

ANDREW BARTOW AND THE CEMENT THAT MADE THE ERIE CANAL

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JULY 1817 WAS A GOOD MONTH for DeWitt Clinton. On the first of July, he was inaugurated in Albany as governor of New York. On July 4th, ground was broken outside the village of Rome for the Erie Canal, the great waterway project that would make New York the Empire State and New York City the commercial center of the western world, and would give Clinton, as the canal's strongest advocate, his most enduring fame. Earlier in the year, Clinton had been elected president of the New-York Historical Society, succeeding the late Gouverneur Morris, his long-time collaborator in the Erie dream. Clinton had already followed Morris at the head of the state canal commission, on which both had served since its creation at the beginning of the decade.

On the eighteenth of July 1817, Clinton did a bit of routine canal business that proved fortuitous for both the canal and for American engineering. He hired his friend Andrew Bartow as the canal commission's agent for securing land grants along the canal line from Utica west to the Seneca River, the portion that had been approved by the legislature.¹ Bartow (1773-1861), described in contemporary accounts as "sprightly, pleasing," "genial and frank," and "by no means parsimonious in communicating," saddled his horse, and over the ensuing months gained voluntary grants from 90 percent of the farmers and other landowners he visited.² The following spring, the grateful commissioners named Andrew Bartow their agent for all purchases of timber, plank, sand, and lime necessary for canal construction.³ In this role, Bartow developed an American hydraulic cement, a discovery that enabled the completion of New York's canal and the birth of the country's canal age. For nearly two centuries, this achievement has been credited to someone else.

Known then as water-lime, hydraulic cement is a mortar that hardens underwater to seal masonry joints, and is essential to any structure in or around water. Lime is its key ingredient, and though a wide band of various types of limestone runs from Buffalo to Albany and down the Hudson River Valley, little of it has the qualities necessary for a waterproof mortar. Pure limestone, burned and pulverized, yields common or quick lime; lime for hydraulic cement requires limestone that includes some clay. When combined with sand and water, common lime makes an excellent cement for dry structures, but only clay-bearing lime can be used to create a waterproof cement.

Greek builders established the basic lime, sand, and water cement formula some 2,500 years ago. Romans perfected their own waterproof cement by adding volcanic ash, and built with it throughout Europe until the end of their empire. There were no significant improvements in cement technology until the 1750s, when British civil engineer John Smeaton (1724–92) experimented with a limestone containing mineral-rich clay for the mortar of his celebrated Eddystone Lighthouse (1756–59); Smeaton's formulations were not published in England until 1791 and a comprehensive understanding of hydraulic limes did not emerge in Europe until the 1820s.⁴

When the time came to assemble the locks and other masonry structures for the Erie Canal, no one had as yet developed a good-quality American cement. Two decades earlier, the builders of the country's only other substantial artificial waterway, the Middlesex Canal (1793–1803) in northeast Massachusetts, imported forty tons of mineral-rich volcanic ash from the West Indies for a Roman-type cement that was adequate for the twenty-seven-mile, twenty-lock canal. At 363 miles long, crossing the state from Albany to Buffalo, the Erie Canal would need a great deal of waterproof cement for the eighty-three locks and dozens of bridges, aqueducts, culverts, and other hydraulic masonry structures called for in the design.

New York's canal commissioners were well aware of the cement used for the Middlesex Canal, but when the second season of Erie Canal construction began in the spring of 1818 they had made no provisions for hydraulic cement. As chief engineer Benjamin Wright (1770–1842) later testified to a state assembly committee, the commissioners "appeared to think that common quick lime would do for the work."⁵ It was cheap and abundant, and the commissioners, including amateur scientist Clinton, balked at Wright's insistence that arrangements be made for importing a proper cement.

The canal commissioners largely avoided the cement issue well into the 1818 season because construction on the seventy-mile level between Utica and the settlement that became Syracuse had required no locks and little other hydraulic masonry. West of Syracuse and

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east of Utica, however, the topography changed dramatically, and construction there would begin in the 1819 season. In addition, by August 1818, minor structures built with common lime already were showing signs of failing. Hydraulic cement was suddenly and urgently needed.

The traditional hero of the Erie cement story is Canvass White (1790–1834), a young assistant engineer on the Erie project. At Clinton's urging (but White's own expense), White had traveled to England at the end of the 1817 season to study the canals of Great Britain. In London, he visited John Isaac Hawkins (1772–1854), an authority on waterproof cement. Hawkins gave White samples of hydraulic lime, and anticipated that the Erie Canal commissioners would soon come calling.⁶

White returned to upstate New York and, according to the story told thirty years later in Joshua Clark's *Onondaga; or Reminiscences of Earlier and Later Times*, undertook the search for the right, and regional, hydraulic limestone. According to Clark, White soon became aware that a Madison County supplier of quick lime had delivered some that unexpectedly kept its shape when wet. At White's instructions, a local expert was brought in to conduct experiments "to prove what this new substance should be." The expert "took some of the rough stone, and in the trip hammer shop of John B. Yates, at Chittenango, burned a parcel, pulverized it in a mortar, and in Elisha Carey's bar-room... in the presence of Messrs. Wright, White, and several others, mixed it with sand, rolled a ball of it, and placed it in a bucket of water for the night. In the morning it had set, was solid enough to roll across the floor." Later, Clark relates, White himself, at "considerable expense, and by repeated experiments... found this to be an excellent substitute for the Roman cement, and he sought for and obtained a patent right of the United States for this discovery." As far as Clark knew, the expert that White had called in was one "Dr. Barto, a scientific gentleman from Herkimer County."⁷ Clark apparently was unaware that "Dr. Barto" was canal agent Andrew Bartow and no mere consultant.

By 1849, when Clark's book appeared, everyone involved in the discovery was dead with the exception of Bartow, who had gone blind and might not have been aware of the publication. A half century later, Clark's account was quoted verbatim in what is now the gospel text for canal historians, Noble E. Whitford's *History of the Canal System of the State of New York*, issued by the state in 1906.⁸ Historians who write about the canal's hydraulic cement invariably cite Whitford or other accounts based on Clark's text.⁹ Though official records clearly document his position as land and procurement agent, Bartow either is awarded the supporting (and misspelled) role scripted by Clark or goes unmentioned altogether. However,

unpublished documents, including Bartow's own writings and his correspondence with Canvass White, tell a different story.

The great-grandson of a Cambridge-educated Anglican minister assigned in 1702 to southern New York, Andrew Abramse Bartow was raised on the Westchester County estate established by his grandparents, Theophilus and Bathsheba Pell Bartow.¹⁰ Andrew Bartow married Mary Hunt, of nearby Hunt's Point, and in 1806, relocated to a large farm in the Herkimer County town of Fairfield. A prominent leader from his arrival, Bartow promoted Fairfield's selection in 1812 as the home of the College of Physicians and Surgeons of the Western District of New York, commonly known as Fairfield Medical College.¹¹ As a school trustee, Bartow often appeared in Albany before the New York State Board of Regents, presided over by Governor DeWitt Clinton.

A respected professional, Andrew Bartow took seriously his responsibility for the development of American hydraulic cement. It was "with extreme diffidence as well as with indescribable anxiety" that he penned a statement to the canal commissioners in late 1818, detailing his claim "as the first discoverer [of] the important and usefull cement — the water lime."¹²

In Bartow's telling, he and Benjamin Wright were examining Onondaga County quarries at the beginning of August 1818 in search of suitable stone for locks and lime for cement. Stopping at a local furnace that was processing common limestone, Wright saw some lime powder, the color of which seemed promising, on the floor. The two men examined the material and compared it with samples of the stone from which it had been burnt and pulverized. Bartow took the lime powder away to his lodgings to mix with varying amounts of sand and water, initially to no avail; as he later wrote, "...either from the length of time in which it had been burnt, or my ignorance in compounding it, my first experiment failed." With Wright's encouragement, and unwilling "to abandon a subject which I conceived of so much importance to the safety of the canal," Bartow soon returned to the furnace with Samuel Horn, an English mason employed on the canal. Horn remarked that the material resembled Barrow lime, a prized hydraulic lime from stone quarried at Barrow-upon-Soar in Leicestershire. This time, Bartow and Horn took samples of the stone in their pockets as well as more of the lime. They burned and pulverized the stone themselves, but again failed to compound a suitable cement.

Bartow, "not yet discouraged," went back to the furnace with a wagon and carted away enough stone for extensive testing back home in Herkimer County. James Hadley, a recent graduate of Fairfield Medical College, helped Bartow with yet more experiments.¹³

Bartow began burning chunks of stone and grinding it down;

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“although baffled at first,” he ultimately succeeded in reducing it to lime. Taking one part lime and two parts sand, he formed the mixture into cakes, immediately immersed them in water, and left them with Wright in nearby Utica. In eight days, the cakes were hard as rock. A mixture of equal parts of lime and sand was found to work just as well. Further tests by Hadley under laboratory conditions confirmed the result for Bartow: “a cement which I have the confidence to think fully answers my most sanguine expectations.” Bartow assured the commissioners that “independent of the gratification of being first to demonstrate the plenty and existence of this useful cement, and the probable benefit to myself, nothing affords me so much solid pleasure, as rendering a benefit to the canal.”¹⁴ There is nothing in Bartow’s statement about cement balls rolled along a barroom floor. Nor is there any mention of Canvass White.

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The commissioners made a point of acknowledging no individual discoverer. “[W]e expect to make a very important use,” they noted briefly in their January 1819 annual report, of “a kind of meagre limestone...as by a number of small experiments, in which, after being thoroughly burned and slaked, or ground, and mixed in equal portions with sand, it appears to form a cement that uniformly hardens under water.”¹⁵ By the time of the commissioners’ February 1820 annual report, the cement had proven “a discovery of the greatest importance,” having been used during the 1819 season for practically all masonry work on the canal. The commissioners continued, “This material has been discovered in the progress of our exertions; and it will doubtless hereafter be considered as an article of prime necessity, throughout our country, for all hydraulic masonry.”¹⁶ They were correct about New York’s contribution to the birth of the American hydraulic cement industry but they had no inclination to promote the potentially lucrative economic interests of any individual, especially Canvass White, in whose name a patent for “water lime cement” had been granted seventeen days earlier.¹⁷

If Andrew Bartow was the true discoverer of hydraulic cement in America, why did Canvass White get the patent? That answer comes in the later recollections of Bartow’s daughters, Mary and Elizabeth Bartow, and in the letters they saved which had passed between their father and White.

As the daughters recalled in 1880 to longtime family friend and local lawyer Samuel Earl, it was their father who made his cement experiments known to White, and not White who requested them of Bartow.¹⁸ After Bartow’s experiments proved successful, the two men made an agreement whereby White paid Bartow \$2,000 up front and obtained a patent in his own name, with Bartow holding a 25 percent interest in future royalties.¹⁹ While the daughters are the only extant

source for the origins of the deal, the Bartow-White letters they preserved make clear Bartow's "fourth part of the patent."²⁰

The arrangement probably originated with Canvass White, a rising young engineer willing to assume all the risk, trouble, and expense, while the older Bartow would have been happy to receive a serendipitous financial windfall: "after making the discovery," wrote Earl, "he freely talked about it, without the thought of any personal benefit to himself, through a patent."²¹ Once the deal was made, White had his fill of trouble and Bartow all the frustrations of a silent partner.

"This has so far been a bad business for me," White wrote to Bartow in April 1823. After three years of refusals by the commissioners to offer compensation for cement produced by suppliers who hadn't paid the four-cents-per-bushel royalty, White was \$1,600 in debt.²² "These men may combine," the exasperated patentee warned Bartow, "and make a good deal of trouble."²³

Bartow was equally exasperated, with his partner's "ill success attending the introduction of our water-cement into common use." In an attempt to compete with other suppliers, White had set up a plant in Chittenango, but the purchaser of a large order had claimed the cement was of poor quality and refused to pay. "The reverses experienced in your attempts," Bartow wrote to White, "appear to be owing to the want of your personal skill and attention, in the selection and calcination of the lime in grinding, and compounding it for use."²⁴ Discussions between the partners to sell out their respective interests to each other or third parties, or pursue their interests separately by region, came to nothing.²⁵

In the end, they remained partners in the patent, with White's assurance to Bartow that "you shall have your portion of any remuneration that may be obtained from the State."²⁶ By late 1823, that seemed their best hope.

After obtaining the patent in 1820, White sued Timothy Brown, a cement supplier from Madison County.²⁷ Once they were successful in the courts, Bartow reasoned, the state legislature could choose to indemnify the losers. A federal district court subsequently awarded White \$1,700, but Brown hadn't paid up by September 1823, when White hoped to move the case to the U.S. Supreme Court: "That decision will be law; and if it should be favorable, we shall stand a chance to be remunerated by collecting a percentage on all that has been manufactured."²⁸

Wisely, Brown steered clear of the high court and in 1824 took his case directly to the state legislature, which was more interested in the canal's bottom line than federal patent rights. Two sessions later, in 1825, and with the Erie Canal just months from completion, no definitive action had been taken by the legislature, and it seems



Barrel from Erie Canal Celebration, ca. 1825. Inscribed: "Keg / from which Governor Clinton / poured the water of Lake Erie into the Atlantic / October 26, 1825 / on the completion of the Erie Canal." Wood, metal, and paint (X.48).

that White and Bartow had tired of the fight. An 1824 assembly report on the petition of Brown and other cement manufacturers determined that the canal commissioners had “appropriate[d] the discovery of this water lime cement to their own fame.” Rightly or wrongly, “the manner in which they announced the discovery, was well calculated to lull contractors into a belief, that the discovery was the common property of the canal commissioners, who carefully avoided recognizing” White or any other person as entitled to credit.²⁹ The 1824 session ended with no decision.

During the 1825 session an assembly committee recommended that the patent rights be purchased by the state for \$10,000. It was “just and equitable” that Brown be indemnified against the outstanding judgment, advisable that further prosecutions be prevented, and “highly important to secure to the people of this state the free use” of proper cement for its canals.³⁰ The committee reported White’s willingness to take the deal, but the session ended that spring without further action.

OVER HALF A MILLION bushels of cement were used to complete the Erie Canal.³¹ If royalties had been paid on all of it, White would have earned \$15,000, Bartow \$5,000 (by comparison, Erie chief engineer Wright pulled a \$1,500 annual salary). As it happened, nearly all of the cement was produced without any royalties being paid by some two dozen suppliers. If all had been sued successfully, they would have been liable under federal law for treble damages.

By 1825, White and Bartow had no illusions about the strength of their patent rights. Each had moved on.

Canvass White was already a nationally prominent engineer. He had left the Erie Canal project before its completion to become chief engineer of Pennsylvania’s Union Canal and to advise New York City on its water supply system. White and his brother Hugh later opened a cement plant at Cohoes on the Hudson River north of Albany. After his brother’s premature death in 1834, Hugh White followed the band of hydraulic limestone down the Hudson Valley to Ulster County, where he opened a cement works near Rosendale. “White’s Cement” was shipped down Rondout Creek to the Hudson and off to construction projects throughout the northeast, including the Croton Aqueduct that began supplying New York City’s first clean drinking water in 1842. Hugh White later sold out his interest to the Rosendale Cement Company, which became the providers of mortar for the Brooklyn Bridge, the pedestal of the Statue of Liberty, and the Panama Canal.

It was, however, Andrew Bartow's earlier verdict on the hydraulic qualities of the Rosendale region's limestone that had initiated the area's cement industry. In December 1825, Bartow was working as a contractor for the Delaware and Hudson Canal Company, an engineering project designed to link those two rivers. Company president Maurice Wurts asked Bartow to conduct experiments on lime found near the line of the planned canal, hoping to avoid purchasing and transporting cement from upstate suppliers.³² Bartow ran his familiar tests in Ulster County and found that its native limestone made "a very superior article of hydraulic cement."³³ The Delaware and Hudson Canal would be the first of the many works made with what became known and celebrated as Rosendale cement. Though he made no claim for discovering this limestone, his proof of its hydraulic properties was Andrew Bartow's second great contribution to the founding of the American cement industry.

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NOTES

1. DeWitt Clinton to Andrew Bartow, 18 July 1817, Andrew A. Bartow Papers, Oneida County Historical Society, Utica, NY (hereafter cited as Bartow Papers). "The author thanks Jane Dieffenbacher, Fairfield Town Historian, for making him aware of her biographical research on Bartow and the materials revealing his role in the hydraulic cement discovery. See Jane Dieffenbacher, "Andrew A. Bartow and the Bartow Family," *Legacy, Annals of Herkimer County* 8, nos. 1 and 2 (1995), 1–9.
2. *New-York Statesman*, 30 June 1820; Samuel Earl, "Andrew A. Bartow, and the Discovery of Water-Lime in this Country," *Transactions of the Oneida Historical Society* (1881), 131, 143 (hereafter cited as Earl); *Laws of the State of New York in Relation to the Erie and Champlain Canals, Together with the Annual Reports of the Canal Commissioners and other Documents* (Albany: 1825), 1:380 (hereafter cited as *Canal Laws*).
3. Affidavit of canal commissioner Myron Holley, 26 May 1818, Bartow Papers.
4. For background, see Paul J. Krumnacher, "Lime and Cement Technology: Transition from Traditional to Standardized Treatment Methods" (master's thesis, Virginia Polytechnic Institute and State University, 2001; <http://scholar.lib.vt.edu/theses/available/etd-02182001-031406/unrestricted/Draftsst.PDF>).
5. *Canal Laws*, 2:217.
6. John I. Hawkins to the Pennsylvania Society for the Promotion of the Internal Improvement of the Commonwealth, 31 Oct 1825, in *The Franklin Journal and American Mechanics Magazine* 1, no. 4 (April 1826), 198.
7. Joshua V. H. Clark, *Onondaga; or Reminiscences of Earlier and Later Times* (Syracuse: Stoddard and Babcock, 1849), 2:65. Clark's informal history "may not be written with the beautiful precision of a Bancroft, nor the extreme minutiae of a Prescott, with the profundity of a Gibbon, nor the fascination of a Hume; but for those for whom it was intended, his fellow-men, nine-tenths of whom were farmers, like himself, who could readily appreciate the difficulties under which he labored, nothing could be more worthy of their acceptance." Henry C. Van Schaack, "Joshua V. H. Clark," *The Historical Magazine* 8, no. 1 (July 1870), 37.
8. Noble E. Whitford, *History of the Canal System of the State of New York, Together with Brief Histories of the Canals of the United States and Canada*, 2 vols. (Albany: Brandow Printing Company, 1906).
9. The latest to do so is Peter L. Bernstein, *Wedding of the Waters: the Erie Canal and the Making of a Great Nation* (New York: Norton, 2005), 212–14.
10. Among Bartow's notable relatives were John and Ann Pell Bartow, namesakes of the landmark Bartow-Pell Mansion in the Pelham Bay section of the Bronx, and his cousin Theodosia, the first wife of Aaron Burr.

11. The school was the sixth medical school in the country and the first west of the Hudson; it was absorbed by other medical institutions in 1841. The most notable of its roughly six hundred graduates was botanist Asa Gray, in 1831.
12. Andrew Bartow, "Claim of Doct. A. A. Bartow to Canal Commissioners on the discovery of the Water Lime," [1818], 1, Bartow Papers. The undated, unsigned, and possibly unsent statement is clearly in Bartow's hand; its content strongly suggests a late 1818 date of composition and gives every appearance of an honest account of Bartow's actions.
13. Hadley became a chemistry professor, his son James a renowned Yale-educated philologist, and his grandson Arthur a world-famous economist and president of Yale University.
14. Bartow, "Claim," 2, Bartow Papers.
15. "Report of Canal Commissioners," 25 Jan 1819, in *Canal Laws*, 1:406. On pages 407 and 409, the report briefly describes the general duties of the commissioners' land and procurement agent without naming him, and details White's engineering activities with no mention of any cement investigations.
16. "Report of Canal Commissioners," 18 Feb 1820, *Canal Laws*, 1:448–49.
17. The closest that DeWitt Clinton came to acknowledging publicly the truth that he certainly knew was under the pseudonym "Hibernicus," the canal traveling naturalist-correspondent of 1820. "I had at Utica an account of this discovery from a Dr. Bartow, one of the agents of the Canal Board... He informs me... that he and Mr. White, one of the Canal Engineers, had originated and matured the discovery." *New-York Statesman*, 30 June 1820.
18. The daughters' scenario is supported by the organizational relationships of the agent and the engineer: Bartow was employed by and reported to the commissioners and was not a member of the engineering staff *per se*.
19. Earl, 125–43.
20. Canvass White to Bartow, 16 Apr 1823, Bartow Papers.
21. Earl, 140.
22. White to Bartow, 12 Apr 1823, Bartow Papers.
23. White to Bartow, 16 Apr 1823, Bartow Papers.
24. Bartow to White, 19 May 1823, Bartow Papers.
25. See White to Bartow, 12, 16, and 25 April 1823, 9 June 1823; Benjamin Wright to Bartow, 13 May 1823; Bartow to White, 19 May 1823, 28 June 1823, Bartow Papers.
26. White to Bartow, 16 Apr 1823, Bartow Papers.
27. "In a compromise so far as my interest goes, I am willing to be liberal," Bartow assured his partner; "but if by the refusal of the Commissioners to do us justice, we are driven to prosecute, I ask the utmost farthing which can be recovered." Bartow to White, 19 May 1823, Bartow Papers.
28. White to Bartow, 15 Sep 1823, Bartow Papers.
29. *Canal Laws*, 2:216.
30. *Canal Laws*, 2:382.
31. *Ibid.*
32. Maurice Wurts to Bartow, 9 Dec 1825, Bartow Papers.
33. Earl, 141.