The Chesapeake & Ohio Canal —

Marvelous Engineering Failure

by **Dr. Arthur D. Delagrange,** *Massachusetts Beta '62*

Race to the West

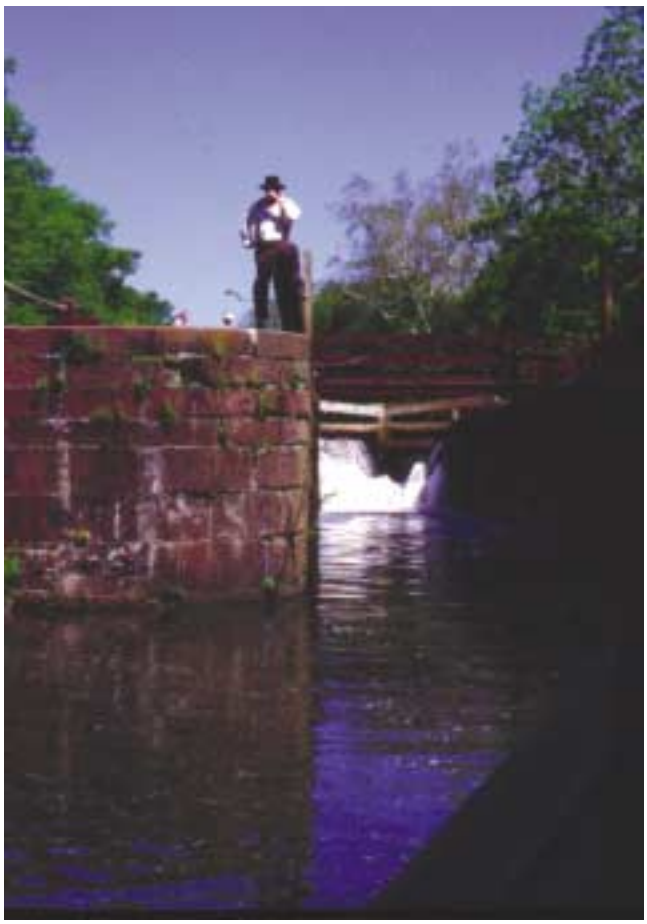
In the early 1800s roads from the eastern seaboard to the west were miserable — in good weather. People could make their way westward, and the population in the Ohio valley was growing rapidly. But the cost of shipping manufactured items from the seaboard towns to them made the goods unaffordable. Likewise, the wealth of raw materials in the mountains and beyond was well known on the coast, but seemed beyond reach. These bulk products likely as not would be shipped all the way down the Mississippi to the Gulf of Mexico, from where they could easily go to Europe instead of the east coast.

Two alternate forms of transportation began construction on the same day (July 4, 1828) to cross the Allegheny Mountains from eastern ports and reach the Ohio River valley for this lucrative trade. Neither knew at the outset exactly how it was going to overcome the obstacles. One eventually made it; the other never did. The railroad, starting with the Baltimore & Ohio (B&O), succeeded beyond anyone's wildest dreams, connecting the east coast not only to the Ohio/Mississippi valley but eventually the west coast, thus opening up the entire interior of the country. This is the story of the loser.

A New Canal

The Chesapeake & Ohio Canal (C&O) headed west from the sea-level port of Georgetown (named for George Washington, now part of DC) along the Maryland bank of the Potomac River. It was a fair bet for success, replacing an operating but inferior canal on the Virginia side which was really just the river itself, unusable in periods of low water, with locks built around the worst rapids. The new canal would be primarily a ditch beside the river, with a series of eight dams on the river to supply adequate water, although the river pool itself was used where the gorge was too narrow to allow any construction. George Washington, a surveyor himself, had been president of the first canal company and championed the cause of a new one. He owned considerable lands to the west, which might have intensified his interest.

The first shovelful of dirt was turned by President John Quincy Adams, who in his speech practically tied the future of the country to the canal. Technical planning was less impressive. A chief engineer had been hired less than two weeks before: Benjamin Wright, who had been the chief engineer on the Erie Canal. He had been highly successful there, but had no formal training, and the terrain would be more difficult this time.



A lock — downstream gate open for boat to enter; upstream gate closed but leaking badly (milepost 14).

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Ruins of dam #3, damaged in the flood of 1924 that closed the canal (milepost 64).

The ditch was lined with clay to reduce leakage. Side creeks were not used. In fact, these were routed under the canal, necessitating stone aqueducts to separate the two channels. The locks had mammoth wooden gates, angled upstream so the 16-ton force of the water held them shut. They were operated by hand. A smaller gate had to be opened to fill or drain the lock to equalize the water level on either side of the big gate before it could be opened. It took 10 minutes for a boat to pass through a lock. The dams originally were timber frames filled with rocks and rubble, but leaked badly and later were replaced with concrete. The locks were made with huge stones cut precisely and laid without mortar, although farther up the river where good stone was scarce timber-sheathed walls were used, these being much more susceptible to damage from the barges. An extensive system of gates and channels was used to maintain the proper water level and slight downstream current in the ditch, or isolate the canal entirely when the river flooded. This was little help when the river level rose above that of the canal.

Construction pushed westward slowly, often awaiting skilled workers, necessary materials, or simply more capital. Sufficient skilled labor was not available locally, so groups were imported from the North or even Europe, leading to ethnic clashes. Costs were enormous, and revenue, of course, wouldn't grow until the canal did. The first obstacle was Great Falls, at the geological fault line separating the tidewater from the piedmont. The falls are really overgrown rapids, but the workers had to cut through solid rock to get around them. Excavation was with hand tools and blasting powder, with horse-drawn sleds to move the rock. Seneca, above the falls, was reached in 1831. However, similar problems were often encountered at the ridges farther west. Over the eons, the river carved its way through, but often left little or no room for anything else.

Three eras of transportation: the aqueduct is from the canal; the rectangular pillars are from the railroad (now also a hike/bike path); the round pillar is the present highway bridge (milepost 116).

Worse yet, at Point of Rocks the canal and the railroad collided. From here on the two fought over right-of-way, often spending months or years in court. Also, the canal had to pass through a large tract of land owned by Charles Carroll, who had turned the first shovelful of dirt for the railroad; he was less than cooperative. Other landowners demanded high prices, knowing the canal had little leeway as to where to go.

Paw Paw tunnel — looking out of the tunnel into the cut (milepost 155).

The canal's most impressive engineering accomplishment was also its death knell: In order to short-cut a six-mile loop of bad bends in the river at Paw Paw, WV, a tunnel was bored through a ridge. The tunnel was more than 3,000 feet long but still required a deep cut at one end, totalling over a mile of rock removal. The rock was hard enough to require blasting but not solid enough to be stable; cave-ins were frequent. Two twin shafts (twin to provide air circulation) were sunk from above so work progressed from four inside faces in addition to the two outside. Even so, with labor troubles and epidemics and cash shortages, the two-year construction plan stretched to 14, and the cost increased by a factor of almost 20. This for a tunnel that was not wide enough for barges to pass. Eastbound and westbound operators often argued for hours, sometimes days, over who was to go first. Construction continued the last 30 miles. A lock and a dam were eliminated to reduce cost, which later caused insufficient water. The canal finally reached Cumberland in 1850, but the railroad was already there. The canal stopped at the foot of the Alleghenies, while the railroad pressed on.

The canal covered a distance of 185 miles, climbing more than 600 feet in elevation through 74 locks past seven dams.

Replica canal boat on restored section of canal, modified to carry tourists. Great Falls Tavern is in the background. (milepost 14).

The round trip took two weeks (today, six hours by car). The canal boats were just slightly smaller than the locks themselves, which were 100 feet long and 15 feet wide, and of 4.5 feet of draft (the canal was specified as six feet deep, but tended to silt in). They could carry more than 100 tons in addition to having living quarters for the crew, typically the owner and his entire family, and stabling for alternating teams of animals. In the peak years there were more than 500 of these boats, hauling nearly a million tons of coal alone. (This becomes even more impressive considering that during cold weather, the peak demand for coal, the canal was likely to be out of service because of ice!) The boat crews, lock operators, repair crews, stablemen, innkeepers, and various other services along the canal constituted an entire subculture, and it was definitely not high society. Today most of the buildings are gone, destroyed by floods or simply abandoned, as generally there are no roads nearby.

The Civil War

The canal was heavily used by the North during the Civil War. It suffered relatively little damage in spite of lying right on the boundary. The Rebels attacked it, but it was vigorously defended by the Union. The Confederacy apparently thought that the railroad was either more important or easier to damage and concentrated its attacks there.

Great Falls — the first major obstacle to the canal (milepost 14).

Demise of the Canal

The river that was the lifeblood of the canal was also its nemesis, and ultimately destroyed it. With most of the forests in the drainage basin cleared, floods were a continuous problem. A severe flood in 1889 drove the company into receivership, and its principal stockholder, the B&O, took over its operation! An even worse flood in 1924 obliterated three dams, severely damaged a fourth, and caused much other damage. No one thought the canal worth rebuilding. Its near-century of troubled service was over. It had served well, but not well enough.

Did the Canal Have to Fail?

Nature succeeds where man fails: only this beaver dam keeps water in this section of the canal (milepost 155).

Failure analysis after the fact is always desirable, and it is fun to speculate *what if*? Referring to its original competitor, both the canal and the railroad were initially slow (horse/mule), prone to flood damage (the B&O mostly followed rivers and creeks), and generally beset with financial troubles and a host of other problems. The difference was that the railroad was easier to repair, change, or adapt to new technology, chiefly steam power. It was regularly straightened, widened, and levelled, while the canal basically had to live with its original design, making it seriously self-limiting. The Paw Paw tunnel and its problems epitomized the situation.

In retrospect it would have probably been better simply to dam the river enough to ensure deep water everywhere and use it instead of the ditch (except for locks, which are required either way). The boats would have to contend with the variable, but not severe, river current, and sections of the canal had to be done this way anyway. The upstream barges were normally more lightly loaded, and steam power would have eased the problem. A rough guess is that the number of dams would have doubled, but the cost of the ditch would mostly have been eliminated and the aqueducts replaced by simple bridges for the towpath. With some improvement, the dams would have withstood the

The final insult. When the new longer and taller railway cars wouldn't fit through the old double-track tunnel at Point of Rocks, one track was moved to the center of the tunnel and the now-defunct canal filled in for the other (milepost 49).

floods; three survived intact to modern times. Steam power would surely have taken over quickly, increasing speed somewhat and eliminating the towpath and its bridges altogether. Single-file operation would have been eliminated except for the locks, these possibly supplanted by a second set on the Virginia side. Water would have backed into some of the side streams, making them an integral part of the system and expanding the sparse coverage. The canal would have long been good for hauling coal, still a mainstay of the railroads not ceded to highways.

To the opposite extreme, the towpath itself had to be a good road (by standards then). What if, instead of a ditch, the company had simply built a wide, level, all weather road? The Romans had built such roads a millenium earlier! Steam carriages had been built as early as 1803. The effort expended in building dams and locks could have made a fine road. Would the rock and concrete in each dam and its locks have paved the 26 miles in between? A rough estimate says close. (A parkway was, in fact, suggested after the canal closed, but rejected in favor of environmental preservation.) The other turnpikes of the day mostly comprised short sections, some poorly maintained, going up and down the hills. Perhaps steam power would have been applied to the wagons, advancing the advent of the automobile by half a century! Wagons could carry much more tonnage on rails, but as far as bulk the size was about the same. And the advantages of the railroad over the canal — hill-climbing, side routes, passing, repairability, and general flexibility — were the same as those that would eventually give the highway dominance over the railroad.

Epilogue

The remains of the canal and the towpath degenerated until 1954 when Supreme Court justice William O. Douglas lead a group including newspaper editors on a hike of the entire towpath to garner support for its restoration. It was declared a national monument in 1961 and promoted to a national historic park in 1971, if not the longest of these, certainly the narrowest.

The towpath is maintained. Replica canal boats operate during the summer on short restored stretches at Great Falls and Georgetown. However, nature still wreaks havoc, and frequently there are closed sections. In the west the towpath ironically ends at a restored railroad station in Cumberland. Going east into Georgetown, one literally encounters a brick wall — a modern building extends across the towpath. In splendid counter-irony, the B&O was eventually taken over by the C&O railroad.

Footnote

The simplest way to find access to the canal is to locate a highway bridge across the Potomac. There are many other access points; some have directions from main roads, but some are quite obscure. The towpath ranges from smooth rolled gravel to dirt with large puddles and protruding tree roots. Mountain bikes are recommended, and even these must be carried in a few places or detours used. There are primitive rest facilities and water available at regular intervals. There are visitor centers at Georgetown, Great Falls, Williamsport, Hancock, and Cumberland. For information call 301/739-4200. Most of this information was provided by the National Park Service; special thanks go to Ranger Paul Apple. ⍭

Replica canal boat being pulled along the canal by a team of mules (milepost 14).

The author, left, next to a sluice gate used to let water into the canal from a dammed section of the river (milepost 64).