Muskingum dams be built by the Army Engineers, and a special Engineer District at Zanesville, under command of Colonel Joseph D. Arthur, accomplished the feat of building those fourteen dams from scratch in five years, 1934-1938, by driving the engineers and work-relief laborers to the limit, except Saturday nights. And moreover, because hungry and unemployed engineers and workers were then a dime a dozen, the Zanesville District did the job with rare economy. Thanks to the remarkable work of its soils laboratory, the Zanesville District also built the project with considerable technological flair.

Major W. D. Styer

Two days after President Roosevelt signed the National Industrial Recovery Act, Marshall O. Leighton, consultant to the Pittsburgh Flood Commission, was in the PWA Washington office with an application for funding construction of nine dams upstream of Pittsburgh: on Loyalhanna, Tionesta, French, Redbank, and Crooked creeks and Allegheny River, and on Tygart River and West and Middle Forks of the Monongahela River. Building the nine dams, the Flood Commission estimated, would put 46,000 men to work.

The PWA sent the Flood Commission's application to Major Wilhelm D. Styer, Pittsburgh District Engineer, for review. He eliminated the proposed dam on the Middle Fork of the Tygart, commented that without dams on the Conemaugh and Youghiogheny rivers the plan offered only limited flood protection for Pittsburgh, and sent the application on to the Ohio River Division. He recommended that the government cooperate with



Upper pool Lower pool

October 2, 1930, Lock & Dam 11, Monongahela River

the Flood Commission in building seven dams and fund entirely the eighth, the Tygart River Dam, because of its large benefits for navigation.

The need for a dam on the Tygart had become clear during the 1930 drought when the upper Monongahela River went dry, suspending navigation above Lock 8 and threatening to close all locks. The District Engineer had been forced to ask officials of the West Penn Power Company, owners of Lake Lynn completed in 1926 on the Cheat River, to release lake water to maintain navigable pools on the lower Monongahela. The company cooperated fully, releasing 65,000 acre-feet of water from Lake Lynn, without charge, to keep barges moving until rains began in December. That gracious gesture saved the District much embarrassment. Without releases from Lake Lynn, river traffic would have ceased, steel and primary product plants lining the Monongahela and upper Ohio and relying on barge shipments would have shut down, secondary plants using steel would have closed, and the faltering depression-ridden national economy of 1930 would have received another severe blow.

Major Styer badly wanted Tygart Dam built to prevent recurrence of the near disaster of 1930, when only the generosity of the power company had saved Monongahela navigation. Division Engineer George R. Spalding concurred, recommending full federal funding and immediate construction of the Tygart Dam. He did not agree with Styer about the seven other dams, however, whose principal benefits would result from flood control. Because the Corps mission was limited to navigation, Spalding recommended that funds for the seven flood control dams be loaned by the PWA to the Flood Commission of Pittsburgh or to the Tri-State Authority, which had been founded in 1933 to unite local governments in West Virginia, Ohio, and Pennsylvania in support of flood control projects. Those agencies would have full authority to construct, operate, and maintain flood control reservoirs. The PWA did not fund the entire Pittsburgh flood control program, but on January 11, 1934, it gave the signal to proceed with Tygart.

Under the general direction of Major Styer and Charles Wellons, successor to John Arras as prin-

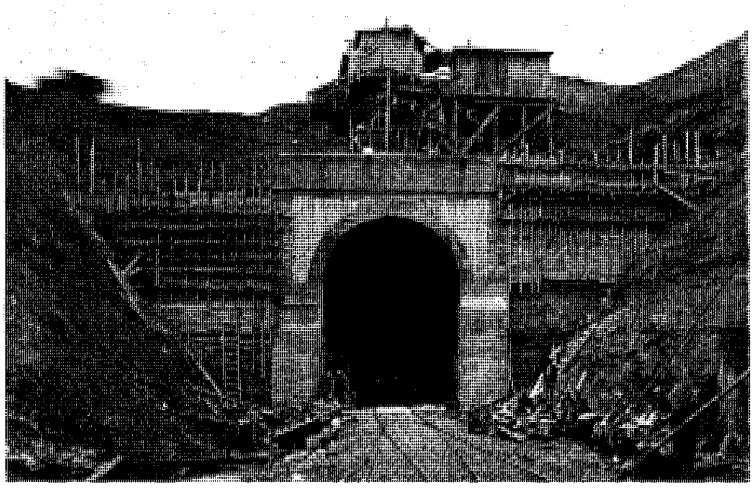
cipal engineer, the Pittsburgh District worked out the design for Tygart Dam during 1934. Jack H. Dodds directed masonry design; William E. Sidney devised the crest gates and mechanical appliances; and Nicholls W. Bowden, aided by Harry E. Anderson and Emil P. Schuleen, took care of project hydraulics. The contractor, Frederick Snare Corporation, began building the largest concrete dam east of the Mississippi late that year, under local supervision of Majors William E. Potter and Benjamin F. Fowlkes, resident engineer Charles Wagner, and inspectors F. E. Barrett and Don D. Rait.

Built on seamed sandstone overlying soft shale, the construction of Tygart Dam presented interesting geologic challenges, solved by the District through extensive core-drilling and testing to establish foundation characteristics and rational design formulas.

The dam was located just above Grafton in Taylor County, West Virginia, and fifteen miles north of Philippi, where the first land battle of the Civil War had taken place. Tygart River had once carried a heavy logging commerce, and a small excursion steamer with a tea-kettle engine had operated at Grafton, but workmen swarming over the site in 1934 saw little evidence that the stream had ever been used for any purpose, other than water supply for the town of Grafton.

The workers relocated the Grafton-Belington branch of the Baltimore and Ohio Railroad and a few miles of highway and removed the buildings from the Yates, Stonehouse, Cecil, Cove Run, Moatsville, and Pleasant Creek communities that were to be inundated by the reservoir. Beginning in January 1935, the massive concrete monoliths began to sprout across the river bed and inch upwards, finally rising 230 feet and stretching 1,921 feet across the stream.

Completed in February 1938 at a cost of $18.5 million, the "watchdog" on the Tygart served its first function during its construction. PWA had



Railroad relocation for Tygart Dam required a tunnel

funded the job to assist economic recovery, and about half the project costs were paid out to the 2,200 construction workers, not including the workers elsewhere who produced the cement, steel, and materials that went into the dam.

Responsibility for leashing the watch dog was handed as of January 1938 to a "Flood Control Group," with the kind of responsibility later assigned to the Hydrology Branch. The Flood Control Group was a subsection of the Projects Section in Engineering Division. The operations plan was simple in theory. The reservoir would be practically empty the first of each year, with 278,000 acre-feet of storage capacity ready to catch winter and early spring floods. Around the first of April, impoundment would begin at a rate sufficient to provide by July first, 100,000 acre-feet of storage available for slow release to maintain navigable pools on the Monongahela. During the first two weeks in December, the pool would be lowered to a level that would again provide full winter flood control. Simple in theory, but tough in practice, for droughts can occur in January, floods in July, and floods frequently follow one on the heels of another.

By early spring it was recognized that having an Engineering Division section responsible for day-to-day impoundments and releases at a structure assigned to Operations and Maintenance Division created a conflict of interest. It was recommended that "one especially selected employee (of the Projects Section) familiar with the Operations studies already conducted and who has been specializing on hydrologic and hydraulic studies, be transferred to the Operations Division..." The employee was

Robert M. Morris. He was placed in charge of routine operation of Tygart Dam, with the Flood Control Subsection to be called on only in emergency. One of the members of the subsection was Thomas L. Riley, who later became Chief of Hydrology Branch.

Morris and Riley had quite a workout in the second year Tygart Dam operated. They had to handle the third and fifth greatest floods of record at the site, a major test of operations methods. The February 1939 flood had a double peak, on January 31 and February 4, requiring discharge of the first peak through the dam before the second arrived. Impoundment to store water for low flow releases had begun before the April 16 flood arrived and gross storage reached 221,000 acre-feet, but Tygart Dam still had about 68,000 acre-feet of unused storage.

After preventing major flood damages in early 1939, the "watchdog" on the Tygart performed its other function from August to November 1939 when drought conditions nearly as severe as those of 1930 prevailed. Monongahela navigation continued during the drought solely because of Tygart Dam releases, that supplied 69.5% of river flow at Lock 15 and 38.2% of flow at Lock 5, and also much reduced the water supply and pollution problems normal to Monongahela droughts. During its first two years, Tygart Dam provided benefits aggregating more than $3.3 million. "It is believed," said Tom Reilly, "that the results achieved thus far by the Tygart Dam, even in the experimental stage, amply justify the funds expended for its construction and operation and are the most conclusive proof that can be offered for the extension of the flood control system of the Upper Ohio River Basin."

The Saint Patrick's Day Flood Towards noon on St. Patrick's Day in 1936, water began to lap over the banks of Stony Creek and the Little Conemaugh and inch into Johnstown streets. Worried workers began to muster out of the valley, abandoning their cars in the flooded streets and wading home. Others, who had become accustomed to repeated flooding, thought the water would recede before quitting

Johnstown, Pennsylvania, March 1936

time, remained at their jobs, and were marooned in downtown buildings for the night. By dark, pianos were floating in the streets, currents were smashing abandoned automobiles about, and men were leaving their refuge atop streetcars and swimming for their lives. Marooned in the Capital Building, Mayor Daniel J. Shields looked out his office windows and helplessly watched as a man drowned. Power and telephone service ended, and apprehension increased amongst the stranded workers, who could see little save water rushing through the city and car lights moving on surrounding hills. Sleepy, cold, hungry, they welcomed the dawn.

The flood at Johnstown was receding by morning, on its way downriver to Pittsburgh, Wheeling, and other communities. "A scene of inconceivable desolation, following devastation by a flood that rivaled the deluge caused by the historic dam break in 1889," said a reporter from *Engineering News-Record* in his description of Johnstown. He said the waters of the Little Conemaugh and Stony Creek, racing through the business and industrial district and much of the residential area, had caused nearly thirty deaths in Johnstown, left 16,000 people homeless, destroyed 77 buildings, and damaged another 4,500. He estimated damages at Johnstown at $33 million, about a third the assessed valuation of the city, but thought human suffering and shock a more serious consequence. Especially the needless suffering that occurred when rumor spread on the afternoon of March 18 that Quemahoning Dam above the city had broken and thousands panicked and fled to the hills in a cold, drenching rain.

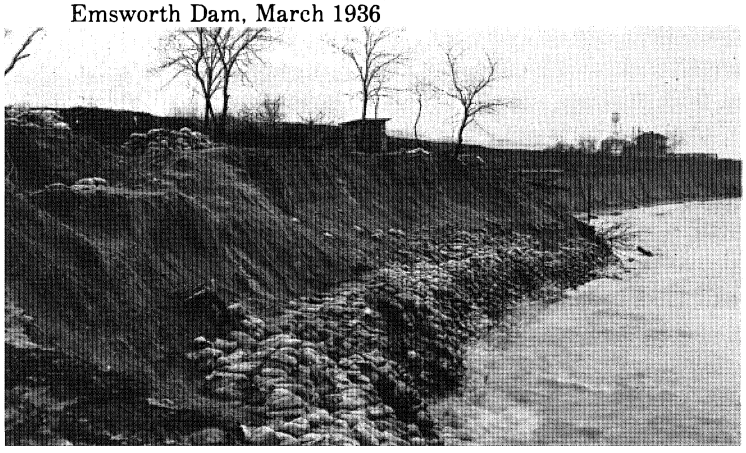
The rivers crested at 46 feet at Pittsburgh on March 18, surpassing the 1763 record by more than

Upstream along the Allegheny River, Pittsburgh, March 1936

Downtown Wheeling, West Virginia, March 1936

Flood damages, Emsworth Dam reconstruction, March 1936

Erosion along left bank of Ohio River main channel, vicinity of Emsworth Dam, March 1936

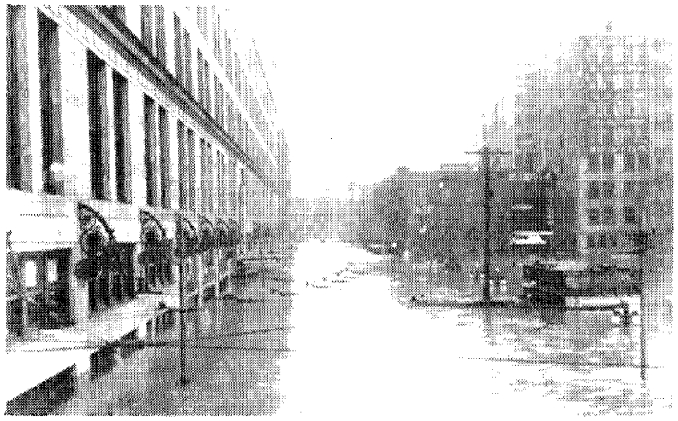


5 feet and flooding 62% of the Golden Triangle. Power, phone, utility services were disrupted. Fires broke out. Boats on rescue missions cruised the streets of Pittsburgh, Verona, Oakmont, Sharpsburg, Etna, and other towns. Scattered looting and vandalism occurred in the evacuated areas. A man marooned in a Liberty Avenue building shot at boatmen who refused to take him out. State police were called; the National Guard mobilized.

Water entirely covered Wheeling Island and left Wheeling, Wellsville, Steubenville, and other towns along the upper Ohio "sodden masses of wreckage, mud and slime." The St. Patrick's Day flood took nearly 200 lives and caused damages in the Pittsburgh Engineer District amounting to $199 million. President Roosevelt sent in thousands of Works Projects Administration and Civilian Conservation Corps workers to clear the debris and clean the mud from the stricken towns, and spent millions to assist in community recovery.

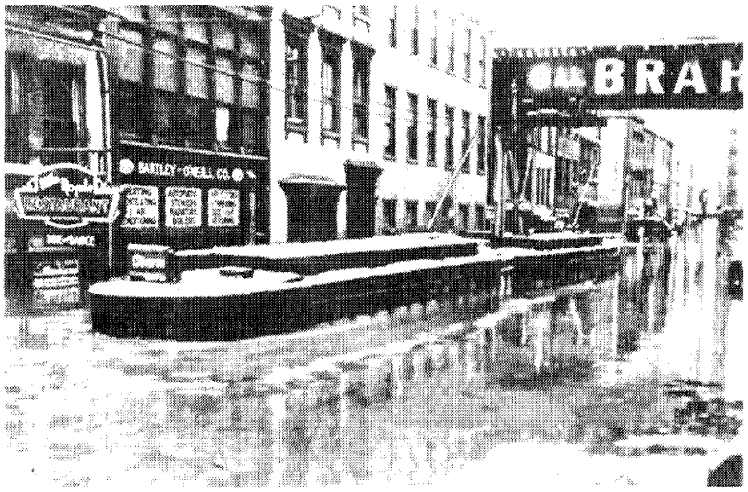
Major Wilhelm Styer and the Pittsburgh Engineers joined in the rescue work at the height of the flood, but devoted most of their attention to saving Emsworth Dam on the Ohio and Dam 4 on the Allegheny. A derelict barge slammed into and wrecked the lower lockgates at Emsworth, and the flood topped a cofferdam, in place while Emsworth Dam was being raised to provide a deeper harbor for Pittsburgh, pushed a whirler and gantry crane into the cofferdam, destroyed the concrete esplanade at the lock, and cut a large slice out of Neville Island at the main dam abutment. Erosion of the island menaced the dam, but the Engineers saved it by dropping 24,000 sandbags onto the island bank and stopping the scour.

Major Styer took personal charge of emergency work to save Allegheny Dam 4 at Braeburn-Natrona, where he faced a situation similar to that met by "Goliath" Sibert at Dam 3 in 1907. The flood breached Braeburn dike, which joined Dam 4 abutment to high ground, bypassing the dam and swiftly eroding the bank, threatening to consume the Pennsylvania Railroad track and the Braeburn Steel



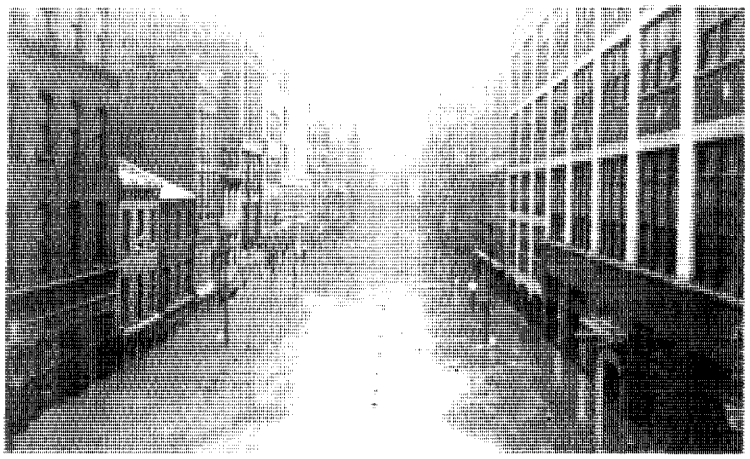
Joseph Horne Company Department Store, Stanwix Street, Pittsburgh, March 1936

Works. Major Styer arranged shipment of train loads of 5 to 20-ton stone blocks from quarries up to 60 miles away and dumped the stones into the breach. Swift current washed away the huge blocks as fast as they were placed, and Colonel Styer brought up six old railroad locomotives to push into the breach as a last resort. The stone blocks finally took hold, however, and stopped the erosion before use of the locomotives became necessary. Styer did not have to blow out Dam 4. The breach was closed and the dam remained in service.



Lower Penn Avenue, Pittsburgh, March 1936

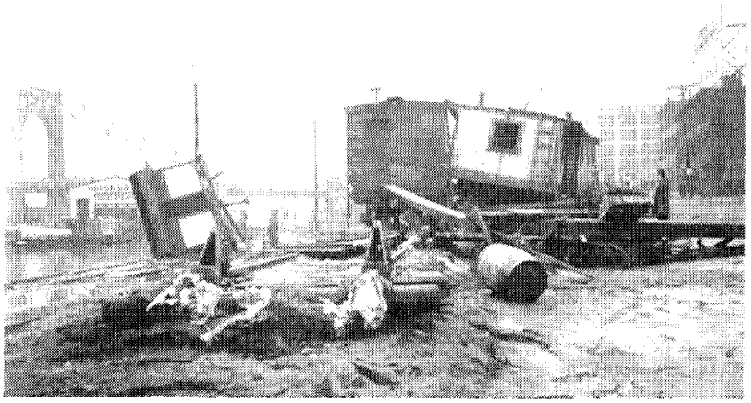
An End to Hypocrisy "We are now living under a hypocritical fiction. Improvement of navigation being under federal control, is made the excuse for flood control," wrote Arthur E. Morgan in 1928. Morgan, president of Antioch College, had built the Miami River basin flood control project and in 1933 became chairman of Tennessee Valley Authority. "By gradual accumulation of precedent we are, in fact, amending the Federal Constitution, but in such a partial and inefficient manner that the Federal Government is acquiring obligation for flood control without the necessary powers for its proper execution," he explained. "The legal structure of flood control should be as well built and as comprehensive as the engineering design."



Ninth Street from Duquesne Way, Pittsburgh, March 1936

Morgan's assessment of the situation was fairly accurate. Congress had been backing toward a flood control program in the Ohio River basin since 1884, when it told "Padre" Merrill to build levees around some towns to improve navigation by keeping boats in the channel during floods. But the St. Patrick's Day flood, ending with a paper flood of letters and telegrams in Washington, put an end to that hypocrisy.

Wreckage along right bank of Allegheny River above Sixth Street Bridge, Pittsburgh, March 1936



President H. B. Kirkpatrick called a meeting of the Pittsburgh Chamber of Commerce on March 27 at the Pittsburgh Athletic Association, because the Chamber office was still without power. He organized a Citizens' Committee on Flood Control and dispatched a telegram to federal dignitaries:
OUR ORGANIZATION REPRESENTING THE GREAT INDUSTRIES OF THE PITTSBURGH DISTRICT AS WELL AS THOUSANDS OF

SMALLER BUSINESS CONCERNS MOST EARNESTLY URGES THAT YOU COME TO PITTSBURGH AND SURVEY FOR YOURSELVES THE SHOCKING DESTRUCTION WORKED BY THE FLOOD IN THIS GREAT INDUSTRIAL AREA PERIOD SOBER ESTIMATES MADE BY MEN OF EXPERIENCED JUDGMENT CALCULATE PROPERTY DAMAGE IN ALLEGHENY COUNTY ALONE AT ONE HUNDRED FIFTY TO TWO HUNDRED MILLION DOLLARS PERIOD IF THE LOSSES SUFFERED BY THE INDUSTRIES WHICH LINE OUR THREE RIVERS FOR A DISTANCE OF FORTY TO FIFTY MILES BEYOND THE CITY ARE INCLUDED THE FIGURES REACH A SHOCKING TOTAL PERIOD BY PERSONAL INSPECTION YOU WILL BE BETTER ABLE TO MAKE A RIGHTFUL DECISION AS TO THE EXTENT BY WHICH THE WHOLE NATIONAL INTEREST IS INVOLVED IN THIS DEVASTATION OF THE MOST HIGHLY INDUSTRIALIZED REGION IN AMERICA PERIOD

Secretary of War George Dern and Chief of Engineers Edwin Markham accepted the invitation. They toured Johnstown and Pittsburgh on April 2-3 in company with Major Styer and his successor Colonel W. E. R. Covell. General Markham, on his return to Washington, graphically described the water levels and damages he saw in Horne's department store in Pittsburgh's Golden Triangle to the House Committee on Flood Control.

The Chamber of Commerce's flood control committee joined with the Tri-State Authority, headed by State Senator William B. Rodgers, Jr., uniting political and civic leaders of the Pittsburgh vicinity in a campaign for federal flood control. They pressed their campaign through the media. They distributed a hundred thousand pamphlets urging construction of the flood control project. They participated in a mass flood control rally organized by the League of Women Voters on May 18, 1936, in Washington.

Federal offices in Pittsburgh and Washington, in the meantime, were working their way out from under a paper flood of letters urging flood control and suggesting various solutions to the flood problem. President Roosevelt received a telegram reading: *"HAVE THE OHIO FLOOD PROBLEM SOLVED STOP WILL WRITE YOU STOP WILL START ON THE MISSISSIPPI PROBLEM NEXT WEEK."* Alas, the letter of explanation never arrived.

A Westmoreland County tailor suggested cutting a canal to divert Allegheny River floods from New Kensington through flat country south of Latrobe and by tunnel through the mountains to the Potomac River. Captain Lucius D. Clay, deputy to the District Engineer and later the military governor of occupied Germany, responded that costs of the canal and tunnel might exceed national financial resources and asked whether people living along the Potomac might not object.

Another interesting suggestion came from Thomas L. Pfarr, Chief Fire Marshal of Allegheny County, who recommended that the Engineers dredge the Allegheny, Monongahela, and Ohio rivers 25 feet deeper and remove "unnecessary

Flood damaged merchandise, March 1936

islands." Actually, the idea was not too far-fetched; something similar was done at Johnstown. One junior officer, weary from working through piles of letters from well-meaning people, finally devised a standard response: "We appreciate your suggestion, but there is no difficulty whatever in determining how to prevent floods, the only difficulty being to procure the wherewithal."

Congress had been studying and debating a flood control bill for several months before the St. Patrick's Day flood hit. Just after the flood, Senator Royal S. Copeland asked the Chief of Engineers if he would recommend reservoirs for flood protection of Pittsburgh and the Ohio River basin. General Markham replied that the proposed reservoirs were meritorious, but "it would appear that their authorization should be considered only in connection with such a general program, the terms of which thereafter may be construed as a basic policy definitive of Federal interest." In short, hypocrisy should end. Senator Copeland revised the bill, and the Flood Control Act, as passed by Congress on June 22, 1936, read:

> *It is hereby recognized that destructive floods upon the rivers of the United States, upsetting orderly processes and causing loss of life and property, including the erosion of lands, and impairing and obstructing navigation, highways, railroads, and other channels of commerce between the States, constitute a menace to national welfare; that it is the sense of Congress that flood control on navigable waters or their tributaries is a proper activity of the Federal Government....*

One obstacle to flood control in the upper Ohio River basin remained. "It is my belief that, for many reasons," said President Franklin Roosevelt, "the Federal Government should not be charged with the cost of land necessary for levees, dams, and reservoirs." That policy, made part of the 1936 flood control act, forced state governments to buy the lands and easements for reservoir projects whose benefits would extend to other states.

Political and civic leaders at Pittsburgh bitterly opposed the President's cost-sharing plan for flood control and accused him of inconsistency. Why do you favor full federal funding of reservoirs in the Far West and in the Tennessee River basin, but not in the Ohio River basin, they queried. The population of Allegheny County, they said, is fifteen times greater than the population of Nevada, and equal to the combined populations of Nevada, Wyoming, Delaware, Vermont, and New Mexico, and we pay more taxes. Pennsylvania moved ahead and appropriated funds for purchase of lands at the Tionesta and Crooked Creek reservoir sites, but West Virginia and other states let Congress and the President know, explicitly, that they had no intention of cooperating.

Under questioning by the House Committee on Flood Control, Chief of Engineers Edwin Markham admitted the cost-sharing requirement for reservoirs might "seriously retard, if not prevent, the consummation of a flood-control program for the protection of the valley." He favored requirements of cooperation for local protection projects, construction of levees and floodwalls around individual communities, for if local interests were not sufficiently concerned to supply the lands and operate the projects after completion, then no one suffered but themselves. "Reservoirs," he said, "fall into a different category, for the benefits from these structures are not local but far-reaching."

After the record flood of January 1937 laid waste to the lower Ohio River basin, Roosevelt gave up his policy, and in 1938 Congress ended the cost-sharing requirement for reservoirs. In fact, in the 1938 flood control act Congress provided also that communities that had channel improvement projects approved in 1936, which included Johnstown, Punxsutawney, and Elkins in the Pittsburgh District, would not have to pay the costs of lands and project operation and maintenance.

Flood Free Johnstown "We want to keep you from having those floods again," said President Franklin Roosevelt. "The federal government, if I

Site of a dam that was never built

have anything to do with it, will cooperate with your state and community to prevent further floods."

The President, in company with the Secretary of War, the Chief of Engineers, Governor George H. Earle, Mayor Daniel Shields, and District Engineer W. E. R. Covell, motored through the Conemaugh valley on August 13, 1936. They stopped at a proposed reservoir site, where Colonel Covell explained the District studies of protective measures for Johnstown. At Roxbury Park, the President promised the people of "Flood City, U.S.A." they would have protection. That day, he signed an order allocating $300,000 to the Pittsburgh District for planning a solution to Johnstown's flood problems.

The District found what at first seemed a desirable reservoir site on Stony Creek, eight miles upstream from Johnstown, but it would have affected Hollsopple and mining communities, flooded two major railroad tracks, and field investigation showed the site was honeycombed with mines that made a reservoir very costly. The District then planned a channel rectification project, involving deepening and widening 8.7 miles of Stony Creek, Little Conemaugh, and Conemaugh Rivers where they flowed through Johnstown, laying concrete bank slope paving, building low dikes and floodwalls, and relocating railroads, highways, and utilities.

Project engineers A. M. Hertz and C. E. Paul and resident engineer Charles H. Wagner supervised the five contractors who began work on the Johnstown project in August 1938. Thanks to the unique provision of the 1938 flood control act, Johnstown became one of the handful of cities in the nation that had all construction, operation, and maintenance costs funded by the Federal Government. President Roosevelt took personal interest in the project and visited Johnstown again in June 1940 in company with District Engineer Ludson "Goop" Worsham.

"When I visited Johnstown in 1936," said the President, waving his cigarette holder, "Colonel Covell told me a reservoir was planned. What happened?"

"That was the Hollsopple site," General Worsham replied. "It was abandoned because it would have caused more damages than flooding the area it was to protect."

The President then asked how deep the channels were being cut, what were the angles of their side slopes, how thick was the concrete paving, and what size floods the channels could handle.

Surprised by questions that normally only another engineer would ask, General Worsham explained the project at length and in detail, telling him it would carry a flood equal to that of March 1936 without trouble.

"Suppose we have a higher flood?" the President quickly interjected.

General Worsham paused a moment to consider the question, then responded, "Mr. President, we must have some faith in the Lord."

The President slapped his thigh and laughed loudly, pleased with the answer. General Worsham later recalled he had been so pleasantly surprised by Roosevelt's intense interest in the Johnstown project that "he almost made me a Democrat."

Many flood projects were suspended in 1942 because the workers and materials were needed for critical military projects, but not the work at Johnstown. District Engineer Gilbert Van B. Wilkes dedicated the project on November 27, 1943. "Today, Johnstown can boast that it has the largest and best channel improvement in the United States," he told a crowd at Johnstown. "We believe that the flood troubles of the city of Johnstown are at

Colonel W. E. R. Covell

an end. The work was prosecuted during wartime because of the immense importance to the war effort of the products produced here in this city. We salute the FLOOD FREE CITY OF JOHNSTOWN." One wonders, however, whether the President's special interest in the project might not have had more than a little to do with its early completion.

Watchdogs at the Headwaters The dapper Colonel W. E. R. Covell, in full uniform as usual, buttons shining and boots glistening, strode into Room 1026 in the Federal Courthouse Building, Pittsburgh District headquarters, took his chair at the head of the table, and opened the conference. "Gentlemen," he began, "in this District we expect to build dams that are *absolutely* safe at the *least* possible cost. You are the best engineers obtainable in the country, and we expect you to decide how to build the safest and most economical dams in the world." With that, he turned the meeting over to Charles M. Wellons, who was to serve as chairman of the Board of Consultants.

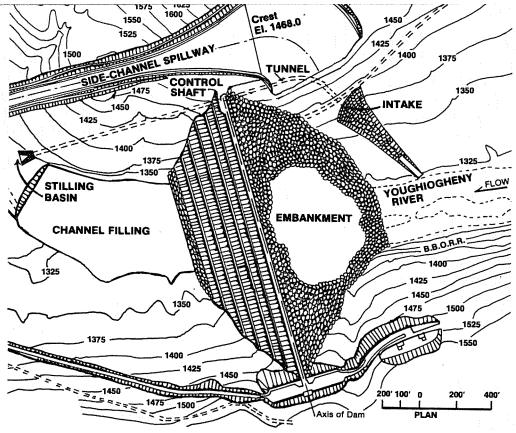
Charged with planning and building an unbreakable chain of dams upstream of Pittsburgh, Covell sought the best engineers he could find and brought them to Pittsburgh for their first meeting on December 16, 1936. Looking down the long table, he knew he had succeeded. First, there was his own staff: Wellons, the principal engineer; William E. Sidney, a mechanical genius; Jack Dodds, the practical engineer; Shailer Philbrick, a foundations expert; Emil Schuleen, the hydraulic operations man; and District stalwarts Harry E. Anderson, D. P. Grosshans, D. E. Oelschlager, Don D. Rait, and A. L. Alin.

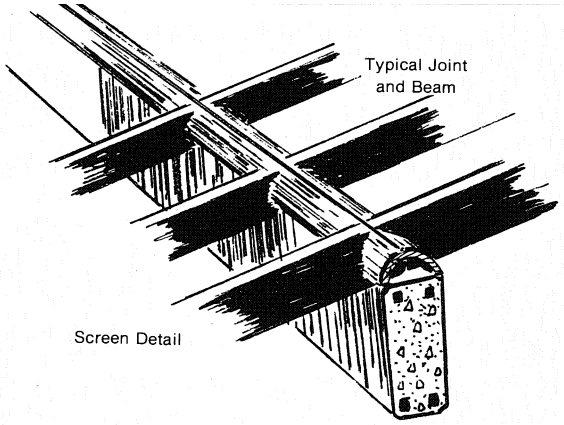
From Washington came William McAlpine, Edward B. Burwell, and William Gerig. McAlpine, a rasping, straightforward fellow, had rushed the Ohio River locks and dams to completion in 1929 and had directed the canalization of the Upper Mississippi. He became, by act of Congress, senior engineer in the Corps, and in 1965 the Ohio River dam at Louisville was named in his honor. Burwell, from Ohio River Division, became chief geologist for the Corps. Gerig had been a roving trouble-shooter for the Corps since 1889 and had been division engineer under Goethals in Panama. Like McAlpine, Gerig's long experience with river engineering had made him extremely skeptical of theory. When younger engineers explained their theories, Gerig sometimes looked them in the eye and asked, "You don't believe all that damn stuff, do you?"

From outside the Corps, Covell had recruited James P. Growdon, William P. Creager, and Warren J. Mead. Growdon, tall, distinguished, outspoken, had built monumental rockfill dams as chief engineer for Alcoa, generally with free-hand experimental techniques. Creager, consulting engineer on a hundred different projects, had an unmitigated penchant for writing. While consultant for the Pittsburgh District, he completed a three volume work: *Engineering for Dams.* Mead, a sharp young geologist from M.I.T., had designed Boulder Dam on the Colorado River.

After Wellons completed the preliminaries, he introduced the speakers at the first session. Emil Schuleen described hydraulics operations planning: maximum probable floods, flood storage requirements, proposed operations methods. Ed Burwell outlined the geology of the Tionesta, Crooked Creek, and Redbank Creek reservoir sites and the feasibility of dam types: concrete, rockfill, or earth embankment. William Sidney discussed proposed outlet and conduit types and various valve, bulkhead, and crest gate systems. And last, Professor Harold A. Thomas from Carnegie Tech presented the flood routing model he was building for the District. The first meeting of the Board of Consultants then adjourned.

Next morning, the Board members, District staff, and officers from Division and the Chief's office, dressed in the warmest woollens they could find, piled into a dozen sedans, usually heaterless, parked along the busy downtown streets outside the District office and motored off up two-lane roads into the countryside for a first look at the dam sites. During the winter of 1936 the District had drill-rigs boring cores and inspection pits to reveal foundation con-





YOUGHIOGHENY DAM

ditions at sites on Tionesta, Crooked, and Redbank creeks northeast of Pittsburgh. Because of the high costs of relocating railroads and villages, the Redbank Creek site was abandoned for one on Mahoning Creek. When as near the dam sites as possible, the engineers piled out of the cars and hiked, with toes freezing, through the snow and muck to the drill-rigs to inspect cores taken from the rock. Some boarded metal cages hanging on cables and were let down into the inspection pits below the frost line to see the strata in place.

While thawing out in ramshackle hotels at night, the engineers discussed what they had seen during the day and argued geology and dam design. The arguments continued during a series of meetings and inspection trips throughout 1937 and 1938 until details were hammered out. Soils samples were shipped to the soils laboratory directed by Robert I. Phillippe, Frank Mellinger, and others at Zanesville until 1938, when the Muskingum project was finished, and the soils lab moved into a building on Susquehanna Street in Pittsburgh. The lab moved to Cincinnati in 1942 and became the Ohio River Division Laboratory at Mariemont.

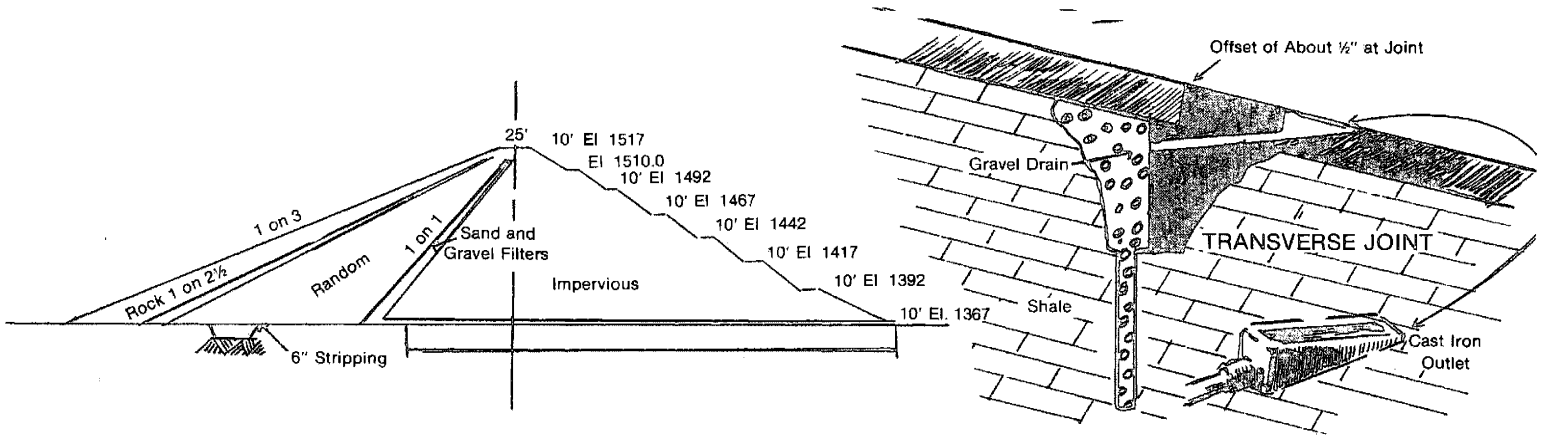
After lengthy and heated debates about how much freeboard each dam should have above probable maximum flood storage, what the earthquake safety factor should be, the relative merits of concrete gravity, rockfill, and earthen dams, and other engineering features, the Board agreed on rolled earth embankment dams on Tionesta and Crooked Creeks and a concrete gravity dam on Mahoning Creek. District geologist Shailer Philbrick later recalled: "To me it was an interesting and well as sometimes almost a thrilling thing to be with those fellows and see how they worked out their problems, because in those days there were not computers and many of those things were worked out on the basis of feeling. Now whether this is good engineering or not I don't know but it was the art, and they practiced it exceedingly well."

Pennsylvania finished land acquisition for reservoirs on Tionesta and Crooked creeks and the District began construction of rolled earthfill dams in 1938. Captain James K. Herbert and engineers W. B. House and G. P. Fleetwood directed contractors S. H. Groves and Sons and Lundin Brothers at the Tionesta Dam, 1.2 miles above the mouth of Tionesta Creek, and contractor George M. Brewster at the Crooked Creek Dam, 6.7 miles up Crooked Creek. Both were finished in 1940, several months ahead of schedule.

After the venture into earth dam construction, the District returned to the concrete gravity type on Mahoning Creek, 22 miles above its mouth. Resident engineers Charles "Wag" Wagner and James "Raucous Bill" Bowman watched the contractor, Dravo Corporation, as it began a search for access to the Mahoning Creek site in February 1939. The contractor built a 3.8 mile rail spur from the Pittsburgh and Shawmut Railroad to move thousands of tons of cement, sand, and gravel to the site, completed drilling the inspection and grouting holes, and had cellular steel pile cofferdams in place by the end of June. Whirler cranes, mounted on concrete piers that became part of the dam, began swinging buckets of concrete to the forms in July 1939, steadily inching the monoliths upwards. The $6.5 million Mahoning Creek Dam was finished on June 2, 1941, a year ahead of schedule.

Congressman Robert G. Allen of Greensburg told the House Committee on Flood Control in 1937 that, because losses had been so high during the St. Patrick's Day flood, people of Vandergrift on the Kiskiminetas River moved their property to the second stories of their homes at every rain. He asked, and got, early construction of a dam on the Loyalhanna Creek, 4.5 miles above its confluence with the Conemaugh at Saltsburg. Engineer Ralph Patt inspected the work of the Great Lakes Dredge and Dock Company, when it began building the combined concrete gravity and earth embankment dam in February 1939 on the Loyalhanna.

As a result of planning and supervision problems, the Great Lakes Dredge and Dock Company, which had an excellent record in its field but no experience with big dam construction, was losing money on the Loyalhanna Dam contract. Company president Edwin Markham, who had retired in 1937 as Chief



of Engineers of the Corps, visited the District to see what could be done. Captain Herbert D. Vogel, then working with Herb Winn, D. P. Keelor, and Wilfred Bauknight in the District inspection division to prod contractors and maintain quality standards, asked District Engineer Ludson Worsham how the Loyalhanna contract and General Markham should be handled. "The first day," Worsham said, "we will extend to him all the respect and courtesy that is due an ex-Chief of Engineers. After that he's just another damn contractor!" General Markham and his firm were held to the grinder and completed the $5.4 million Loyalhanna Dam in June 1942.

Last and largest of the six dams, including Tygart, that the Pittsburgh District began before December 7, 1941, was Youghiogheny Dam on the Youghiogheny River 1.2 miles above Confluence, Pennsylvania. Its reservoir was to extend south to Friendsville, Maryland.

A dam on the Youghiogheny had been advocated for years. As early as 1913, E. A. Schooley of the Connellsville Chamber of Commerce told District Engineer Francis R. Shunk that his town and the Youghiogheny valley had suffered many devastating floods and had severe water supply problems. "As a preventative measure," Schooley said, "we suggest immediate construction of the proposed reservoir south of Confluence and impounding the waters of the Youghiogheny River, thereby arresting flood crests and, incidentally, supplying about ten times the stream's present minimum flow during the dry period."

The Pittsburgh District thought the Youghiogheny Dam a key to flood protection for the upper Ohio basin, but relocations costs were high. After it became clear that West Virginia would not support construction of a dam and reservoir on the West Fork of the Monongahela, the District moved ahead with plans for the Youghiogheny Dam in Pennsylvania.

Youghiogheny Dam was to be built under two contracts: the outlet tunnel by Herman Holmes, the rolled earthfill dam and spillway by Hunkin Conkey Company and Shofner, Gordon and Hinman. Resident Engineer Charles Wagner supervised construction of the outlet tunnel, beginning in November 1939, but difficulties encountered in locating proper fill materials for the dam delayed the start of that work.

At a Board of Consultants meeting just before Christmas, 1940, District soils expert Shailer Philbrick was directed to find another million and a half cubic yards of fill material. Unhappy with the assignment, because he had planned a Christmas trip with his family, he walked out of the meeting grumbling all the while and ran into William E. Sidney. Sidney was a character, who had learned mechanical engineering through correspondence courses and wide experience with Pittsburgh Plate Glass, Superior Machine Tool, and Army Ordnance before joining the District in 1925. He sometimes worked out designs in his home basement, while listening to his pet parrot, and often prefaced his remarks with "Last evening the parrot said...."

Philbrick explained his problem to Mr. Sidney, saying, "This is a helluva situation. I've got to find a million and a half cubic yards before I go off for Christmas."

"There's no problem with this at all," replied Sidney, with a straight face. "Just send a requisition over to Procurement Branch for a million and a half cubic yards of soil for Youghiogheny Dam."

Humor often relieved tensions generated by the hectic pace at which the engineers worked in 1940. With addition of Dam Design and Projects Sections, the Soils Laboratory, and various branches, the number of District employees in 1940 was nearly double what it had been in 1930; and the District had also been assigned airfield construction when President Roosevelt began improving the nation's defensive capability. Philbrick located materials for Youghiogheny Dam through some innovative engineering, but construction of the dam had just begun when the thud of bombs at Pearl Harbor brought the Pittsburgh District its greatest military challenge.