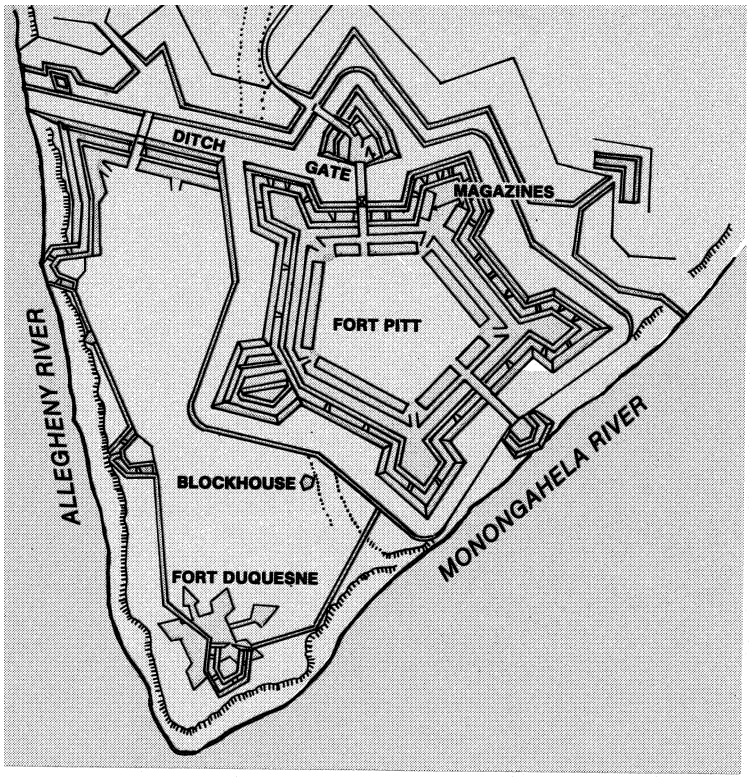


Chapter 12
YE DELUGE OR INUNDATION

"Many Houses drove away & ye New Banks of ye fort Broke down very low. Many Goods wet & Damaged, ye Water getting into ye Magazines has I believe Wet all ye Ammunition & our powder also," wrote Quaker trader James Kenney while the January 1762 flood was receding from Fort Pitt. His cellar was full of water, everything in the village around the fort was mud covered, but Kenney was thankful because he had hauled his trading goods to safety in a canoe and no one had been drowned by "ye Deluge or Inundation."

Thomas P. Roberts smiled at the Quaker's quaint account of the 1762 flood: it seemed familiar, very much like what he had seen in Pittsburgh during March of 1907. He scribbled the description on a notecard, added it to his thick collection of information about historic floods in the Pittsburgh Engineer District, and glanced through his file on the 1762 flood. He had a 1762 flood report by Colonel Henry Bouquet, who said the flood got into the fort through drains and sally ports and even boiled out of the ground, washing away earthen revetments and floating the barracks down the Ohio. Seneca Indian refugees, crowding into the village after the flood to ask succor from agents George Croghan and Thomas Hutchins, told Bouquet that great floods seldom occurred at Fort Pitt.

Roberts smiled again. The Senecas spoke with forked tongues. Surely they remembered the ice flood of 1754 when George Washington nearly drowned trying to cross the Allegheny and the flood of 1757 that nearly reached the rafters of cabins in the village around French Fort Duquesne.

At the bottom of the card stack, Roberts found the April 1762 report on flood damages at Fort Pitt made by Colonel William Eyre, chief engineer to General Jeffrey Amherst. Eyre found the earthen escarpments of the fort washed out and tumbled down; he recommended they be revetted with brick before another inundation carried them completely away. He said buildings inside the fort had been flooded to a four-foot depth; he recommended "flood-proofing" by raising the first floor of the buildings at least five feet off the parade ground. Because protective measures would be costly and might be undone by a higher flood, Colonel Eyre suggested that Fort Pitt be abandoned and the garrison moved across the Monongahela to the top of Coal Hill.

Roberts picked up his pencil and made some quick calculations to compare flood crest elevations. The 1762 flood was four feet deep on the parade ground inside Fort Pitt. That would be.....39 feet on the Point gage, 14 feet above the 25-foot flood stage. Why, that was a half foot higher than the "Fifty-Million Dollar" flood that ravaged Pittsburgh on the Ides of March in 1907! The figures confirmed what "Padre" Merrill had once told him. "Bear in mind," the Colonel said, "that even the great flood of 1884 was equaled by floods that occurred before the white man's axe had felled a single tree in the Ohio Valley; it is not the axe of the woodman that is to be feared, but the plow of the farmer."

Because information about river flow and floods was vital to proper bridge design and waterway project planning, Thomas Roberts, like most engineers and like his father before him, had collected data about flood elevations and river flows throughout his career. His intensive study of historic floods, however, began in early 1908 after his friend Hiram Chittenden had written to ask if he thought the cutting of forests was causing greater river flows at flood time and lesser flows during droughts.

As Chief Engineer of the Lake Erie and Ohio River Canal Company, Roberts had become ac-

General Hiram Chittenden (as a captain)
Dr Jesse Remington

quainted with General Chittenden in 1895, when the officer was surveying canal routes across Ohio for the Corps; and in 1908 Roberts was installing drum weirs designed by the General atop dams on the Monongahela River. During the 1895 canal surveys, Chittenden had planned dams and reservoirs to supply water to the proposed canals, and that experience had influenced his 1897 report on improvement of the upper Missouri River basin, in which he revived Charles Ellet's reservoir scheme. Chittenden had proposed unified river basin development and federal construction of dams and reservoirs for multiple purposes.

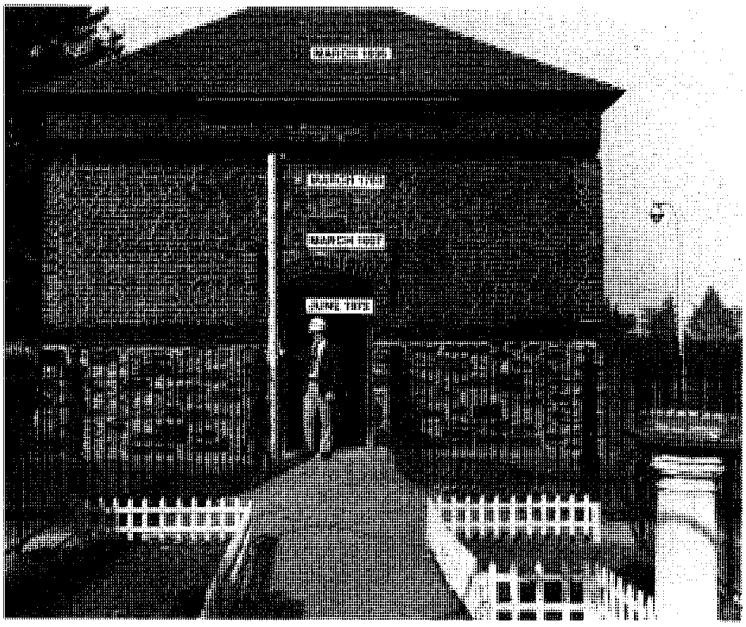
The Chittenden report on the Missouri River basin and major floods on the Monongahela and Mississippi rivers in 1897 had stimulated new interest in flood control measures. The Pittsburgh Chamber of Commerce sent a representative to the National Board of Trade convention in 1898 to urge support for federal construction of flood control reservoirs. The National Board of Trade had given its support to the reservoir scheme, won approval from President Theodore Roosevelt, and secured enactment of the National Irrigation Act of 1902, which authorized federal funding for reservoir construction in the arid West, but not in the Ohio River basin.

The Pittsburgh Chamber of Commerce had also endorsed the old idea that reforestation was a flood preventive measure. It urged creation of federal forest reserves at the headwaters of the Monongahela and Allegheny basins as a means of reducing flood flows and improving river navigation during droughts. That removal of forest cover increased water runoff rates, thereby increasing flooding problems and reducing low water flows, was a popular concept, publicized during the 19th century by such journals as the *Southern Lumberman.* In 1884, editors of the *Southern Lumberman* wrote:

> *The trouble seems to grow worse every year. Each time the river gets higher. This is one of nature's ways of punishing man. For generations, armies of settlers have been occupied in cutting the timber along the banks of the Tennessee, Ohio, Monongahela, and Allegheny rivers. The mountain sources of these streams have been stripped of the trees--their natural covering. The result is ruinous. The trees which hindered the rush of waters, which absorbed much of the moisture of melting snows, are gone. No longer are the waters impeded. They rush in floods, carrying everything before them, and Dame Nature is avenged.*

General Chittenden had asked Thomas Roberts' opinions on the effects of forestation on river flows because in 1908 many conservationists, notably Gifford Pinchot, chief forester to President Theodore Roosevelt, were proposing federal purchase of timberland reserves as a benefit to navigation and a flood preventive measure. The General knew that Roberts had been involved with waterways projects since 1866 and that he had a collection of his father's papers dating back to 1820.

In preparing his response to Chittenden, Roberts first reviewed his long career on projects scattered across America from the Appalachians to the Rockies and also in Brazil. He had carried a transit miles across areas where forests had been cut off, but had never seen signs of gullying and erosion where brush and scub timber remained; that, he had seen only in plowed fields. Nor had he seen erosion on treeless plains where man had not bared the earth. He especially remembered the plains of the upper San Francisco River valley in Brazil, where



Fort Pitt Blockhouse

rainfall was heavy; he had seen no signs there that lack of forest cover had any major effect on runoff rates.

Expanding his study to Pittsburgh Engineer District records, Roberts learned that engineers had long questioned the idea that deforestation affected flows of major rivers. He found an 1843 report by Captain John Sanders on the subject. "I cannot discover that it was ever different," Sanders had reported, "and we have some knowledge of the river since 1760, fully eighty years. The forests of the Ohio remained in their native state more than half of that period; so there is no cause of alarm from the portentous prophecies of those philosophers who imagine our rivers are to dry up with the clearing of the forests."

Biology and botany textbooks directly contradicted Captain Sanders' opinion, so Roberts began assembly of personal records he and his father had maintained, examination of Pittsburgh Engineer District files, and intensive study in Pittsburgh libraries of materials relating to historic floods. He hoped to compare flood elevations and flow records from times before forests had been depleted with those of a later date. Fortunately, the blockhouse built in 1763-64 at Fort Pitt still stood in 1908 (as it still does), enabling him to determine the approximate elevations of early floods.

The Flood of 1763 "This Morning ye Water was rose equal to ye Banks in some places," wrote trader James Kenney on March 8, 1763, but "notwithstanding some people would not believe that it would overflow, but toward Noon it got in ye Street & they began to muster off, but ye dead Faith of Several promp'd 'em to delay carrying away their Goods untill ye Water was got so high that they had to break in ye Roofs or Gable Ends of ye Houses to get them away in Battoes."

Thomas Roberts had seen the same thing many times. He had often wondered why people stayed in their homes until flood waters were so high that they had to be rescued by boat. Thumbing through his notes, he found a report on the 1763 flood by the commandant of Fort Pitt. The commandant mentioned the loss of workshops and boatyard that followed cabins from the village downriver, total erosion of three sides of the fort, the deaths of two men by drowning, one in Turtle Creek and the other in Two Mile Run, and the fact that the river crested 22 inches higher than it had in 1762. That would be, Roberts figured, about a 40.9-foot stage, the highest flood at Pittsburgh before 1907 and more than two feet higher than the March 1907 flood.

He wondered whether Colonel Bouquet had taken the Seneca ruse in 1762 seriously. Perhaps so, for Bouquet had not begun the floodproofing and bank revetment recommended by Colonel Eyre before the 1763 flood washed over the fort. He noted that Bouquet had appointed Thomas Hutchins as engineer in charge of restoring the fort and completing redoubts on the three sides of the fort exposed by the 1763 flood. Hutchins must have finished the job quickly, because about 150 soldiers in the fort withstood an attack and siege by perhaps 400 Indians in July and August 1763.

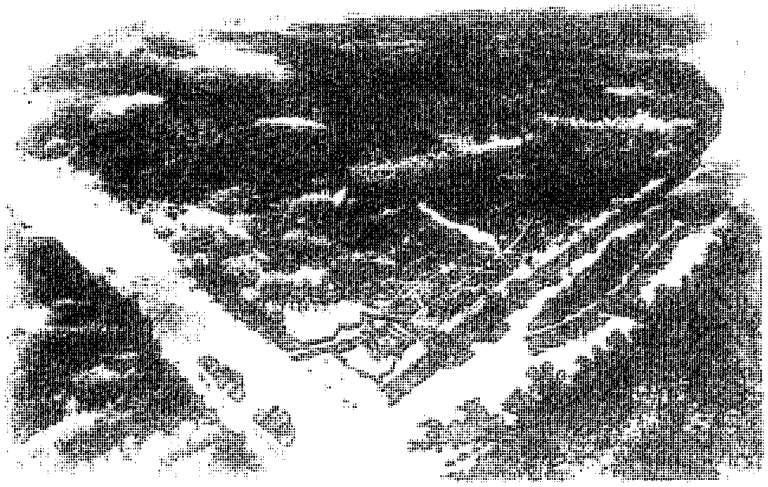
Roberts surmised that pioneers worried little about floods. In fact, it appeared they welcomed high water, for they could get their produce to markets more easily when floods covered rocks and snags and shoals that impeded low water navigation. Pioneers had been warned of floods by Indians, who pointed up into trees to show where they had once tied their canoes, but pioneers disregarded the warnings and built where they pleased, near the rivers where water supply was abundant and access to markets easier. "Pumpkin floods," the pioneers called them, because their principal losses were bottomland crops. General William "Tippecanoe" Harrison was apparently the only pioneer who worried about the Indian warnings. After study of Indian mounds, General Harrison had concluded the Ohio valley once supported a large and relatively advanced Indian civilization. He speculated that a great flood had swept away the Indian villages at riverside and thought it probable that tribal leaders had interpreted the flood as a warning from heaven and had led the tribes to refuge on smaller streams.

If flood frequency had not increased and floods had not reached higher crests than in pioneer times, then why did people believe they had? Perhaps, Roberts thought, it was because losses due to floods had grown as more people settled along the rivers and built mills and factories near the water supply. By 1832, people had forgotten the record floods of 1762 and 1763, for they commonly thought the flood of February 1832 the highest ever. Certainly, it was the most damaging to that date and was thought a major calamity.

Newspaper accounts of the 1832 flood listed heavy damages in the Kiskiminetas basin: saltworks, the major area industry, were nearly ruined, the Pennsylvania Canal from Johnstown to Freeport was broken at several places, Blairsville and Freeport were evacuated in the face of rising water. The rivers rose so fast to their 38-foot crest of February 10 at Pittsburgh that people fled without saving movable property. Frame homes washed away, brick homes cracked, factories and mills were closed, and damages amounted to $200,000 in 1832 currency. Some foolish businessman had built a factory on Smoky Island at the mouth of the Allegheny: both factory and island disappeared during the flood.

Bridgewater, Fallston, and Sharon in the Beaver River basin were inundated, their foundries and ironworks carried away. General Abner Lacock, a noted engineer on the Pennsylvania canals, had water to the ceiling in his home at Beaver, lost his barns, fences, crops, furnishings, and library. Roberts thought General Lacock, an old friend of his father's, should have known better than to build a home in the floodplain.

The 1832 flood inundated Wellsburg and Steubenville to ten-foot depths and destroyed most of Warrenton, leaving only seven houses standing. People driven from their homes at Wheeling had taken refuge on nearby hills and watched in awe as hundreds of homes and buildings floated toward Cincinnati. Newspaper accounts of the "terrible calamity" showed that floods had ceased to amuse the settlers by 1832. Men out of work because factories were flooded were not funny; and the sight of men in skiffs searching the rivers for their homes and children was no less than grim.



Pittsburgh in 1760

Floods of Record Thomas Roberts learned that floods occurred on one stream or another almost every year in the headwaters district. Most were forgotten a month after the water subsided, but old-timers remembered the remarkable double flood of 1852, the "barrel flood" of 1865, the "Butchers Run" flood of 1874, and the July 1888 Monongahela flood. He had personal reasons for remembering the floods of 1867 and 1884.

On April 6 and April 19, 1852, floods hit 28 feet and 34.9 feet on the Pittsburgh gage, causing severe damages in both the Allegheny and Monongahela basins. Roberts was especially intrigued by a reporter's graphic description of the April 19 flood on the Allegheny at Pittsburgh:

> *We stood upon the St. Clair Street Bridge as the rafts were coming down and the scene was as unparalleled as it was deplorable. The entire surface of the river was thickly dotted with unbroken rafts, fragments of rafts and isolated logs and boards. Some of the rafts had three or four men on board, some two, some one, and many were guided only by the current of the stream. The latter were almost sure to strike a bridge pier, and the collisions invariably separated them into still smaller fragments. We saw probably a dozen that were manned strike upon the piers, and in several instances the courageous raftsmen were compelled to leap from one fragment to another to avoid being hurled amidst the crashing timbers. The coolness and self-possession of the hardy raftsmen was marked and admired by the hundreds who witnessed the unusual scene from the bridges and shores.*

The "barrel flood" of 1865 was so named because Oil City, in the midst of the petroleum boom, was flooded to the hills on March 17. Oil Creek swept its valley clean: thousands of barrels, oil derricks and drill rigs, the McClintock and Oil City bridges, all went down the Allegheny. Meadville and Franklin on French Creek were inundated; all towns along the Allegheny suffered; and the Freeport canal aqueduct was lost. Roberts chuckled when he read the last: General "Harry" White had gotten him in fiscal hot water in 1878 by hiring men to remove the Freeport aqueduct piers after all funds for the Allegheny project had been expended.

Not long after the "barrel flood," Roberts had joined his father on the Ohio River project. His first professional experience with a flood had come in 1867 when General Henry L. Abbot ordered the Pittsburgh office to investigate the flood of March 1867 that set new records on the lower Ohio. General Abbot had been partner with General Andrew A. Humphreys in a ten-year study of Mississippi River floods, which they published in 1861 as the *Report upon the Physics and Hydraulics of the Mississippi River*. When Humphreys became Chief of Engineers in 1866, he established a special flood study section under General Abbot to continue study of floods.

Two major floods, one in February and the other in March, beset Pittsburgh in 1867. Neither set records, but with flow contributed by the Kentucky, Green, Wabash, Cumberland, and Tennessee rivers, the two floods had more or less merged downstream of Pittsburgh into one long flood of record duration at record stages below Louisville.

"The account of the flood will fill our office with a perfect flood of letters," Roberts recalled commenting when he dropped a bundle of questionnaires to friends along the Ohio and its tributaries into the mail. As expected, reports of precipitation patterns, river stages, and flood damages poured into the

Butcher's Run Flood, July 26, 1874
Allegheny City (now North Side, Pittsburgh)
Carnegie Library of Pittsburgh

Pittsburgh office throughout 1867, and in late winter, after summer inspection work had ended, he had labored hours in the Pittsburgh office tabulating flood data. In December, he had mailed to General Abbot the first official Army Engineer report on a flood in the Ohio River basin.

Milnor Roberts had considered the effects Charles Ellet's reservoirs might have had on the 1867 flood crests and had concluded many more reservoirs would be needed to control floods than Ellet had thought. "Flood control by reservoirs," said Milnor Roberts, "within the practicable limits of cost is impossible." Colonel William Merrill had agreed: costs would be nearly prohibitive, building and operating a reservoir system to control Ohio and Mississippi floods would require a technology not then in existence, and reservoirs could not control local floods, such as the 1874 "Butchers Run" disaster at Pittsburgh.

The "Butchers Run" flood of Sunday, July 26, 1874, was never forgotten by those who saw it. Rain throughout that Sunday had soaked the ground and converted normally insignificant streams into torrents. Drizzle dwindled toward dark, but at nine that evening, after people had retired for the night, a violent cloudburst came from Chartiers valley across the Ohio and over the north side of Pittsburgh. Even the official report on the storm reflected the terror of that evening. It rained, the report said, "as if the very flood gates of heaven had been opened; the lightning flashed amidst deafening peals of thunder, imparting to the scene a dismal and terrific grandeur."

McLaughlins Run and Painters Run in Chartiers valley, Butchers Run and Spring Garden Creek in Allegheny City (North Side), and Woods Run in Pittsburgh became raging rivers, tumbling buildings from their foundations, crushing bridges, and sweeping families from their beds. All were lost together.

General James Moorhead, "Old Slackwater," organized work parties to dig the 150 dead from the debris and clear the streets, and directed relief work for the survivors. Congress had not then involved the Corps of Engineers in disaster recovery work, except as individual humanitarian efforts, but Colonel Merrill sent the dredges *Ohio* and *Oswego* to clear debris from the Allegheny at the mouths of the flooded creeks. They removed 19,201 cubic yards of wreckage and deposits from the creek mouths.

Memories flooded back to Thomas Roberts as he scanned through his notes on the July 1888 flood on the Monongahela. He had been chief engineer of the navigation company at the time and recalled the wreckage of his lock houses intermingled with broken coal barges spinning downriver on the flood crest. The more recent floods of 1897 and 1907 had been bad, but to his mind the July 1888 flood had never been surpassed on the Monongahela. That was the flood that convinced the Coal Exchange that Davis Island Dam was not "Merrill's folly." He paused to read a reporter's account of that flood:

> *The waters that have been sweeping the valley of the Monongahela and the valleys of its tributaries leave in their track scenes of desolation and ruin that have never had their counterpart in the same localities. From Pittsburgh to the mountain fastnesses of Randolph county, towns have been ravaged, manufactories have been inundated, boats have been sunk, houses and lumber have been floated off, fields with their wheat in shock and growing crops have been devastated, families driven to the hills for shelter, and in many instances the accumulation of years of toil and self-denial have been lost in an hour. The losses entailed by the flood will not fall short of*

three million dollars, a large proportion of which falls with crushing effect upon the people of the thriving counties of Monongahela, [sic], Marion, Taylor, Harrison, Lewis, Barbour, Upshur, and Randolph in West Virginia.

The Anti-Forestry Corps Roberts at last finished his research. Records indicated that neither flood frequency nor flood heights measured on the Pittsburgh gage were increasing. In fact, the greatest flood of record at Pittsburgh before 1908 had occurred in 1763, long before John DuBois and other loggers had cleared the Appalachian forests at the headwaters of the Allegheny and the Monongahela.

The other side of General Chittenden's question was whether deforestation had caused low river flows of longer duration. Roberts had learned that low flows had practically suspended navigation down the Ohio even before the Revolution: British army units and George Morgan's "navy" had found it did not pay to try navigating the Ohio after June in any year. Roberts could also produce vivid accounts of problems with low water navigation written by General Anthony Wayne in 1793, by Major Andrew Ellicott in 1796, by Captain Meriwether Lewis in 1803, and by a state survey commission in 1819. He had no accurate discharge records for those years, but records for 1838 were abundant.

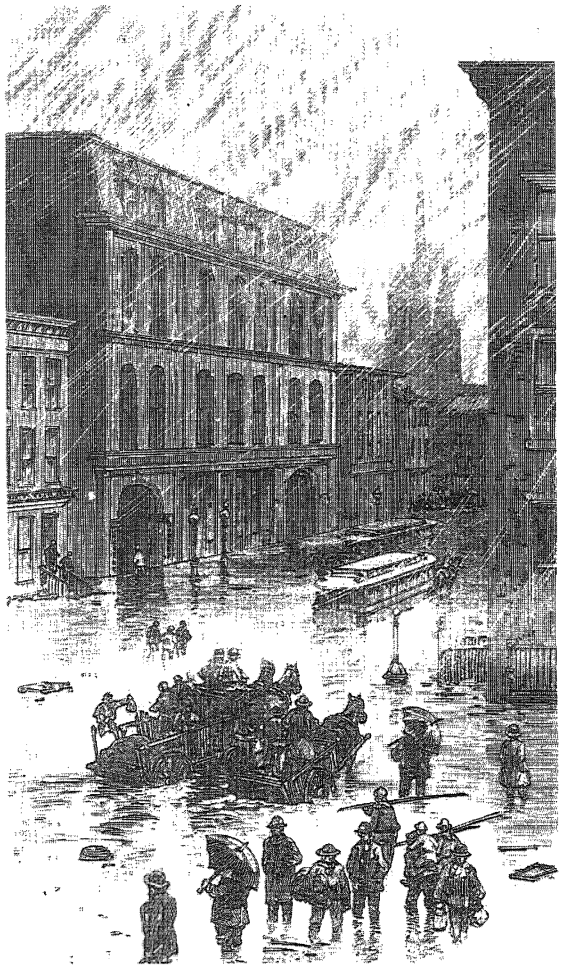
Captain John Sanders had gaged the discharge of the Ohio just below Pittsburgh in 1838 at 1400 cubic feet per second (cfs). Milnor Roberts had gaged the flow of the Monongahela at Brownsville on September 19 that year at 75 cfs. "My father," Roberts told Chittenden, "said every tributary of the Monongahela between Brownsville and McKeesport was dry at its mouth in 1838; precisely what I observed myself in 1895. The country along the river was still well forested in 1838; by 1895 perhaps over 70% was cleared and under cultivation."

"The forest men have always the best theories at their disposal and can indulge in the most patriotic and glowing figures of speech, which almost everyone will concede ought to be true--even when recorded facts are arrayed against them," said Roberts in his summation. "I am ready at once to grant that with the deforesting of the country, saw mills on minor tributaries cannot be operated so many months of the year as before. I will go farther and state it as my belief that ordinary summer freshets, even on major rivers, may be higher and shorter lived than before the country was deforested, but the records do not show that the low water discharge of the Ohio is becoming less or that the great floods are more frequent and discharging more water per unit of time than formerly."

Using the report supplied by Roberts, General Chittenden published a paper debunking the idea that deforestation caused greater floods and lesser drought flows on larger streams. Roberts also published his findings in the *Proceedings* of the Engineers' Society of Western Pennsylvania and various engineering journals. The thrust of their argument was that, while creation of national forests might be desirable for many reasons, planting trees and preserving timber stands did not hold water.

Forest conservationists of the early 20th century pictured themselves to the public as crusaders engaged in a moral struggle against "evil" corporations and bureaucracies, and they made Chittenden and Roberts and other engineers persuaded by historical evidence appear as ogres who opposed the goals of forestry. That was never true. The Army Engineers merely said that forest conservation would not be a very effective method of achieving flood control or benefiting navigation. Conservationists, nevertheless, successfully pinned the "anti-forestry" label on the Corps.

Forestry enthusiasts won their battle against "evil" opposition on March 1, 1911, when Congress enacted the Weeks Appalachian Forest Act, which approved federal-state cooperation in acquiring lands at the headwaters of the Allegheny and the Monongahela and in other areas as forest preserves. Wording of the act showed that conservationists had



Valentine's Day Flood of 1884
Sixth Street and Penn Avenue, Pittsburgh
Carnegie Library of Pittsburgh

won their struggle with ogre Thomas Roberts: the stated purpose of the act was the acquisition of forest lands "for the purpose of conserving the navigability of rivers." By the time the St. Patrick's Day flood inundated the Pittsburgh District in 1936, the Federal Government owned some 1.25 million acres of forest lands in the Allegheny and Monongahela basins.


HARPER'S WEEKLY
JOURNAL OF CIVILIZATION
NEW YORK SATURDAY MARCH 1, 1884

The issue that featured the flood problem
Carnegie Library of Pittsburgh

The Valentine's Day Flood

The farmers lost largely of their horses and cattle, nearly all their grain and feed, and all their fencing. The merchants and manufacturers lost their stocks, and the mechanics were thrown out of employment. Coal mines and salt works were flooded, and everything was desolate indeed. It will be weeks and months before business can be resumed and help will be needed long after the waters have subsided.

So one reporter described damages done in the Ohio basin by the Valentine's Day flood of 1884, so named because it climbed to a new record stage on that day at Cincinnati. It peaked at Pittsburgh on February 6 at 36.3 feet, not surpassing stages reached in 1762, 1763, or 1832, but certainly high enough. People in the Youghiogheny valley perhaps suffered most. In West Newton, some people lashed their homes to trees and fled to safety; others were rescued by boat from the second stories of buildings. At least 10,000 Pittsburghers were left homeless and 15,000 out of work. Wheeling was a "sickening spectacle," with 5,000 refugees and no communications or utility services. Conditions were even more serious farther down the Ohio, where private and municipal levees had been overtopped.

VALENTINE'S DAY
FLOOD OF 1884

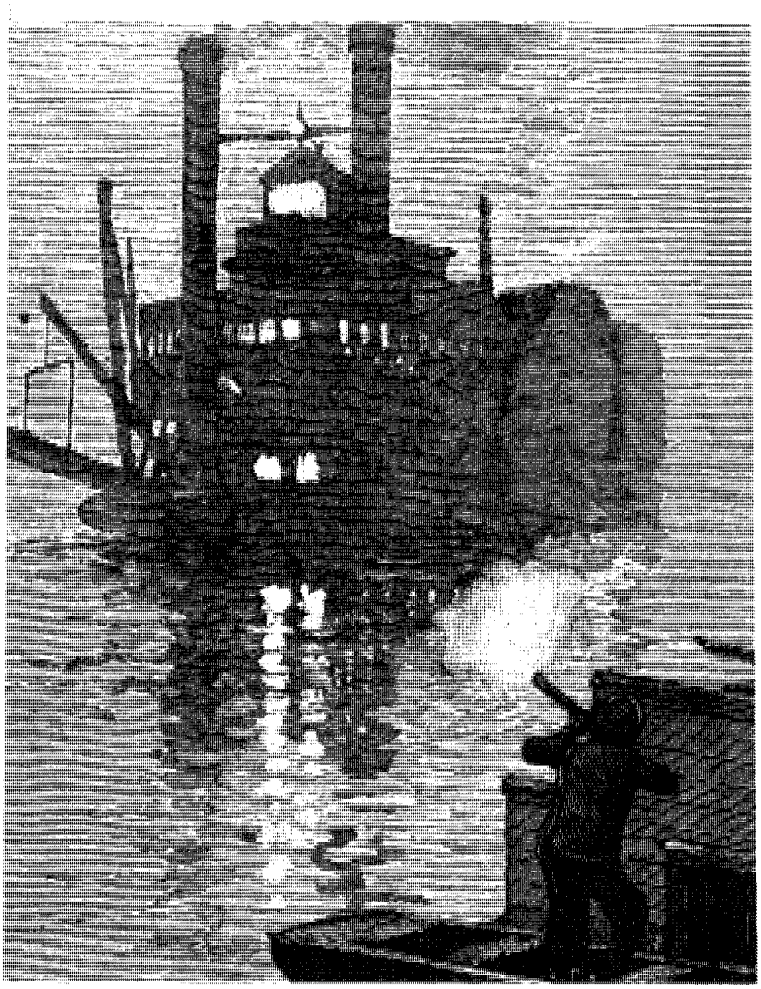
Carnegie Library of Pittsburgh

Relief boat at Newport, Kentucky
(across the Ohio from Cincinnati)

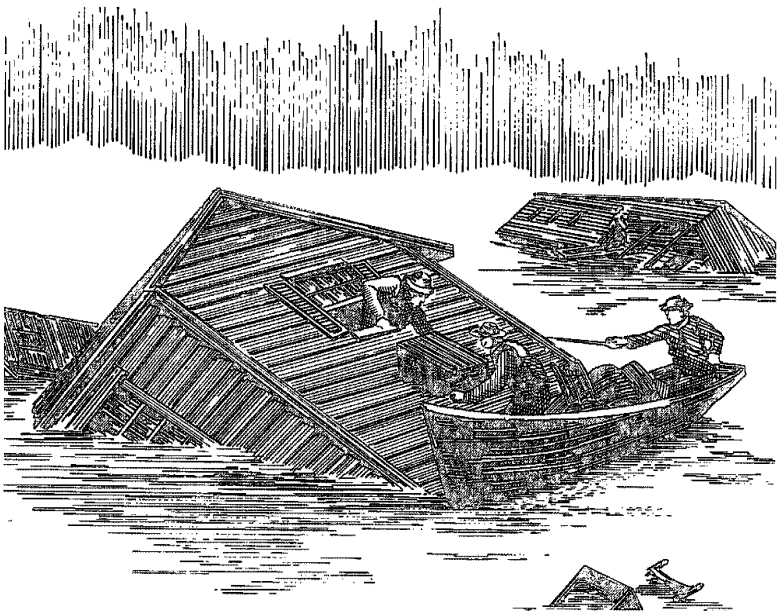
Mayor Robert Lyon of Pittsburgh on February 6 organized a disaster committee, which sent the steamers *Iron City* and *Resolute,* freighted with emergency supplies purchased with public donations, downriver for the relief of stricken communities along the Ohio. The American Red Cross, for the first time, joined in a flood relief mission on the Ohio. Clara Barton herself traveled to the Ohio and chartered the steamers *Josh V. Throop* and *Mattie Bell* for the job.

Congress had funded purchase of emergency supplies for disaster victims from time to time since 1811. It first provided assistance for victims of an Ohio River flood in 1884. Army Quartermaster officers purchased food, blankets, and other items and distributed the supplies aboard Army Engineer boats and the chartered steamers *Katie Stockdale* and *Granite State.*

The Valentine's Day flood also resulted in some new interest in the Ellet reservoir scheme for flood control. New York engineer Samuel McElroy declared it was unprofessional for engineers not to respond when the public demanded remedies for flood problems. During surveys of the upper Allegheny River basin, he had seen potential reservoir sites on the Mahoning, Redbank, Tionesta, Kinzua, Potato, and Conewango creeks. He admitted that costs of the Ellet reservoir plans might be high, but asked if the millions of dollars worth of property



Don't come near, you'll make waves!



Salvage? or looting?

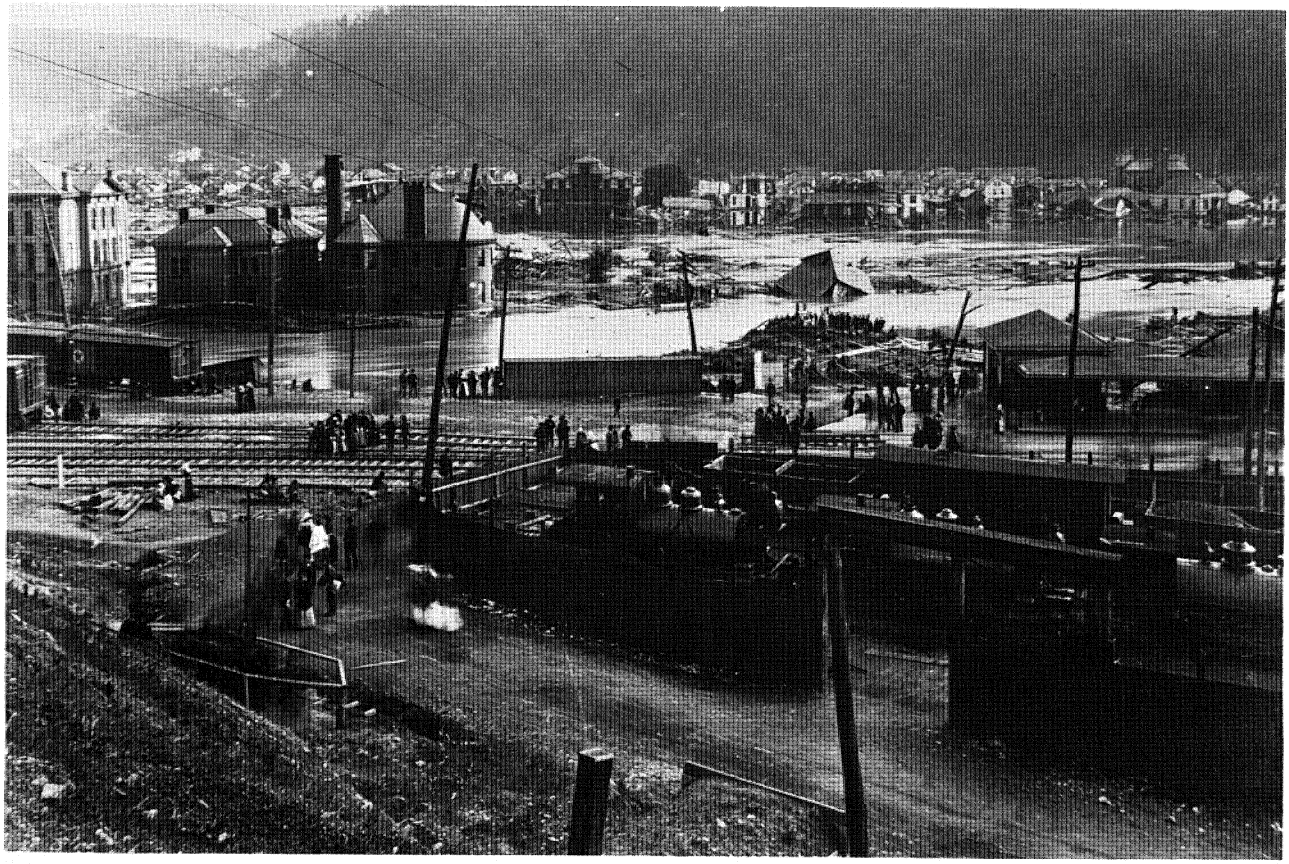
saved from floods by such a system might not make the investment worthwhile.

Congress was not prepared in 1884 to undertake a massive flood control program. Many congressmen doubted that such a program would be legal under the Constitution. Public clamor for some flood protective measures was so intense, however, that in 1884 Congress took its first hesitant step down the long road toward control of floods in the Ohio River basin.

Since the constitutionality of federal navigation projects was no longer seriously questioned in 1884, Congress directed Colonel William Merrill to improve Ohio River navigation by raising and strengthening levees at Shawneetown, Illinois, and at Lawrenceburg and Jeffersonville, Indiana. "Padre" Merrill protested that, though he personally thought flood protection a laudable goal, building levees would not benefit navigation at all, except perhaps to keep boats in the channel and out of towns during high water. In each of his yearly reports, Merrill objected to the hypocrisy of building levees for flood protection on the pretext of improving navigation, but Congress ignored him.

A similar case occurred at Zanesville on the Muskingum River in central Ohio. A stone masonry wall built by Ohio to protect Zanesville from floods was overtopped and breached, and Senator Marcus Hanna of Cleveland slipped an appropriation through Congress for restoration of the wall to improve the navigation of Cleveland harbor! The Corps of Engineers protested that restoring the wall would not improve navigation and that Zanesville was not part of Cleveland harbor, not even in the same watershed. The complaint was fruitless. The influential Senator Hanna, as usual, got what he wanted. At Zanesville, Wheeling Engineer District completed the first concrete floodwall in the Ohio River basin, perhaps the first federal project of its sort in the United States.

To protect his greatest engineering achievement, the Davis Island Dam, Colonel Merrill built the first federal levee in the Pittsburgh District after the 1884 flood. That flood struck the Davis Island project, then still under construction, on February 6, completely submerging Davis Island, clearing it of workshops and barracks where construction workers lived, and taking out the cofferdam around the dam weir foundation. Located between the movable wicket section and the fixed cribwork in the back channel, Davis Island actually formed part of the dam. To prevent further erosion of the island and damage to the project, Merrill directed William Martin to build an earthen levee, planted with locust and willow trees for stabilization, across the head of Davis Island and down to the dam abutments. The job was done in 1885 and the island behind the levee was later filled to raise its surface above ordinary flood levels.



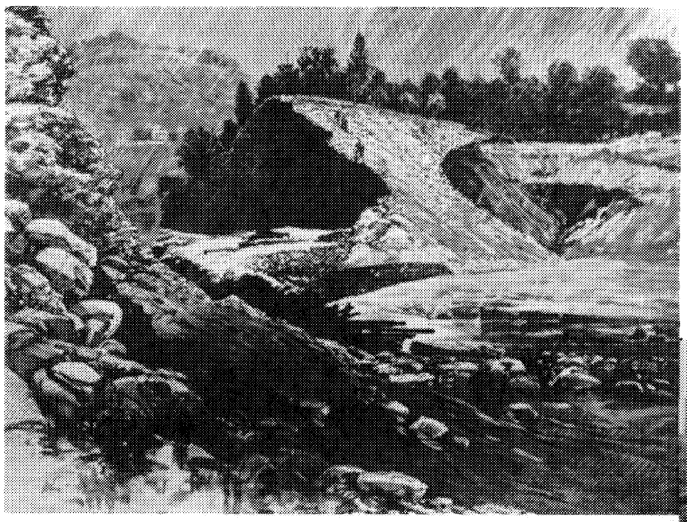
"Johnstown...the city was practically destroyed." Irving London, Johnstown, Pa.

The Johnstown Disaster President and Mrs. Benjamin Harrison spent Sunday, June 2, 1889, with the Secretary of War in a telegraph office reading the poignant and shocking news from Johnstown, where an old earthen dam had failed on the last day of May and unleashed a flood that killed 2,209 people. The South Fork Dam, built on a tributary of the Conemaugh in 1852 to supply water to the Pennsylvania Canal and purchased in 1879 by a fishing club, was filled in late May by a rainstorm that dropped up to eight inches of water over the Alleghenies. When the dam failed, it released a seething flood wave atop already swollen streams that smashed its way down the Conemaugh valley, ripping up trees, wiping out villages, and engulfing entire trains. A mass of debris was rolling on the flood crest when it hit Johnstown at the juncture of Stony Creek and Little Conemaugh River. The city was practically destroyed by the most memorable flood in American history.

The President and Mrs. Harrison were so moved by events at Johnstown that they presided at a public meeting in Washington to collect donations for the victims, and the President asked Governor James Beaver of Pennsylvania if the Federal Government could help. The Governor asked for temporary bridging because all bridges at Johnstown were gone except a stone bridge just below the city that was impassable because of debris lodged against it. Without bridges, people at Johnstown were unable to learn the fate of relatives living across the streams and emergency work was gravely hampered. The President ordered the Army Engineers to attend to it immediately.

Superintendent John G. Parke had a 225-foot ponton bridge at West Point, where it was used for cadet training. General Parke had a personal interest in developments at Johnstown: his nephew John G. Parke, an engineering student at the University of Pennsylvania, had taken a summer job at South Fork Dam. Young Parke had made the near-legendary horseback ride down the valley to warn people the dam was failing, but, because he was a stranger, people had ignored the warning. General Parke had the West Point pontons aboard a train and on the way to Johnstown a few hours after he received the President's orders. Lieutenant John Biddle and thirty men from Company E, Corps of Engineers Battalion, had charge of the bridge.

Colonel William R. King had ponton and trestle bridge equipage stored at the Engineer School at Willett's Point, New York. It was surplus material that King had used to bridge the James River at Richmond in 1865. He loaded "all that could be trusted," 188 feet of ponton and 140 feet of trestle bridge, on a train in charge of Captain Eric Bergland, Lieutenants Mason M. Patrick and Thomas H. Rees, and sixty-nine enlisted men specially chosen for construction proficiency.



The breach through South Fork Dam
Carnegie Library of Pittsburgh

The pontoon bridge across Stony Creek
Irving London, Johnstown, Pa.

Captain Clinton B. Sears was given command of the mission and sent to Johnstown ahead of the bridges. He arrived June 5, conferred with Pennsylvania Adjutant General Daniel H. Hastings, and arranged for B. & O. Railroad engineers to bridge the Little Conemaugh while the Corps bridged Stony Creek. He selected sites for the ponton bridges across Stony Creek at Franklin and Poplar streets, where bridges had stood before the flood, built unloading ramps next to the rail track, and cut a road from the ramps to the creek bank.

Delayed for three days by congestion on the tracks that had not been broken by the flood, the Engineers and their pontons finally rolled into Johnstown on the night of June 7. They worked throughout that night moving the bridge equipage from the trains to the creek bank. Already exhausted by three nights of only intermittent sleep aboard the trains and soaked by continuing rain because boots and ponchos had been left behind in their haste to get to Johnstown, the men were bleary eyed and frazzled at sunrise on June 8, but the people who had survived the disaster were much cheered by the sight of the blue uniforms of Engineers, with the silver castles flashing on their kepis. Despite discomforts, the men worked with little complaint, save one old sergeant who had forgotten his plug and was distressed that every tobacco store in the vicinity had been destroyed.

Rains made the banks soft and slippery, Stony Creek was still running bankfull with swift current, and floating and submerged debris made the job somewhat hazardous, but the men were experienced professionals who had laid bridges under enemy fire. One by one, they launched the pontons on Stony Creek, anchored them in place across the stream, and laid down the timber stringers and chess plank decking. By 1:30 that afternoon, they had a 200-foot wagon bridge open to traffic, and at 5:00 they opened the second 320-foot bridge. Both handled a heavy and constant traffic.

Because coordinating the work of state, local, and volunteer workers presented problems, Captain Sears of the Corps was asked to take charge of all debris clearance and disaster recovery work. He refused, for his orders were to build the bridges; nothing else. He rode over the area, however, and devised an operations plan dividing the area into five sectors and assigning civil engineers, contractors, and volunteer workers to each sector. State Adjutant General Hastings adopted that plan.

After bodies had been removed, demolition expert Arthur Kirk began clearing the steel-wire tangled mountain of debris lodged against the stone bridge below the city. The blasts rocked the valley, broke windows, cracked walls, and people complained that dynamite might destroy what the flood had

Pennsylvania Railroad bridge
Irving London, Johnstown, Pa.

missed. Captain Sears observed the blasting was not removing the debris, merely changing its location, and, remembering how powerful snagboats cleared the rivers, he recommended that dynamiting be curtailed and steam engines with hoisting derricks be used to separate the debris, in combination with application of the torch to burn the debris and end the stench and potential health hazard of decaying animal carcasses. That plan also was accepted.

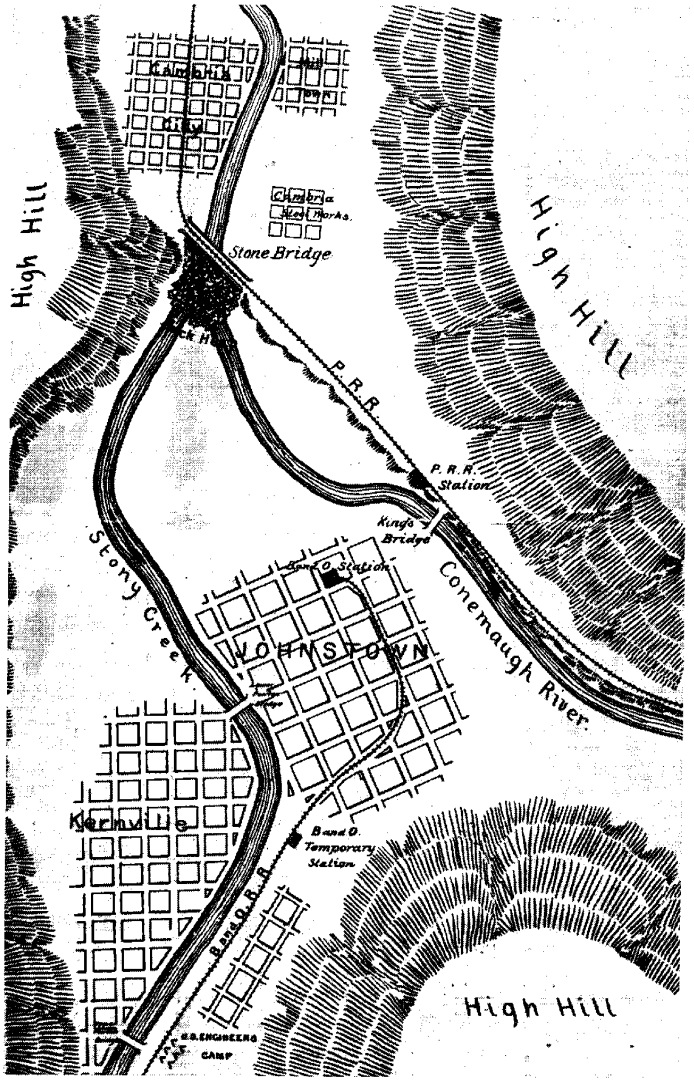
"As the work was now properly organized and well in hand," said Sears, "I could be of no further use, and asked for a recall, with General Hasting's assent." Sears and the West Point detachment left on June 15. Lieutenant Mason M. Patrick (who later became first chief of the Army Air Corps) and 53 men remained to replace the pontons with a temporary trestle bridge, finishing that job in July. The Chief of Engineers commended Sears and his men for their energetic work; President Harrison said he was pleased; and the Johnstown survivors presented a public resolution of thanks to the Corps.

A month after the flood, Governor Beaver told the Secretary of War that streams in the Johnstown vicinity were so filled with rock, sand, and debris that "great danger threatens the whole valley in case of an ordinary freshet." He asked assignment of the Army Engineers to a survey as a preliminary for a project to restore stream channels and increase their flood-carrying capacity.

Thomas Roberts visited Johnstown on his own, not as a Corps representative, and he agreed with the Governor. "What is needed," he said, "is a new permanent course of ample section, to be secured in part by dredging, and in part by water-tight embankments."

The Secretary of War and Chief of Engineers explained to Governor Beaver, however, that law authorized only navigation improvements and his request for flood protection planning at Johnstown could not be honored. "It is certainly a matter that will require the action of Congress before steps can be taken to bring about the desired end," they told the Governor, with apparent regret.

Johnstown 1889 — The Military Engineer



Major W. L. Sibert

The Fifty Million Dollar Flood Rain-soaked, weary, and worried, Major William Sibert, John Arras, and Thomas Roberts trudged back into the District office on the evening of January 15, 1907, doffed their slickers, poured themselves a cup of hot coffee, and sat down at a conference table to mull over their troubles. Early that afternoon they had learned that a flood was undermining the abutment of Allegheny River Dam 3.

Major Sibert had first called the Pennsylvania Railroad, whose track passed near Dam 3, and asked for quick delivery of stone and slag to dump onto the bank at the abutment. He and his staff then went to the dam near Springdale a few miles from the office. By the time they arrived the abutment was gone and the bank was crumbling rapidly into the breach. The dam itself had held, but the flood pouring around one end of the dam was cutting the sandy bank so fast that by late afternoon buildings were dropping into the river. Nine homes, outbuildings, and 5.3 acres of land eventually caved in, and the erosion threatened to take the Pennsylvania track and the Heidenkamp Mirror factory.

Sibert, Arras, Roberts, and the District staff debated the problem throughout the evening. If the dam held, and it seemed it would, the flood would continue rushing through the breached abutment, caving the bank, cutting the railroad, and eating up a million dollar factory. Upstream gage readings and precipitation reports indicated the flood would continue. How could flow through the breach be reduced and bank erosion slowed? After hours of discussion amongst the staff, Major Sibert made his decision: the dam would have to go. He telegraphed the Chief of Engineers to explain the situation and issued orders for blowing the dam.

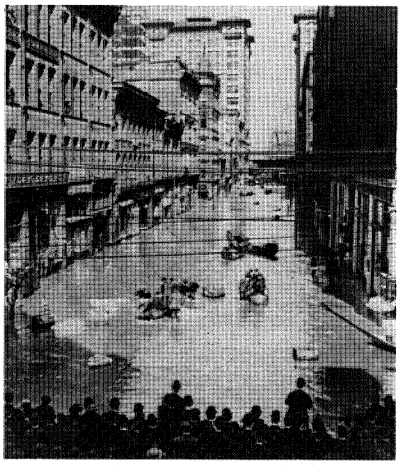
Blasting began the next morning. A few good men rowed a skiff loaded with dynamite onto the river, floated down on the flood, and dropped anchors above the dam. From those moorings, the men unreeled rope letting their skiff slip down to the dam, then placed 500-pound dynamite charges and detonated them one by one to blow out the dam crest. Dynamiting continued until a 560-foot section of the dam at midstream had been removed to a 12-foot depth.

"Now," Sibert advised the Chief of Engineers, "we have a fighting chance to save the Heidenkamp plant. We are placing stone on the bank as fast as we can unload it."

Placing stone had begun from a railroad siding 220 feet back from the caving bank on the morning dynamiting was begun. Caving was so swift that the track went into the river that afternoon. The 425 workers changed to a siding another 80 feet back, next to the main track, and resumed dumping stone. They dumped 23,479 tons of rock and slag before the bank stabilized. Sibert had saved the railroad and mirror factory, but at the cost of a dam.

The *New York Sun* printed an editorial on January 30 attacking slow progress on waterway projects. The editors commented, however, that "no charge of dilatoriness can be brought against the officer who a few weeks ago saved a million dollars worth of property by assuming the responsibility of blowing up $80,000 worth of dam." Sibert was perhaps the only Corps officer ever commended by the Chief of Engineers for destroying a government dam, but Sibert was first to admit that the real heroes were the men who rowed a boatload of dynamite down a flooded river.

March 15, 1907
Pittsburgh, north side
Carnegie Library of Pittsburgh



March 15, 1907, Sixth Street looking north from Liberty Avenue
Carnegie Library of Pittsburgh

Bank stabilization at Dam 3 had just been finished when the "Fifty Million Dollar" flood seethed down the rivers, inundating 52% of the Golden Triangle business district of Pittsburgh. When it crested at 38.5 feet on the Ides of March, steamboats tied up in Wood and Water streets, ice floated through the downtown area, and water closed a hundred office buildings, 33 miles of streets, 17 miles of railroad track, 9 miles of street railway. Businessmen lost $2 million because of damages to plants and work suspensions, their 100,000 employees lost $1.3 million in pay, and damages in the Pittsburgh vicinity alone reached $50 million.

When John Arras learned the March 1907 flood resulted from rains covering no more than half the watershed above Pittsburgh, he became alarmed, for he estimated that if heavy rains were to fall over most of the watershed, Pittsburgh might suffer a 45-foot flood. "Pittsburgh," he warned, "is in danger of a flood calamity similar to that which wrought such death and destruction at Johnstown."

Thomas Roberts came to a similar conclusion. "The possibilities of such a disaster are," he told the Engineers' Society of Western Pennsylvania, "extremely remote, as we have no record of great cloudburst storms covering the entire latitude embraced between the heads of the Allegheny and Monongahela rivers, a distance on a north and south line of 240 miles. There is, however, food for serious thought."

In the aftermath of the flood, many people conceived innovative solutions to flooding problems. A riverman suggested sending sternwheelers to tributary headwaters when floods seemed imminent, anchoring them with bows pointed downstream, and at the appropriate moment rolling the paddles at top speed to neatly back floods upstream? Others proposed excavation of huge gutters alongside rivers to carry superfluous water harmlessly to the ocean? An oilman recommended the "pit-hole" method: drilling 10-foot holes deep into rock strata and sending floods underground, either to join ground water or be converted into steam in the bowels of the earth? A young disciple of Thomas Edison proposed the "hot-wire" plan: simply suspending electric wires a few feet above normal river levels to be activated at floodtime to boil off the flood?

Professional engineers at Pittsburgh looked again at reservoirs for flood control. Thomas Roberts and John Arras, in 1907 and 1908, suggested Pittsburgh might be protected by many small reservoirs upstream from the city and levees around the Golden Triangle and low-lying areas. After study of General Chittenden's report on the upper Missouri basin, consulting engineer Morris Knowles suggested a multipurpose reservoir system to protect Pittsburgh from floods and to augment low-water flows, thereby benefiting navigation, reducing the effects of pollution, and increasing industrial water supply. He told the Engineers' Society of Western Pennsylvania that the "Fifty Million Dollar" flood "should be used to so agitate and prepare the public mind that funds for this purpose can be obtained. It is a worthy object in which this Society and other civic organizations can unite in a strong effort."

When a 33.7-foot flood occurred at Pittsburgh in February 1908, George M. Lehman, former assistant on Lake Erie to Ohio River canal surveys and Pittsburgh District employee, advised the Pittsburgh Chamber of Commerce it should begin immediate study of area flooding and flood damages. Five days later, on February 20, the Chamber appointed a committee to undertake the study: its chairman was industrialist Howard J. Heinz and members were General Albert J. Logan, A. J. Kelly, H. M. Brackenridge, Captain William B.

Rodgers, George M. Lehman, and Morris Knowles. Heinz, Lehman, and Pittsburgh District Engineer Henry C. Newcomer composed the engineering subcommittee, but Colonel Newcomer resigned in December after it became evident that the committee planned more than mere computation of flood damages.

The original committee became the Flood Commission of Pittsburgh, financed by donations from business and contributions from the city and county, and expanded its membership. Notable additions were newspaperman Wilmer M. Jacoby, irrigation expert George H. Maxwell, and engineers E. K. Morse, Emil Swensson, William G. Wilkins, George S. Davison, A. B. Shepherd, S. C. Long, Paul Didier, and Julian Kennedy. The Commission initiated full scale study of flood problems and remedial measures and employed Kenneth C. Grant as principal engineer. Grant traveled widely in Europe and learned that Germans had built reservoirs for flood control and low-flow augmentation in the Oder and Ruhr River basin and Russians had done the same in the Volga and Msta valleys. If European engineers could build multipurpose dams and reservoirs and make them work, surely Americans could do the same.

The Anti-Reservoir Corps At Ohio River Lock and Dam 13 dedication ceremonies in 1909, Wheeling District Engineer Frederick W. Altstaetter unleashed some of his pent-up resentment. He said:

> *The men who proposed and carried out the work so far done have been opposed at every point by contrary ideas. They have been accused of lack of knowledge, of lack of interest, of opposition to progress, of failure to appreciate the needs of the river--and, I might add, I feel a little sensitive on this subject, as I have been cited myself in a recent magazine as a horrible example of the petrified conservatism of the Corps of Engineers. From the beginning, the engineering features of the Ohio have been a source of discussion on the part of engineers and pseudo-engineers, projects and counter projects have been advocated and ignorance seems never to have discouraged anyone from launching a new theory of improvement.*

Changing views of the role of engineers in society and the purposes of waterway projects during the early 20th century impaled the Army Engineers on the horns of a dilemma. Progressives seemed to think engineers could solve the ills of society. "The engineering profession can contribute more than any other class of citizens, for the engineer is the true conservationist of society," said Morris Knowles, who thought engineers "better equipped, by training and habits of thought," than other citizens to determine public policy issues. Army Engineers had a less egotistical view of their functions, thinking of themselves as servants to the people, or at least to the representatives elected by the people. Before they undertook planning of any sort, they wanted approval from Congress; before they studied multiple purpose water resource projects, law required that they have authority and funding from Congress.

Captain Altstaetter was indeed a petrified conservative: he obeyed the law, which required the Engineers to review proposed projects only in the light of how they might benefit river navigation. The Corps reported many times that multipurpose reservoirs would be desirable, but the benefits they would provide for river navigation alone would be insufficient to defray their costs of construction.

"The Engineer Corps of the Army has been put in a strait-jacket by Congress itself," lamented Francis Newlands, the Nevada Senator who led a campaign in Congress for multipurpose reservoir construction. "In one of my speeches," he said, "I made numerous quotations from river and harbor bills absolutely forbidding the Engineer Corps to make any suggestions outside of the matter particularly submitted to them."

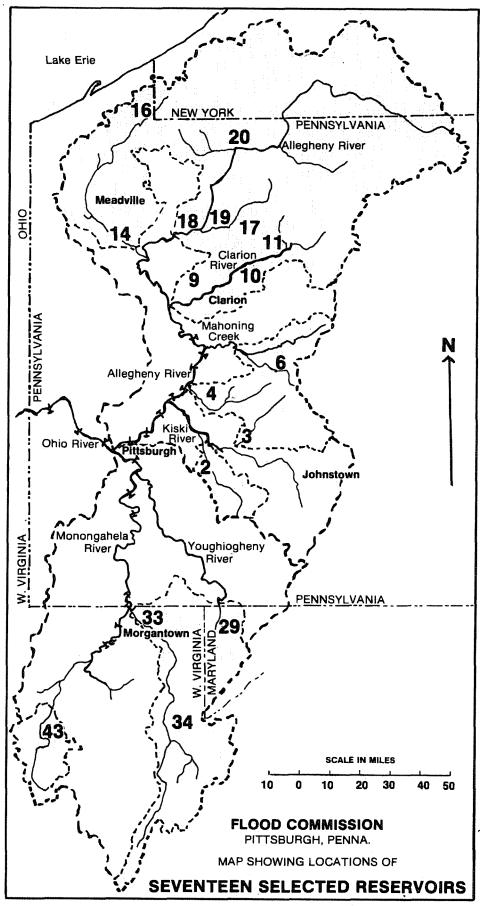
Benefits to navigation alone, the Corps contended, would never justify construction of reservoirs for

18	Allegheny River, Dam No. 1
19	Allegheny River, Dam No. 2
20	Allegheny River, Dam No. 3
2	Loyalhanna Lake Dam
3	Blacklick Creek Dam
4	Crooked Creek Dam
6	Mahoning Creek Dam, No. 2
9	Clarion River, Dam No. 1
10	Clarion River, Dam No. 3
11	Clarion River, Dam No. 4
14	French Creek Dam
16	North Branch Dam
17	Tionesta Lake Dam
29	Youghiogheny River, Dam No. 2
33	Cheat River, Dam No. 1
34	Cheat River, Dam No. 2
43	West Fork Dam

flood control, hydroelectric power development, water quality and navigation improvement; all project benefits would have to be considered before the benefit-cost ratio would be favorable. Because of that honesty, the Engineers were accused of being opposed to reservoirs and the officers were written off as "petrified conservatives." Upset by personal attacks upon him and his District, Captain Altstaetter said:

> *In its revised form, this project has been made a more attractive pill for the country to swallow by saying that great water power could be developed at the various reservoir sites, that floods would be reduced, and that the tributaries would be improved, while on the tail of the project we find tied a proviso that forests would have to be planted in the watersheds above the reservoirs to keep debris from washing into them and filling them up. In this scheme large districts are flooded, people are driven from their homes, towns and smiling valleys are ruthlessly turned into reservoir sites; highways and railways are covered with the penned-up waters, farms are turned into forests, and we are calmly told that all these things are to be done in the interests of navigation. Truly, navigation is asked to carry a heavy burden.*

In 1907, Marshall O. Leighton, Chief Hydrographer of the U. S. Geological Survey and engineer for the Inland Waterways Commission, debated the reservoir question with Corps officers in various engineering journals. Each time he broached the subject of reservoirs, someone asked him, "Have you read Milnor Roberts?" He contended things had changed since Roberts so effectively quashed Ellet's plans. Roberts had complained high dams would destroy flatboat and raft traffic; Leighton said that traffic had virtually ended. Roberts argued that construction and land acquisition costs would be prohibitive; Leighton said costs would be less than benefits. Roberts contended management of a reservoir system would be too complex; Leighton thought the telegraph and telephone could overcome that problem. Roberts



warned that high dams could fail; Leighton argued that engineering advances had obviated that objection and said he would not worry at all if the dams were built by the Army Engineers. Leighton's ideas were welcomed at Pittsburgh, and he became consulting engineer to the Pittsburgh Flood Commission.

General William H. Bixby, the Central Division Engineer who served with Leighton on the Inland Waterways Commission, said the reservoir issue in 1907 was no longer one of possibility but one of practicability. Bixby pointed out that federal law tied all waterway projects to navigation alone. "The objection to the storage reservoir method," he said, "has not been due to the lack of suggestions by the U. S. Engineer Corps as much as to the fact that Congress, representing the general public, has been reluctant to enter upon an enterprise of such magnitude in cost and such great extension of Federal powers as would result." He thought multipurpose reservoir projects had enormous advantages and "should be looked forward to as something exceedingly desirable as soon as law and general public sentiment are ready for the same."

Editors of *Engineering News*, which carried the Leighton-Bixby debate, declared that further public argument would be fruitless, that the questions at issue could only be settled by surveys in the field. "If the reservoir system of river control can be made practicable anywhere in the Ohio River basin, it is on the rivers which meet at Pittsburgh,"

the editors concluded. "Here, then, is the place to make the first test."

Pittsburgh Flood Commission Report At a dinner at the Schenley Hotel on April 16, 1912, the Flood Commission of Pittsburgh released its monumental report on its four-year study. Speakers at the dinner were Senator Newlands and Marshall O. Leighton. First of its kind, the voluminous Commission report predicted Pittsburgh someday would experience a 40-foot flood and recommended construction of levees and reservoirs to protect the city. The Commission had found seventeen likely sites for reservoirs in the Allegheny and Monongahela basins. It estimated project costs at near $24 million and benefits at about $96 million, nearly a 4 to 1 benefit/cost ratio, to be achieved through flood damage reductions, water power development, and low flow augmentation to improve navigation and water quality.

In the year it issued its report, the Flood Commission received three major setbacks. On November 5, 1912, Pittsburghers rejected a bond issue that would have funded construction of a levee-floodwall to protect low-lying areas of the city. In December, a board of engineer officers appointed to review the Commission's report and determine how the proposed reservoirs would benefit navigation made an unfavorable report. "A system of impounding reservoirs at the headwaters of the Allegheny, Monongahela, and Ohio Rivers and their tributaries," the board reported, "while probably feasible, would be of such small benefit to navigation that the Federal Government would not be justified in cooperating with local interests for their construction."

The third setback came from farmers, lumbermen, railroad owners, and people living near the proposed reservoir sites who vigorously opposed the Flood Commission's plans to inundate their homes and businesses to save Pittsburgh. The Flood Commission report was "dam nonsense," abhorrent to the people of the upper Allegheny basin, said editors of the *Oil City Derrick*. Attorney T. F. Ritchey of Tionesta complained the proposed reservoirs would wipe out navigation, cripple the lumber industry, destroy railroads and businesses, and so divide Forest County that it could no longer exist as a county. "Five to ten million dollars damages," he estimated, "and it still would not, in our opinion, prevent floods."

Those setbacks did not deter the Flood Commission, nor those who supported the reservoir concept. "It is greatly to be desired," wrote General Hiram Chittenden, "that the scheme be fully tried out. Not only would it give Pittsburgh a large measure of relief, but the effect of the example, in settling many disputed theories, would be of great value to the engineering profession and the country at large."

General Chittenden had retired from the Corps of Engineers in 1910, because President Theodore Roosevelt, with his passion for physical fitness, had ordered every officer in the Army to ride a horse fifty miles. Chittenden had tried and failed; the experience crippled him for life. He continued his engineering career from a wheelchair, however, cooperating with Arthur E. Morgan in planning flood control dams in the Miami River basin of Ohio. In one of his last papers before his death in 1917, General Chittenden warned engineers about the obstacles in the path of flood control and indeed any public project:

> *The greatest obstacles that the promoters of public work have to overcome are not those of nature, but of men. Nature is sometimes a stubborn adversary, but she always acts in the open, without subterfuge or indirection. But human ignorance, prejudice and self-interest are handicaps of a different character. Ignorance is least important, because it may yield to instruction. Prejudice--that is, prejudgment of a case and then sticking to it regardless of facts--is immeasurably worse. But self-interest is the most insuperable obstacle of all. Public measures are judged by their effect on the private pocket-book, and the rarest phenomenon in the world is a willingness to subordinate personal interest to the public welfare.*