

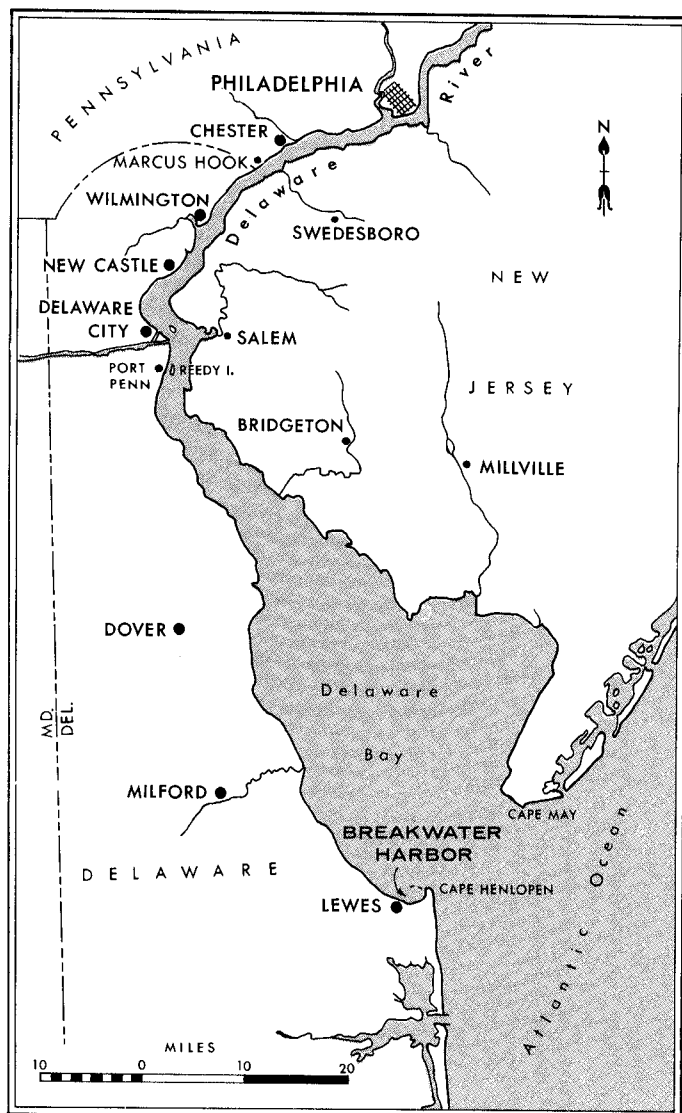
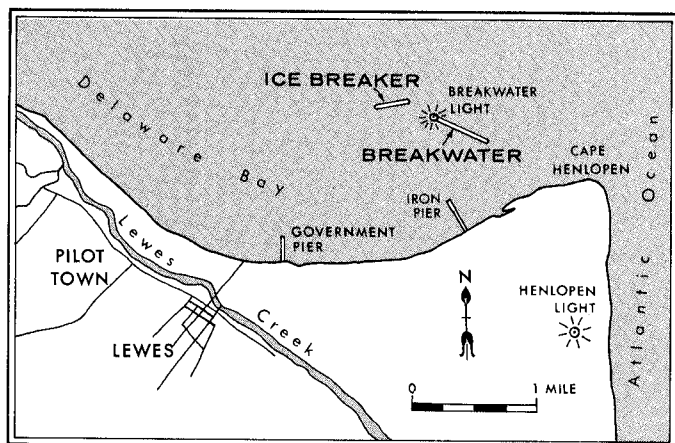
THE DELAWARE BREAKWATER AND ICE BREAKER

John Quincy Adams, sixth president of the United States, gifted orator and promoter of the Monroe Doctrine, was the first president to urge Federal improvements on a large scale. Among the public works sponsored by him, several of importance were initiated in the District area during his administration. One of these was the Delaware Breakwater and Ice Breaker.¹

"The experiment in relation to this great work, has now been fairly made. It already affords a good harbor for the vessels engaged in transporting materials used in its construction, and for such vessels engaged in commerce as may take shelter under it in times of storm."

This statement by the Quartermaster General in his report to the Secretary of War reflects satisfaction with the progress of the project in October, 1833, at the end of its fifth construction season. In this report, figures show 75 percent of the breakwater length laid down at levels varying from 15 feet above the sea bottom to five feet above high water. Even greater progress was reported for the ice breaker. An appropriation was requested for the 1834 work season in the unprecedented amount of \$350,000. The QMG wrote to the Engineer of the Work: *"The energy with which the work has been prosecuted is unparalleled, and not a doubt can now remain as to its importance to the Commerce of the Country. If appropriations can be obtained it must be completed in 1835."*

The Department's optimism was amply justified. Since 1828, when first contract advertisements were published in newspapers of New Castle and Philadelphia, 518,733 tons of stone had been deposited in the waters off Cape Henlopen. A fairly workable system had been evolved, by trial and error, for dealing with contractors, inspectors and boatmen,



The drawing shows a simple truss gantry made of iron-reinforced timbers, supported by two movable timber braces. The top arm of the pivoting truss is equipped with a pulley over which a chain is passed, then wound on a hand-cranked windlass.

Strickland's crane design was approved in January, 1831 and four rigs were built. They were put to work in the 1831 season; by then small sections of breakwater and icebreaker had been raised to the highwater line.

—Tennessee State Library

and prospects seemed to favor completion of the structure at the estimated cost of \$2,216,950. The year 1833 had been the best in five; deliveries of stone to the site totalled 154,459 tons by September, bringing the work season to an early close with exhaustion of the year's appropriation. In the opinion of the Department, twice the tonnage could have been delivered if sufficient funds had been made available by Congress.

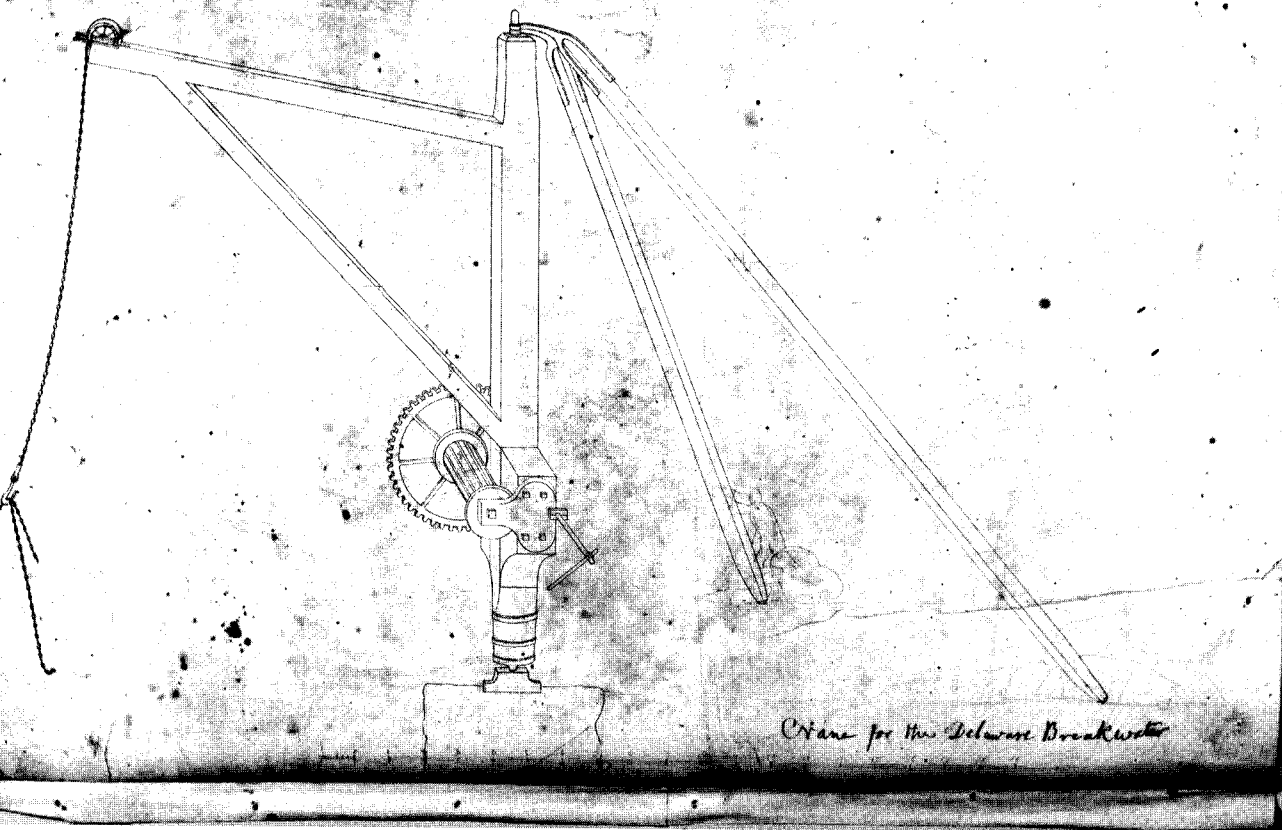
Difficulties experienced in the first years of the work are reflected in records of the quantities of stone deposited at the site: only 242,770 tons for 1829, 1830 and 1831. The unit of measure was tallied at first in perches, at 25 cubic feet or 2,700 pounds per perch. Initially, it was required that all cargoes be weighed, measured and marked before and after loading at the quarries and again prior to discharging at the breakwater. Stones weighing between one sixth of a ton and two tons were specified. The elaborate tally system, crude weighing devices and general inexperience of all concerned soon created situations vexing enough to stall the whole operation.

Halsey Rogers and Co., sole contractor for 1829, decided in early September to close down his quarry at the Palisades, North (Hudson) River New York with less than 25 percent of his quota delivered and six weeks of the season to go. The Department adjudged this act to constitute non-performance and recommended that H. Rogers' contract be voided. Canvass White and Company, also of New York, received the contract by transfer and started deliveries on 24 April 1830—minimum acceptable size of stone to be one quarter ton.

Important criteria changes made over the

next 12 months affected inspection, the hiring of personnel, supervision and stone sizes. A new preference for a profusion of small suppliers² supplanted the sole contractor philosophy. Soundings made on the work site in spring 1830 proved that wave and tide action of the past winter had lowered the structure by six to fifteen feet. While an increase in stone sizes seemed in order, it was not required until February 1831, when a new contract with Leiper & Crosby specified 25 or 30 thousand perches of stone in pieces of 2-1/4 to five or six tons. A month previously Mr. Strickland's³ design for a crane had been approved and four were constructed for handling heavy blocks at the breakwater.

William Strickland was advised of his appointment as Engineer for construction of the Breakwater by letter of the Quartermaster General dated 24 November, 1828. Strickland had served on the Commission appointed by the War Department to determine the feasibility of locating a Breakwater at the mouth of Delaware Bay. It is not clear by what criterion he was selected to superintend this rather important National improvement, but there is little doubt that his appointment, granted by Mr. Southard, at the direction of Mr. Adams⁴ was regarded as superfluous by the Quartermaster General⁵. That officer, whose department was charged with administrative responsibility for the project, frankly expressed his disapproval⁶. The recurrent theme of his opposition dealt with Mr. Strickland's nearly total absence from the scene of operations. Doubtless, the engineer found it inconvenient, and possibly distasteful, to absent himself from Philadelphia, where he pursued a busy professional career which included superintendence of the Naval Hospi-



tal at a salary of \$2,000 per year. Under like conditions and for similar reasons, Strickland had declined, in May 1827, to continue his services as engineer of the Pennsylvania Main Line Canal, in charge of its Eastern Division.

Since no amount of persuasion could induce Mr. Strickland to take up residence at Lewes, in March 1831 the Department assigned a young officer, Lt. Wm. M. Bell, to the Post, with the title of Assistant Engineer and full responsibility for supervision of the work. The beneficial effect was almost immediate. Much of the slack was removed from the delivery procedure, more efficient workmen were hired at the site and their problems became known and were resolved without undue delay. A scheme to boost carrier prices, concocted between Sloop Masters of the Delaware and Hudson Rivers, was nipped in the bud. The Department moved to segregate the two areas (Delaware River, Hudson

River), requiring that contractors deal exclusively with quarrymen and carriers located in their own base areas.

The success of "The Man at the Scene" experiment was followed by further field assignments of Engineer Officers and responsible supervisory craftsmen. Bids for supply contracts were now invited for a minimum of 5,000 perches of stone "throwing the whole business open to all, in order that working men of limited means may become competitors."⁷ Many small quarries along the Delaware River and its tributary creeks in Pennsylvania and New Jersey became scenes of renewed activity, their proprietors or lessors uniting to become joint bidders. In February 1832 the Department awarded contracts to fifteen contractors for delivery of 120,400 tons of stone.

A majority of the House Ways and Means Committee in 1832 opposed further appro-

William Strickland

—Historical Society of Pennsylvania



priations for the breakwater, but the minority took the subject before the Congress and succeeded in obtaining the \$270,000 which had been requested. In his annual report for 1831 the Quartermaster General stressed the extreme desirability of obtaining the full amount of the appropriation, "for the contingent expenses of the work are heavy, and are about the same whether we have a large or small appropriation." These contingent expenses multiplied as inspection and lading points were added at quarries and docks up and down the river. Lt. Dimmock at Lewes, Lt. Waite at the quarries and Maj. Bender in Philadelphia were meeting higher payrolls, due not only to an increase in personnel, but also because it was determined that "efficient men were cheaper at a higher rate of wages, than inefficient ones at very reduced terms." All of this made for a smoother operation, and indeed, the work was proceeding very well. It soon became apparent, however, that the prevailing method of letting many contracts over a widely dispersed area, though beneficial to "working men of limited means," was pushing overhead costs to unreasonable heights.

As a consequence the Department again made revisions in its contract philosophy, urged in specific terms by the Secretary of War,⁸ who had declined to support a request to increase the breakwater appropriation for 1833. A precedent may at this time have been established for the pre-award survey and the approved bidders list. Perturbed by the high incidence of contractor non-performance, the Department ruled for inspection of the quarries of prospective contractors; proof of ability to perform was required and prior contractors who had failed were barred from

competition. Furthermore, the minimum to be furnished by any individual or company was fixed at ten thousand perches (13,500 tons) and all contractors were to confine their activities to quarries which they worked themselves.

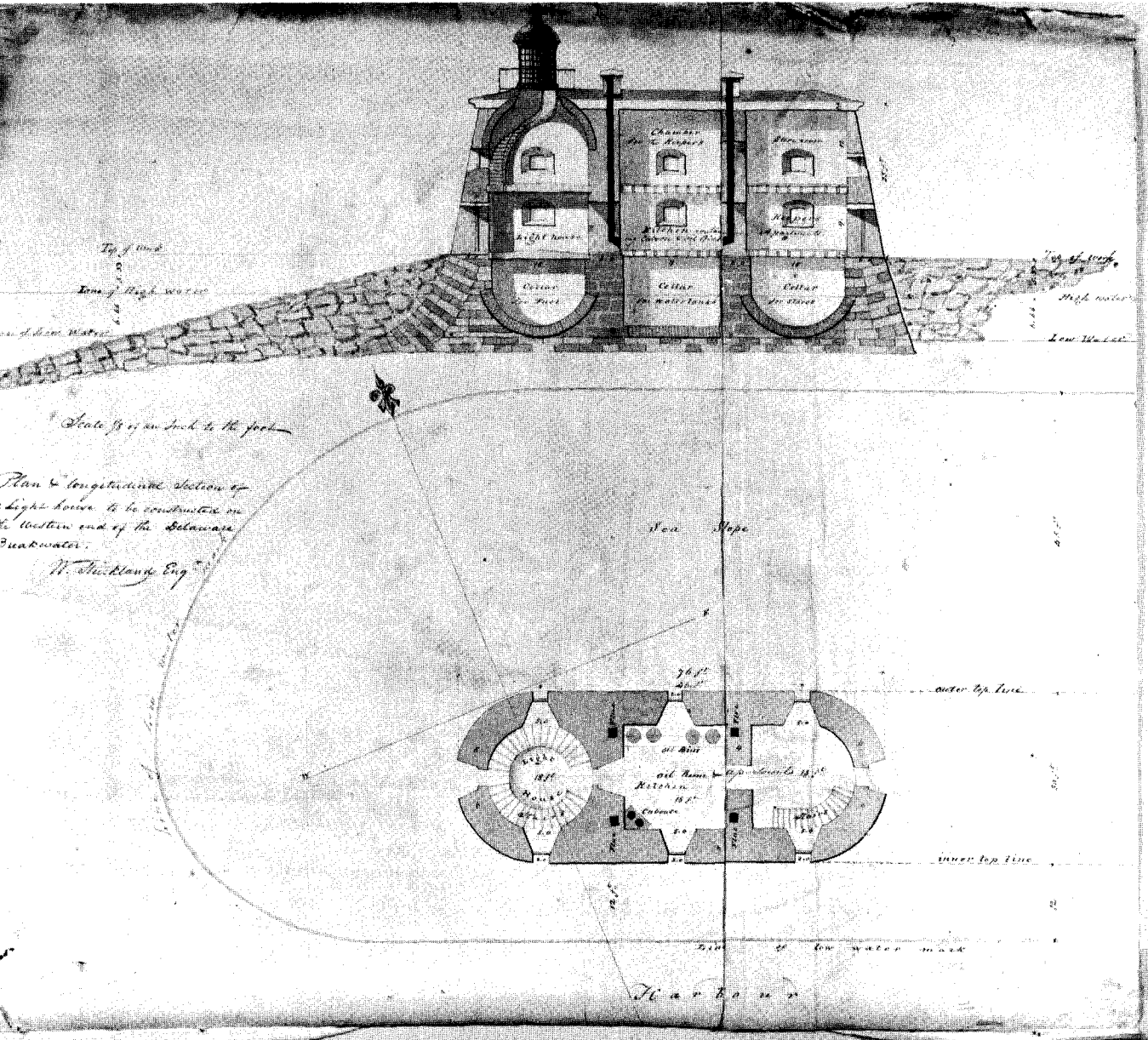
This device effectively separated the big ones from the little ones, with the result that the entire new procurement for 100,000 tons was awarded under one contract to Messrs. Leiper, Hill and Jacques. The work was now confined to the area of Delaware River and Bay, the New York people having been disqualified under the new regulations. Mr. Strickland was relieved of his duties as Engineer-in-Charge by Gen. Jesup's letter of 12 February 1833, and his position filled a week later by Lt. Charles Dimmock, an Engineer Officer. Then, on March 16 the Department wrote, by direction of the Secretary of War, to inform Strickland of his reinstatement and continuance for another six months. The Engineer was again urged to reside at the work site and to perform duty obligations as are required of all Officers-in-Charge. No mention was made of salary, so presumably it continued at \$3,000, to which figure it was reduced at the beginning of his second year of employment. Previously, the salary was \$3,500 per annum.

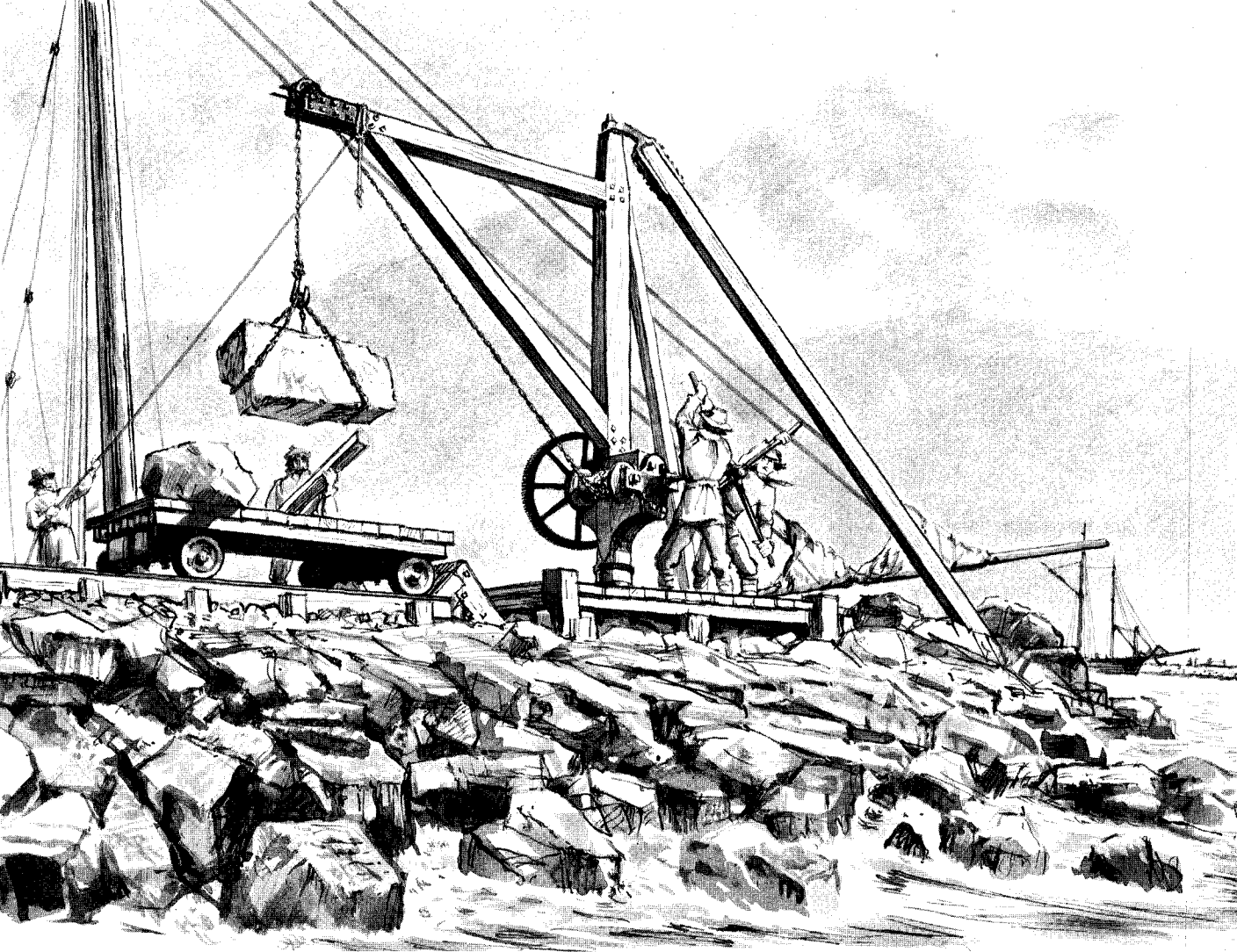
In October (1833) the Department requested Strickland to furnish plans and specifications for a lighthouse to be built on the western extremity of the breakwater, and a drawing and description of mooring buoys for the harbor. The Engineer's term of employment having again expired, the question of his reassignment recurred. Once more the Department recommended that Strickland be replaced by an officer and again was instructed

Plan and longitudinal section of a lighthouse to be constructed on the western end of the Delaware Breakwater.

William Strickland's drawing, submitted at the request of the War Department in October 1833. Western Union Telegraph Co. was given permission to occupy the light in 1876 for use as a telegraph station. The structure was removed after closure of the gap between the breakwater and the ice breaker.

—Tennessee State Library





by higher authority to continue him at the post, the question of salary to be decided by the President. The annual report expressed satisfaction with the season's work just completed and optimistically predicted completion of the project in 1835. Lt. Dimmock at Lewes was instructed to make the seasonal soundings, pay all bills and shut down for the winter.

In June of 1834 Lt. John F. Lane arrived at the breakwater as the new Assistant Engineer. William Strickland was reconfirmed in the principal engineer's post by direction of the Secretary of War "in consequence of the unanimous recommendation of the Chamber of Commerce of Philadelphia." The stone contracts for the season were awarded to Leiper and Co. of Ridley Creek Quarries, Pa. and J.F. Hill, of Crum Creek Quarries near Chester, Pa. Another attempt by the ship-

masters to boost freight rates was aborted by close cooperation of the quarrymen with the Department. Dr. Hall, a civilian, was approved as surgeon for the breakwater at a stipend of \$50.00 per month (\$25.00 per month during the winter) and the season closed on October 18th, the stone boats having hauled down a total of 122,995 tons.

There was alarm and disappointment in the Department's correspondence of Autumn 1834. Shoaling at the west end of the work had unaccountably accelerated; late season surveys showed a general shallowing of the harbor of three to ten feet. The annual report recommended, with detectable reluctance, that construction be suspended, or at least curtailed, pending the results of new studies of the tides and currents off Cape Henlopen. An appropriation of \$100,000 was requested for 1835 "to bring the whole of the work

Construction proceeded simultaneously on the breakwater and the icebreaker. There is no evidence that mechanical power was employed—vessels under sail delivered the stone, which was loaded on and off by manpower, the heavy pieces by man-powered cranes. Weather was an important factor in the construction schedule and the work season was limited to an average five months, usually from late April through September.

Marker lights were provided at the close of the first work season and Delaware Bay shipping availed itself of whatever shelter was afforded by the structures from the earliest stages of their development.

already founded to its destined height.” The prior year’s appropriation was \$270,000. Extension of the structure eastward was to await a re-evaluation of the sea’s behavior patterns in the project area.

An inspection team consisting of Gen. Jesup, Quartermaster General; Col. Joseph G. Totten, Corps of Engineers and Col. S. Thayer, Corps of Engineers visited the breakwater between the first and tenth of November. Mr. Strickland was requested to accompany the team, but there is no record of his having complied. The team’s report was signed by the three officers named above and submitted to the Secretary of War under date of 10 November. The report corroborated the findings of Lt. Lane’s survey and recommended extensive observations of the waters of the lower bay.

In lieu of a firm criterion of procedure, the Department’s instructions to Lt. Lane implied that nothing should be overlooked, no pains be spared; “*As the day has passed by when results could be arrived at intuitively, and opinions taken for ascertained facts in science, the more minute and particular your observations the better, however unnecessary or even frivolous they may appear to ignorant pretenders.*” The theory that a beneficial scouring effect, produced by the action of tides and currents, would naturally keep the harbor dredged out, was discredited. The idea may have been generated by the Strickland Report of April, 1830, made subsequent to the annual Spring survey, which cited an erosion of the Point of Cape Henlopen. General Jesup seized upon the fact, rejoicing that “. . . . *The wearing away of the Point of the Cape was a circumstance more to be*

desired than any other circumstance that could have occurred—we have no longer to fear the filling up or obstruction of the harbour, for the fact stated proves that the deposite by the tide is more than counteracted by the current and the ebb.”⁹

By the fall of 1834 a total of 640,520 tons of stone had been deposited at the breakwater and ice breaker. The work was stalled and would not resume for an entire year, and then at a reduced pace. General Jesup wrote: “It seems strange that there should have been so large a deposite of mud and sand during the last winter and no deposite during the preceding years.” Seeming to attribute some culpability to the Engineer, Jesup found occasion to exercise his surgically keen logic in an analysis and rejection of Strickland’s proposal for installation of mooring buoys in the breakwater harbor. But the Engineer stayed on the payroll, and the General conceded resignedly in a letter to Lt. Lane that—“If Mr. Strickland leave the service, it will be by resignation and not by removal—of the latter there is no intention.”

The Delaware Breakwater was the first structure of its kind to be attempted in the Western Hemisphere. There were precedents in Europe: The breakwaters of Cherbourg, Plymouth and Kingstown were subjects of study and observation by the American builders. Available writings on the subject were not profuse, possibly limited to M. Cachin’s *Memoir on Cherbourg Breakwater*, an article on Plymouth Breakwater in Dupin’s *Naval Force of Great Britain* and the work of Erney on the *Motion of Waves*.

Utilizing rubble mound construction (pierres perdues), stone was dumped on the

bottom of the Bay along a base averaging 160 feet in width, with side slopes angled at approximately 45 degrees to a top width of 22 feet. The crest was about 14 feet above mean low water but the whole of the work was not brought to this height until 1869. Stone deliveries made between 1835 and 1839 consisted predominantly of large sizes and were placed almost exclusively on the seaward face of the breakwater proper. A final appropriation in 1838-38 brought the original construction period to a close. The last delivery was loaded September 2, 1839 at the Crum Creek Quarries of William I. Leiper. The cargo was 53 tons, all sizes, taken on the sloop *Lady Jackson*, Michael Yonker, Master and discharged at the breakwater on September sixth.

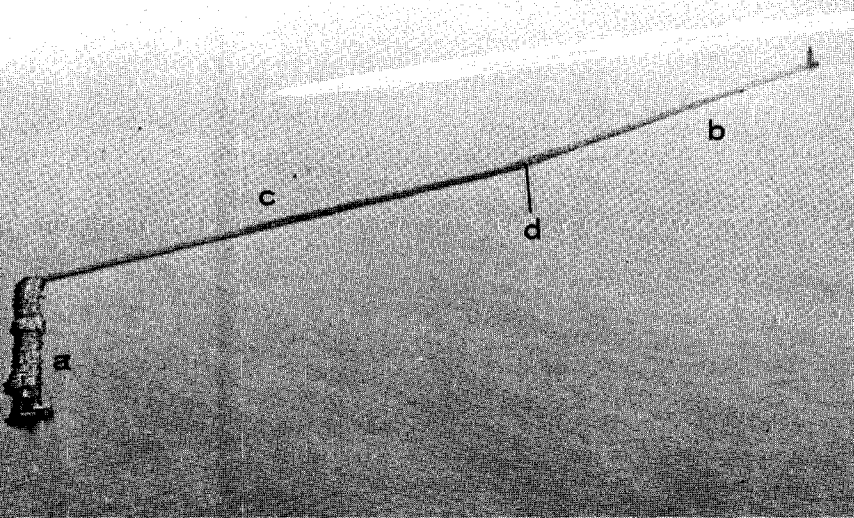
The total of 835,000 tons of stone had been deposited in the Bay since the Spring of 1829 at a cost of \$1,880,000. The breakwater's length at base was 2,586 feet—far short of the intended 3,600 feet.

The ice breaker, too fell 99 feet short of design length, and achieved full height for a mere 100 running feet of its length, requiring 9,000 tons of stone for completion. Three unfinished portions of the breakwater, totaling 652 running feet, required 10,500 tons to reach final height. Whatever it lacked, it was the second greatest structure of its kind in the world (on a par with Plymouth Breakwater) and in 1840 William Strickland could say: "The Work may be considered now so finished as to have accomplished materially the purposes for which it was projected."

There is a distinction to be drawn between the Delaware edifice and its models at Cherbrough and Plymouth. The latter were designed for military purposes while the Delaware Breakwater's intended function was, from the beginning, to benefit trade and commerce. The table reveals something of its usefulness during the latter seven years of construction.

Number of Days' Shelter¹⁰

Years	Ships	Brigs	Schooners	Sloops	Pilot Boats	Total
1833	22	178	372	167	127	886
1834	48	315	667	303	411	1,744
1835	133	569	1,719	461	644	3,526
1836	301	1,027	2,719	620	767	5,434
1837	227	478	2,777	629	732	4,843
1838	165	732	3,191	765	685	5,538
1839	165	504	3,561	734	697	5,661
Total	1,061	3,803	15,006	3,679	4,063	27,612



The old breakwater as it appears today, looking seaward. The icebreaker (a) was originally separated from the breakwater proper (b) by a 1,350-foot interval. The "Gap" structure (c) was completed in 1897. William Strickland's lighthouse was located at d, then the western end of the breakwater. The point of Cape Henlopen, seen in the distance, continues to encroach upon Breakwater Harbor, shifting northwestward. In 1879 Captain Ludlow, C of E, calculated its advance at 800 feet in 50 years, or an average rate of 16 feet per year.

Report of Stone delivered at the Delaware Breakwater Week Ending July 6th 1833.

Date	Contractors	Quantity delivered at Breakwater Proper						Quantity delivered at Ice Breaker									
		Quarrying Stone		Expanding Stone		Quarrying Stone		Expanding Stone									
		Yds	Cut	Pieces	Tons	Yds	Cut	Pieces	Tons	Yds	Cut	Pieces	Tons	Yds	Cut	Pieces	Tons
1833.	Chas J. S. M. Soper Soper Hill & Squires	181	09	4004	3127	17	136	380	04	227	16	4503	3659	18	192	515	07
		181	09	4004	3127	17	136	380	04	227	16	4503	3659	18	192	515	07

Ad. Traquair
Inspector of Stone.

Total 8835 Pieces 7683 Tons Approx

Quarrying Stone 409 Tons approx.
William Strickland
Eng^r. Del. Breakwater.

The Quartermaster General became resigned to Engineer Strickland's absentee supervision, but remained adamant that the Engineer should personally sign all reports. This form, one of a considerable variety written in the clerk's fine hand, lists quantities and categories of stone delivered at the Delaware breakwater for the week ending July 6, 1833. It bears the signatures of William Strickland and the estimable inspector of stone, Adam Traquair.

—Federal Records Center, National Archives,
Philadelphia



Early log books for Delaware Bay. 1834 book at top records wind, weather and triangulation data. At bottom, left and right, are books 2 and 3 of Major Bache's Survey in the Vicinity of the Delaware Breakwater, 1842.

—Historical Collection, Philadelphia District

A survey of Breakwater Harbor conducted in 1842 by Major Hartman Bache of the Topographical Engineers produced a detailed report on the harbor bottom and the protective structures. Major Bache's observations recorded the dimensions already cited and some disturbing trends in the shoaling patterns. He found the harbor already too shallow for vessels of the largest class and the gap between the two structures serving as a channel for most violent tidal action and the primary cause of shoaling. The gap nullified the ice breaker's effectiveness in embracing a "Harbor of Refuge" and destroyed an estimated 50 percent of protected harbor space. In his view, vessels seeking shelter below the barriers were vulnerable to running ice; instances were cited of a while occupying fleet being swept out to sea by floating ice masses. Major Bache proposed completion of the existing structures to their originally intended dimensions and closure of the gap.¹¹

A \$30,000 appropriation a dozen years later, in fiscal 1851-52, was just enough to supply 7,000 tons of stone and to replace the deteriorated handling equipment. Major of Engineers J.G. Barnard urged further appropriations in sufficient amounts to immediately prosecute the work's completion and closure of the gap, to save it from becoming a national disgrace instead of a national benefit.¹² Major Barnard requested \$300,000 for fiscal 1854-55 to accomplish a construction program which he quite specifically defined. He considered it feasible and economical to build the linking structure

largely of stone removed from the existing breakwater, of which "the accumulated mass is twice that necessary." Major Barnard found the original design to be a blind copy of the Cherbourg slopes and considered "the profile and principles upon which (it was) based radically vicious." He recommended a top width of twelve feet only, finished off with rather monolithic pieces of dimension stone and careful placement of materials in the zone of the tide range. Underlining the urgent need for a true Harbor of Refuge, Major Barnard pointed to the great increase in coastal trade and to the observed fact that, within a few hours of a storm threat more than 200 sail had crowded into the harbor at one time. A tabular statement of vessels for the ten-year period 1840-49 showed the harbor to be used by an average of 25 vessels daily.

But "The Gap" remained; shoaling reached a more or less stabilized condition, and occasionally a vessel foundered in the bay. The fiscal wheels ground slowly on, eventually producing the required appropriations in 1864, 1866 and 1867. With these funds the breakwater and ice breaker were completed to the design height but not to their originally intended lengths. In 1869, forty years after the first Palisades stones were dropped in the bay off Cape Henlopen, the old breakwater chapter was closed. The total cost to the Government amounted to \$2,123,000. Construction had spanned the terms in office of 12 Presidents. Ex-president Millard Fillmore still lived and the incumbent was Andrew Johnson.