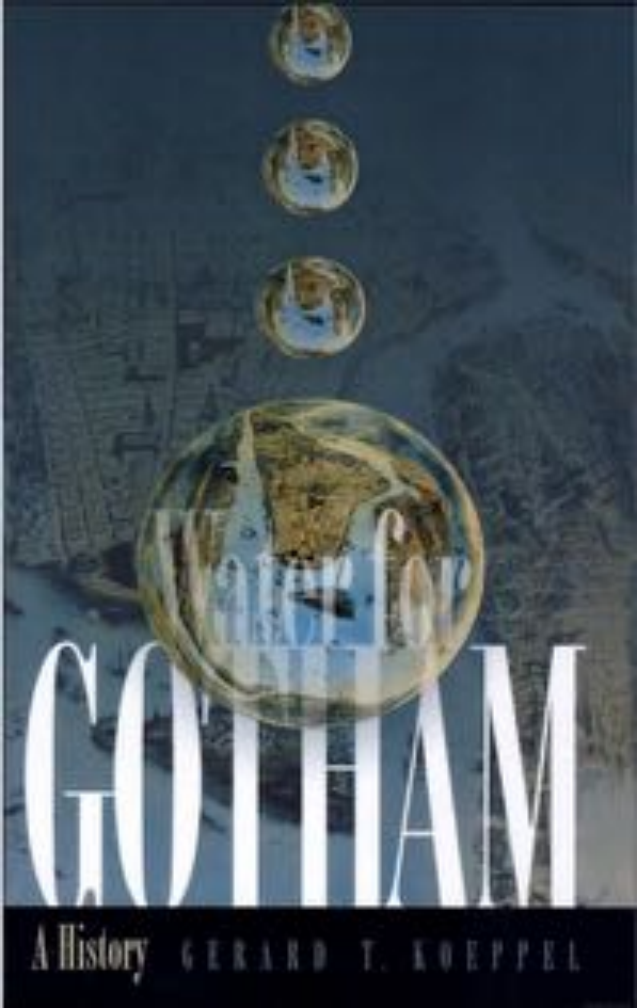
Water for
GOTHAM
A History
GERARD T. KOEPPEL

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*Frontispiece:* Union Square, circa 1848. In this lithograph featuring the Croton fountain at Union Square, the octagonal 13th Street Reservoir building is shown one block south and east of the square. I. N. Phelps Stokes Collection. Miriam and Ira D. Wallach Division of Art, Prints and Photographs. The New York Public Library. Astor, Lenox and Tilden Foundations.)

The summer brought a more significant flourishing of opposition to the Democratic commissioners from the Whig press, notably in August issues of the influential *New-York Mirror,* George Pope Morris's conservative literary weekly. The over-abundant and expensive Croton could hardly be needed with the cheap and ample Bronx close at hand, argued the *Mirror,* fearful of heavy new taxes on its wealthy readers.[68] The commissioners' only response was consulting with Albert Stein, a German-born engineer who had just completed a water supply for Nashville; with the commissioners in tow, Stein conducted gauges of the Croton in September and prepared a brief supportive report.[69] Any festering political opposition to the commissioners in the Whig-controlled Common Council fizzled after the early November state elections, when Democrats humbled Whigs in the city, state, and county.

The real trouble for the commissioners was in deciding just how to design their aqueduct. After their consultation with Stein and while Douglass's surveys continued into the fall, the commissioners sent two new engineering parties into the field.

For some months earlier in the year, the council and the commissioners had been solicited with sketchy Croton plans by Daniel Rhodes, who suggested ponding the Croton with a much higher dam and much farther downriver than initially planned by Douglass, either at Quaker's Bridge two miles from the river's mouth or up a few more miles at Garretson's Mill.[70] Though they had little confidence in the overall proposals of the otherwise unknown Rhodes (who sought millions of dollars to do the work himself), the commissioners were impressed with his thoughts on dam location. In late October, they hired Erie Canal veteran John Martineau to offer a plan for conveying the Croton from "a lofty dam" at Garretson's to a reservoir at Murray Hill.

How Martineau, whose life and engineering career are relatively obscure, came to his important assignment is unclear, but after obtaining the necessary instruments and collecting a team, Martineau commenced his surveys early in November from the mouth of the Croton. There is no indication that Douglass opposed Martineau's work.[71]

For a more limited assignment, the commissioners hired a third engineer, one possessing much local knowledge. George Cartwright, Croton gauger in the 1820s and Douglass party traverser in 1833, was now

employed to run levels upriver from Garretson's Mill to determine how much land would be overflowed by a thirty-eight-foot-high dam. Again, there is no indication of how Douglass felt about yet another engineer's entry into the field that had been his exclusively; Cartwright had worked with Douglass and there is no suggestion of any tension between them. Cartwright ran his levels early in January. It seems that the commissioners were adding engineers not from any misgivings about Douglass but because they wanted many answers quickly.[72]

### *The Commissioners' Report*

By early February, the water commissioners had received reports from Douglass, Martineau, and Cartwright. On February 16, 1835, nearly a year ahead of the deadline set by the 1834 law, they handed in their own recommendations to the Common Council, urging its prompt decision so that the public vote could take place during the city elections in eight weeks. By leaving such a small window for council consideration, the commissioners effectively limited interference from the city government.

The council had plenty to digest. With the appended reports of the Croton engineers and city officials, route profiles and maps, and assorted communications from interested schemers, the commissioners' report ran over two hundred pages, the most comprehensive accounting to date of New York's water situation. The council ordered twenty-five hundred copies distributed throughout the city, and pondered the commissioners' blueprint for seizing the Croton.[73]

After conscientiously explaining their rejection of numerous unsolicited ideas (including damming the Hudson at Greenwich Village), the commissioners proceeded to the varying findings of their engineers. Sensible to the shifting focus downstream from Muscoot Hill, Douglass now favored a thirty-three-foot-high dam at Garretson's; at the head of steep rapids and surrounded by bold shores forming natural abutments, the dam would create a two-hundred-acre reservoir, 155½ feet above tide. From Garretson's, Douglass recommended his 1833 river route, at a grade reduced by the shorter distance and lower elevation to a foot a mile but requiring more tunnels than deep cuts through Westchester ridges. The high Harlem crossing would remain the same, with a simplified route down

Manhattan: arches across Manhattanville Valley and a reservoir only at Murray Hill. Douglass described the natural terrain along each of the route's thirty-nine miles, and detailed the construction costs for the masonry conduit and its supporting structures. At just under $5 million, the plan was still more costly than his original river route.

Martineau had reached different and less expensive conclusions. Following his instructions, he priced a route from a dam forty-four feet high at Garretson's to a distributing reservoir at Murray Hill at $4.2 million, but he favored a plan with two significant differences: a much higher dam down at Halman's Hill near the mouth of the river, where the Croton was only twenty feet above tide; and a Harlem crossing of multiple, eight-foot pipes laid on a low embankment across the river. The dam would create a seven-hundred-acre lake (backing up the Croton beyond Garretson's) and allow a foot-per-mile grade along a shorter aqueduct course; the Harlem pipe siphon would likewise save money and also avoid the significant engineering questions of a Harlem high bridge. With several required Westchester and Manhattan reservoirs, Martineau's favored plan was only $4 million.

After the commissioners sorted out significant differences of opinion on the Croton's daily flow (they rejected Cartwright's mistaken new gauging of one hundred million gallons, believed Douglass's and Stein's fifty million, and trusted Stein's worst-drought reduction to thirty million), they decided on a plan that mingled the recommendations of Martineau and Douglass: a high dam at Halman's (eliminating five miles of aqueduct), pipe siphons at the Harlem (half the cost of a high bridge), arches across Manhattanville Valley, and masonry conduit to a single reservoir at Murray Hill (less than half the cost of a Manhattanville reservoir and iron pipe to Murray Hill). Recalculating their engineers' various estimates, the commissioners put the cost of delivering the Croton to Murray Hill at $4,250,709.71. As the work later took shape, changes would be made by and for the commissioners, but for the moment they believed they had come up with the best aqueduct at the lowest cost.

For distributing Croton water, the commissioners relied on a report from city water engineer Uzziah Wenman, who detailed how 167½ miles of pipe (ranging from twenty-inch mains to mostly six-inch branches) would run

Creek; it was designed in 1795 by William Weston, the English engineer who four years later advised New York City to tap the Bronx River for its drinking water. Jervis's formal education ended at age fifteen, and he worked alongside his father for the next seven years, farming and lumbering. The family were members of the local Congregational Church, where Jervis adopted Calvinistic beliefs that guided him for the rest of his long life. Distant and reserved by nature, Jervis was honest and industrious, and expected the same in others.

Jervis might have remained on the heavily mortgaged farm had it not been for a combination of fortunate events and the influence of two men. Uncle John Bloomfield directed his inquisitive young nephew to his copy of the *Edinburgh Encyclopedia,* one of the few English-language reference works with authoritative articles on engineering. Local family friend and future New York City water consultant Benjamin Wright was chief engineer of the middle section of the Erie Canal, for which the ground breaking ceremony was held on July 4, 1817, in Rome. Jervis's father was hoping to contract for canal work and Wright was looking for axemen from Jervis's lumbering operations. To gain information for his father, the slender but "very handy" John Jervis became an axeman on the Erie Canal. The rest is engineering history.

Under the tutelage of Wright, who became a lifelong friend and mentor, Jervis rose quickly in the "Erie School of Engineering." Promoted to rodman in 1818, Jervis befriended Canvass White, then himself rising fast as Wright's principal assistant. By 1819, Jervis was a resident engineer; over the next four seasons, he became known for careful engineering and contracting records, delighting his superiors and saving tens of thousands of dollars in attempted contractor fraud. Jervis came to the attention of, and forged lasting relationships with, numerous state canal officials, especially Canal Commissioner William C. Bouck, a leading Democratic politician who was elected governor in 1842. In the spring of 1823, Jervis was made superintending engineer of a fifty-mile stretch of the canal, a position he shared for a few months with future Croton consultant John Martineau and then held alone until leaving the canal in the spring of 1825, the year the "Big Ditch" was dedicated. By then, White and Wright had moved on, and Jervis, too, was eager for new opportunities.

dent, these first reported deaths on the Croton were blamed on the victims: "It is but justice to say that both the above accidents were the result of carelessness"[65]

Workers had blasted out over six hundred feet of tunnel by the end of December, when the commissioners issued their next semiannual report to the Common Council. It included significant reports from their chief engineer on the Harlem crossing and the reservoirs and other structures on Manhattan.[66]

Jervis had studied the general ideas of Canvass White and John Martineau, who had each suggested an embankment carrying a pipe siphon, and David Douglass, who had envisioned an arched high bridge carrying the Croton in masonry conduit at grade level. Jervis submitted plans for both.

As Douglass had observed back in 1833, the length and height of a grade-level Harlem crossing demanded a structure of unprecedented size in the United States. Stone arch bridges, of course, had been pioneered in grand style by the ancient Romans and refined in modern Europe, but there were no successful models in America of the dimensions required at the Harlem.

Jervis was well aware of troubles with two of the country's most notable bridges. The Erie Canal crossing of the Genesee River at Rochester had been accomplished with eleven Romanesque arches fifty feet wide; when it was completed in 1823, the structure, 802 feet long, was the longest stone arch bridge in the United States. Unfortunately, local sandstone was used for its construction and ten years later fear of collapse had induced Canal Commissioner Bouck to ask Jervis to examine its design; by the late 1830s, a new bridge was built, which, like its predecessor, was less than thirty feet high. At Schenectady, near the eastern end of the Erie Canal, two low, unarched stone bridges crossed the Mohawk River—one of them 1,118 feet long, rested on twenty-six piers, the longest bridge of any type in the country—but both bridges had proved costly to maintain, and in 1835, consultant Jervis had urged without success that they be replaced with a new canal segment along the Mohawk.[67]

Nonetheless, Jervis offered a plan for a Harlem high bridge of larger dimensions than imagined by Douglass. Jervis's bridge would be 1,450 feet long and rise 138 feet above high tide. It would consist of a series of six-