NAUTICAL CHARTS CONTRIBUTE to ECONOMIC GROWTH and NATIONAL DEFENSE, 1807-1945

HISTORICAL REFERENCES TO COAST SURVEY CHARTING

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Nautical charts contribute to U.S. economic growth

> "But, sir, what does the country want in the coast survey? They want a very useful work done, a very important work done, and they want it done in the best manner. It is not purely a question of science. It is not a mere matter of knowledge and reputation to the country; it is a thing in which the business of the country, the great interests of the country, are deeply involved. We wish to obtain some knowledge of the coast of the United States; we wish to diminish the hazards of navigation; we wish to diminish the expense of transportation; we wish to place means in the hands of navigators which will save human life from the perils which surround it. That is what we wish to do."
>
> – U.S. Senator John Davis (MA), 1849[1]

By Mathew Brady - Beinecke Rare Book & Manuscript Library, Yale University [2], Public Domain, Wikipedia

Maps and charts throughout history do not just represent the world. They helped drive the social and economic growth around the world. They also assisted in time of war. This report provides resource material and references describing the role Coast Survey's nautical charts played in the economic growth and national defense of the United States.

Coast Survey has been creating and updating nautical charts since 1835. There are many reasons why we created and updated charts in the order we have. For instance, seafloors are changeable – especially along the Atlantic and Gulf coasts – and charts need to show new and dangerous shoals. Survey technologies improve – from leadline, to wire drag, to multibeam and side scan sonars – which gives us better and more exact data for informing the navigator. An issue that we still deal with is the ever-increasing draft of shipping vessels, from 12 feet in 1825 to 30 feet in 1895, to the 65-foot draft of some of the world's largest ships today. There were often other pressing reasons behind Coast Survey's charting priorities: economic and geopolitical events. From the young nation's East Coast shipping, to the territorial expansion south and west, to the discovery and development of new resources, the young nation's maritime interests demanded nautical charts. As commercial activity increased, so did Coast Survey's charting activity.

This brief report pulls together Congressional records, agency notes, historical biographies and, of course, Coast Survey's charts in a geopolitical context. By examining history, we can get a better idea of the important relationship between Coast Survey and the growth and stability of the United States.

THE NATION'S CHARTMAKER SINCE 1807

"He wished that the whole coast could be surveyed"

Most histories of Coast Survey start with 1807, when President Thomas Jefferson signed "AN ACT to provide for surveying the coasts of the United States." A modern view is that, since Jefferson was considered a man of science, the survey was his idea. In reality, Congress was involved in specific surveys of the coast as early as the 1790s, when George Washington was still president. For instance, during a House floor debate on December 16, 1795, on whether Congress should pay for a survey of Georgia coast, "Mr. [Jonathan] Dayton had no doubt of the Constitution empowering the House to lend the three thousand dollars, but did not like the mode of lending it. He wished that the whole coast could be surveyed."

The matter was referred to committee, which presented this abstract to the full House on January 11, 1796.

> "The report was dated the 29th of December last, and being on a subject of the highest consequence to the commercial interest of this country, the following abstract of the report is presented:
>
> "The coast not only of Georgia, but also of South Carolina, North Carolina and Virginia, has never been surveyed with the degree of accuracy which their importance to the commerce and navigation of the United States demands. As to Georgia, in particular, whose harbors are numerous, and as yet very little known, few observations have been made upon its coast, and those few have now become uncertain, from the shifting of bars, banks, and channels. The committee are of opinion, that, to obtain accurate surveys and charts of those coasts and inland navigation, would be an object of national importance and general advantage...
>
> "*Resolved*, That the President of the United States be requested to obtain, as soon as possible, complete and accurate charts, made out from actual survey and observation, of the seacoast, from the river St. Mary's in Georgia, to Chesapeake Bay, inclusive, and that _____ dollars be appropriated for that purpose."

We can look to Representative Samuel W. Dana* (Conn.), ten years later, for a summary of the sporadic legislative attempts to survey the coast and, finally, a comprehensive approach. On December 15, 1806, Dana introduced a resolution instructing the House of Representatives' Committee of Commerce and Manufactures to:

> "inquire into the expediency of making provision for a survey of the coasts of the United States, designating the several islands, with the shoals and roads, or places of anchorage, within twenty leagues of any part of the shores of the United States."

Representative Jacob Crowninshield† (MA-2), the committee chair, joined Dana in debate. (See APPENDIX 1 Legislative history of "An Act to provide for surveying the coasts of the United States" for the extended legislative history.)

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* A member of the Federalist Party, Samuel W. Dana served in the House from 1797 to 1810, representing Connecticut's At-large District, and in the Senate from 1810 to 1821.

† Jacob Crowninshield was a Democratic-Republican, representing Massachusetts's 2nd District from 1803 to 1809. In the 9th Congress, he was chairman of the House Committee on Commerce and Manufactures. The Crowninshield family in general was prominent in early American maritime affairs. Thomas Jefferson offered him the position of U.S. Secretary of the Navy, but ill health prevented him from entering upon his duties. He died on April 15, 1808, at the age of 38.

The contemporary report of the House debate gives us some understanding of the act's provisions.

> Mr. Dana, of Connecticut. – In 1802, an act was passed, authorizing a survey of Long Island Sound. In pursuance of that act, the Secretary of the Treasury caused a survey to be taken by two men, who appear to have been, what the act intended, intelligent and proper persons. And there has since been published a chart of the Sound, handsomely executed, on a large scale, which must, I presume, be regarded as convenient and valuable by those concerned in that branch of navigation.
>
> At the last session of Congress, an act was passed for another survey. It made provision for surveying the coast of North Carolina between Cape Hatteras and Cape Fear, with the shoals lying off or between those capes. I understand that measures have been taken for executing this act, but that the vessel employed in the service, and all the papers respecting the survey which had been made, had been lost near Ocracoke Inlet, in one of the desolating storms experienced on the coast in the course of the present year.
>
> The surveys, which have thus been authorized, were perhaps of the most urgent necessity; but other surveys of the coast are desirable. What has already been done may be regarded as introductory to a general survey of the coasts of the United States under authority of the Government. With a correct chart of every part of the coast, our seamen would no longer be under the necessity of relying on the imperfect or erroneous accounts given of our coast by foreign navigators. I hope the lives of our seamen, the interest of our merchants, and the benefits to the revenue, will be regarded as affording ample compensation for making a complete survey of the coasts of the United States, at the public expense.
>
> The information which may be obtained will also be useful in designating portions of territorial sea to be regarded as the maritime precincts of the United States, within which, of course, the navigation ought to be free from the belligerent searches and seizures.
>
> It is proposed to extend the survey to the distance of twenty leagues from the shore. This distance is mentioned with a view to the second article of the treaty with Great Britain in 1783, which describes our boundaries as "comprehending all islands within twenty leagues of any part of the shores of the United States."
>
> The resolution, which I propose for the consideration of the House, is expressed in these words:
>
> Resolved, That the Committee of Commerce and Manufactures be instructed to inquire into the expediency of making provision for a survey of the coasts of the United States, designating the several islands, with the shoals and roads or places of anchorage within twenty leagues of any part of the shores of the United States.

[*end Dana*]

> Mr. Crowninshield, of Massachusetts, was very glad to see the resolution offered, but he should like it better if it were more extensive. He believed there were many shoals on the coast lying at more than twenty leagues distance from the shore. Among others, St. George's Bank was at more than this distance. He wished that the resolution might be varied so as to comprehend all the shoals on the coast, from St. Croix to the southern extreme of Louisiana.

Mr. C. had always thought it important that an accurate survey should be made of our coast. Holland's chart‡, though the best, is very inaccurate.

Mr. Dana accorded with the chairman of the Committee of Commerce and Manufactures (Mr. Crowninshield) in respect to the utility of an accurate survey of the shoal which he had mentioned, but was against altering the resolution so as to include any islands at a greater distance than twenty leagues from the shore. The treaty of 1773 [sic] authorizes us to consider islands within that distance as appertaining to the territory of the United States. There is, therefore, peculiar propriety in extending the proposed survey to the distance of twenty leagues along the whole of our coast. If any shoals at a greater distance from shore are to be surveyed, special provision for this purpose may be made in the details of a bill which the committee may report. It would be more convenient to specify the details in a bill than in a general resolution for inquiry.

Mr. Crowninshield then moved to strike out twenty and insert fifty in the resolution. He was confident that there were shoals lying more than twenty leagues distant from the shore, and he thought it important to have them surveyed. It might be that there are no islands beyond that distance. He was not certain in regard to them, but he was sure that there were extensive shoals.

Mr. Dana suggested that the gentleman (Mr. Crowninshield) might designate, by way of amendment, particular shoals which he wished to be surveyed.

Mr. Cook, of Massachusetts, doubted whether all of St. George's Bank was within even fifty leagues of the shore. If it were in order, he would move to strike out twenty and insert seventy.

A division of the question on striking out twenty and inserting fifty was called for.

Mr. Crowninshield at length withdrew his motion, and it was agreed that the resolution should lie on the table.

Dana's resolution was referred to Crowninshield's committee the next day and, on January 6, 1807, the committee introduced H.R. 21, authorizing and requesting President Jefferson to "cause a survey to be taken of the coasts of the United States." After some amendments, the House passed the bill on January 20, and sent it to the Senate. The Senate also had some amendments, with which the House concurred. Both congressional chambers approved the final bill on February 9, and the bill was "laid before the President of the United States."

President Jefferson signed the legislation the next day.

An Act to provide for surveying the coasts of the United States[2]

Be it enacted &c., That the President of the United States shall be, and he is hereby, authorized and requested to cause a survey to be taken of the coasts of the Untied States, in which shall be designated the islands and shoals, with the roads or places of anchorage, within twenty leagues of any part of the shores of the United States; and also the respective courses and distances

‡ "Holland's chart" refers not to the country, but to Samuel Holland, Surveyor General of British North America. Charts produced by Holland and his team of surveyors covered coastal waters from the Saint John River to New York. They were combined with other charts into the *Atlantic Neptune*, a folio of charts, published in 1777.

between the principal capes, or head lands, together with such other matters as he may deem proper for completing an accurate chart of every part of the coasts within the extent aforesaid.

Sec. 2. *And be it further enacted*, That it shall be lawful for the President of the United States to cause such examinations and observations to be made, with respect to St. George's bank, and any other bank or shoal and the sounding and currents beyond the distance aforesaid to the Gulf Stream, as in his opinion may be especially subservient to the commercial interests of the United States.

Sec. 3. *And be it further enacted*, That the President of the United States shall be, and he is hereby authorized and requested, for any of the purposes aforesaid, to cause proper and intelligent persons to be employed, and also such of the public vessels in actual service, as he may judge expedient, and to give such instructions for regulating their conduct as to him may appear proper, according to the tenor of this act.

Sec. 4. *And be it further enacted*, That for carrying this act into effect there shall be, and hereby is appropriated, a sum not exceeding fifty thousand dollars, to be paid out of any money in the Treasury, not otherwise appropriated.

Approved, February 10, 1807

In 1807, when Jefferson approved the legislation authorizing a survey of the coasts of the United States, the states' coasts extended from New Hampshire to Georgia (although Congress intended the survey to extend to the Louisiana Territory, which had been purchased in 1803). By the time of the permanent establishment of the Coast Survey in 1832**,** coastal states Louisiana, Mississippi, Alabama and Maine had been admitted to the Union. The coasts of the states in 1832 encompassed 25,342 miles of tidal shoreline.§

In 1849, Jefferson Davis pointed out: "the length of our shore line is estimated at twenty-eight thousand miles. It is certainly beyond that, because there are indentations of the coast not shown on the charts by which we estimate."[3] (Note that the total tidal shoreline of today's 50 states, including the shoreline along the Great Lakes, is 93,311 statute miles.)

§ Tidal shoreline includes the outer coast, and the sounds, bays, rivers and creeks to the head of tidewater or to a point where tidal waters narrow to a width of 100 feet

Setting the foundation with scientific precision

In 1832, when the agency was reestablished after almost two decades of ineffective operations under military command, Coast Survey was placed in the Treasury Department, as were other federal operations associated with business. Ferdinand R. Hassler, whose scientific vision for basing charts on precise triangulation was originally adopted by the Jefferson Administration in 1807, was appointed superintendent. He was 62 years old. Finally, in1833, the "new" Coast Survey resumed the triangulations they were forced to abandon and started to take soundings.

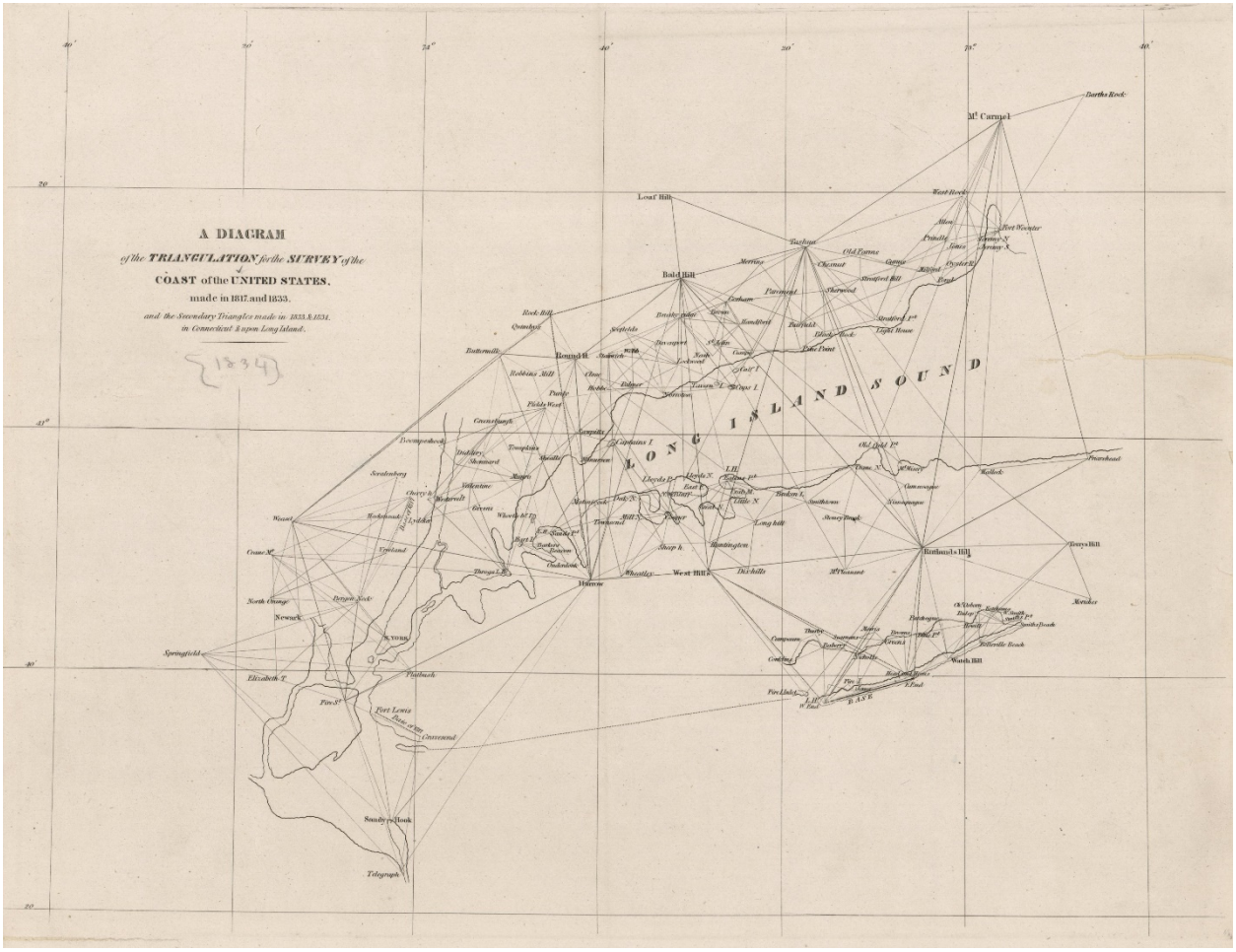


Diagram of Hassler's original triangulation from 1817 and 1833-1834. Library of Congress, "A collection of maps, charts, drawings, surveys, etc, published from time to time, by order of the two houses of Congress."

Hassler was a man of pure science. He approached chart making methodically, stressing the importance of setting a permanent and true foundation for charts. Triangulate the coast. Make astronomical observations for latitude, longitude, and azimuth of certain lines. Make magnetic observations to determine variation of compasses. Look to the topography of the shoreline, then hydrography of the coastal waters. Then, finally, came the field reports and chart production – which could take years.

Unfortunately, his science was so pure that he did not appreciate the geopolitical forces raging around him. Congress and a growing commercial sector wanted charts – but Hassler based his triangulation and surveying on a scientific, rather than political or economic, approach. His plan was to begin at New York – which was to become the nation's commercial center – and work north and south, covering 11,000 square miles from Rhode Island to the Chesapeake Bay, regardless of government or industry priorities. He stuck to his plan, which was scientifically sound, but which frustrated Congress.

One can judge Hassler's high integrity by the challenges he faced, and overcame. The scientific talent for such an undertaking in the U.S. was scarce, so he had to train his people. He only had a budget of $100,000 per year. And railroads and steamboat transportation was yet to be industrialized, so travel – especially carrying the delicate instruments he used – was never easy.

Hassler did not want to publish the early work of Coast Survey. As he explained in his report to the Second Session of the 27nd Congress[4], in 1842, he withheld charts until Coast Survey could produce "authentic publication" in "proper time." He feared that incomplete charts would be turned "into profit for the private pockets of single individuals, having no exclusive claims to its benefit; and the public would be deluded by being presented with results falsely set up as authentic."

On March 17 and 18, 1842, Hassler appeared before a House committee[5] to answer questions on his plan and progress in producing nautical charts. The committee asked 134 questions, of which we present a few here to explain (as reported by the committee) why Hassler had not yet published official charts.

> 20. Question. What reason is there for concealing from the public the elements of the work between Friar's Head and Mount Holly? Answer. None.
>
> 21. Question. Has it been published? Answer. No; it is not proper.
>
> 22. Question. Why is it not proper? Answer. Because it will introduce imitations of the work, to the detriment of its validity.
>
> 23. Question. Imitations by whom? Answer. By common chart sellers, or others.
>
> 24. Question. How is the survey injured by individuals publishing charts copied from those of the survey? Answer. Because the maps would not be official.
>
> 25. Question. Would not the publication of the data with the maps enable scientific men to judge of the accuracy of the work? Answer. Of course.

26. Question. Would not the withholding of the data until the completion of the survey enable the operator to force results? Answer. No; in the manner in which the work is carried on it cannot be.

27. Question. Can scientific men judge of the accuracy of the work unless the mathematical elements of it be published? Answer. No.

28. Question. Have the mathematical elements of the charts of Bridgeport, New Haven, and Newark, been published? Answer. No; that will come into the general account.

29. Question. When do you propose to publish such a general account? Answer. So soon as I shall have reached the verification base on the Chesapeake.

30. Question. When do you expect to reach that point? Answer. In a few years.

Still, Congress needed charts necessary for a quickly growing Navy, Revenue Cutter Service, and shipping industry. Hassler documented the requests in *Report on the Survey of the Coast*[6].

"Whenever a special map has been called for, as extract of the works of the coast survey, it has been immediately given; so have been—

The harbor of Bridgeport and its neighborhood;
The harbor of New Haven and its neighborhood;
The bay of Newark and its neighborhood.

These were presented to Congress, and published in the documents of Congress. Other extracts have been delivered in manuscript, whenever desired and authorized, to different public offices, and otherwise.

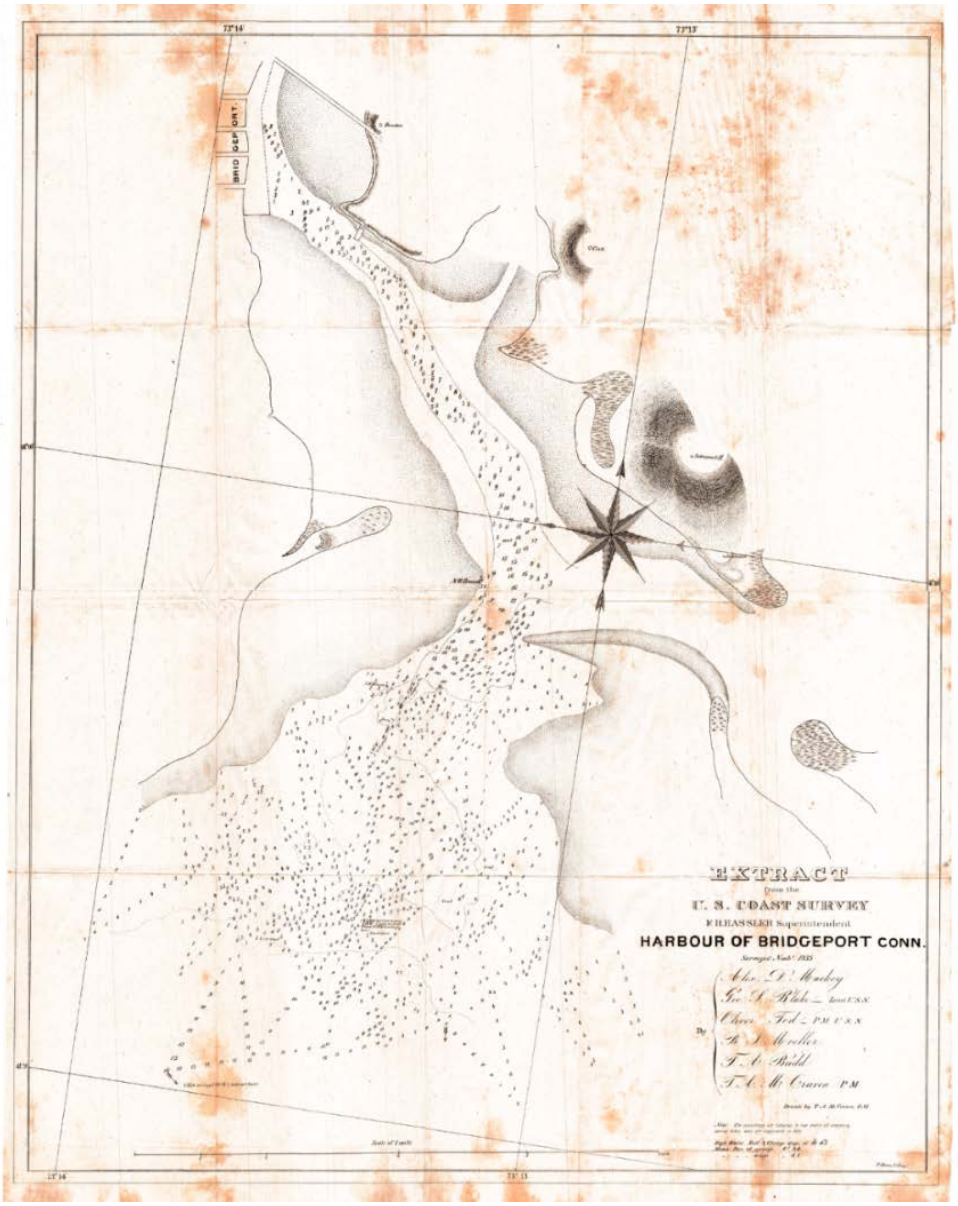
To meet a congressional request in relation to the development of a naval harbor, the Navy [under which Coast Survey was temporarily operating] submitted an "Extract from the U.S. Coast Survey, Harbour of Bridgeport, Connecticut, surveyed Novb[r] 1835."

On February 25, 1836, the Navy Department transmitted to the U.S. Senate the "chart of the harbor and bars of Bridgeport, Connecticut, being an extract from the United States coast survey, under the superintendence of Mr. Hassler." The purpose of the chart seems to be to determine whether Bridgeport could serve as a federal navigation harbor. On March 7, Navy Secretary Mahlon Dickerson enclosed a letter by Lt. George S. Blake (who had been assigned to Coast Survey work by the Navy), explaining the chart of the harbor and bars of Bridgeport:

"For the utility of the improvement, it may be said that the commerce of Bridgeport, notwithstanding the obstructions to the harbor, is considerable. The shipping owned in the place, I was informed, amounts to nearly two thousand tons; a portion of which is in the whaling business, although the vessels so employed are compelled to lie at an exposed and highly dangerous anchorage without the out bar when receiving or discharging their cargoes. A valuable ship, recently so situated, was driven from her moorings aground, and with difficulty saved after sustaining great damage. I would observe, also, the improvement proposed would not only be of great importance to the enterprising community of Bridgeport, but that the value of the harbor to the extensive trade of Long Island sound, generally, would be much enhanced by it."

The Harbour of Bridgeport chart wasn't nearly as good, technically or artistically, as the first professionally engraved chart in 1844, but it met an economic need.

Aaron Shalowitz, author of the 1964 authoritative books *Shore and Sea Boundaries*, Volumes 1-3, wrote that the Bridgeport Harbor chart "was probably produced commercially on contract, and Congress had the engraving done… Neither the plate nor a copy of the chart is available in the Bureau [of Coast and Geodetic Survey] at the present time." Our recent research of the Congressional record seems to indicate that Congress did not, in fact, have the engraving done, since the Navy sent the completed chart to the U.S. Senate. Even better, we recently found the Bridgeport Harbor chart[7] in the holdings of the Connecticut Historical Society.



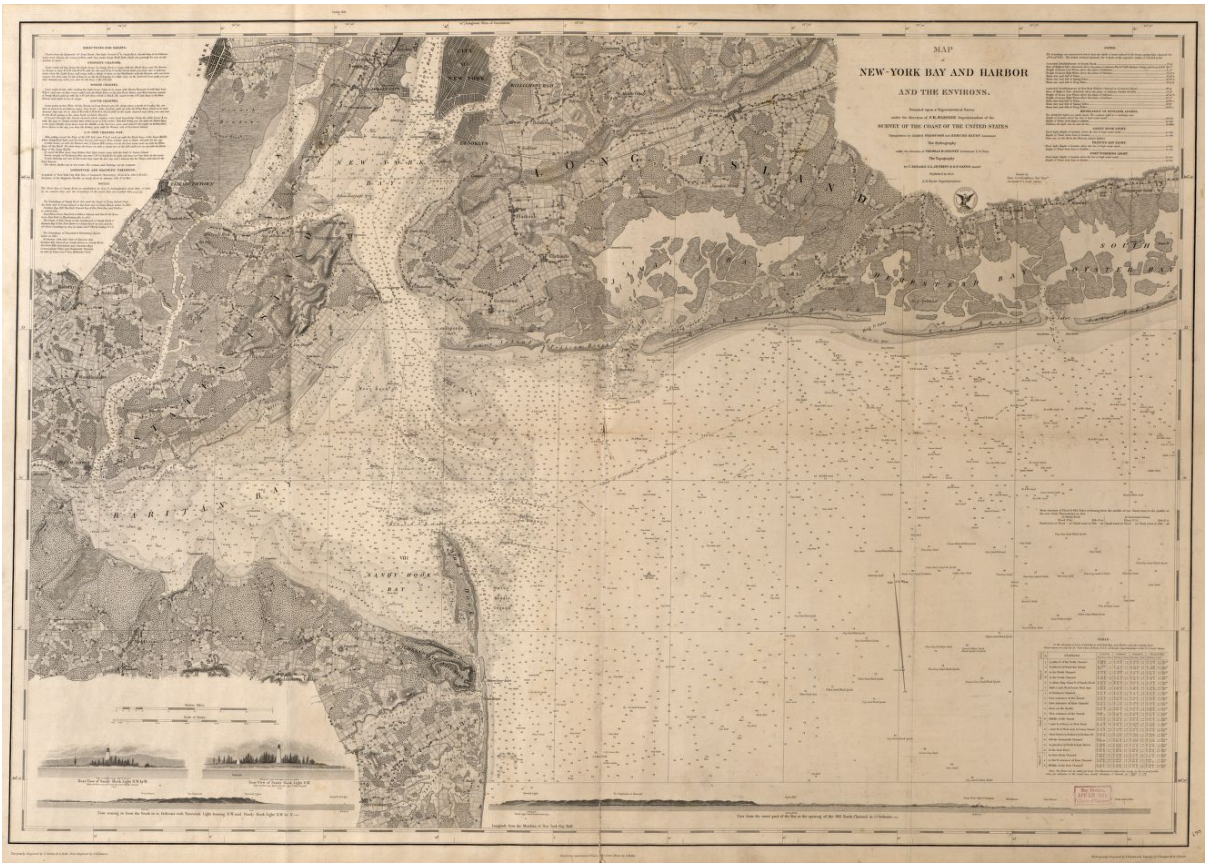
Harbour of Bridgeport, Conn., published by the U.S. Coast Survey.
Reprinted with permission from the Connecticut Historical Society[8]

Coast Survey's second "extract" chart, in 1837, was based on Lt. Thomas Gedney's partial survey of Newark Bay NJ and the mouth of the Hackensack River. The third was a chart of New Haven, reportedly engraved for Congress in 1838. Additionally, according to congressional reports, U.S. Senator Jefferson Davis – who was a strong supporter of Hassler – saw another chart: "I saw, in the office of the Coast Survey, two maps of New London and its vicinity – one of 1840, the other of 1847," Davis reported.**

Shalowitz reports that Coast Survey obtained a copperplate printing press in 1842. Hassler was finally planning to print the kind of chart he had envisioned.

> "The map of New York is known to be in a state of considerable forwardness; it will contain about 1,170 square miles of the work. The engraving has been begun. After that map is finished, it will be possible to proceed to a regular succession of publications, east and south of that place, provided the regular order and progress of the work be allowed to proceed in all respects as it is now organized."
>
> – F.R. Hassler, *Report Showing the Progress of the Coast Survey*[9]

Ferdinand Hassler died in 1843, before he was able to see his New York chart published. Alexander Bache became superintendent and issued the 1845 chart of "New York-Bay and Harbor and the Environs." As Shalowitz explained, it "showed the fine detail that was possible from a copper-plate engraving."



** Senator Davis seems to be mistaken. The earliest nautical chart we have on record for New London is from 1848. The hydrography was done under Hassler's direction in 1839, however, so perhaps the 1840 "chart" was an H-sheet of the area.

Focusing on commercial needs

Alexander Bache in the field

Alexander Bache, Coast Survey's second superintendent, was a national scientific leader. He was also politically perceptive. Instead of following Hassler's plan to radiate the agency's work out from New York Bay, Bache reorganized Coast Survey's work plan, defining the requirements for triangulation, and astronomic, topographic, and hydrographic work. He divided the Atlantic coast, and later the Gulf and Pacific coasts, into sections. He insisted that survey work proceed in every section, every year. With this scheme, the Survey could avoid the "bilious" summer diseases in the South, and avoid incapacitating winter storms north of the Chesapeake. With the additional advantage of growing transportation networks, Bache was able to speed up the survey and set charting priorities that would address the growing nation's maritime and economic needs.

"Some of these places are of importance as harbors of refuge for coasting vessels, and others on account of the commerce of the towns upon them," Bache wrote in the Survey's 1844 Annual Report.

To get charts out the door quickly, Bache adopted the practice of issuing preliminary charts, as Coast and Geodetic Survey Superintendent Herbert Ogden explained in 1889:

> "Soon after the plan of reorganization of 1843 had been adopted, surveying parties were on the Atlantic and Gulf coasts at many points; the principal harbors and headlands with outlying shoals were first surveyed and it was but a few years before charts of them were published. The less important shores between these points were left for future work, but hydrographic examinations, or nautical surveys, were made of them, and preliminary charts of long stretches of coast were issued, to be followed when the surveys had been completed by the finished chart of reliable data. So elastic was the system adopted for the conduct of the work, that its availability was limited only by the annual appropriations."[10]

In 1845, Treasury Secretary Robert J. Walker informed Congress that Bache was moving as fast as he could††.

> "The coast survey is rapidly progressing, having been extended eastward to the eastern coast of Massachusetts, and southward nearly to the dividing line of Maryland and Virginia, on the Chesapeake. Two new centres of operation have been opened, under the sanction of the Department, in North Carolina, and on the Gulf of Mexico, from which the work may be spread until the parts unite. Important positions for forts, navy-yards, harbors, and light-houses, present themselves along this interesting portion of the coast of Louisiana, Mississippi, and Alabama, and the islands guarding the interior channel between Mobile and New Orleans. Great economy exists in the administration of the fund appropriated for the coast survey; and every effort is made by the superintendent to press the work onward to a completion; and his report in detail will be hereafter submitted to Congress. Three charts, resulting from the survey, have been published within the past year, and five more are nearly ready for publication..."[11]

†† Secretary Walker was Bache's brother-in-law, and Vice President George Bache was his uncle, perhaps easing Bache's walk through thorny political fields.

"Making known the before unknown and hidden dangers"

Finding Gedney Channel into New York Harbor

From the beginning, the survey found new channels for efficient navigation into America's harbors. One of the most important was Gedney Channel into New York Harbor. Commander Thomas R. Gedney, USN, who was one of the two earliest senior naval officers attached to the Coast Survey, commanded Coast Survey's first hydrographic vessel, the *Jersey*, in 1834 and in 1835, when he discovered the famed channel while surveying under Hassler's direction.

In his web history, "Rebirth of the Survey," NOAA historian Capt. Albert "Skip" Theberge, Jr. (NOAA, ret.) gives some insight into the discovery.

"Prior to this survey, ships approaching New York had to sail to the New Jersey coast and pass close to the shore at Sandy Hook as this was the only channel known into the harbor," Theberge explains. "Larger ships had to wait for high tide to enter the harbor. Hassler felt that there had to be another deep-water channel over the bar and instructed Gedney to search for it. Lieutenant Gedney discovered a channel that led directly into the harbor, farther to the north, which was two feet deeper than the Sandy Hook channel, was of sufficient width to allow vessels to beat into or out of the harbor under most wind conditions, and cut down the sailing time into New York harbor considerably.

"The military importance of this discovery was also pointed out: if the channel had been known to exist during the Revolutionary War, it would have made the blockade and occupation of New York much more difficult for the British. This channel, called New Channel on the survey sheets, became known as Gedney Channel."

(For more of Theberge's insight, see APPENDIX 3 A Deeper Look at Gedney Channel.)

Fifteen years after Gedney's survey, at the 1849 annual meeting of the American Association for the Advancement of Science, Bache enthusiastically described the extraordinary discovery.

> "There was a rich harvest of hydrography in Long Island Sound, -- discoveries of detached rocks, about which little had been said. But in the case of the entrance to New York harbor, there was a richer harvest still; for there Captain Gedney found a new channel, now called by his name. This was either a new channel, or a channel which had long existed, but was newly discovered, most probably the latter, and that in the progress of the hydrography of the Coast Survey. The advantages of a channel, having two feet more of water in it than the main ship channel, will be appreciated by all. Buoys have been placed in it, and it is easy to find the way out and in.

"There is no chart extant of the Delaware, deserving the name"

In his comments to the AAAS in 1849, Bache also commented on discoveries in Delaware Bay:

> "The discovery or determination of three channels in Delaware Bay... are not of so much interest as the channel into New York harbor, but they are of very great importance. One of them is now constantly used by vessels carrying coal from Philadelphia to the eastern parts of the Union; buoys having been placed in it, so that it is known. Another one enables vessels to

pass directly across the breakwater, when they are lying in Cape May Roads, and the wind comes out at northwest, exposing them to the dangers of a lee-shore."[12]

Lieutenant Commanding George S. Blake, who conducted the surveys in Delaware Bay, expanded on these discoveries in his letter of January 11, 1844, to Superintendent Hassler:

> "DEAR SIR: In reply to your letter of the 6th instant, relative to recent discoveries made in the Delaware Bay by the parties of the coast survey engaged there, I beg to say, that our charts show a perfectly safe and direct channel, practicable for merchant vessels of the largest size, at *low water*, and, when the tide is two-thirds up, for frigates, to the westward of a narrow dangerous ridge, about fourteen miles long, running through the middle of the bay, called upon the old charts Joe Flogger, or Folger, and where no channel has heretofore been supposed to exist.
>
> "The advantages of this discovery to the commerce of Philadelphia, as well as to the naval establishment there, when this channel is properly buoyed, must be very great...
>
> "Other discoveries have been made in the Delaware of much importance. Among them, three channels over the 'ridges of Cape May,' which, when properly buoyed, will be of very great utility to the great and increasing coal trade of Philadelphia...
>
> "I should add, that there is no chart extant of the Delaware, deserving the name. The situation assigned by the most authentic chart to one of the principal light-houses is nearly *seven* miles in error. Many dangerous shoals having but few feet water upon them, and upon which numerous wrecks have occurred, are laid down from three to five miles from the truth, and the bay is in one part represented as *fifteen* miles in width, when it is actually but *seven*."

Finding a usable channel for Navy access

In 1848, the Navy asked Coast Survey to sound out the Buttermilk Channel between Governor's Island and Brooklyn. They wanted access to docks for a planned Navy yard. At the time, they believed that large ocean-going ships could not traverse this area; but Coast Survey discovered a usable channel. It so happened that the Coast Surveyor conducting the survey was David Dixon Porter, who was later to show his mettle as an admiral in the Civil War. To prove to skeptics that the alleged Buttermilk Channel existed and that Hell Gate Channel could be safely traversed, Porter piloted the Revenue Cutter *Jefferson* through both channels – while carrying a delegation of dignitaries, including New York ship owners, pilots, and the Secretary of the Treasury.[13]

The Survey published a sketch of Buttermilk Channel in 1849.

Tackling the difficult Nantucket Shoals, "the grave of thousands"

From 1846 to 1860, and then again in the 1880s and '90s, substantial survey resources were dedicated to "the single most difficult hydrographic survey project undertaken by the Coast Survey early in Bache's administration…" writes Skip Theberge.[14] The project area was Nantucket Shoals.

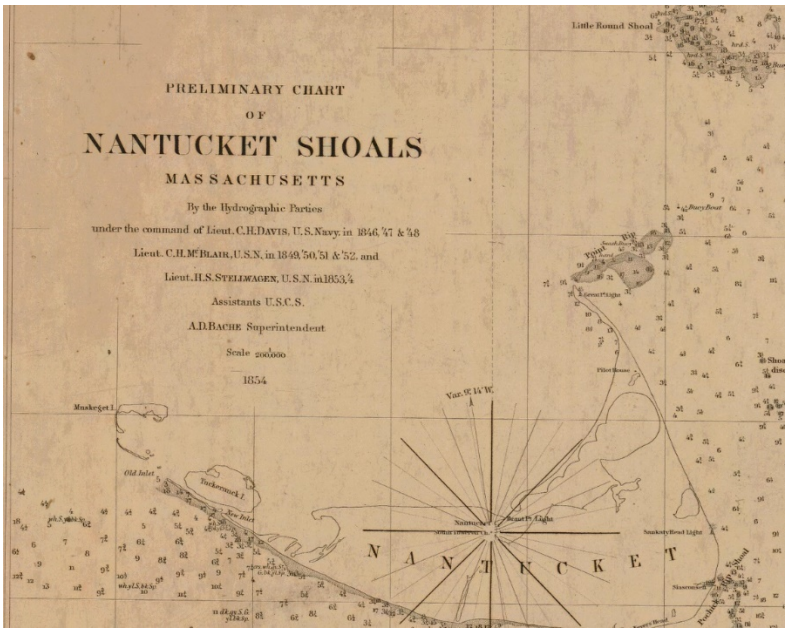
"This survey was begun in 1846, following a letter from the astronomer William Mitchell, a good friend of Bache's, detailing the number of vessels that had passed the Nantucket light-boat in the past three years," Theberge explains. "From the beginning of 1842 to July 1845, there had been 569 ships, 4,469 brigs, 28,109 schooners, and 11,503 sloops pass by the light-boat. Yet, Mitchell related, '...The history of this most dangerous and fatal shoal is startling. Situated in mid-ocean; having, in low ebbs, scarcely a foot of water; in a

region proverbial for its heavy swell; rising, at times, without a moment's warning; the dread of all mariners, and the grave of thousands..."'

At the 1849 AAAS annual meeting, Bache himself explained the value of charting the shoals:

> "The hydrographers have had a long and difficult piece of work in this section. They have had those famous Nantucket Shoals to stop them. But if the Survey had rendered no other benefit to the country than making known the before unknown and hidden dangers of that part of the coast – dangers, because unknown and hidden – it certainly would have repaid to the country in money the whole amount which it has cost. One vessel which came very near stranding upon shoals – now, through the enterprise of Lieut. Com'g Charles H. Davis[#], made known and familiar to us – had a cargo which paid the Government a duty of $125,000; and if this sum had been devoted to the survey, the shoal would have been discovered years ago. I have endeavored to mark upon this map the discoveries which Lieut. Davis has made... The dangers which he has developed, and six of which he made known last year, have, for all time, enrolled his name among the benefactors of his race."[15]

Coast Survey also found a danger "in the channel out of which the whaling vessels of Nantucket pass to sea, and through which all the coasters bound to and from the Southern States, wend their way, twelve feet of water just in the channel where the charts had nothing less than thirty!" Bache told the AAAS. "Notice will at once be given to warn the coasters that they must steer clear of [survey commanding officer, LT] McBlair's twelve feet shoal…"



To warn mariners, Coast Survey first published a series of survey sketches, then came the preliminary chart of Nantucket Shoals in 1854. Then, in 1861, the *Coast Survey Annual Report* indicated that a survey that year "has developed a prolongation of the shoal," extending several miles north and east. In 1864, Coast Survey

[#] Lt.Charles Henry Davis (USN) worked for Coast Survey from 1846 to 1849. In the Civil War, he was appointed to the Blockade Strategy Board and later took command of the Western Gunboat Flotilla. He was promoted to rear admiral. After the war, he was the superintendent of the U.S. Naval Observatory and served on the Lighthouse Board.

issued a new preliminary chart, displaying those updated discoveries. In 1893, the Coast and Geodetic Survey issued a "permanent" chart 213 of the Nantucket Shoals, at 1:80,000.

Bache directed the use of preliminary charts elsewhere as well, to improve navigation safety. When Coast Survey examined Hatteras Inlet, for instance, Lt. Commanding John Maffit§§ recognized that it would serve as a harbor of refuge, and so a preliminary chart was published, "showing how vessels may take advantage of this refuge."[16]

Charting the Florida Reef, a "menace to shipping"

James Tilghman has written about Coast Survey's efforts to survey the Florida Reef in the 1850s. As Tilghman points out, as settlers moved west, American ship traffic increased through the Strait of Florida.

"By the mid-1800s the reef lay on the margin of one of the busiest shipping lanes in the world, and the number of shipwrecks reached a vessel a week by most accounts," Tilghman writes. "Losses and salvage awards approached $2 million annually; insurance rates skyrocketed; and Key West, the closest port with a court to adjudicate salvage claims, was on its way to becoming the richest city in Florida and one of the richest on a per capita basis in the United States."

"Congress called for an expedited survey of the Keys and reef, and the job of ending the mayhem fell to the US Coast Survey."[17]

In the 1851 Coast Survey Annual Report, Bache reported:

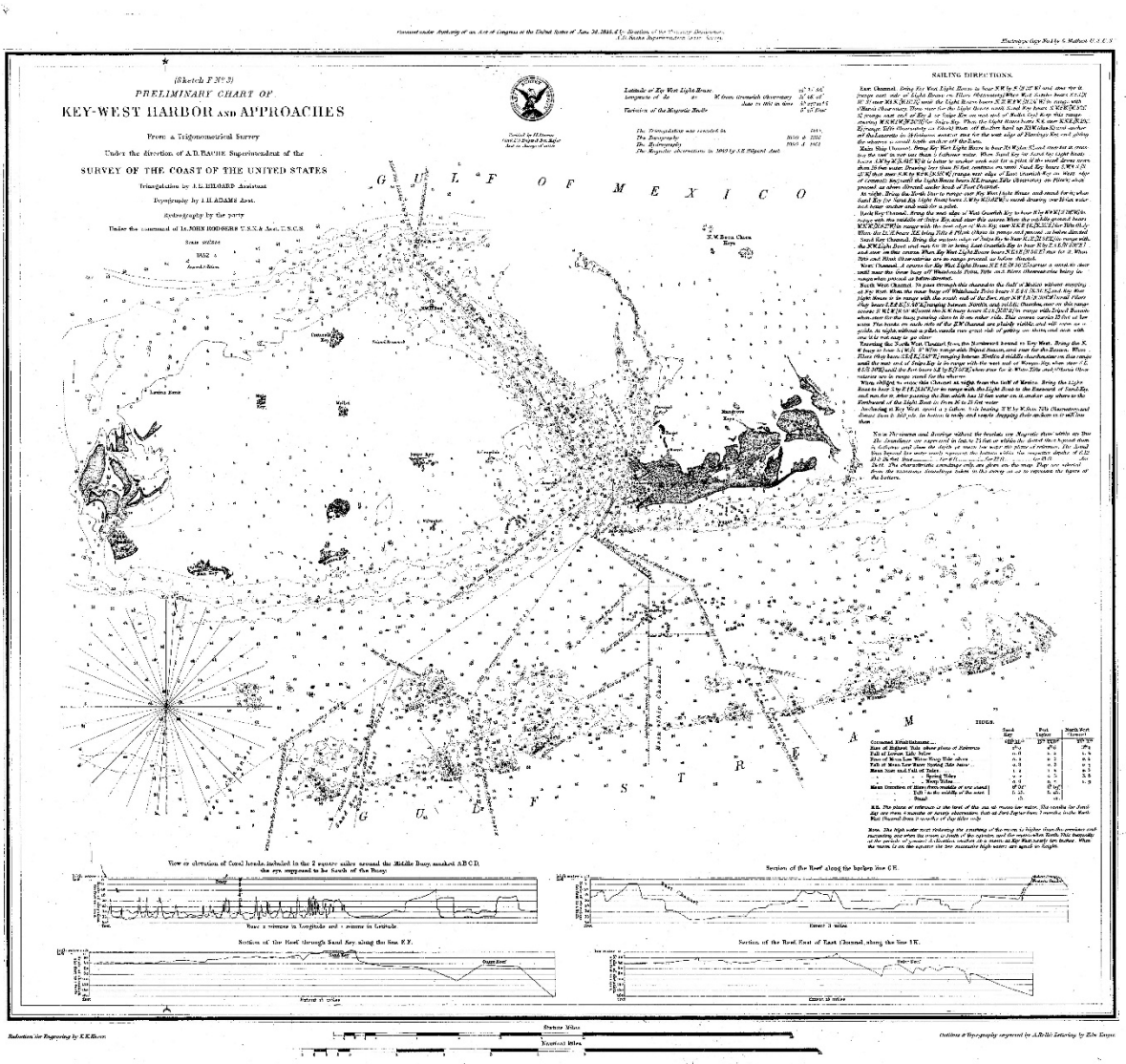
> "The work on this important and comparatively ill-known portion of our coast has been pushed vigorously, as far as the appropriation permitted, in all its branches... It should be remembered that the appropriation recommended by the Treasury Department in 1848-49 for the speedy survey of this section, was reduced from $100,000 to $30,000, and that the present limited scale of work merely provides for the ordinary rate of progress. Even as it is, however, the knowledge acquired and now ready for publication will be of no small value towards the saving of life and property, so often lost or periled [sic] on this coast.
>
> "The harbors of Key West and Cedar Keys, the passage of the Boca Grande, and many of the smaller keys and reefs, have been thoroughly examined and mapped; mistakes of charts in present use rectified; and determinations made for the sites of lights and buoys indispensable to the safety of navigation."

Tilghman reports that surveying the Florida reefs took forty years.

"The Keys were unlike anything the Survey had previously encountered. Two hundred miles of coral reefs with hundreds of islands and channels through both that were critical to navigation – all set in a tropical wilderness with the Gulf Stream coursing by just offshore. The hydrographic parties alone measured 47,000 angles; steamed, rowed or sailed more than 17,500 miles; and cast the lead over 500,000 times – a significant fraction of all the soundings made and all the miles run to make them during the first forty years of the

§§ John Newland Maffitt became a midshipman for the Navy at the age of 13. In 1842, he was detached to the U.S. Coast Survey and worked briefly with Superintendent Hassler before Hassler died. Maffitt worked for Coast Survey for 15 years, becoming intimately familiar with the Atlantic coast, waterways, and inlets. Maffitt resigned his commission at the outbreak of the Civil War and used his experience to become a successful Confederate raider. He was a blockade runner, bringing supplies to Wilmington, North Carolina; Charleston, South Carolina; and Mobile, Alabama.

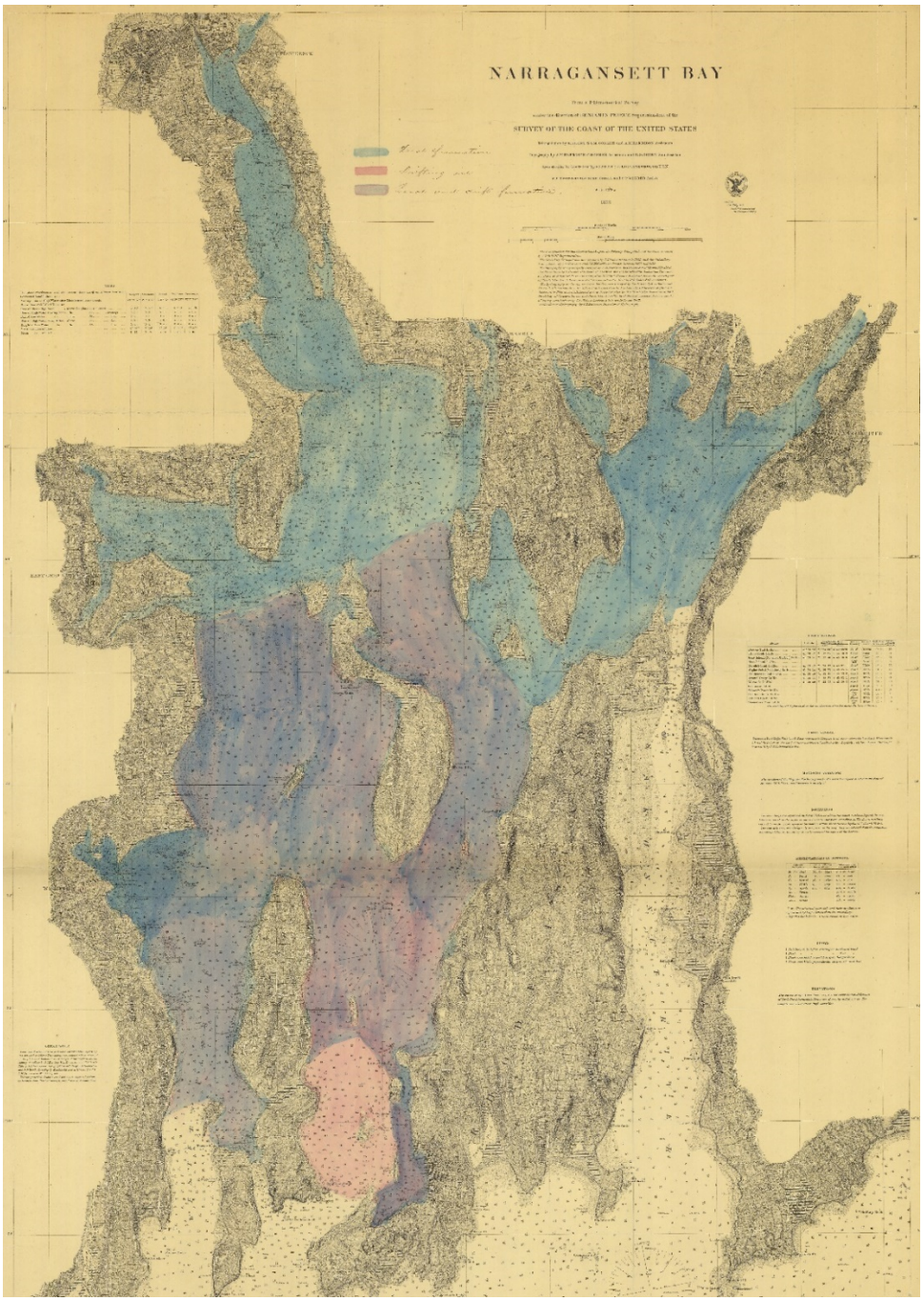
Survey's existence. And the work had to be done under trying circumstances. Mosquitoes, sand flies, debilitating heat, impenetrable growth, the occasional bear or panther, Seminole and Civil wars, wrecks, hostile wreckers, hardly any fresh water, no fresh food except fish, no place to pitch a tent, no place to stay but on board the small survey vessels, and nowhere to go or get mail save Key West, which was usually too far away."[18]



[Preliminary Chart of Key West Harbor and Approaches, 1852]

Establishing the "unfinished study of ice formation along the Atlantic Coast

A series of 13 sheets showing ice formation along the Atlantic Coast have only grown in significance since they were created in 1874 and 1875. Lt. C.A. Bradbury (USN) studied the ice patterns during the winter of 1974-75, and shaded pristine nautical charts to show different formations according to the thickness of the ice.



Bradbury used watercolors to indicate the ice formation. Blue was "Local formation," pink was "Drifting ice, and purple was a combination of "Local and drift formation."

The 1875 annual report discussed the study:

> "Lieut. C. A. Bradbury, U.S.N., after service in the hydrographic party on board the steamer *Blake*, daring the summer of 1874, off the coast of New England, was temporarily attached to this branch of the service. While he was at the office, exceptionally cold weather, after the opening of the present year, so much interrupted navigation along the eastern coast as to make a record desirable of peculiarities in the ice formation. At my request, he visited the ports of New England, and from pilots and others collected and recorded particulars at places near which ice was then regarded as dangerous to vessels in approaching the coast, and at others in which it had been or was then a hindrance to navigation. Inquiry was made also with reference to periods of recurrence in excessive ice formation; the dates at which navigation had been closed in preceding years; the effect of ice on sailing courses here and there; and whether or not well-set buoys had been displaced by moving ice in the course of the winter.
>
> "As results of the investigation, it appears, from the detailed report of Lieutenant Bradbury, that the extensive local formations of ice in January broke up, and in the first week of February accumulated as drift-ice along the shores. Twelve days of severe cold followed, and in that period the local formations were renewed by ice, some of which remained in place until the middle of March. Meanwhile, the drift ice, by subsequent freezing, had formed extended masses, as in the lower parts of bays along the coast of Maine; also, in Cape Cod Bay; and as far to the southward as Long Island Sound the frozen drift was found in connection with ice, which remained where it had formed. The movements of sailing-vessels were impeded, and navigation, except by powerful steam-vessels, was attended with danger in most of the sounds, bays, rivers, and harbors of the coast between Narragansett Bay and Eastport until the middle of March. On the coast of Maine, only a few of the buoys were displaced; but, as being more exposed to the sweep of large bodies of drift-ice, the displacement of buoys was general in Nantucket Sound, Vineyard Sound, Long Island Sound, Cape Cod Bay, Buzzard's Bay, and in the harbors adjacent. Lieutenant Bradbury's report was accompanied by a series of engraved charts, on which he indicated the extent of the local and casual ice formations in each of the localities. The unusual impediments recorded as affecting navigation seem to be due to the sudden cold that formed into fixed masses the ice which was liberated at the end of January. The substance of Lieutenant Bradbury's report will be embodied in the Coast Pilot."

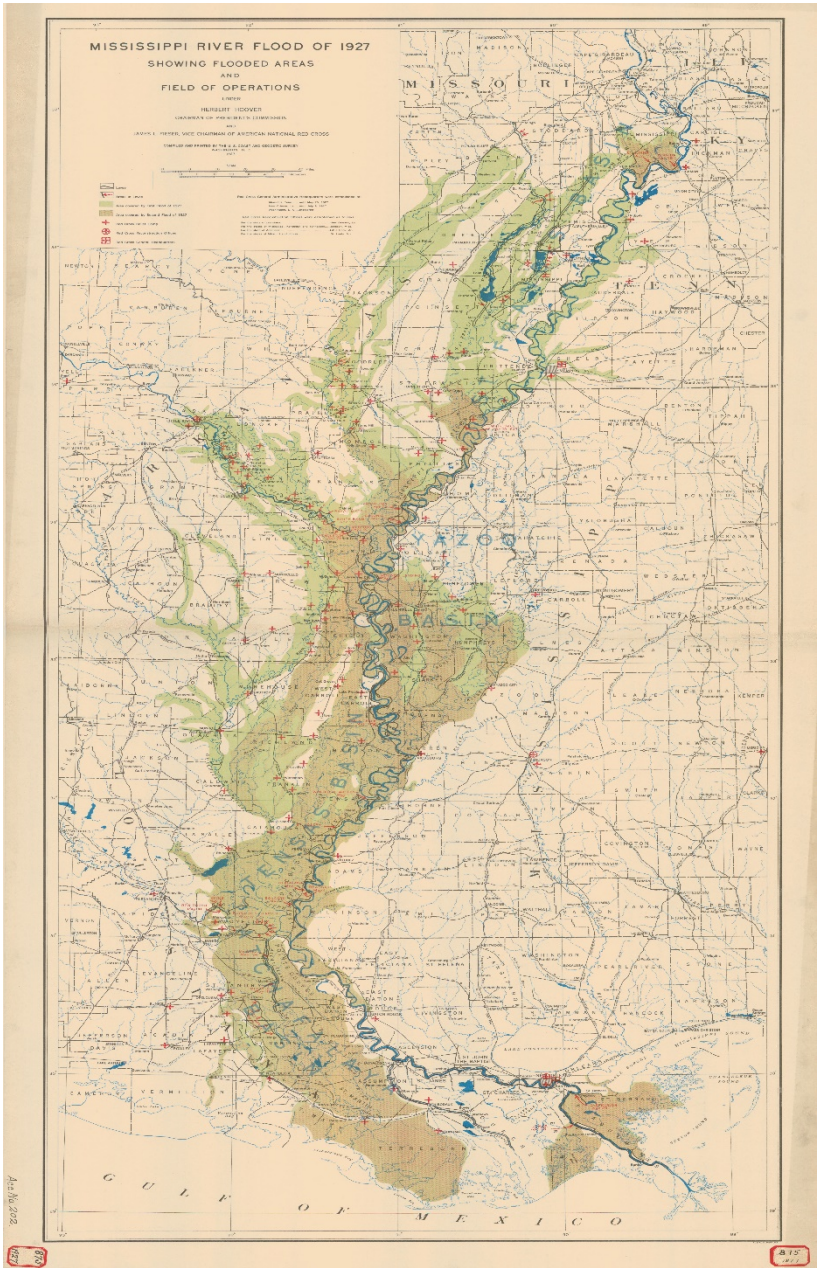
Lt. Bradbury spent the next winter in charge of the C&GS schooner *Palinurus* on the Florida coast, and it appears no more work was done on the ice survey. Bradbury's ice charts are in the NOAA Photo Library's Historical Map Collection:

- Sheet No. 1, Cape Sable to Sandy Hook
- Winter Habor, Maine
- Coast Chart No. 5 from Penobscot Bay to Kennebec Entrance
- Chart of Casco Bay, Maine
- Coast Chart No. 8 from Wells to Cape Ann
- Coast Chart No. 9 Boston Bay and Approaches
- General Chart No. 11 from Cape Ann to Gay Head
- Chart of Narrangansett Bay
- Coast Chart No. 11 from Monomoy and Nantucket Shoals to Muskeget Channel, Massachusetts

- Coast Chart No. 12 from Muskeget Channel to Buzzards Bay and Entrance to Vineyard Sound, Mass
- Chart of The Harbor of New London
- Chart of Harbor of New Haven
- Chart of Harbors of Black Rock and Bridgeport

Mapping the Mississippi flood

The Survey acquired new responsibilities as technologies changed, but it retained old responsibilities as well. Since the Mississippi River Commission was founded in 1879, a high-ranking officer of the Survey had always been a member. In 1927 a disastrous flood on the Mississippi River wreaked damage and suffering on a scale that was unparalleled in modern American life. Herbert Hoover chaired a commission to investigate the flood and its causes, a role whose success sent him to the White House. The commission asked the Coast and



Geodetic Survey to analyze the floods and map them. The resulting map (Mississippi River Flood of 1927), which shows how levees were deliberately dynamited to flood the bayous and spare the city of New Orleans, contains a graphic drama unmatched until the era of NOAA's maps of the damage caused by Hurricane Katrina.

Speeding mail delivery?

Although Coast Survey charted the Gulf Stream, the agency did not discover it. That honor went to Benjamin Franklin, more than 90 years before Coast Survey tackled it. Why would Benjamin Franklin, not known as an oceanographer, investigate the phenomena off the East Coast?

Franklin had noticed the difference in the waters when he first crossed the Atlantic in 1726. More than 40 years later, when he was Deputy Postmaster-General for the colonies in 1768, the Boston customs office complained that it was taking two weeks longer for mail from England to reach New York than Rhode Island. The intellectually inquisitive Franklin was on the case, investigating how differences in water temperatures and flow affect the efficiency of ocean shipping. He enlisted the help of his cousin, Timothy Folger, captain of a Nantucket merchant vessel, in his search for answers. Using information gathered from whalers, they produced the first chart of the Gulf Stream.

George M. Bache

About 75 years later, Coast Survey used newly developed scientific methods to chart the Gulf Stream.*** Coincidentally, as U.S. Senator Jefferson Davis pointed out in 1849[19], it was a family affair. Coast Survey Superintendent Alexander Bache was Franklin's great-grandson, and two of the men who studied the Gulf Stream for Coast Survey were Bache's brothers, George Mifflin Bache and Richard Meade Bache.

> "It is somewhat remarkable that Doctor Franklin, about the year 1760, first observed the change of temperature in that Gulf stream, and indicated its application to useful purposes of navigation, and that it now falls upon his descendant – and one worthy to be a descendant of him whose common-sense taught him the most difficult lessons of philosophy, and placed him in advance of the age in which he lived, whose science was of the daring kind which brought Jove's bolts from his charged battery, and held them by a silken string; so useful, that it lives on the cottage roof and in the parlor fire-place; so permanent, that his name is known where wisdom is honored and virtue respected – somewhat strange that this problem, first marked out by him, should descend, for its solution, to the present superintendent of the coast survey, the great-grandson of the original discoverer, and that the most extensive observations should have been made by a brother of the superintendent†††, a gallant sailor, who, devoted to the honor of his profession

*** These are considered to be the nation's first modern oceanographic expeditions. See "The Gulf Stream," at NOAA Library's online history.

††† George Bache lost his life while serving on the Coast Survey Brig *Washington*. In early September 1846, the ship was ascertaining the presence of the Gulf Stream, when she was hit by the hurricane. A wave of the "tremendous sea" broke over the ship, "sweeping the deck fore and aft, and carrying with it the poop cabin, and nearly all the officers and men. She partly righted; all succeeded in getting on board again, with the exception of George M. Bache, lieutenant commanding; James Dorsey, Benjamin Dolloff, and John Fishbourne, quartermasters; Henry Shroeder, sailmaker's mate; Francis Butler, Lewis Maynard, Thomas Stamford, and William Wright, seamen; and

and the duty in which he was engaged, lost his life in the exploration of the character of this phenomenon, and left behind him labors which have not yet been properly appreciated."

— U.S. Senator Jefferson Davis, February 19, 1849

"The limits of our coast have been greatly extended"

Throughout the years, Bache often had to answer congressional inquiries on the survey's progress. When would the survey be completed? At the 1849 annual meeting of the American Association for the Advancement of Science, Bache answered:

> "The question was asked me about this time, how long I thought the survey would be in finishing. This was at the session at which Texas was annexed; and I asked the gentleman what extent of coast he meant to include? Did he mean to the St. Mary's? Did he mean to include Florida and Louisiana, which had been purchased after the survey had commenced? Did he mean to include this coast of Texas, which we had just been adding to the Union, and which alone had added two years to the duration of the survey? Since then Oregon has been made a territory, and California acquired, and thus the limits of our coast have been greatly extended, and with this extension the importance of the survey has greatly increased."[20]

"For aid in great national projects" in the Gulf of Mexico

The U.S. annexed Texas on December 29, 1845. Bache immediately asked Congress for additional funds to survey Texas and in 1847 was able to commence a reconnaissance of the coast, from Galveston southward. The first Texas chart was of Galveston Bay, 520, published in 1853.

In the meantime, the industries and city fathers of Mobile, Alabama, were clamoring for a chart of Mobile Bay. They made a definitive case for Coast Survey's attention in a letter to Superintendent Bache, in July 1847, laying out the bay's strategic geographic position for interstate commerce and the "commercial advancement" of Mobile.[21] They specifically pointed out two reasons for needing a chart:

> "It is known to you that there is now in progress a reconnaissance of the route of a railroad to connect the gulf of Mexico with the western waters; that Mobile is fixed upon as the southern terminus, and that the mouth of the Ohio river will probably be selected as the western. In the completion of this road, the citizens of Mobile are, of course, deeply interested; and being convinced that the success of this project is to be equally beneficial to the country at large, as a leading motive for your compliance with the request expressed in this letter.
>
> In connexion with this plan, we beg leave to call your attention also to another subject, which, while a matter of great local interest to us, is also of no less moment to the government, and those who look to it for aid in great national objects; we allude to the selection of a suitable stopping place on the gulf of Mexico for the European steamers.
>
> We are of the opinion that Mobile possesses every requisite to justify a recommendation of it for this purpose..."

Peter Hanson and Edward Grennin, ordinary seaman." — *Coast Survey Annual Report, 1846*. Also see "Hurricane," by Skip Theberge, *Hydro International*, 12/7/2013

Coast Survey had already begun (in 1846) laying the foundations for charting Mobile Bay and its entrance, as the Preliminary Sketch of Mobile Bay H No. 10 (1851) and Preliminary Sketch of Mobile Bay H No. 2 (1852) indicate, but the Survey would need several more years to adequately triangulate and survey for the necessary charts. In his reply to the Mobile citizens, Bache listed the work done to date. Then he explained:

> "You are aware that time is required to obtain reliable results from such a work, and I expect your favorable consideration of the efforts already made and making, even though the completion of the work should not keep pace with your desires or mine. The extent of our work is great, and the means furnished limited, requiring careful consideration of the best times and seasons for working in different parts of the coast, in order to obtain the largest return for expenditures and a due regard to the pressing wants of navigation in different parts of the Union.
>
> "In order to anticipate somewhat the results which the regular operations would furnish, and thus explicitly to meet your wishes, I will direct the officer in charge of the hydrographic party in your section to make, on his return to you, a reconnaissance of such parts of the bay as may be most important as indicating, from comparisons with former and future surveys, the changes which are going on, and which should be carefully examined from time to time..."

In his annual report of 1847, Bache explained how the sectional work in the Gulf was progressing, charting not only the ports, but the coastline between them. In the Gulf of Mexico, Bache recognized that the charts were valuable to much more than the locale's citizens, noting…

> "...the survey between Mobile and New Orleans, already in full progress, the results of which are important, not only locally and to the southwest, but to all the vast territory of the west which uses New Orleans and Mobile as its ports."

Coast Survey produced the first Entrance to Mobile chart in 1851, and charted the entire Mobile Bay in 1856.

(In a quirk of history, nearing the end of the Civil War, in 1864, Coast Survey used those charts to prepare a new edition, in tint, of Mobile Bay and Approaches – which the Union fleet was able to use at the Battle of Mobile Bay that August.)

"The very unexpected change" on the West Coast

In 1846, the Polk Administration and Great Britain agreed on a resolution to the borders of the Oregon Territory. With increasing immigration to Oregon, and with a political resolution in hand, Coast Survey made plans to survey the coast, organizing a land and hydrographic party in the autumn of 1848 to proceed to Oregon. In 1849, Bache reported, "the land party is complete within itself for all the operations of the survey." But then he says, "The very unexpected change in the relations of the western coast has, of course, interfered materially with the usefulness, and added greatly to the expense of the parties..."

One might assume the "very unexpected change" was the discovery of gold nuggets in the Sacramento Valley in 1848. As History.com puts it, this discovery was "arguably one of the most significant events to shape American history during the first half of the 19th century. As news spread of the discovery, thousands of prospective gold miners traveled by sea or over land to San Francisco and the surrounding area." In addition, the U.S. had wrested possession of Southern California the year earlier, when the Mexican leaders from Los Angeles surrendered the city peacefully to the American military force. Coast Survey's charts were now needed along the entire West Coast.

Bache sent young men "with a reputation to make" to the West Coast. George Davidson, who was shortly to take over West Coast operations for the survey, arrived in 1850. Bache was able to report to the Congress by the end of the year: "a hydrographic examination of the coast from the entrance to Columbia river to Monterey has been made, and a preliminary chart prepared is engraving at the office."[22] In 1851, Coast Survey published the "Reconnaissance of the Western Coast of the United States from Monterey to the Columbia River," in three sheets. (See Sheet 3.)

In 1853, Bache reported:

> "A rough estimate of the comparative progress of the work, in different years, may be had from the fact that in 1844 the work was going on in nine States, in 1846 in fifteen; in 1847 it had been extended to eighteen, and now embraces all the States on both Eastern and Western coasts."

The coast surveyors found new and unexpected ways to serve in the west. As Bache pointed out, "Lieut. Comg. [James] Alden has had incidental opportunities of usefulness out of the immediate-line of his duty, of which he has, with characteristic zeal and promptitude, availed himself." One especially helpful opportunity came in 1855. The Preliminary Chart of Monterey Bay, (chart 618) used soundings collected during a hydrographic survey conducted in 1856 by the U.S. Coast Survey steamer *Active*, commanded by Alden. The survey took place later than scheduled, because Coast Survey volunteered the services of *Active* "to engage in repelling Indian hostilities in Washington Territory."[23] (In reality, the ship acted as a dispatch vessel and carried bread and other food for the settlers, and arms for the troops.)

The directive for *Active*, by Wm. Mervine, Commanding Pacific Squadron, is jarring to our ears today – but it is actual history, and so we record Mervine's letter to Alden:

> UNITED STATES FLAG-SHIP INDEPENDENCE
> San Francisco, November 29, 1855
>
> SIR: The savage demonstrations of the Indians in Washington Territory, in murdering many of the settlers, the concert of action between the different tribes, together with their attacks upon the regular troops, seem to indicate a general Indian war, the declared object of which is the extermination of all the white population.
>
> This alarming state of affairs calls for all the available naval force which can be spared from other duties.
>
> As you have promptly tendered the services of the United States surveying steamer *Active*, under your command, which you state can be spared during the winter without detriment to the service in which she is engaged, you will therefore prepare her for sea with all possible despatch, and, so soon as you shall be ready, proceed to Puget's Sound, where you will act in concert with the sloop of war *Decatur*, and the forces under the command of Major General John E. Wool, in affording aid and protection to the inhabitants residing on the Sound, wherever the same may be required.
>
> You will take on board as large a supply of stores, especially bread, as your vessel can store.
>
> Upon falling in with the *Decatur* in Seattle, transfer to her all your surplus stores.
>
> Commander Sterett reports that, in consequence of the settlers being without arms, he has supplied them with all those belonging to the *Decatur*; you will therefore make a requisition

upon the ordnance officer of the United States army at Benicia for forty muskets, and the same number of pistols and cutlasses, if they can be furnished, for her use.

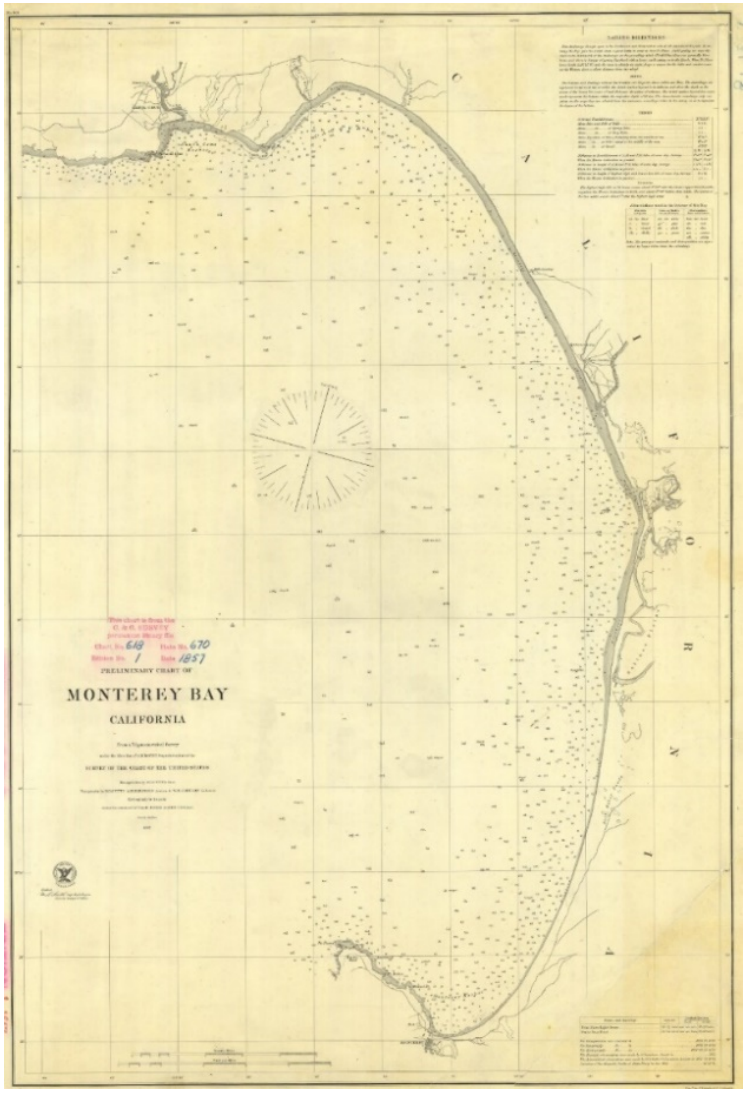
I shall, in all probability, sail from this port very soon; you will therefore communicate all matters of importance, through Commander Gansevoort, direct to the Honorable Secretary of the Navy, as circumstances shall render expedient, transmitting to me duplicate copies thereof, to Valparaiso, by the way of Panama, addressed to the care of the United States consul at the latter place.

Very respectfully, your obedient servant,
WM. MERVINE
Commanding Pacific Squadron

Active, commanded by Lt. Alden, was back surveying the coast of California by the spring of 1856.

By 1893, the Survey was working up and down the West Coast. New railroads, wagon roads, and wharves drove a Coast Survey return to San Diego, and Seattle required a resurvey of its harbor as its population increased from 10,000 forty years prior, to 50,000 in 1891.

Preliminary Chart 618 Monterey Bay, hydrography in 1856, Lt. Commanding James Alden.



Civil War

> "That no coast can be effectively attacked, defended, or blockaded without accurate maps and charts, has been fully proved by the events of the last two years, if, indeed, such a proposition required practical proof."
>
> — Alexander Bache, November 7, 1862

Coast Survey's maps, charts, and expertise, before and during the Civil War, were crucial during the nation's darkest hours.‡‡‡

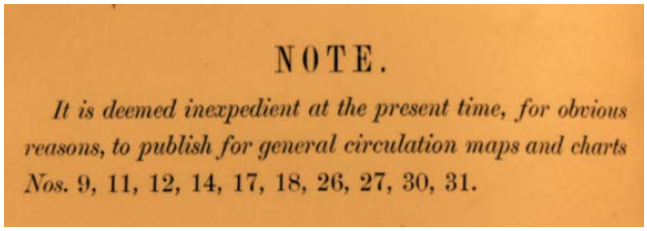
As NOAA historian John Cloud reports: "The first indication of the changes in the Coast Survey as war approached was the reduction in fieldwork on the Pacific coast. Both hydrographic and topographic survey parties returned steadily to the east, leaving a small field staff primarily working on completing the topographic surveys of San Francisco Bay. Map compilation and production based on previous fieldwork continued, but clearly, by 1858 the Survey was anticipating war on the Atlantic and Gulf coasts."

Preparing for the coming storm

Cloud writes: "By 1858, Survey field parties had worked along portions of the entire coastline of the slave-holding states, to the Mexican border. This work was discontinuous, however, and in many cases, harbor surveys only 10 years old were obsolete. Bache redoubled efforts to fill in missing areas of the coast, and to survey strategic areas. One of the highest priorities was Charleston, South Carolina. The harbor was one of the most important ports in American commerce, military bases and forts ringed its approaches — and it was the hothouse of pro-slavery rebellion. The Survey worked intensely all around the harbor."[24]

By 1860, slave states were publicly threatening secession if Abraham Lincoln won the presidency. As southern states began to secede, Coast Survey pulled its survey parties from southern projects and activities.

Again, from Cloud: "In January 1861, Bache finished and published the Survey's annual report for the year 1860. The report made almost no mention of the gathering storm, apart from oblique statements about the rapid termination of certain survey parties here and there. But the report also included a small and subtle but rather extraordinary document. As in all of Bache's annual reports, the major portion of the volume, presented first, was the section of texts of the report and its many appendices. Following that was a second section, composed of folded lithographs of the figures and texts. The last page of the first, printed section was always a list of Sketches and Figures. In the 1860 report, the backside of the Index of Sketches had glued to it a very small printed piece of paper. The small piece of paper notes that many of the maps and charts listed on the List of Sketches were not, in fact, bound in the volume. As the paper politely indicates: 'It is deemed inexpedient at the present time, for obvious reasons, to publish for general circulation maps and charts Nos…' The ten charts



NOTE.

It is deemed inexpedient at the present time, for obvious reasons, to publish for general circulation maps and charts Nos. 9, 11, 12, 14, 17, 18, 26, 27, 30, 31.

‡‡‡ NOAA historians Capt. Albert "Skip" Theberge, Jr. (NOAA, ret.) and Dr. John Cloud are the best sources of information on Coast Survey during the Civil War. See Theberge's web article, "The Coast Survey in the Civil War, 1861-1865," and Cloud's report, *The U.S. Coast Survey in the Civil War*. In 1916, the U.S. Coast and Geodetic Survey compiled a comprehensive report, *Military and Naval Service of the United States Coast Survey 1861-1865*.

covered coastal areas in the Mississippi Sound in the Gulf of Mexico, and coastal bays along the Florida coast and up the Atlantic coast to Chesapeake Bay. All charted areas were entirely the lands and waters of slave-holding states."

"At the very same moment, however, the Survey, while not publishing the maps for general circulation, was in fact quietly in the early stages of an extraordinary project to publish the very same maps, plus many others, but to do so secretly. The secret project used the deliberately innocuous name of "Notes on the Coast."[25]

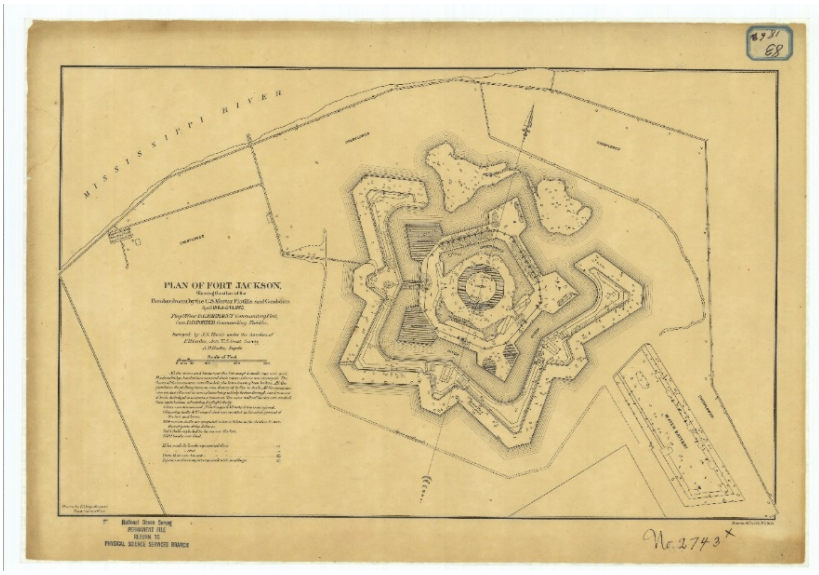
Bache was a "member of the 'Commission on Conference,' a secret committee set up to devise strategy for the anticipated naval blockade of the Confederates along the Atlantic and Gulf coast. He directed a compilation of the most recent revisions of nautical charts, sailing directions for mariners…"[26]

Bache quickly transformed the civilian Coast Survey into an arm of the war effort. As noted by one of his contemporaries (who had previously served with the Coast Survey), Cmdr. Charles H. Davis, U.S. Navy:

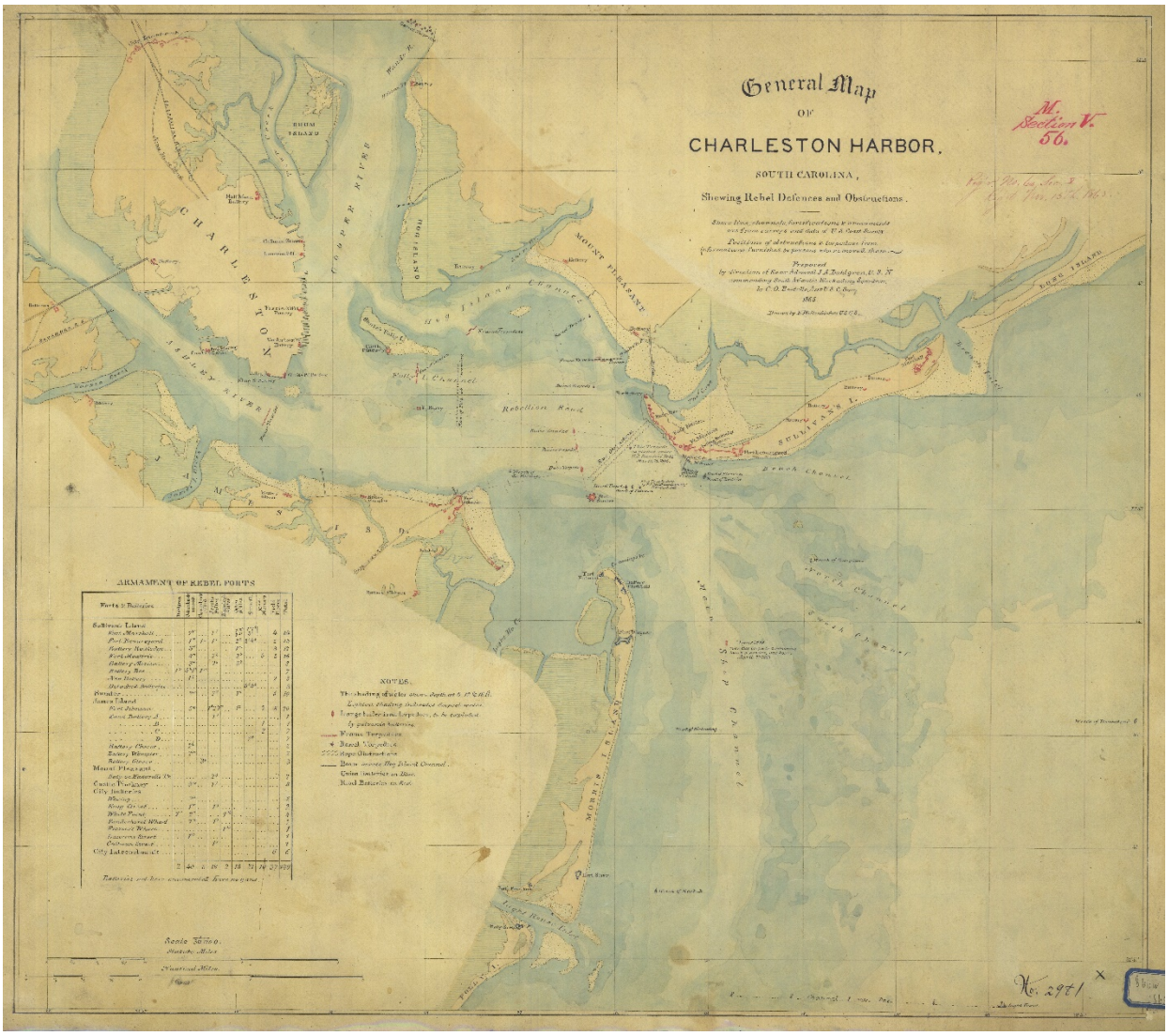
> Bache's ingenuity has been exercised in discovering methods of making the coast survey cooperative in the great movement of the day. The new commission I have already spoken of; in addition to this, he has made special surveys, made and distributed maps of the seat of war, and, above all, he has managed so as to have calls made on his office for reconnaissances; and he is now, by means of his assistants, actually performing the duty of a topographical corps to this division of the army, for which service he has received the thanks and compliments of the President, the Secretary of War, and the general-in-chief. And his assistants will accompany the army in its advance, and from the active members of the topographical staff. He certainly possesses a very remarkable talent for this kind of government.[27]

Serving in all theaters and with all major commanders

Throughout the war, Coast Survey personnel served in all theaters and with all major commanders. They served as hydrographers, topographers, and scouts, oftentimes in advance of the front lines. After a Coast Survey reconnaissance party gave positions and distances for stationing mortar boats in the 1862 bombardment of Fort Jackson, for example, the team depicted the flotilla's successful campaign, in Plan of Fort Jackson Showing the effect of the Bombardment by the U.S. Mortar Flotilla and Gunboats.



Coast Survey's charts also helped the nation recover, economically, from the war. For instance, following the Confederate evacuation of Charleston in 1865, the General Map of Charleston Harbor, South Carolina, Showing Rebel Defences and Obstructions guided efforts to remove obstructions to the harbor, facilitating the resumption of commerce.

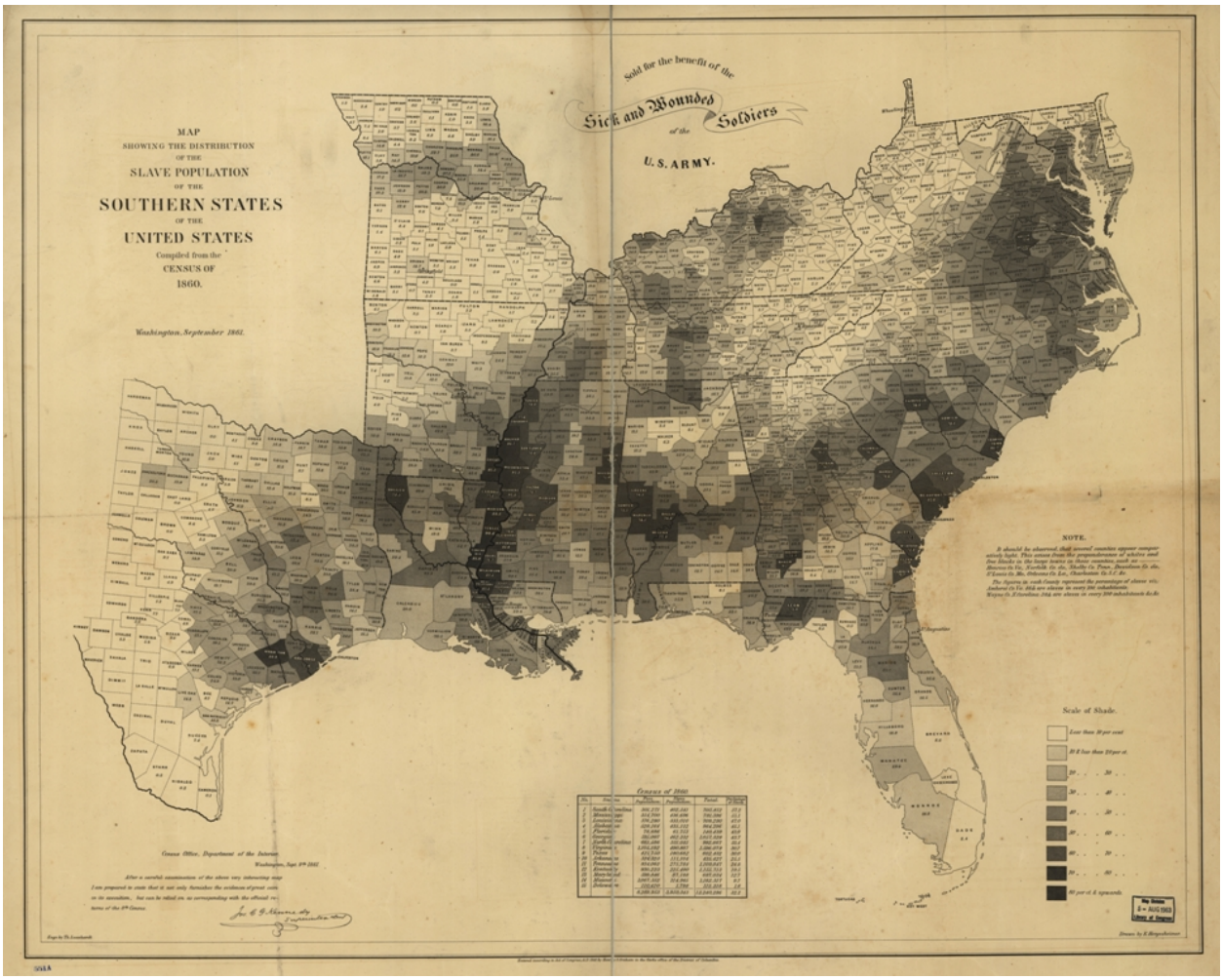


Destabilizing the South

Commercial lithographer Henry S. Graham printed the Map Showing the Distribution of the Slave Population of the Southern States of the United States, a choropleth map based the 1860 census. Although the development of this slave density map was a collaborative government effort, cartographers working for Edwin Hergesheimer, U.S. Coast Survey Drafting Division, created it. It was "Sold for the benefit of the Sick

and wounded soldiers of the Union Army," which indicates the involvement of the U.S. Sanitary Commission, of which Bache was vice-president. Note, however, that it does not "credit" the Coast Survey. [xii]

This map was more than a collaborative effort initiated by the federal government; it is a reflection of the beliefs of the cartographers and administrators who made it. The Coast Survey took the statistics from the 8th Census, supervised by Joseph Camp Griffith Kennedy, who was pro-Union and created controversy regarding the information to be gathered about slaves. Kennedy wanted to include slaves by name, but Congress refused. Superintendent Bache was also pro-Union, and allowed his staff to undertake such a map. Hergesheimer was an immigrant from Germany, who left his native country after the failed 1848 liberal revolution in Germany, to lend his expertise to the U.S. Coast Survey. Hergesheimer and his German colleagues were largely against slavery and strongly supported the Union.



They created the map to explain the secession crisis, providing a visual link between secession and slavery by showing that the states seceded in the order of their slave density. The mapmakers consciously limited the map to just the Southern states, including the border states of Maryland, Virginia, and Kentucky, but not the

[xii] For a definitive study of the slave density chart, see Susan Schulten, "Visualizing Slavery," *The New York Times Opinionator*, December 9, 2010.

western slave states of Nebraska, New Mexico, and Utah. During and after the war, the Union could use the map to argue that the destruction of the Confederacy meant the destruction of slavery.

According to artist Francis Bicknell Carpenter, President Abraham Lincoln frequently consulted this map in considering the relationship between emancipation and military strategy. Carpenter, who took up residence at the White House in February 1864 to paint President Lincoln, wrote that Lincoln would look at the map and send his armies to free blacks in some of the highest density areas in order to destabilize Southern order.[28] Carpenter painted the map into symbolic significance in his painting "First Reading of the Emancipation Proclamation of President Lincoln," which is now located in the U.S. Capitol.

In this painting, Carpenter captures the moment Lincoln announces his decision for emancipation to his cabinet. The slave density map is purposely placed in the corner, demonstrating the weight of this proclamation in graphic and statistical terms.

Responding to Congress and local officials

Through the centuries, Coast Survey has fulfilled requests from elected officials – especially those officials who controlled the purse strings that enabled the Survey to chart the coast. Elected officials who are responsive to their constituents often have important insights into what work can best advance their region's economic development. Accordingly, Superintendent Bache strove to respond to official requests as rapidly as possible, without jeopardizing the agency's integrity or scientific validity.

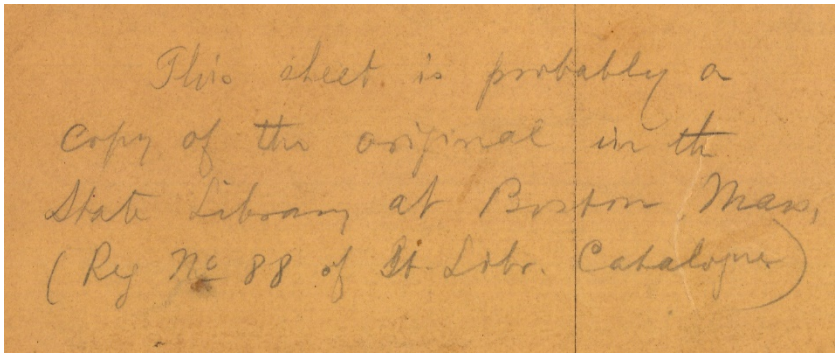
"A very violent motive" for the Boston Harbor chart"

> "I certainly did have Boston Harbor surveyed two years before it would have been done in the regular course. But then I had a very violent motive for this; namely, an appropriation made by the State of Massachusetts to hasten the survey of the coast; an act of liberality which has never

been imitated by any other State in the Union. We have two large manuscript maps of Boston Harbor[xiii], which you will see in the State House, in the month of October next, of a very finished character."

— Alexander Bache, AAAS Proceedings, 1849

This is likely the H-sheet that Bache was referring to. In the lower right corner, in faint pencil, someone wrote: "This sheet is probably a copy of the original in the State Library of Boston, Mass…"



Charting Maine "in a deliberate bid for his support"

Coast Survey published nine new charts of Maine waters during the 14 years between 1866 and 1880, a dedication of resources that was quite exceptional given the vast amount of work awaiting them around the country. According to Thomas Manning, author of *U.S. Coast Survey vs. Naval Hydrographic Office: A 19th-Century Rivalry in Science and Politics*, dedicating resources to Maine may have been the result of political necessities.

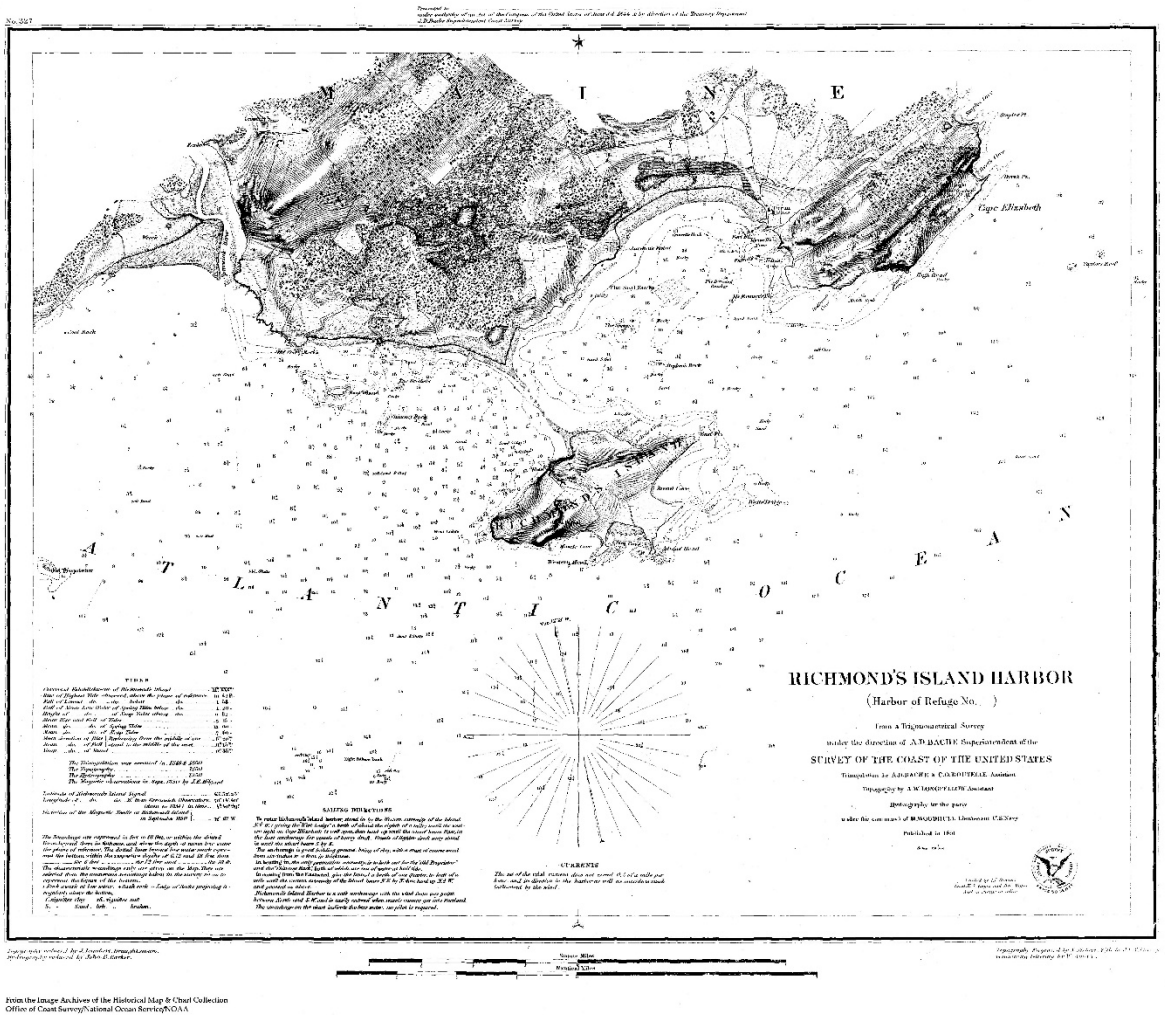
"James G. Blaine of Maine came from a state with a long and much-indented coastline," Manning wrote of the then-Congressman. "When the Coast Survey, in a deliberate bid for his support and to help American

[xiii] The earliest Coast Survey "Boston Harbor" chart in the Historical Map & Chart Collection is from 1856.

yachtsmen, operated continuously on the Maine coast after 1865, Blaine, first in the House and then in the Senate, responded effectively in getting money for the bureau."[29]

While Blaine's support was undeniably helpful, it must be noted that Coast Survey was active on the Maine coast more than a decade before Blaine was elected. In fact, Coast Survey's 1850 annual report tells us about some of the work, including for the chart of Richmond's Island Harbor (below):

> "The requisite magnetic observations for charts of Newburyport, Portsmouth, mouth of Saco river, and Richmond's Island harbor, have been made. The secondary triangulation of the coast of New Hampshire and Maine has been extended, and a special survey of Richmond's Island harbor -- a harbor of refuge at the entrance of Casco Bay -- has been made."



From the Image Archives of the Historical Map & Chart Collection
Office of Coast Survey/National Ocean Service/NOAA

Still, Bache knew he had to obtain the resources necessary to advance the work of the Survey, as needed by a growing Nation, and he was responsive. Blaine was in the House from 1863 to 1876 (as Speaker from 1869 to 1874), and then in the Senate from 1876 to 1881. Coast Survey published a new Maine chart in 1866, 1867, 1868, 1870, 1871, 1873, 1875, 1876, and 1880. After Blaine left Congress and became U.S. Secretary of State (1889-92), Coast Survey published five more Maine charts (1883, 1885, 1888, 1890, 1895), and then didn't issue another until 1915 – an interval of 20 years.

Yale's New Haven map

Manning also points out that Yale College President Noah Porter, geologist James D. Dana, and other members of the Yale faculty petitioned the Survey in 1870 for a map of the city of New Haven and its environs. 1870 is generally considered to mark the beginning of the era of the city's regional dominance[30], and Yale was expanding[xiv]

The area depicted on Chart 362, Harbor of New Haven, 1875, was surveyed two years after the request, in 1872. In 1877, commercial chart makers produced a combined hydrographical/topographical map, City and Vicinity of New Haven 1877 "derived wholly from the maps of the U.S. Coast Survey and of the City Engineer Department."

Approaches to Baltimore Harbor

The United States suffered an economic depression from 1893 to 1897. In 1896, with the country looking to recovery, Baltimore maritime interests needed new charts. On a squeaker vote, Congress approved almost $54,000 for a resurvey of the Chesapeake Bay, last mapped 47 years before. (See the 1865 chart, Approaches to Baltimore, surveyed in 1849.) With the dedicated congressional funds, the Coast and Geodetic Survey re-surveyed the bay from 1896 to 1899, and published the new Approaches to Baltimore Harbor in 1900.

Mapping Alaska

On March 29, 1867, Russian Ambassador Baron de Stoeckl informed Secretary of State William Seward that the tsar had agreed to sell Russian interests in Alaska to the United States. Stoeckl and Seward drafted a treaty that same night. On March 30, the countries considered Alaska as "sold." But there was still a legislative hurdle to clear: on June 20, President Andrew Johnson signed the treaty and sent it to the United States Senate for confirmation."[31]

Reconnoitering "Seward's Folly"

The purchase was controversial. On May 18, 1867, during the tumult and debate over "Seward's Folly," Coast Survey Superintendent Benjamin Peirce telegraphed George Davidson, head of the Survey on the West Coast, conveying Treasury Secretary McCulloch's request for a reconnaissance of the coast of Alaska. U.S. Coast Survey thus became a pioneer federal agency in Alaska when Davidson accompanied the Revenue Cutter *Lincoln* as it departed for Alaska on July 21.

The U.S. officially purchased Alaska on August 1, just days before Davidson's group arrived in Sitka on August 11. After aggressively reconnoitering for a month, it became apparent that the explorers would have to leave, according to Davidson's report. On September 13, in Unalaska:

> "...the proposed trip to the island of St. Paul, about two hundred and forty miles to the northward in the Behring Sea, was abandoned by Captain Howard, and also that to Cook's Inlet, on account of the lateness of the season, the short supply of coal, and the anticipated bad weather. Therefore our destination was Sitka direct, that the vessel might take part in the

[xiv] From 1870 to 1899, Yale's faculty grew from 64 to 260, and the student body from 755 to 2684. http://guides.library.yale.edu/yalehistory

ceremonies attending the transfer of the territory, and the raising of the American flag by the commissioner."[32]

When Davidson reached California, he submitted a voluminous report on what they found. (See page 187 to 329 in the Survey's 1867 annual report.) He began the report:

United States Coast Survey Station
San Francisco, California, November 30, 1867

Dear Sir: I herewith submit the report of the operations of my party on the geographical reconnaissance of Alaska.

The first part exhibits the inception and plan of work proposed, and the details of execution; then follow descriptions of the coast, of the great oceanic currents of the North Pacific, and the discussion of their influence upon the routes between Japan and China and the Pacific coast of the United States; of the climate, vegetable productions of the country, the minerals, fisheries, furs, &c., and of the inhabitants and their prospective relation to the new order of rules and trade, with official statements of their numbers. Details of the coast line, harbors, bays, headlands, &c., are given, in part from personal observation, but principally from the descriptions of Vancouver, Mearer, Portlock, Dixon, Lisiansky, &c. A list of four hundred and thirty-four geographical positions is given in the appendix.[33]

After Davidson's initial reconnaissance, Coast Survey's work in Alaska largely followed the development of natural resources and defense requirements, when funds allowed.

George Davidson compiled Coast Survey's first "base map" of Alaska (Northwestern America Showing the Territory Ceded by Russia to the United States) from the maps of the Russian captain, Mikhail Tebenkoff, from manuscript maps furnished by Prince Dmitry Petrovich Maksutov, the last governor of Russian America, and from Davidson's own observations.

Actual Coast Survey hydrographic surveys began four years later, in August 1871, in the vicinity of the Aleutian Islands, when Assistant W. H. Dall led a field party with the schooner *Humboldt*. Dall's survey data was used to create the chart of Iliuliuk Harbor, issued in 1875. Other Alaska charts issued in 1875, using data collected by Dall, include Shumagins Harbors, Port Mulgrave, and an assortment of sketches.

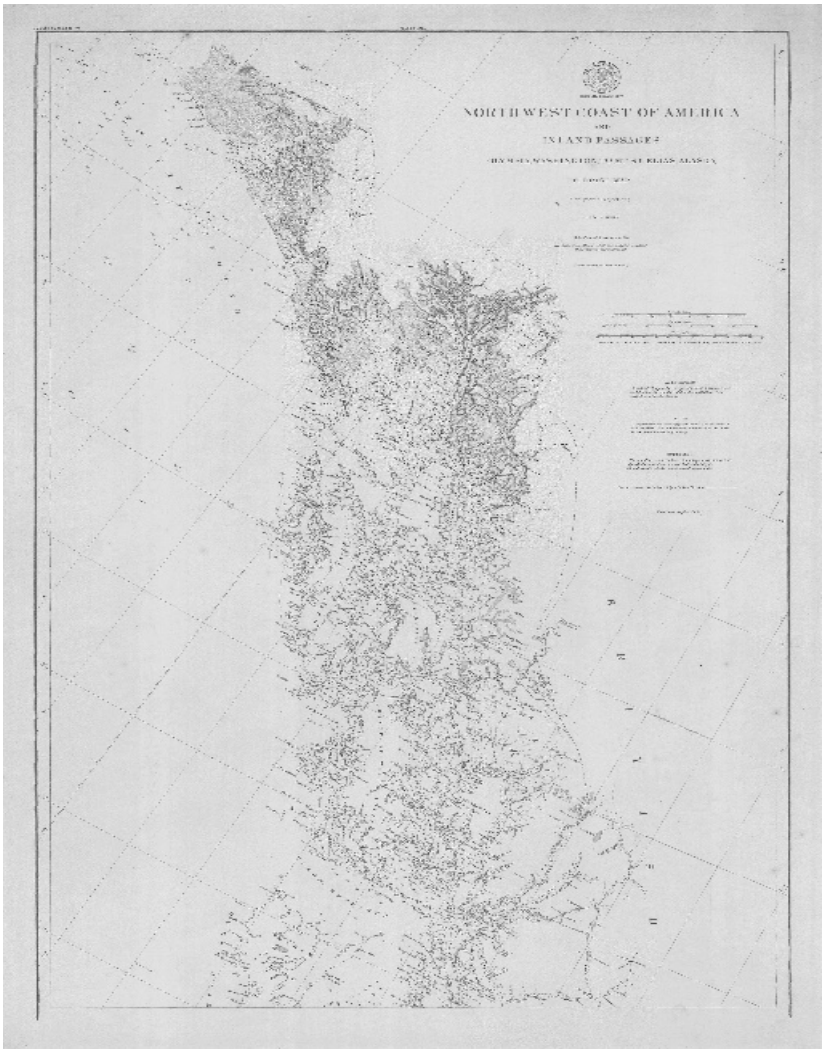
Opening navigation to gold fields

Coast Survey experienced severe budget reductions in the late seventies, and Alaskan work was suspended. But then, in 1880, gold seekers Joe Juneau and Richard Harris Juneau discovered gold.*

In 1882, due to the gold discovery – but also because of the developing salmon-canning industry – Coast Survey revived the Alaska work, and began charting the "Inside Passage" through the Alexander Archipelago (1,100 islands). According to historian Thomas Manning, "commercial and fishing interests, centered in San Francisco, were insisting that interior passage of southeastern Alaska, like Wrangell Strait, needed more mapping to uncover their hidden dangers."[34]

* The Juneau Convention and Visitor's Bureau points out that Tlingit Chief Kowee first pointed Harris and Juneau in the direction of gold.

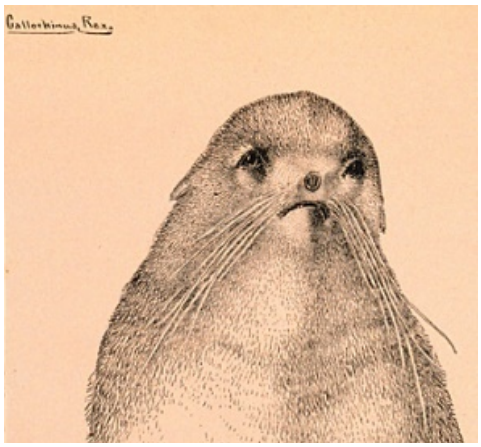
The initial chart of Alaska and Adjoining Territories was published in 1884, with an updated version in 1887. In 1889, the Coast and Geodetic Survey published the nautical chart of the Northwest Coast of America.



In 1896, more gold was discovered, this time in the Klondike. The Klondike strike made Saint Michaels the new objective for ocean freight. The sea route from Puget Sound to Saint Michaels crosses the Aleutian Archipelago, so large-scale charts were needed. The route passes Nunivak and Saint Lawrence islands, so C&GS charted that area. Congress appropriated $100,000 to survey the Yukon River, a passageway to the gold fields, and despite survey teams searching for "depth" in the Yukon delta, their work was in vain.

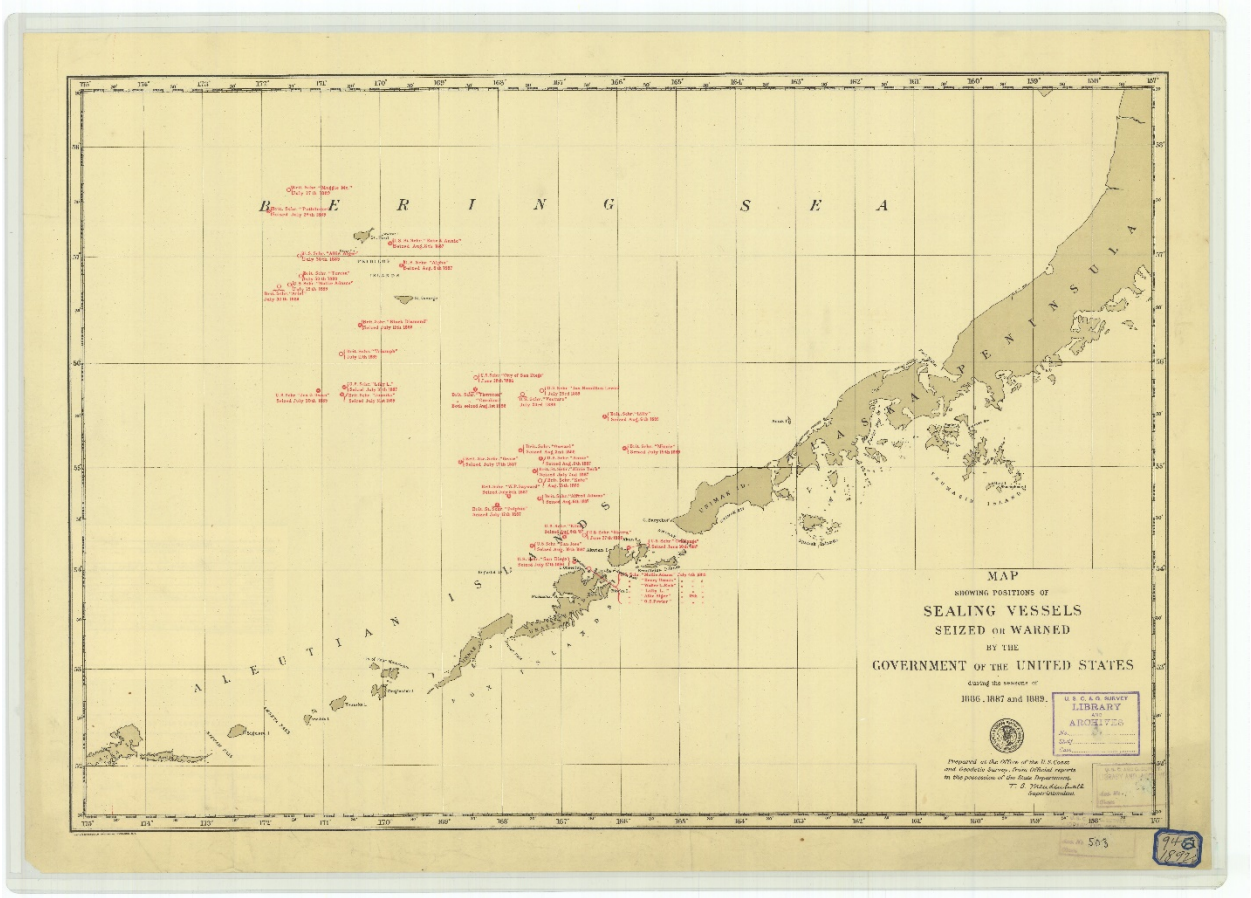
Then, in September 1898, gold was discovered in Nome, so Coast Survey charted Norton Sound to help ensure safe passage for the miners and the supporting commercial interests.

Protecting Alaska's fur seals



Part of a sketch by Henry Wood Elliott, 1873

Another "resource" of Alaska, in the Pribilof Islands, was the northern fur seal. As explained by the NOAA video "Henry Wood Elliott: Defender of the Fur Seal," the fur seal's pelt had been sought after for centuries, and was hunted close to extinction. Hunting was an international affair, but after the U.S. purchase of Alaska, the U.S. Treasury granted an exclusive harvest lease to the Alaska Commercial Company, which was allowed to take 100,000 seals each year. But, poaching became rampant. (See "North Pacific Fur Seal Treaty of 1911.") To educate policy makers on the scope of the problem, the Survey worked with the U.S. State Department to produce the Map Showing Positions of Sealing Vessels Seized or Warned by the Government of the United States during the seasons of 1886, 1887 and 1889.



President Grover Cleveland acted with tact and authority to protect the diminishing fur seal population. A year after his Proclamation 385 – Inclusion of the Bering Sea in Prohibition of Killing Fur-Bearing Animals in Alaska, signed on April 14, 1896, Coast Survey directed Assistant Will Ward Duffield to organize a party at Seattle for the survey of the Pribilof Islands, which began on May 25, 1897, and continued until 1898.

From the 1898 annual report:

> "In Alaska, where a long and tortuous coast and a suddenly developed commerce are imposing upon the Survey work of a most important character, good progress was made. The Pribilof Islands were completely surveyed and mapped and good progress was made in the surveys of southeast Alaska."

That year, the Survey published 13 topographic and nautical charts of the fur seal rookeries (charts 3215 to 3228).

Charting dangers "from reports of vessels which have been wrecked on them"

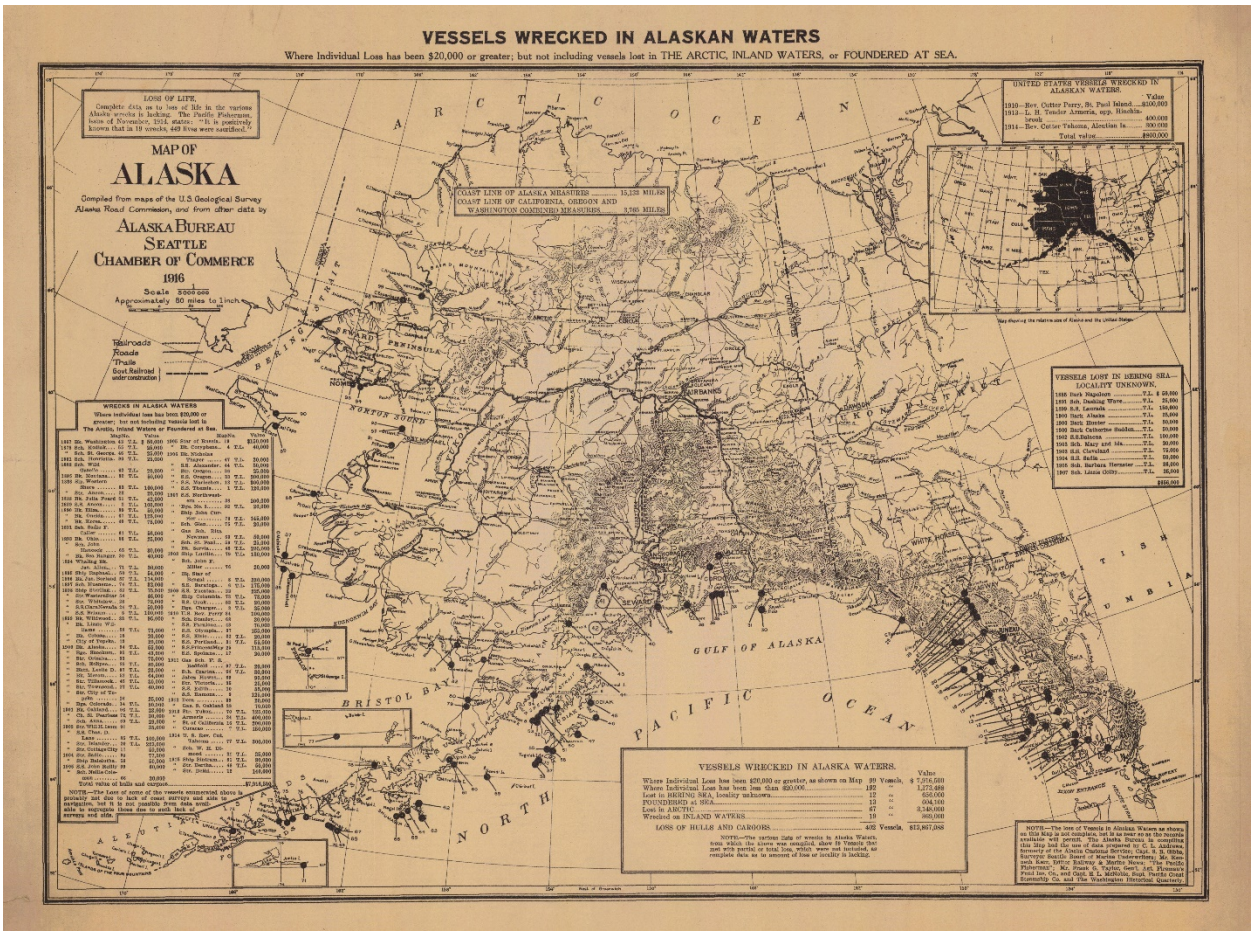
Assigning field survey teams to areas experiencing economic growth was supposed to meet the short-term needs of the commercial sector, ala Superintendent Bache's plan in 1844. But it gave short shrift to the steady and thorough progress envisioned by Superintendent Hassler in the 1830s. As an "editorial" in the July 1901 *National Geographic* put it:

> "The problem to be solved by the Coast and Geodetic Survey has been one where a nice balance had to be established between accuracy on the one hand and the pressing need for large results on the other. Instead of being able to concentrate its field force on one portion of the coast and accomplish a steady advance with uninterrupted sequence season after season, it has been constrained to scatter its parties and follow the erratic movements of the prospector and miner."[35]

President Woodrow Wilson also called for better charts in Alaska, pointing out the "ships and lives have been lost, in his message to Congress on December 8, 1914:

> There is another matter of which I must make special mention, if I am to discharge my conscience, lest it should escape your attention. It may seem a very small thing. It affects only a single item of appropriation. But many human lives and many great enterprises hang upon it. It is the matter of making adequate provision for the survey and charting of our coasts. It is immediately pressing and exigent in connection with the immense coast line of Alaska, a coast line greater than that of the United States themselves, though it is also very important indeed with regard to the older coasts of the continent. We can not use our great Alaskan domain, ships will not ply thither, if those coasts and their many hidden dangers are not thoroughly surveyed and charted. The work is incomplete at almost every point. Ships and lives have been lost in threading what were supposed to be well-known main channels. We have not provided adequate vessels or adequate machinery for the survey and charting. We have used old vessels that were not big enough or strong enough and which were so nearly unseaworthy that our inspectors would not have allowed private owners to send them to sea. This is a matter which, as I have said, seems small, but is in reality very great. Its importance has only to be looked into to be appreciated.

It was clear that Alaska's resource development was outstripping Coast Survey's ability to chart the vast coastline. (See this 1916 map showing the distribution of mineral deposits in Alaska.) The Alaska Bureau of the Seattle Chamber of Commerce illustrated the extreme need for nautical charts in 1916.



Vessels Wrecked in Alaskan Waters, where individual loss has been $20,000 or greater; but not including vessels lost in the Arctic, inland waters, or foundered at sea, 1916

Coast and Geodetic Survey spoke loudly about the dangers, as reported in the 1918 annual report:

> The amount of these natural resources ripe for exploitation has been so great and the prize they offered so tempting that transportation could not wait for the Government to make the way to them secure. It has gone ahead, finding its own path to each new field, suffering great losses in so doing, but content to suffer them because the returns were so immensely greater.
>
> The Coast and Geodetic Survey, which in this field should have been the pioneer showing the way for commerce to reach each new enterprise, has, instead, been following impotently behind, charting dangers less from data obtained by its own surveys than from reports of vessels which have been wrecked on them.
>
> It is high time that such a state of affairs be corrected, yet it will now take years before the surveys can reach a point where they can even meet the needs of present commerce.[36]

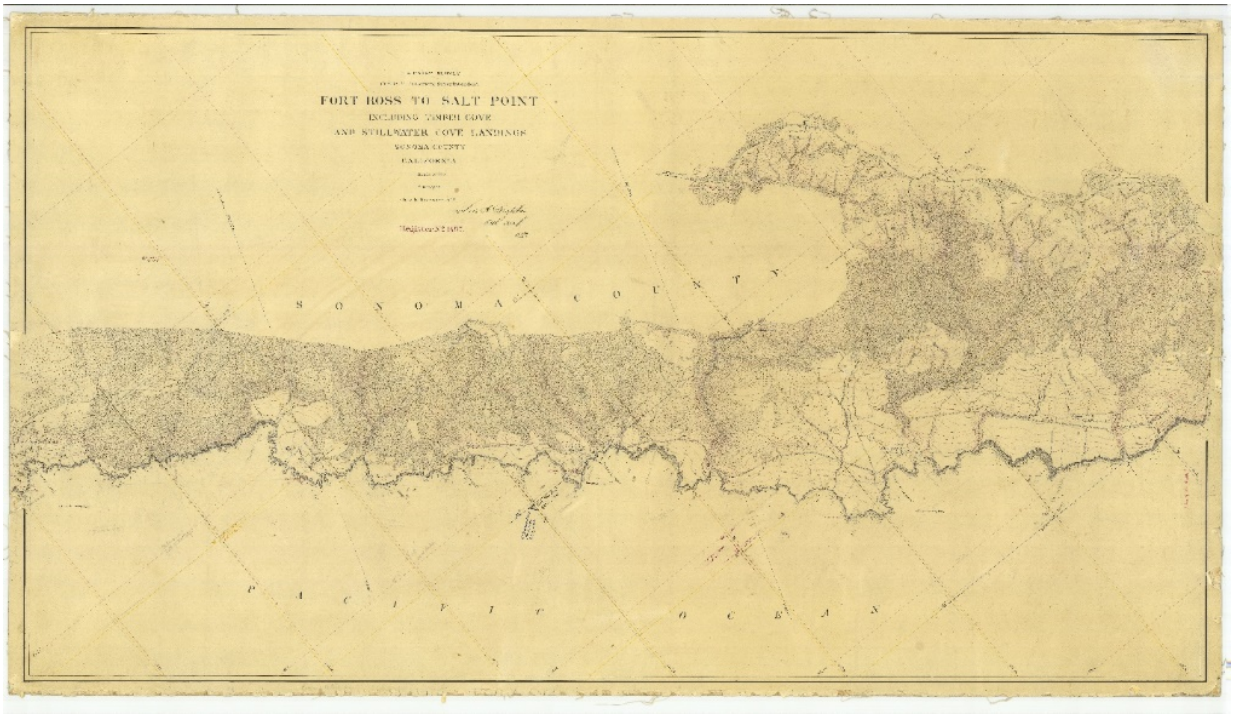
A nation rich in resources

Transporting forest products

"Prior to the California Gold Rush, explorers noted the magnificent stands of coastal redwoods, the world's tallest trees, growing in a swath north to what is now the Oregon border," says Matthew Lawrence, from NOAA's Office of National Marine Sanctuaries. "The hostile coastline without rivers navigable by an ocean-going vessel kept people away from the desirable timber. As the West Coast grew increasingly urban, demand for lumber pushed enterprising entrepreneurs north of San Francisco Bay in search of wood and forest products."

Increasing demand for lumber in the 1860s led to innovations in harvesting and transporting the redwoods. Without large harbors, roadways, or trains, the innovators designed unique transshipment systems, moving the lumber from high coastal bluffs to vessels waiting in "doghole" ports. Lawrence explains that the unusual port description was a "reference to their diminutive size. Mariners felt they were barely large enough for a dog to turn around."

Between 1860 and 1930, the Coast Survey created "T-sheets" and nautical charts to help mariners safely anchor as they awaited the lumber cargos. (T-sheets as shown below were a part of the process of surveying the coast. Triangulation was first, followed by topography – the "T-sheets" – followed in turn by hydrography. All went into the final product: the nautical chart.)



T-Sheet: Fort Ross to Salt Point including Timber Cove and Stillwater Cove Landings, Sonomo County, California, surveyed July to November 1876

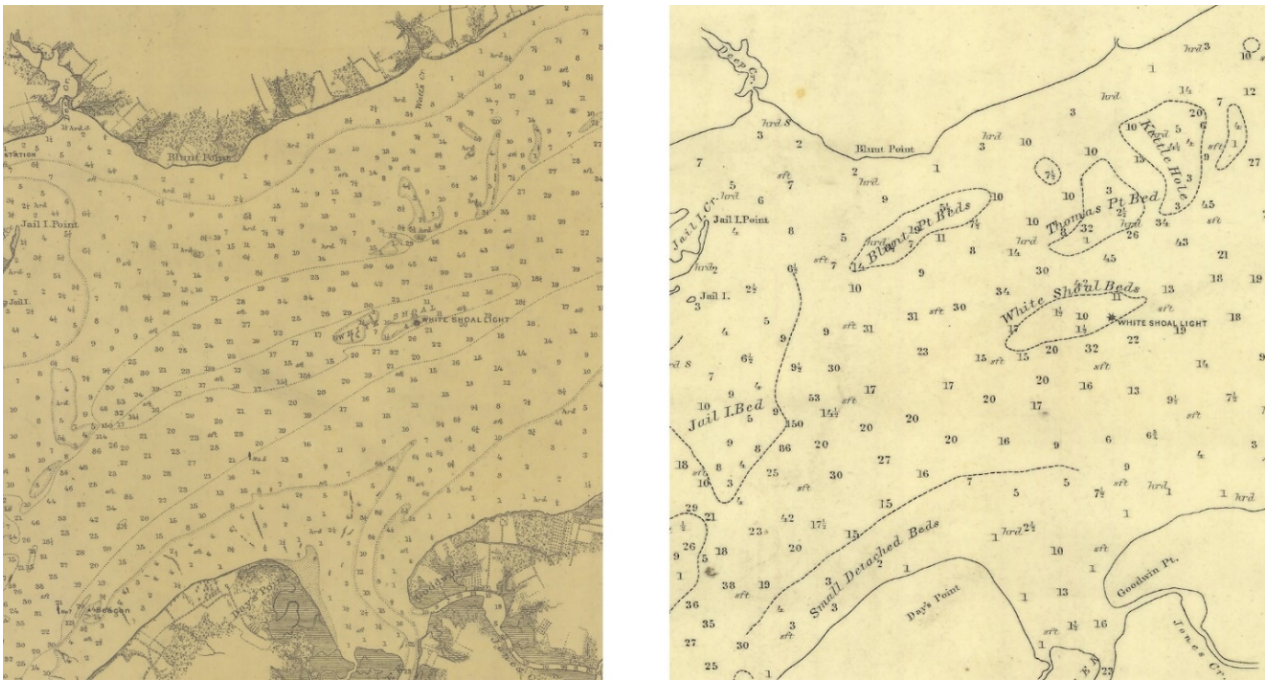
Mapping and monitoring oyster beds

The 1879 annual report refers to a special hydrographic investigation "in regard to the growth of oysters." The Survey was responding to a request by the United States Fish Commissioner, Prof. S.F. Baird, who wanted to preserve "food-producing mollusks" in Chesapeake Bay. The research project was assigned to C&GS Assistant Francis Winslow.

In 1878, Winslow examined oyster beds along 40 miles in the James River, and in Tangier Sound and Pocomoke Sound. His party observed the currents, noted water temperatures, took soundings, and preserved bottom specimens.

As John Cloud writes in his masterful report, "Oysters, Hydrography, and Francis Winslow[37]," once Winslow was tapped to begin Coast Survey research on oysters, "he began a two-pronged strategy: he would apply the by-now familiar skills of Coast Survey geodesy and hydrographic mapping to these mollusks, and he would begin fundamental studies in the biology and development of oysters, a research frontier completely beyond anything the Survey had ever attempted."

Winslow's "original distribution data, especially from the coast of North Carolina, are now foundational for oyster bed restoration 130 years later," Cloud writes.



Coast Survey chart 401A, James River, in 1877, and Winslow's 1878 special version of the chart with oyster data.

Charting shoals for the fishing industry

By 1909, Coast Survey recognized that their earlier charts of Nantucket Shoals were "nowhere adequate and are particularly subject to wrong locations because of the strong and variable currents" which earlier surveys had not accounted for. They additionally recognized that showing the outer limits of the shoals would help ship avoid the area, but the shoals are also important fishing grounds.

As explained in the 1917 annual report:

> The ground fishing industry, especially for flounders, which has in recent years assumed large proportions, is steadily moving seaward, as an area once fished over has to be left for years to recover. Nantucket Island is during the winter the headquarters of this industry. Not only do the present charts not give the needed information in the search for new grounds, but the absence from the chart of existing shoals is a source of danger to the boats running to and from the harbor. Breakers often occur where there is ample depth for boats when the water is smooth. This is an excellent example of how a region usually avoided by commerce may be of importance to an industry which furnishes part of the food supply of the nation.[38]

Editions 3 and 4 of chart 51 were issued in 1910 and 1912, respectively.

Territorial expansion

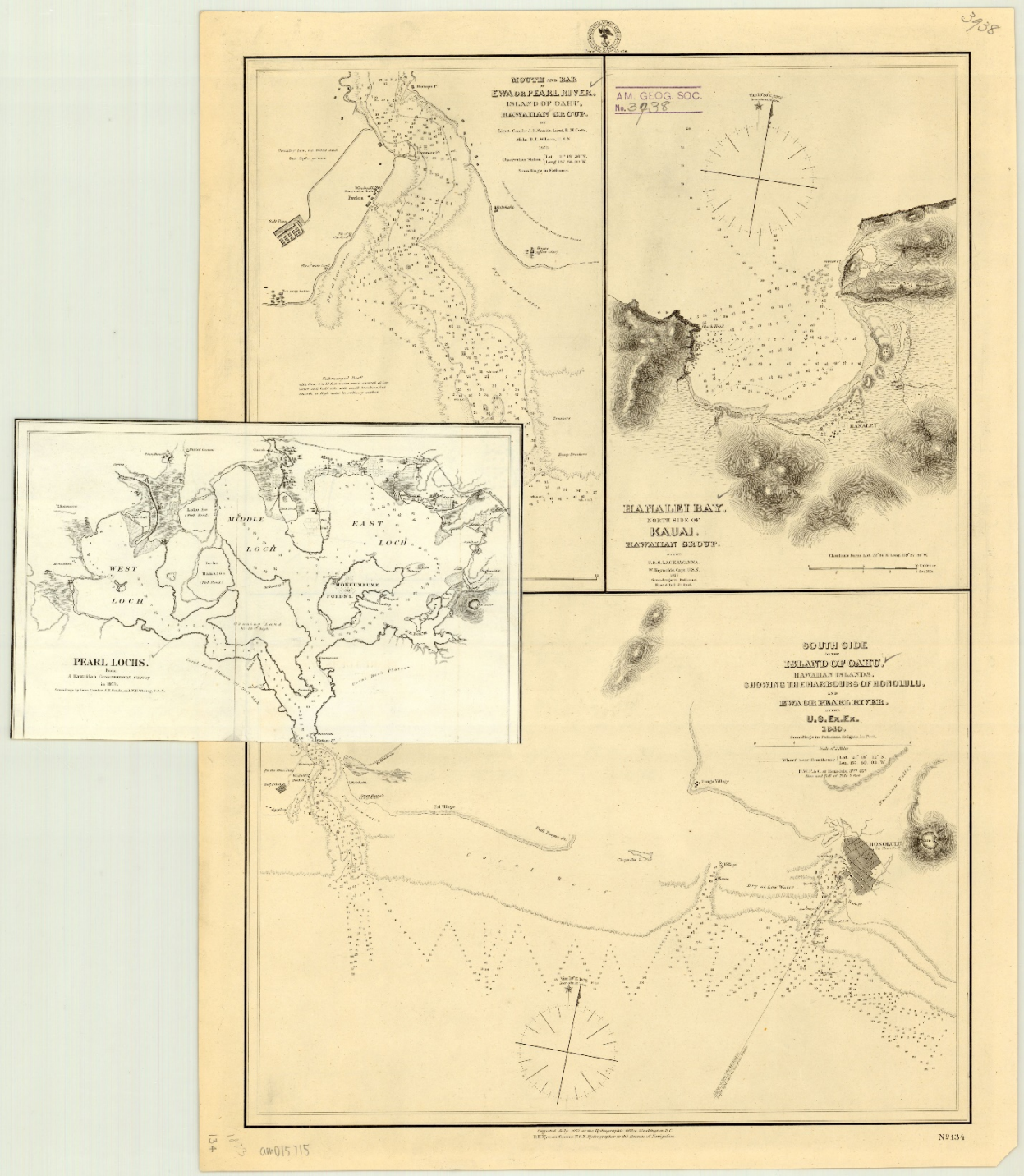
Hawaii

On January 17, 1893, a group of American sugar planters, organized by Sanford Ballard Dole, overthrew Hawaii's monarch, Queen Liliuokalani. The day before the coup, the U.S. minister to Hawaii sent a note to the commander of USS *Boston*, which was in the Honolulu Harbor:

> UNITED STATES LEGATION,
> Honolulu, January 16, 1893
>
> SIR: In view of the existing critical circumstances in Honolulu, including an in-adequate legal force, I request you to land marines and sailors from the ship under your command for the protection of the United States legation and United States consulate, and to secure the safety of American life and property.
>
> Very truly, yours,
> JOHN .L. STEVENS,
> Envoy Extraordinary and
> Minister Plenipotentiary of the United States.[39]

In June 1897, President McKinley signed a treaty of annexation, but approval was defeated in the Senate. Regardless, after the U.S. Battleship *Maine* was blown up in Cuba, the ensuing Spanish-American War – part of which was fought in the Philippine Islands – "established the strategic value of the Hawaiian Islands as a mid-Pacific fueling station and naval installation."[40] The strategic value of the Hawaiian Islands was a factor in convincing Congress to approve annexation of Hawaii. McKinley signed the Newlands Resolution to create the Territory of Hawaii, on July 7, 1898.

Until 1898, the Hawaiian Government Survey had been producing the islands' nautical charts, with assistance from the Hydrographic Office of the U.S. Navy since at least the mid-1800s, as shown on this array (below) of Hawaiian charts.



Charts are in the collection of the [American Geographic Society Library](), reprinted here under the authority of a NOAA-AGSL Memorandum of Understanding.

In 1888, Coast and Geodetic Survey provided assistance in determining accurate latitude and gravity and, in 1898, the Survey published its first nautical chart of the Hawaiian Islands (chart 4100, 1898) – but C&GS used Hawaiian Government surveys and British Admiralty charts as the source.

On March 3, 1899, Congress approved appropriations for the Coast and Geodetic Survey, including:

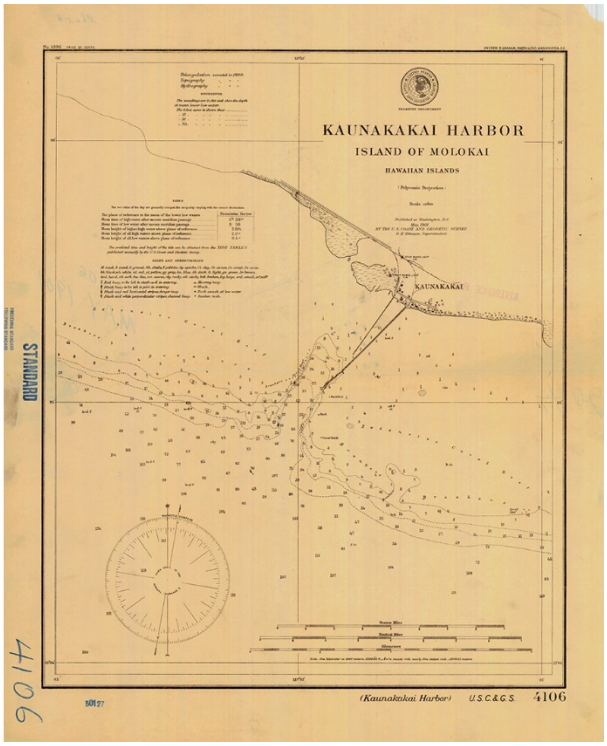
> "For surveys and necessary resurveys of the Pacific coast, including the Hawaiian Islands and Alaska and other coasts on the Pacific Ocean under the jurisdiction of the United States, to be immediately available, and to remain available until expended: *Provided*, That not more than twenty-five thousand dollars of the amount shall be expended outside of Alaska and the Pacific coast of the United States, seventy thousand dollars."[41]

Congress also authorized $15,000 for new equipment and necessary alterations for "new steamer *Pathfinder*" which was originally built for surveys in Alaska. That year, Steamer *Pathfinder* sailed for Hawaii to consult with Hawaii's President Dole on where to begin charting. She arrived at Honolulu on December 2, 1899, and C&GS did its first survey in 1900, supporting maritime development for the export of sugar and pineapples. *Pathfinder* commanding officer Assistant F.W. Perkins reported:

> "At the request of President Dole, it was decided to investigate certain harbors at the island of Maui, where facilities for handling freight are quite insufficient at present and the demand upon them is increasing."[42]

From then on, chart 4100 (1902) Hawaiian Islands was updated with C&GS surveys, and new Survey charts were forthcoming.

One example of Survey charts supporting Hawaii's economic development is Molokai's Kaunakakai Harbor. Rudolph Meyer established the Meyer Sugar Mill in 1878, and they needed easier access to sea-going vessels. As these two charts show, a lengthy wharf was built out to the 22-foot depth, and connected the mill with new railroad tracks.



On the left is a privately-created working sheet from 1882, showing the entrance into Kaunakakai Harbor before the Meyer Sugar Mill was built. On the right is the Survey's 1901 chart, showing safe transit for export shipments.

Puerto Rico

The Spanish-American War lasted from April 21 to August 13, 1898. According to the Survey's 1898 annual report:

> The resources of the Survey were utilized to furnish the greatest possible amount of assistance to the military and naval authorities in the conduct of the war. In addition to the collation and preparation of information regarding maps of Puerto Rico, Cuba, and the Philippines the Survey furnished to the Navy Department between April 1 and June 30, 1898, 27,678 charts.

The Treaty of Paris (signed December 10), gave U.S. ownership of Puerto Rico, Guam, and the Philippine Islands. The U.S. Navy immediately asked the Survey to chart San Juan Harbor PR, and C&GS Assistant W.C. Hodgkins surveyed the harbor by April 1899, producing this sketch of San Juan Harbor. The Survey was to spend the next ten years charting Puerto Rico and surrounding reefs.

Philippine Islands

The 1901 Coast and Geodetic Survey annual report tells us about the beginning of the massive effort to survey the 7,000 islands of the Philippines:

> "A notable event during the year was the inauguration of the survey of the coasts of the Philippine Islands. Acting upon the information obtained by an officer of the Survey sent to the islands for the purpose of reporting upon existing conditions, an assistant of the Coast and Geodetic Survey was sent to Manila with authority to organize a suboffice and establish the necessary facilities for preparing the data obtained by the surveying parties in the field for immediate publication in the form of preliminary charts."

By 1917, 16 years later, the Survey was able to report:

> "The surveys of the coasts of the Philippine Islands have covered all of the localities that are at present of any commercial importance, the remainder of the work being in localities many of which are dangerous to navigators, but which, at the present date, are seldom visited by vessels engaged in trade."

Surveys continued for charts of Manila, Luzon, and other assorted islands through the 1920s and '30s – with at least 45 charts coming out from 1938 to 1940, and another 23 in 1941 alone! See World War II: Mapping caves in the Philippines for more detail.

Aeronautical charts for the new transportation age

The agency's men and women (Coast Survey hired women professionals as early as 1845) led scientific and engineering activities through the decades. In 1926, they started production of aeronautical charts to meet the requirements of the new air transportation age.

"Immediately postwar [WWI], aviation maps were produced exclusively by the Army and Navy, until the Civil Aviation Act of 1926 began the modern era of civilian flying," John Cloud explains. "Under the act, the Coast and Geodetic Survey was given responsibility for civilian aviation maps. For a century, the Survey had created nautical charts, so it now produced 'aeronautical' charts. The Survey's charts were widely sought after as being superior to all others, and the Survey's name for them was adopted around the world." [43]

> "It is doubtful that the extent and magnitude of the work performed by the Bureau is fully known or appreciated. Long before the actual outbreak of hostilities, the Bureau was engaged in a tremendous program of worldwide charting for the armed forces. This was a logical course of procedure for the Bureau had been engaged for years in the making of aeronautical charts of the United States, Territories, and possessions. The modern aeronautical chart was pioneered and developed by the Bureau. The specifications, standards, and procedures developed during the years of peacetime chart production proved to be invaluable during the emergency... It is to the credit of the Bureau and to the soundness of policies that aeronautical charts came through the war but little changed... The many shortcuts and simplified procedures for aeronautical chart compilation and production developed by the Aeronautical Chart Branch of the Bureau, before the outbreak of hostilities, were invaluable during the critical days of 1942 and 1943."
>
> — Colonel H. Arnold Karo, a future vice admiral in the Coast and Geodetic Survey

"The production of target charts for aerial bombing was an extensive project of major importance. Over 1,800 different target charts were prepared, primarily for the AAF," writes Skip Theberge in his History. "Included among these charts were the important objectives of the Romanian oil fields at Ploesti, the industrial area of Yawata where the first B-29 raids over Japan took place, and the cities of Hiroshima and Nagasaki."

Charting the "magenta line" for recreational boating

> [On May 26, 1906] ...a trio of sailboats cast off their lines in Brooklyn, New York, bound for the history books. The organizers of that 1906 race wanted to bring more yachtsmen into the ocean-racing fold, the way other visionaries were looking to do the same for everyday people in other pursuits. Two years later, the first Model T Ford was built. America was changing forever." [44]

The Survey first installed the "magenta line," or Waterway Route, on nautical charts in 1912, when the advent of motor boating produced a demand for charts of the inland waters and shallower waters along the East Coast. The magenta line, or "red line" in the early charts, gave the boater a suggested route to follow while transiting the often complicated Intracoast Waterway.

As reported in the Survey's annual report in 1912:

> "To meet a growing demand for sailing directions for navigating the inland waterways between the Capes of the Chesapeake and Key West, Fla., an officer was detailed in February to make a careful examination of the entire route and to gather the necessary information. These waterways had previously been shown in the charts and a small leaflet descriptive of them had been published, but as many of the channels are under improvement by the United States Engineers and changes had taken place, it was necessary to examine each link in the system in detail in order to show present conditions adequately."

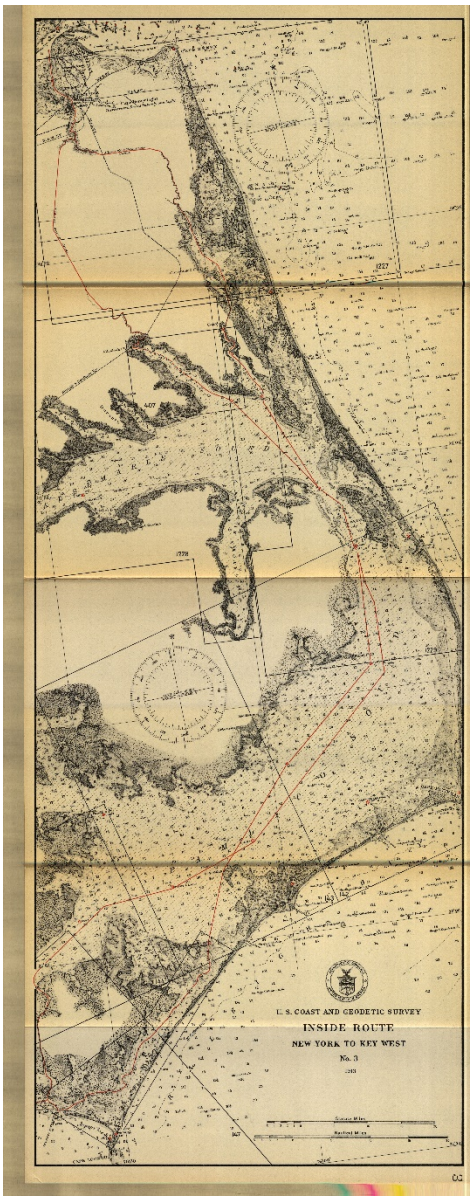
The first known appearance of the "magenta line" is in a set of eight charts (each titled "U.S. Coast and Geodetic Survey INSIDE ROUTE") included in a now-defunct U.S. Coast & Geodetic Survey publication, *Inside Route Pilot*, 1st edition 1912. (This chart edition from 1913, on right, shows the magenta line.)

Why did Coast Survey create the new charts and publication? In the 1911 annual report, Superintendent O.H. Tittman explained[45]:

> "The exacting demands of modern navigation, due to increased traffic, larger size and draft of vessels, and the improvement of channels and harbors, require a corresponding extension of the surveys required to keep the charts up to date. A new chart may require extensive corrections soon after it is issued, and when the number of corrections becomes very great, a new edition becomes necessary. Surveys must be made at frequent intervals to keep pace with changes due to natural causes, to artificial improvements, changes in lights and buoys, and newly discovered rocks and shoals. Many waterways formerly but little frequented are now extensively used, and **the great development of motor boating, has caused an extensive demand for accurate charts of the inland waterways and shallower waters along the coast...**[emphasis added]"

Further into the 1911 annual report, Assistant W.E. Parker explained:

> "EXAMINATION OF INLAND WATERWAYS.
>
> To meet a growing demand for sailing directions for navigating the inland waterways between the Capes of the Chesapeake and Key West, Fla., an officer was detailed in February to make a careful examination of the entire route and to gather the necessary information. These waterways had previously been shown on the charts and a small leaflet descriptive of them had been published, but as many of the channels are under improvement by the United States Engineers and changes had taken place, it was necessary to examine each link in the system in detail in order to show present conditions adequately. The inspection was made in a launch drawing 2 feet forward and 3 feet aft.
>
> "The route taken was as follows: Passing up Elizabeth River and through the Dismal Swamp Canal to Elizabeth City, N. C., thence through the new Government canal to Morehead City and Beaufort. From Morehead City the route was through Bogue Sound to Swansboro, thence out to sea at Bogue Inlet, down the coast to Little River Inlet, and through North Inlet to Winyah Bay, thence to Charleston, thence south to Jacksonville, thence to St. Augustine, thence to Miami, and from Miami to Key West.
>
> "The entire travel from Norfolk to Key West was through inside passages and waterways, except between Bogue Inlet and Winyah Bay and across Bull Bay. At the latter place low tide prevented crossing in the lee of the shoals at the head of the bay. From Biscayne Bay to Key West the route



Inside Route, New York to Key West, No. 3, 1913

was north and west of the keys through cuts dredged by the Florida East Coast Railroad Co.

"Information was obtained regarding the general conditions at places along the route and their facilities for supplying passing craft.

"From Key West the route was retraced to Norfolk, a more detailed examination was made of the waterways, and alternate routes were examined. Particular attention was paid to the shallow waterways not accessible to ocean-going vessels..."

Employing thousands helps Great Depression recovery, improves ICW charts[46]

In 1933, the Coast and Geodetic Survey's Annual Report noted how reduced appropriations "owing to the economic situation" were hurting their work. An important new project was reluctantly deferred:

> "The Bureau repeatedly has stressed the growing obsolescence of its charts of the Atlantic and Gulf intracoastal waterways. The importance of these waters is partly indicated by the fact that for the section from Norfolk to Florida, by 1929 the Federal Government had spent of authorized some $62,540,354 for improvements and that its freight traffic in that year amounted to 52,517,693 tons, exclusive of the ocean freight to and from the larger ports of Norfolk, Charleston, Savannah, Jacksonville, and Miami."

After another couple of years of reduced appropriations, new federal recovery programs kicked into high gear. The magenta line on Intracoastal Waterway charts received major updates in the 1935, thanks to an influx of funding from the Great Depression's Public Works Administration projects.

From the 1935 Coast and Geodetic Survey Review of the Year:

> "Fringing the Atlantic coast from New York to the Mexican border is a system of natural waterways; bays, sounds, and lagoons, linked together almost continuously by narrow, tortuous tidal channels. These waters support an extensive motor-boat traffic carrying local products to centers of distribution, other traffic incidental to the sea-food industry, for which the waters are famous, and for pleasure purposes. The growing importance of these waters has resulted in their extensive improvement under river and harbor appropriations, and when the projects now approaching completion are finished vessels having a draft of not exceeding 7 feet can proceed all the way from Delaware Bay to Miami, while from Choctawatchee Bay to Corpus Christi on the Gulf coast a controlling depth of 6 feet will be available with 9 feet available over the great part of the route."

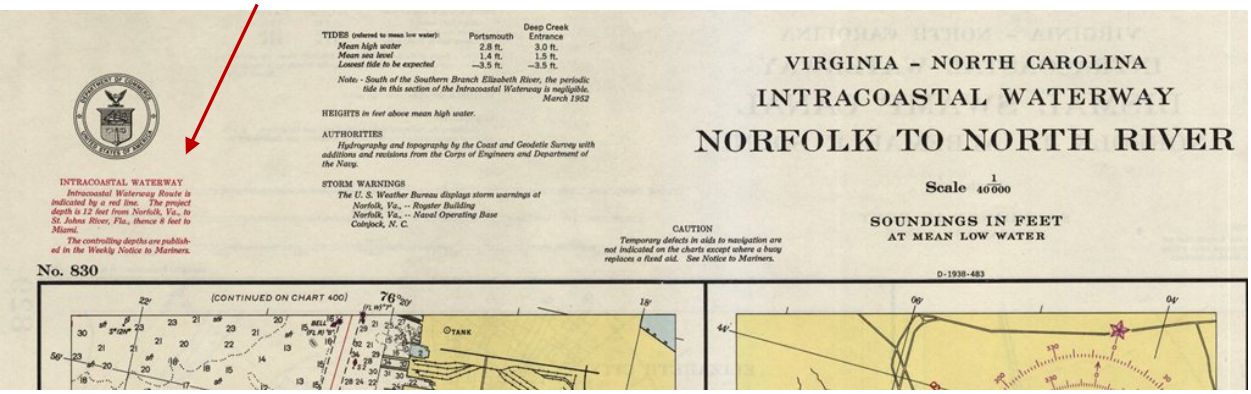
The history of the 1935 updates reflects Roosevelt's strong recovery efforts[47], as the Coast and Geodetic Survey received substantially more appropriations through the Public Works Administration. The regular appropriation for the agency was $2.2 million but, as part of the massive federal effort to pull the country out of depression, an additional $5.1 million in Public Works Administration funds were allotted to the agency. The additional funds more than doubled the manpower: 1,074 employees were paid under regular appropriations and an additional 2,508 employees were paid with Public Works funds. Of the 2,508, 1,991 PW employees were assigned to work in the field.

> "The existing charts of this system of waterways have been based principally on surveys made from 60 to 80 years ago and, necessarily, are obsolete in many respects. Mariners can derive full benefit from the millions of dollars which are being spent in the improvement of the waterways only if those improvements are shown on the charts. For the past several years,

therefore, the Bureau has been urging that funds be provided for this purpose. The granting of Public Works Administration funds provided the needed opportunity. Through their use, while the entire area has not been surveyed, by concentrating on the through route and its most important tributaries, sufficient field surveys have been made so the charts of the entire route can be produced. Numerous other needed harbor revision or other local surveys were made notably along both coasts of Long Island and the north shore of Long Island Sound. On the Pacific coast surveys were made around the islands off the coast of southern California. The newly improved channel for ocean-going vessels in the Sacramento and San Joaquin Rivers was surveyed and charted. Important and difficult wire-drag work along the outer coast was carried on to assure greater safety to coastwise shipping which, in stormy weather, follows the coast as closely as possible."[48]

Also from the 1935 Annual Report's hydrographic and topographic section:

"Entirely new surveys were made of the principal changeable areas of the intracoastal waterways along the Atlantic and Gulf coasts, from New York to Corpus Christi, and the construction lf larger scare charts is now in progress. This accomplishment does not reduce the regular appropriations necessary for Bureau work during a normal year. It simply means the accomplishment with relief funds of work sorely needed for many years to modernize charts, previously beyond the means of the Bureau's normal appropriations. Fourteen shore parties were engaged on this work during the year... United States Coast Pilots and Intracoastal Waterway Pilots, which furnish reliable information to the mariner that cannot be shown on charts, are revised at intervals of 6 to 7 years. Field examinations were made during the year for a complete revision of the United States Coast Pilot, Atlantic Coast, section D, Cape Henry to Key West; United States Coast Pilot, Gulf Coast, Key West to the Rio Grande; and the Intracoastal Waterways Pilots, New York to Key West, and Key West to the Rio Grande."



At some point, the *Inside Route Pilot* was discontinued. The latest edition we have is from 1936. Even though the 1936 edition contains five "Inside Route" charts, it appears that the chart production was changing. Beginning in 1936, the "Inside Route" series of charts were being absorbed into the Intracoastal Waterway nautical charts. See Chart 834 from 1936, which indicates "The Intracoastal Waterway route indicated by a red line." By 1952, the explanation was more expansive. On Chart 830: "INTRACOASTAL WATERWAY. Intracoastal Waterway Route is indicated by a red line. The project depth is 12 feet from Norfolk, Va., to St. Johns River, Fla., thence 8 feet to Miami. The controlling depths are published in the Weekly Notice to Mariners."

The magenta line on Intracoastal Waterway charts updated in 1935 appear to be much the line still on charts until the latest updates were started in 2014, although a more intricate examination would be necessary to determine any changes made in the intervening 77 years.

World Wars

> "Defence is certainly very intimately connected with the purpose of coast survey... Had the bay of New York been known as well then as now, Count d'Estaing would have passed with his vessels of war into the harbor, and would have found the British without the power of effective resistance. Want of knowledge of that channel by the pilots sent to the French fleet induced their commander to abandon, as a hopeless object, an entrance where was really sufficient water for the draught of his vessels."
>
> – U.S. Senator Jefferson Davis, 1849

World War I

On April 6, 1917, the United States declared war on Germany, in the World War that began three years earlier, when Archduke Franz Ferdinand was assassinated. By 1918, over 30 percent of Coast and Geodetic Survey personnel were on active duty with the Army and Navy. With 272 members of the C&GS in active military service, and 5 survey vessels transferred into naval service, the Survey curtailed much of their regularly scheduled hydrographic work. Instead, personnel directed most of their energies to the assistance of the military branches, with the remaining hydrographic parties conducting special confidential surveys for the Navy Department.

Special confidential surveys

The 1918 annual report briefly mentioned some of the hydrographic projects. (*Note: most of the products generated for the war effort are not available in Coast Survey's Historical Map & Chart Collection, nor are they included in the hard copies of the Coast and Geodetic Survey Annual Reports.*)

> Special hydrographic examinations were made by means of the wire drag at points designated by the Navy Department. Among such were the wire-drag surveys in Long Island Sound and in York River (Chesapeake Bay). Quite an extensive wire-drag examination was made of the waters in the vicinity of Eastport, Me. Initial surveys included such work as the location of points for naval fire-control experiments, the reestablishment of the speed-trial course at Lewes, Del., for torpedo-boat destroyers, the location of the Port Jefferson trial course in Long Island Sound, and the Block Island (Rhode Island) trial course.[49]

This C&GS launch was involved in the wire drag survey off Block Island, 1917

Additional war projects included:

- Survey of Hampton Roads naval base, for extensive improvements
- Surveys around the coal piers at Newport News and in the Newport News dredged channel in Hampton Roads, to meet the needs of the Navy Department
- Surveys of the approaches to Portsmouth Harbor NH, approaches to Narrangansett Bay, Long Island Sound, Florida reefs, Cape Cod Canal, and Plymouth Harbor, to "meet the needs of the Navy Department"
- Layout of a one-mile trial course at Alexandria VA, for naval vessels

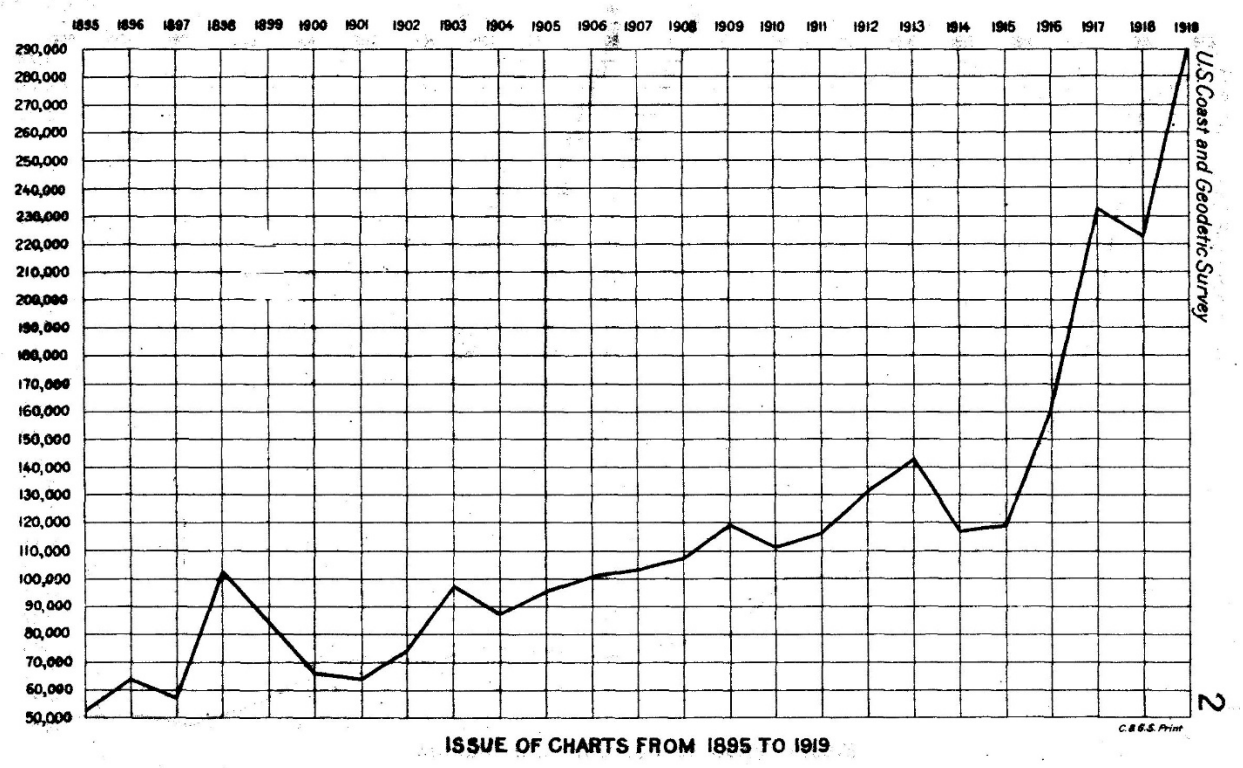
Additionally, the Navy asked for a survey of the Virgin Islands, newly acquired from Denmark in 1917. In addition to the general survey for the Navy, local naval officials requested a number of small surveys. According to the *Coast and Geodetic Survey Annual Report, 1918*:

> One topographic party was started on the sheet embracing the town and harbor on April 22. The other party was started on the western sheet May 1. Both continued with only short interruptions for signal building and triangulation the balance of the fiscal year.
>
> Extreme care was taken to obtain accuracy on the sheet covering the town. An elaborate. control was furnished. The contours were determined with more than ordinary precision, due to the fact that the local government is contemplating installing a water system in the vicinity, and the Coast Survey chart would be studied for a waterworks site.
>
> At the request of the Navy Department particular stress was given the locating of old ruins, stone walls, boundary monuments, etc. All of this topography was done on a 1:10,000 scale. Twenty-foot contours were determined.
>
> At the request of the local authorities a special topographic survey was made of a piece of alien property which it was contemplated to seize for military purposes. This survey consisted in locating the shore line, docks, houses, and contours.

(See chart 905, Virgin Islands, Virgin Gorda to St Thomas and St Croix, 1921, and chart 906, Virgin Passage and Vieques Sound, 1922)

Chart production more than doubles

As happened during the Civil War, Coast and Geodetic Survey ramped up their chart production for the war effort – as well as for the United States Shipping Board, formed in 1917 to promote the development of an American merchant marine, and to address shipping problems during time of war.



Map and chart production in 1919 was 136 percent greater than for the year 1915.

A tribute

In the annual report of 1919, Capt. E. Lester Jones, Coast and Geodetic Survey director from 1915 to 1929, paid tribute to the service of all C&GS personnel through the war:

> "This service has 103 years of active history which show that it has never failed in loyalty, no matter what the call. Its members have always given the benefit of their trained thought and well-informed judgment whenever and wherever they were needed and however they could best be used.
>
> "In the great conflict just ended these traditions have been upheld.
>
> "Admiration is due the spirit that has animated each and every member of the United States Coast and Geodetic Survey. To a man there was an instant and eager response to the country's call for help. At all times, a service which is laboring for the safety of mankind, it stood ready to undertake new work. The kind of work needed was varied-all could not go into battle. The men in the field would have been useless without the executive work behind them at home, and all

honor is due them, who, showing a steady, uncompromising moral courage, unmoved by clamor and undisturbed by outer excitement, have kept steadily at their posts, carrying on most successfully the important and necessary work here.

"Those who were sent to the field were simply performing their duty in another way, and established an enviable and remarkable record, showing again their unusual adaptability and training.

"The Bureau was about equally represented in both Army and Navy and performed signal valuable service in each."

World War II

To Rear Admiral H. Arnold Karo, USC+GS - with best wishes and great appreciation of the assistance of the U.S. Coast and Geodetic Survey in making possible the above scene. C.W. Nimitz, Fleet Admiral, U.S. Navy.

On September 2, 1945, the Japanese officially surrendered to end World War 2. A photo from the day (above), showing Admiral Chester Nimitz signing the Japanese surrender document, has his personal message: "To Rear Admiral H. Arnold Karo, USC&GS — with best wishes and great appreciation of the assistance of the U. S. Coast and Geodetic Survey in making possible the above scene. C. W. Nimitz, Fleet Admiral, U. S. Navy."

In World War 2, the U.S. Coast and Geodetic Survey sent over a thousand civilian members and more than half of its commissioned officers to the military services. They served as hydrographers, artillery surveyors, cartographers, army engineers, intelligence officers, and geophysicists in all theaters of the war. Civilians on the home front produced over 100 million maps and charts for the Allied Forces. Eleven members of the C&GS gave their lives during the war.

The C&GS annual report from 1945 summed up the agency's charting contributions:

> This war more than any other has demonstrated the close relationship that exists between the Bureau's work and the successful operations of our land, sea, and air forces. No naval task force would venture forth unless equipped with charts of the combat area, and no bombing squadron could successfully complete its mission without charts showing the military and industrial objectives sought. When our naval and military forces reentered Philippine waters they had available excellent charts which were the results of surveys made by the Coast and Geodetic Survey over a period of forty years.[50]

The value of C&GS efforts are better understood within the context of the nation's military planning. As Secretary of State Cordell Hull stated, by the end of 1940 the United States was "acting no longer under the precepts of neutrality, but under those of self-defense."[51] Under the 1941 "United States-British Commonwealth Joint Basic War Plan," the Army's role in the Pacific area "would be almost wholly defensive, on a line extending from Alaska (including Unalaska but excluding the outer Aleutians) through Hawaii to Panama..."[52]

U.S. C&GS nautical charts for the war covered the coastal areas of the United States and the Pacific line of defense: Alaska, Hawaii, and Panama. C&GS charts of Midway Island, Guam, and the Philippines were to become pivotal in the war against Japan. In the Atlantic, charts of Puerto Rico, and the Virgin Islands were helpful to naval operations.

Preparing for war

The United States started shifting from neutrality to defense planning after the Munich crisis of September 1938, when France and Britain agreed to give the Sudetenland to Hitler. By 1940, the situation was alarming. On June 10, 1940, President Roosevelt announced his intentions:

> "We will extend to the opponents of force the material resources of this nation; and at the same time we will harness and speed up the use of those resources in order that we ourselves in the Americas may have equipment and training equal to the task of any emergency and every defense."

Coast Survey's chart making started ramping up in mid-1940, after the nation started mobilization. As the Coast and Geodetic Survey reported in its 1941 annual report, "the expansion of our Navy, merchant marine, and air forces, inaugurated in the spring of 1940, brought an immediate increase in the demand for charts and other navigational publications which continued throughout the year." That observation is borne out by the production numbers.

CHART PRODUCTION

Charts	1938	1939	1940	1941	1942	1943	1944	1945
Nautical	351,150	350,062	407,186	621,663	1,081,072	1,916,599	2,913,666	4,330,547
Aeronautical	209,094	366,353	463,917	912,339	3,145,516	11,773,464	17,645,892	16,899,049

Panama: "the most strategic spot in the world today"

Stetson Conn and Byron Fairchild, from the Army's Center of Military History, laid out U.S. military strategy in their book, *United States Army in World War II, The Framework of Hemisphere Defense*. Their explanation on Panama's role in U.S. strategy explains why the U.S. Coast and Geodetic Survey would spend time there when there was a great need for coastal U.S. charts.

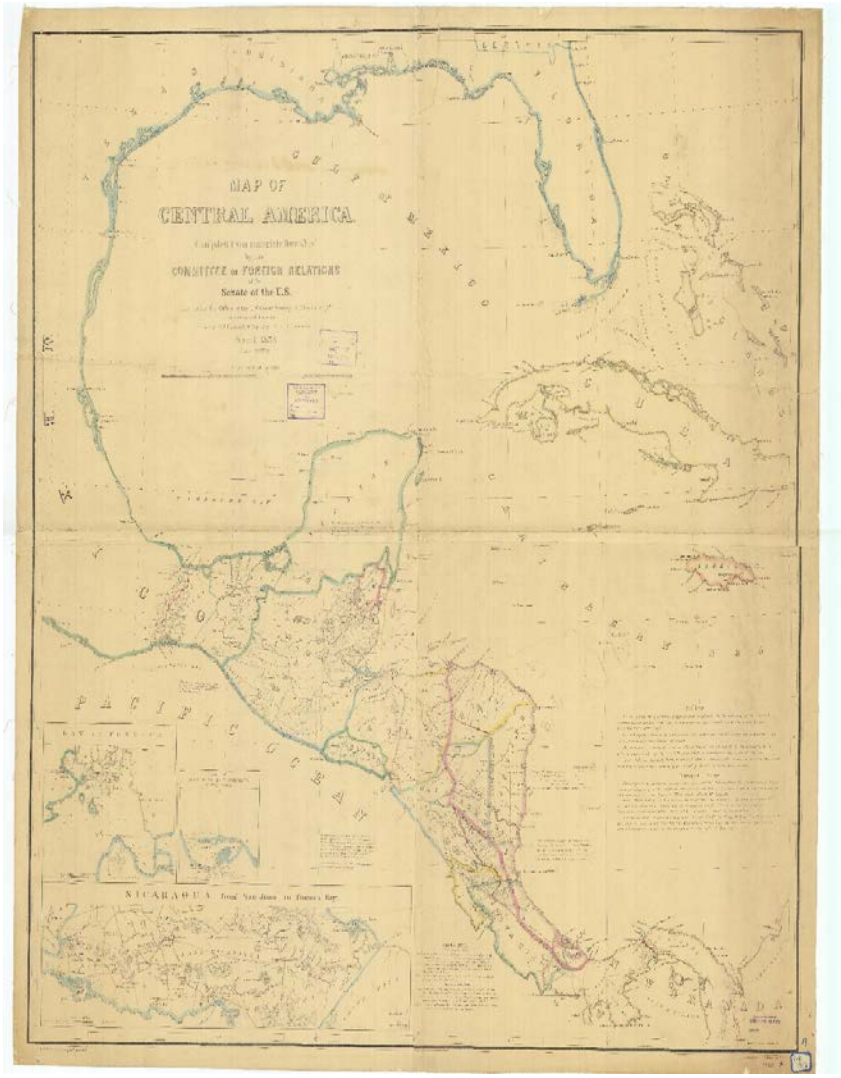
> "The decision in July 1940 to keep the bulk of the United States Fleet in the Pacific to check Japan and guard the supply of vital raw materials such as rubber and tin was made on the assumption that the fleet could be moved swiftly to the Atlantic if necessary. The Panama Canal was therefore considered the key to the successful build-up of American military strength -- the

> Army expressing its vehement concurrence in Mr. Stillman's* characterization of the Canal as 'the most strategic spot in the world today.'"[53]

The U.S. had recognized Panama's strategic value almost a century earlier. In 1846, the U.S. and New Granada (now Panama) signed the Colombia Peace, Amity, Navigation, and Commerce Treaty (known as the Mallarino-Bidlack Agreement), which provided, among many trade provisions, the following guarantee:

> "...the United States guarantee positively and efficaciously to New Granada, by the present stipulation, the perfect neutrality of the before mentioned Isthmus, with the view that the free transit from the one to the other sea, may not be interrupted or embarrassed in any future time while this Treaty exists..."

Ten years later, in March 1856, a special map was produced: "The Map of Central America, Compiled from materials furnished by the Committee on Foreign Relations of the Senate of the U.S., Executed at the Office of the U.S. Coast Survey, A.D. Bache Sup^{dt}…"

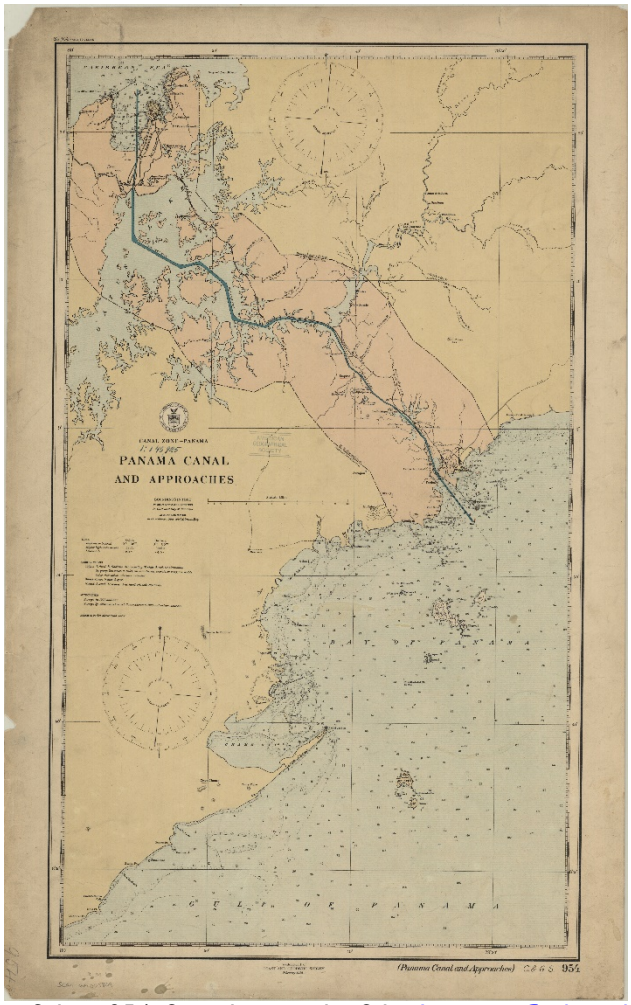


*° According to Conn and Fairchild, Charles R. Stillman, business manager of Time magazine, after a month's research in Washington during June and July 1940, submitted a shrewd analysis of the Army's immediate emergency measures and the long-range defense program to the Army Chief of Staff's office.

Coincidentally, the Watermelon War occurred the next month, along with other unease in the region. On May 15, 1856, President Pierce sent a lengthy message to Congress about New Granada and other affairs in Central America. He ended his message:

> "It would be difficult to suggest a single object of interest, external or internal, more important to the United States than the maintenance of the communication, by land and sea, between the Atlantic and Pacific States and Territories of the Union. It is a material element of the national integrity and sovereignty.
>
> "I have adopted such precautionary measures and have taken such action for the purpose of affording security to the several transit routes of Central America and to the persons and property of citizens of the United States... Should these measures prove inadequate to the object, that fact will be communicated to Congress with such recommendations as the exigency of the case may indicate."

Coast and Geodetic Survey issued the first *nautical* chart of Panama, chart 950, in 1905. Then came a series of charts, 951-954, from 1911 to 1914 respectively. Chart 954 was replaced by chart 955, which had its latest pre-war edition in 1940.



1914 edition of chart 954, from the records of the American Geological Society Library, under authority of a NOAA-AGSL Memorandum of Understanding

Withdrawing Pearl Harbor chart

During the pre-war years, the Hawaiian island of Oahu was one of America's most important military outposts, with the U.S. Army responsible for defending Pearl Harbor. In April 1941, the Army Chief of Staff, General George Marshall, told Roosevelt that Hawaii was impregnable, and Secretary of War Henry Stimson and Secretary of the Navy Frank Knox agreed.

Conn and Fairchild wrote:

"The President and his principal advisers were well aware by late November [1941] that the Japanese might strike almost at once and without warning. The service chiefs expected the first Japanese moves to be made against Thailand and the Burma Road, though they considered an attack on the Philippines a distinct possibility. No one in authority in Washington gave more than a passing thought to Pearl Harbor and the fleet."[54]

C&GS had been charting Hawaii since it became a U.S. territory in 1898. Chart 4107, Pearl Harbor, Island of Oahu showed the harbor in good detail in 1915. However, the government suspended the chart in 1921. The chart would be considered confidential and "withdrawn entirely from issue to the public." C&GS recalled all copies, and cancelled it completely in August 1937. Additionally, C&GS updated chart 4116 on April 16, 1941, adding a "prohibited area" at the approach to Pearl Harbor.

Immediately adjacent to Pearl Harbor is Honolulu, with its commercial harbor. In an eerie coincidence, C&GS published its updated chart of Honolulu Harbor (chart 4109), on November 29, 1941 – 3 days after Japan's carrier force sortied for Hawaii, and one week before the Japanese attack.

Chart 4107 *was suspended in 1921, and cancelled in August 1937. (It was released from confidential files in 1946.)*

M. F. Lisa

80-DRM

August 13, 1937.

To: PLANNING BOARD.

Subject: Cancellation of chart No. 4107, Pearl Harbor.

In May 1921 the Director issued instructions that chart No. 4107 would thereafter be considered as confidential and be withdrawn entirely from issue to the public. Instructions were included for recalling all copies of the chart in the hands of agents and the field stations, placing copies in a place of security, and for elimination of the chart from future publication in the chart catalog. Charts on hand were issued to the Navy until the supply was exhausted but no action has been taken to cancel the chart. No reprints or requests for reprints of this chart have been made. In order that this chart may be formally removed from the records, it is recommended that the chart be now cancelled.

/signed/ L. O. COLBERT
Chief, Division of Charts

C. T. RUDE
Chief, Division of H. & T.

PAUL C. WHITNEY
Chief, Division of T. & C.

Concurred in:

/signed/ C. L. GARNER
Chief, Division of Geodesy

N. H. HECK
Chief, Division of T. M. & S.

J. H. HAWLEY
Chairman, Planning Board.

Approved:

/signed/ J. H. HAWLEY
Acting Director.

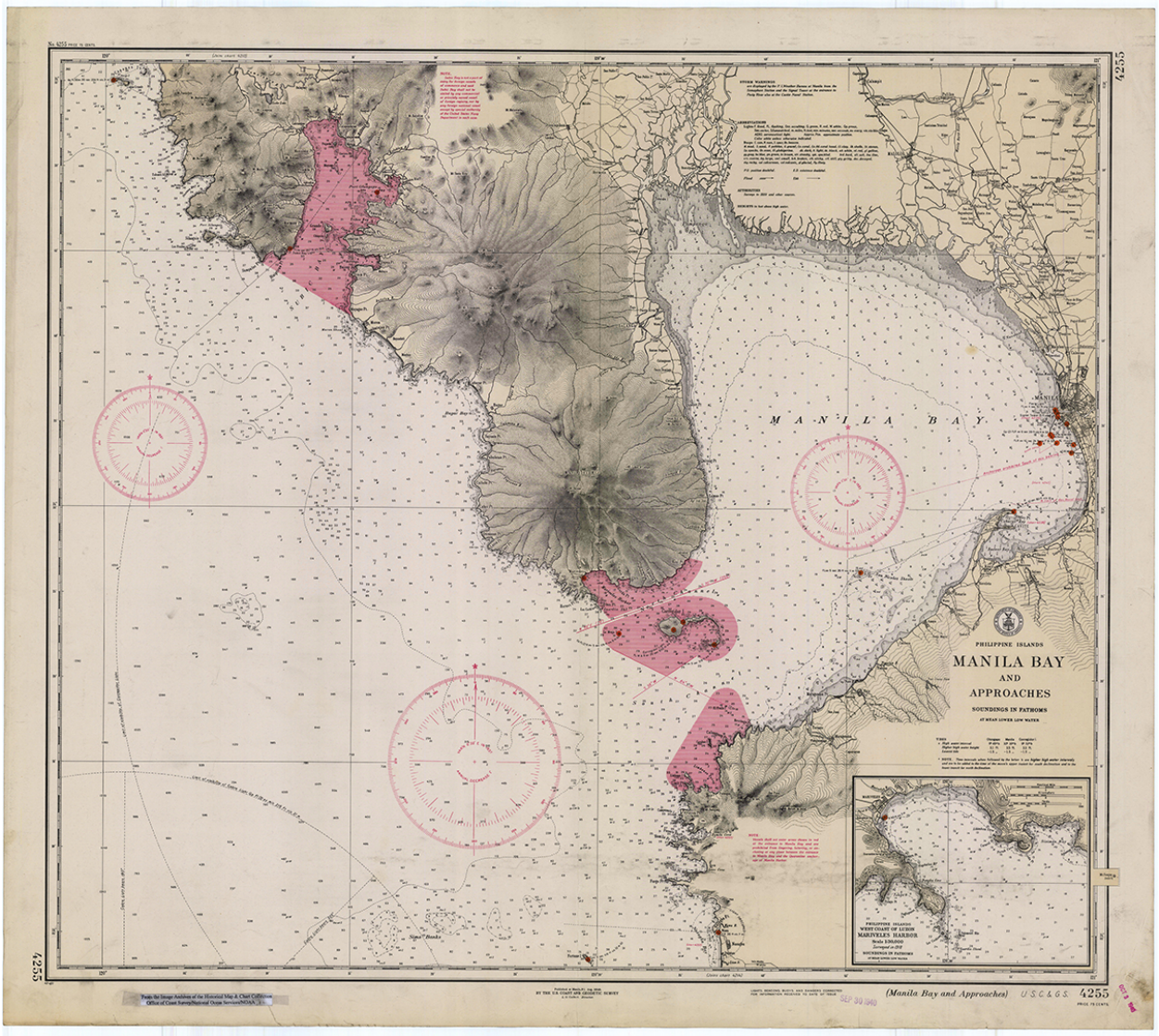
One black-andwwhite copy of this chart is filed in the "Confidential" locker in the vault; all other copies, plates and negatives have been destroyed.

C.

Mapping caves in the Philippine Islands

Spain relinquished the Philippine Islands (and Guam and Puerto Rico) to the United States on November 7, 1900, following the Spanish American War. C&GS issued nautical charts for the islands beginning in 1902. For instance, chart 4255 had eight editions from 1902 to 1940.

Conn and Fairchild explain that "By the end of July [1941] the United States had decided to reverse its policy of standing on the defensive along the Alaska-Hawaii-Panama line; instead it would reinforce and defend the Philippines..."[55] However, the U.S. government took some limited action at least a year before that, as evidenced by the the 9th edition of chart 4255, Manila Bay and Approaches, which was published on August 17, 1940. That chart showed areas forbidden to ships.



The chart displays two special notes in red:

> NOTE: Subic Bay is not a port of entry for foreign vessels of commerce and said Subic Bay shall not be visited by any commercial or privately owned vessel of foreign registry, nor by any foreign national vessel except by special authority of the United States Navy Department in each case.

> NOTE: Vessels shall not enter areas shown in red at the entrance to Manila Bay and are prohibited from lingering, loitering, or anchoring at any place between the entrance to Manila Bay and the Quarantine anchorage of Manila Harbor.

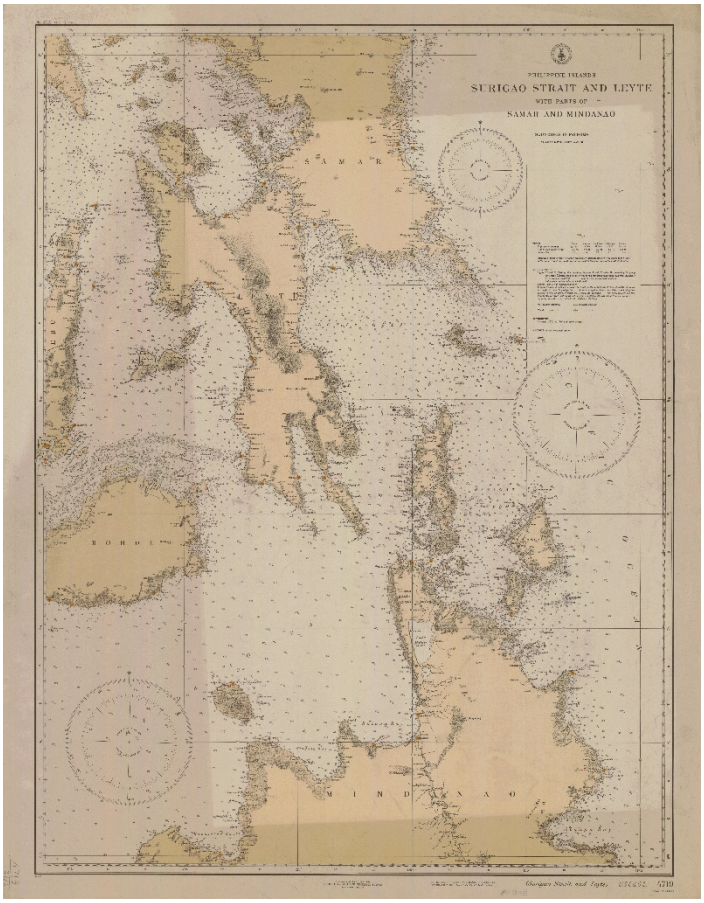
The Japanese attacked the Philippines on December 8, 1941, nine hours after Pearl Harbor. The Survey had five commissioned officers and two civilians on duty in the Philippine Islands when war was declared. Commander George D. Cowie, the man in charge of surveying operations, was killed during a bombing raid on Manila on December 24, 1941.

Japanese occupation began in May 1942.

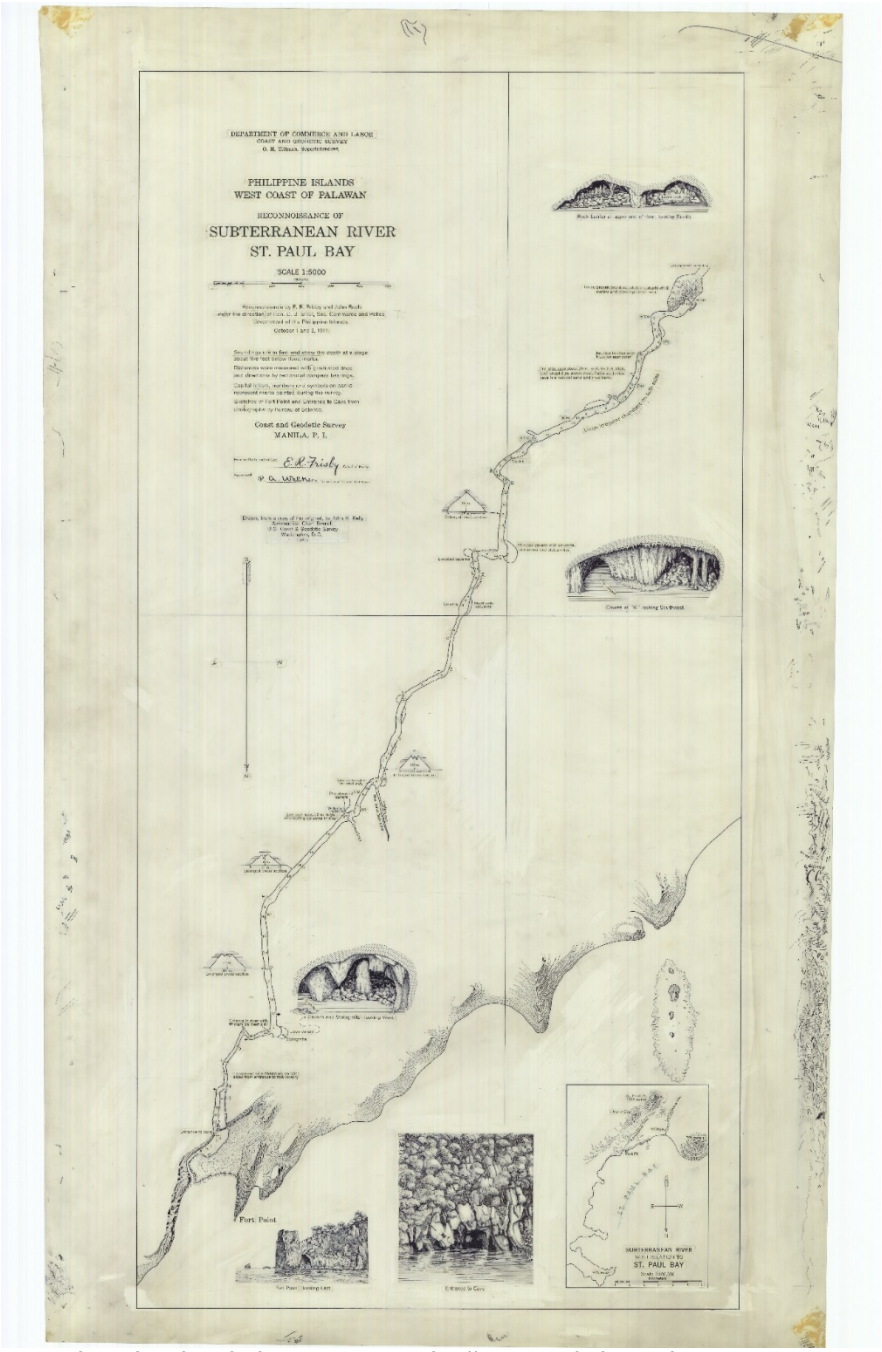
From the 1942 Coast and Geodetic Survey annual report:

> Upon occupation of Manila by the enemy it became necessary for the Bureau's Washington office to undertake the publication of the nautical charts of the Philippine Archipelago which formerly were printed in Manila. This was accomplished without delay. Arrangements had been made for this emergency by maintenance of prepared copies of the latest Manila chart editions in anticipation of their use for this purpose.

In addition to nautical charts, created over 40 years of work, Coast and Geodetic Survey was able to provide sketches and topographic sheets depicting hundreds of coves and harbors, as well as general island coastlines. These were invaluable for the Liberation of the Philippines, which began on Leyte in October 1944. Because of the Survey's work, the Navy had a detailed chart on hand, chart 4719 Surigao Strait and Leyte, 1936



They had the same for landings at Mindoro and Luzon. Finishing the campaign on Palawan Island, Army troops were able to see the caves and caverns shown on the C&GS 1943 sketch Philippine Islands West Coast of Palawan Reconnaissance of Subterranean River Saint Paul Bay.



Even more important than the sketch, however, was the "extremely hazardous reconnaissance of enemy-held beaches at Palawan to determine areas suitable for a forthcoming assault landing by American troops," by Lieutenant Commander Francis X. Popper (U.S. C&GS)* and a small party of men.

* See Popper's Citation for Silver Star Medal, in NOAA's virtual Hall of Honor.

Atlantic Coast

In 1939, conventional military thinking had ruled out an attack on the U.S. mainland, and Germany had initially decided not to provoke the U.S. with submarines along our Atlantic coast. That decision held until a German submarine fired on the U.S. destroyer *Greer*, on September 4, 1941, three months before Pearl Harbor, when *Greer* was tracking the sub *en route* to Iceland.

The Department of Commerce published an excellent summary in 1951, *World War II History of the Coast and Geodetic Survey*, which goes into some detail on the public aspects of the agency's contribution to the war effort. (Also, see NOAA History, *The World Wars*, written by Skip Theberge.) The *History* summarizes the coastal assignments given to C&GS, including surveys for special naval anchorages, approaches to shipyards, and the establishment of areas for testing submarines and other naval vessels. Additionally, "data obtained from hydrographic surveys were used for laying submarine nets on all coasts."

Also, according to the Department of Commerce *History*:

> From November 1940 to March 1941, comprehensive surveys were made at the request of the Navy Department at the sites of proposed naval bases in the British West Indies. Detailed hydrographic, wire-drag, and topographic surveys were completed at Port of Spain, Trinidad, by the ship *Oceanographer*; at Antigua by the *Lydonia*; at Mayaguana by the *Hydrographer*; and in the Portland Bight area of Jamaica by the *Hydrographer* and *Gilbert*.
>
> Extensive coastal surveys were executed along the coast of Maine. Early in the war, the Navy Department requested the compilation of large-scale charts of Casco Bay and approaches in anticipation of the use of that area as an anchorage and base for a part of the Atlantic fleet. Under normal conditions, the facilities of the Coast and Geodetic Survey are insufficient to maintain adequate surveys throughout the extensive water areas under jurisdiction of the United States and it is necessary to give priority to commercially important regions. For this reason, the surveys of Casco Bay and vicinity were not up to date and it was found that extensive new surveys were required for the production of the charts requested. *
>
> ...Casco Bay and adjacent waters were used extensively as anchorages for naval vessels, and particularly for ships engaged in convoy duty. The surveys accomplished contributed materially to the safety of these ships. After completion of the Casco Bay area, surveys were extended to cover the approaches to the important shipbuilding port of Bath♦ and were continued throughout the war in other nearby regions where modern surveys were needed.

The letters from C&GS personnel tell quite a story. A letter from one man tells us about the C&GS "War Mapping Parties" on the East Coast.

> By now I had learned that our work was part of a large project known as War Mapping Party I and that there was a War Mapping Party II. The Parties were just getting started and were formed because the U.S. government had realized that it did not have maps of the East Coast accurate enough to be used to fight an enemy if we should be invaded. This may seem strange now, but at the time submarines were plentiful. I think at least one had landed spies on our

*The updated version of chart 315 Casco Bay was published in 1942, as was the larger scale chart 201 Western Casco Bay. Hydrographic surveys, repeated in 1943, were used to update chart 201 in this 1945 version.
♦Chart 230 Boothbay Harbor to Bath, was updated in 1944, using Coast Survey data from 1942. Prior to this update, the public chart was using Survey data from the 1890s.

> coastline. The War Mapping Parties were formed with the charge of making a new set of topographic maps of the entire East Coast and of completing them as soon as possible. The Maps were to be at a scale of 1 to 20,000 and were to show all features and culture within 25 miles of the shoreline. All buildings, roads, bridges and other structures were to be shown in correct size and shape. Bridges were to be shown and their size and strength was to be noted by them on the maps. The overall idea was that the maps should be so good that artillery fire or aerial bombs could be accurately directed by the maps. The maps were completed in a few years. I understand they have never been released and also that they may be the best maps ever made of the area.
>
> –Eugene L. Maxwell[56]

After the war, the Atlantic coast was strewn with shipwrecks that constituted major hazards to navigation. C&GS vessels conducted wire drag surveys to find those dangers.

Alaska's Aleutian Islands

Lt. Matt Forney (NOAA) recently wrote about some of Coast Survey's work in Alaska during the war.[57] "The Aleutian Islands were strategic, as it meant that Japan would control the North Pacific Ocean great circle route for supplies, and the U.S. feared the Japanese would turn these locations into airbases for bombing the west coast of the U.S. mainland," Forney observed.

The Japanese Northern Army occupied Attu Island (landing there unopposed on June 7, 1942) and Kiska Island, (landing on the next day.)

In his NOAA History, *The World Wars*, Skip Theberge points out:

"With the advent of war and the occupation of the Aleutian Islands by the Japanese, this unsurveyed area attained a strategic importance that required immediate hydrographic surveys in order to prosecute the war effort. In response to this need, the ships *Explorer*, *Surveyor*, *Derickson*, *E. Lester Jones*, and *Patton* were engaged in surveying the Alaska Peninsula and Aleutian Islands. Numerous projects at widely scattered points were instituted in response to military needs as opposed to the previously planned systematic survey of the area."

"On May 11, 1943, the U.S. 17th Infantry Division made an amphibious assault on the Island of Attu to retake this territory and strategic landhold," Forney wrote. "Before the Army could carry out an amphibious attack, however, they called on the men of the U.S. Coast and Geodetic Survey to conduct surveys of landings and anchorages. The U.S. Coast and Geodetic Survey Ship *Hydrographer* conducted this important preemptive survey to ensure the landing vessels avoided shoals and made it safely to shore."

Hydrographer also surveyed Massacre Bay, Attu, to identify shoals and to outline transport anchorages and supply routes. The ship also provided transport services to Shemya, Alaska, so the U.S. could establish a bomber airstrip for retaking Kiska. On August 13, 1943, Hydrographer surveyed the approaches, anchorages, and landings on Kiska to support an amphibious assault to retake this territory. Two days later, Allied Forces invaded, unaware that the Japanese had completely abandoned the island on July 28, after hearing of the fall of Attu.

"Towards the end of the war, surveys were begun in the Point Barrow area at the request of the Navy," Theberge reminds us. "These surveys continued after the war in support of Navy needs and the installation of "dew line" radar installations."

"Commensurate with an expanding and developing America"

> With the end of the war, our immediate task ahead will be channeling back our activities to a peacetime orientation. With full knowledge of the importance of basic mapping programs in the commercial and industrial life of our Nation, we shall continue to serve these interests as we have served our military interests during the war years, and provide the fundamental data necessary to execute such programs commensurate with an expanding and developing America.
>
> —Annual Report of the Director, United States Coast and Geodetic Survey, for the Fiscal Year Ended June 30, 1945[58]

APPENDIX 1
Legislative history of "An Act to provide for surveying the coasts of the United States"

December 15, 1806

On motion of Mr. DANA, and seconded, that the House do come to the following resolution:

Resolved, That the Committee of Commerce and Manufactures be instructed to inquire into the expediency of making provision for a survey of the coasts of the United States, designating the several Islands, with the shoals and roads, or places of anchorage, within twenty leagues of any part of the shores of the United States.

[History of Congress, H. of R., pages 151, 152]

> Mr. DANA, of Connecticut. – In 1802, an act was passed, authorizing a survey of Long Island Sound. In pursuance of that act, the Secretary of the Treasury caused a survey to be taken by two men, who appear to have been, what the act intended, intelligent and proper persons. And there has since been published a chart of the Sound, handsomely executed, on a large scale, which must, I presume, be regarded as convenient and valuable by those concerned in that branch of navigation.
>
> At the last session of Congress, an act was passed for another survey. It made provision for surveying the coast of North Carolina between Cape Hatteras and Cape Fear, with the shoals lying off or between those capes. I understand that measures have been taken for executing this act, but that the vessel employed in the service, and all the papers respecting the survey which had been made, had been lost near Ocracoke Inlet, in one of the desolating storms experienced on the coast in the course of the present year.
>
> The surveys, which have thus been authorized, were perhaps of the most urgent necessity; but other surveys of the coast are desirable. What has already been done may be regarded as introductory to a general survey of the coasts of the United States under authority of the Government. With a correct chart of every part of the coast, our seamen would no longer be under the necessity of relying on the imperfect or erroneous accounts given of our coast by foreign navigators. I hope the lives of our seamen, the interest of our merchants, and the benefits to the revenue, will be regarded as affording ample compensation for making a complete survey of the coasts of the United States, at the public expense.
>
> The information which may be obtained will also be useful in designating portions of territorial sea to be regarded as the maritime precincts of the United States, within which, of course, the navigation ought to be free from the belligerent searches and seizures.
>
> It is proposed to extend the survey to the distance of twenty leagues from the shore. This distance is mentioned with a view to the second article of the treaty with Great Britain in 1783, which describes our boundaries as "comprehending all islands within twenty leagues of any part of the shores of the United States."
>
> The resolution, which I propose for the consideration of the House, is expressed in these words:

> *Resolved*, That the Committee of Commerce and Manufactures be instructed to inquire into the expediency of making provision for a survey of the coasts of the United States, designating the several islands, with the shoals and roads or places of anchorage within twenty leagues of any part of the shores of the United States.

Mr. CROWNINSHIELD, of Massachusetts, was very glad to see the resolution offered, but he should like it better if it were more extensive. He believed there were many shoals on the coast lying at more than twenty leagues distance from the shore. Among others, St. George's Bank was at more than this distance. He wished that the resolution might be varied so as to comprehend all the shoals on the coast, from St. Croix to the southern extreme of Louisiana.

Mr. C. had always thought it important that an accurate survey should be made of our coast. Holland's chart, though the best, is very inaccurate.

Mr. DANA accorded with the chairman of the Committee of Commerce and Manufactures (Mr. CROWNINSHIELD) in respect to the utility of an accurate survey of the shoal which he had mentioned, but was against altering the resolution so as to include any islands at a great distance than twenty leagues from the shore. The treaty of 1773 authorizes us to consider islands within that distance as appertaining to the territory of the United States. There is, therefore, peculiar propriety in extending the proposed survey to the distance of twenty leagues along the whole of our coast. If any shoals at a great distance from shore are to be surveyed, special provision for this purpose may be made in the details of a bill which the committee may report. It would be more convenient to specify the details in a bill than in a general resolution for inquiry.

Mr. Crowninshield then moved to strike out twenty and insert fifty in the resolution. He was confident that there were shoals lying more than twenty leagues distant from the shore, and he thought it important to have them surveyed. It might be that there are no islands beyond that distance. He was not certain in regard to them, but he was sure that there were extensive shoals.

Mr. DANA suggested that the gentleman (Mr. Crowninshield) might designate, by way of amendment, particular shoals which he wished to be surveyed.

Mr. COOK, of Massachusetts, doubted whether all of St. George's Bank was within even fifty leagues of the shore. If it were in order, he would move to strike out twenty and insert seventy.

A division of the question on striking out twenty and inserting fifty was called for.

Mr. CROWNINSHIELD at length withdrew his motion, and it was agreed that the resolution should lie on the table.

Ordered, That the said motion do lie on the table.

December 16, 1806

The House proceeded to consider the motion of Mr. DANA, of yesterday, which lay on the table: Whereupon,

The said motion being again read at the Clerk's table, in the words following, to wit:

> *Resolved*, That the Committee of Commerce and Manufactures be instructed to inquire into the expediency of making provision for a survey of the coasts of the United States, designating the several islands, with the shoals and roads, or places of anchorages, within twenty leagues of any part of the shores of the United States:

A motion was made by Mr. CROWNINSHIELD, and the question being put, to amend the same, by adding, to the end thereof, the following words, to wit: And that the committee be farther instructed to inquire into the expediency of surveying St. George's bank, or any other shoals or banks, which may be deemed dangerous to vessels approaching the shores of the United States:

It was resolved in the affirmative.

Resolved, That this House doth agree to the said resolution, as amended.

January 6, 1807

Mr. EARLY, from the Committee of Commerce and Manufactures, who were directed by a resolution of the House, of the sixteenth ultimo, "to inquire into the expediency of making provision for a survey of the coasts of the United States," presented, according to order, a bill to provide for surveying the coasts of the United States; which was received, and read the first time.

On motion,

The said bill was read the second time, and ordered to be committed to a Committee of the Whole House on Monday next.

H.R. 21

Read the first and second time, and committed to a committee of the whole House, on Monday next.

> **A Bill**,
> To provide for surveying the coasts of the United States.
>
> Sec. 1. *BE it enacted by the senate and house of representatives of the United States of America, in congress assembled*, That the president of the United States shall be, and he is hereby authorized and requested, to cause a survey to be taken of the coasts of the United States, in which shall be designated, the islands and shoals, with the roads or places of anchorage, within twenty leagues of any part of the shores of the United States, and also the respective courses and distances between the principal capes, or head lands, together with such other matters, as he may deem proper, for completing an accurate charts, of every part of the coasts within the extent aforesaid.
>
> Sec. 2. *And be it further enacted*, That it shall be lawful for the president of the United States, to cause such examinations and observations to be made, with respect to St. George's bank, and any other bank or shoal, and the sounding and currents beyond the distance aforesaid, as in his opinion may be especially subservient to the commercial interests of the United States.
>
> Sec. 3. *And be it further enacted*, That the president of the United States shall be, and he is hereby authorized and requested, for any of the purposes aforesaid, to cause proper and intelligent persons to be employed, and also such of the public vessels in actual service, as he may judge expedient, and to give such instructions for regulating their conduct as to him may appear proper, according to the tenor of this act.
>
> Sec. 4. *And be it further enacted*, That for carrying this act into effect there shall be, and hereby is appropriated, a sum not exceeding _____ dollars, to be paid out of any monies in the Treasury, not otherwise appropriated.

Friday, January 16, 1807

The House, according to the order of the day, resolved itself into a Committee of the Whole House on the bill to provide for the surveying of the coasts of the United States; and, after some time spent therein, Mr. Speaker resumed the chair and Mr. Masters reported that the committee had, according to order, had the said bill under consideration, and made an amendment thereto; which he read in his place, and afterwards, delivered in a the Clerk's table, where the same was again twice read, and agreed to by the House.

Ordered, That the said bill, with the amendment, be engrossed, and read the third time on Monday next.

Tuesday, January 20, 1807

An engrossed bill to provide for surveying the coasts of the United States, was read the third time.

Resolved, That the said bill do pass, and that the title be, "An act to provide for surveying the coasts of the United States."

Ordered, That the Clerk of this House do carry the said bill to the Senate, and desire their concurrence.

[Senate]

Tuesday, January 20, 1807

A message from the House of Representatives, by Mr. Beckley, their Clerk:

Mr. President: The House of Representatives have passed a bill, entitled "An act to continue in force, for a limited time, an act, entitled 'An act to suspend the commercial intercourse between the United States and certain parts of the island of St. Domingo;" also, a bill, entitled "An act to provide for surveying the coasts of the United States;" in which bills they desire the concurrence of the of the Senate. And he withdrew.

The bills were read.

Ordered, That they severally pass to the second reading.

Wednesday, January 21, 1807

The bill entitled "An act to provide for surveying the coasts of the United States," was read the second time.

Ordered, That it be referred to Messrs. Mitchill, Adams, and Gaillard, to consider and report thereon.

Monday, January 26, 1807

Mr. Mitchill, from the committee to whom was referred the bill, entitled "An act to provide for surveying the coasts of the United States," reported it with amendments; which were read.

Ordered, That they lie for consideration.

Tuesday, January 27, 1807

The Senate took into consideration, as in committee of the whole, the amendments reported to the bill, entitled "An act to provide for surveying the coast of the United States," and the President having reported the bill to the House with amendments.

Ordered, That this bill pass to the third reading as amended.

Friday, January 30, 1807

The bill, entitled "An act to provide for surveying the coasts of the United States," was read the third time as amended.

Resolved, That this bill pass as amended; and Mr. ADAMS, from the committee, having reported that the amendments are correctly engrossed,

Ordered, That the Secretary request the concurrence of the House of Representatives therein.

Thursday, February 5, 1807

[House]

Mr. EARLY, from the Committee of Commerce and Manufactures, to whom was committed on the third instant, the amendments proposed by the Senate to the bill, entitled "An act to provide for surveying the coasts of the United States," reported that the committee had, according to order, had the said amendments under consideration, and directed him to report to the House their agreement to the same.

The House then proceeded to consider the said amendments, and the same being again severally twice read at the Clerk's table, were, on the question put thereupon, agreed to by the House.

Ordered, That the Clerk of this House do acquaint the Senate therewith.

[Senate]

A message from the House of Representatives, by Mr. Van Zandt, in absence of their Clerk:

Mr. President: The House of Representatives concur in the amendments of the Senate to the bill, entitled "An act to provide for surveying the coasts of the United States." The Speaker of the House of Representatives having signed an enrolled bill, I am directed to bring it to the Senate for the signature of their President. And he withdrew.

Monday, February 9, 1807

[House]

Mr. PORTER, from the Joint Committee for Enrolled Bills, reported that the committee had, according to order, examined the following enrolled bills, to wit:

"An act to provide for surveying the coasts of the United States;"…

Mr. Speaker signed the said enrolled bills.

Ordered, that the Clerk of this House do acquaint the Senate therewith.

[Senate]

Mr. TURNER reported, from the committee, that they had examined and found duly enrolled… the bill, entitled "An act to provide for surveying the coasts of the United States."

The President signed the two enrolled bills reported to have been examined on Thursday last, and the three enrolled bills this day reported to have been examined, and they were delivered to the committee, to be laid before the President of the United States.

Tuesday, February 10, 1807

Public Acts of Congress, Annals of Congress, 9th Congress, 2nd Session, pages 1254 and 1255

An Act to provide for surveying the coasts of the United States

Be it enacted &c., That the President of the United States shall be, and he is hereby, authorized and requested to cause a survey to be taken of the coasts of the Untied States, in which shall be designated the islands and shoals, with the roads or places of anchorage, within twenty leagues of any part of the shores of the United States; and also the respective courses and distances between the principal capes, or head lands, together with such other matters as he may deem proper for completing an accurate chart of every part of the coasts within the extent aforesaid.

SEC. 2. *And be it further enacted*, That it shall be lawful for the President of the United States to cause such examinations and observations to be made, with respect to St. George's bank, and any other bank or shoal and the sounding and currents beyond the distance aforesaid to the Gulf Stream, as in his opinion may be especially subservient to the commercial interests of the United States.

SEC. 3. *And be it further enacted*, That the President of the United States shall be, and he is hereby authorized and requested, for any of the purposes aforesaid, to cause proper and intelligent persons to be employed, and also such of the public vessels in actual service, as he may judge expedient, and to give such instructions for regulating their conduct as to him may appear proper, according to the tenor of this act.

SEC. 4. *And be it further enacted*, That for carrying this act into effect there shall be, and hereby is appropriated, a sum not exceeding fifty thousand dollars, to be paid out of any money in the Treasury, not otherwise appropriated.

Approved, February 10, 1807

[House]

A message was received from the President of the United States, by Mr. Coles, his Secretary, notifying that the President of the United States, by Mr. Coles, his Secretary, notifying that the President did, this day, approve and sign the following acts, which originated in the House, to wit:

… "An act to provide for surveying the coasts of the United States"…

APPENDIX 2
Coast Survey in the federal bureaucracy

Survey of the Coast, Department of the Treasury (1816-18)

Department of the Navy (coast surveys, 1818-32)

Survey of the Coast, Department of the Treasury (1832-34)

Survey of the Coast, Department of the Navy (1834-36)

Coast Survey, Department of the Treasury (1836-78)

Transfers: To Department of Commerce and Labor by the act creating the department (32 Stat. 825), February 14, 1903; to Department of Commerce by the act creating the department (37 Stat. 736), March 4, 1913; to newly-established Environmental Science Services Administration (ESSA), Department of Commerce, by Reorganization Plan No. 2 of 1965, effective July 13, 1965; to the newly-established National Oceanic and Atmospheric Administration, Department of Commerce, October 3, 1970

Leaders of Coast Survey

SUPERINTENDENTS, U.S. COAST SURVEY

1. Ferdinand Rudolph Hassler	1816-1818, 1832-1843
2. Alexander Dallas Bache	1843 – 1867
3. Benjamin Peirce	1867 – 1874
4. Carlisle Pollock Patterson	1874 – 1881
5. Julius Erasmus Hilgard	1881 – 1885
6. Frank Manly Thorn	1885 – 1889
7. Thomas Corwin Mendenhall	1889 – 1894
8. William Ward Duffield	1894 – 1897
9. Henry Smith Pritchett	1897 – 1900
10. Otto Hilgard Tittman	1900 – 1915

DIRECTORS, COAST AND GEODETIC SURVEY

11. Captain Ernest Lester Jones	1915 – 1929
12. Rear Admiral Raymond Stanton Patton	1929 – 1937
13. Rear Admiral Leo Otis Colbert	1938 – 1950
14. Rear Admiral Robert Francis Anthony Studds	1950 – 1955
15. Rear Admiral Henry Arnold Karo	1955 – 1965

DIRECTORS, ENVIRONMENTAL SCIENCE SERVICES ADMINISTRATION

16. Rear Admiral James Chisholm Tison, Jr.	1965 – 1968
17. Rear Admiral Donald A. Jones	1968 - 1970

DIRECTORS, NATIONAL OCEAN SURVEY

18. Rear Admiral Don Jones	1970 – 1972
19. Rear Admiral Allen L. Powell	1972 - 1979

20. Rear Admiral Herbert Lippold 1979 – 1983

DIRECTORS, OFFICE OF CHARTING AND GEODETIC SERVICES

21. Rear Admiral John D. Bossler 1980 – 1985
22. Rear Admiral Wesley V. Hull 1986 – 1990
23. Rear Admiral Austin Yeager 1990 – 1994

DIRECTORS, OFFICE OF COAST SURVEY

24. Frank Maloney 1995 – 1998
25. Captain David B. MacFarland 1999 – 2003
26. Captain Roger L. Parsons 2003 – 2006
27. Captain Steven R. Barnum 2006 – 2009
28. Captain John E. Lowell, Jr. 2009 – 2012
29. Rear Admiral Gerd F. Glang 2012 – 2016
30. Rear Admiral Shepard M. Smith 2016 –

APPENDIX 3
A Deeper Look at Gedney Channel

by Capt. Albert "Skip" Theberge, Jr. (NOAA, ret.)

Although the 1834 field season bore little fruit for the Survey, in 1835 the JERSEY made a discovery that assured the continuance of the Survey under Hassler's superintendence. The JERSEY finished the western half of Great South Bay and then worked westerly along the coast of Long Island. After finishing Long Island, the ship worked at the entrance to New York harbor, from the western tip of Long Island to Sandy Hook. Prior to this survey, ships approaching New York had to sail to the New Jersey coast and pass close to the shore at Sandy Hook as this was the only channel known into the harbor. Larger ships had to wait for high tide to enter the harbor. Hassler felt that there had to be another deep-water channel over the bar and instructed Gedney to search for it. Lieutenant Gedney discovered a channel, which led directly into the harbor, farther to the north, which was two feet deeper than the Sandy Hook channel, was of sufficient width to allow vessels to beat into or out of the harbor under most wind conditions, and cut down the sailing time into New York harbor considerably. The military importance of this discovery was also pointed out: if the channel had been known to exist during the Revolutionary War, it would have made the blockade and occupation of New York much more difficult for the British. This channel, called New Channel on the survey sheets, became known as Gedney Channel.

Hassler wasted no time in publicizing this discovery and in early 1836 took the plotted surveys and many of the naval officers who had worked on the survey to President Andrew Jackson. RADM Benjamin F. Sands recalled that, "We of the hydrographic party had to show off our charts at this special meeting, and the President, Andrew Jackson, expressed himself much pleased, to Mr. Hassler's great gratification." Oddly, Hassler does not mention the discovery of this channel in either his 1835 or 1836 annual report, but in 1837 he writes of this discovery that has such "importance and great value, for the so highly important harbor of New York." He goes on: "Lieutenant Gedney found a channel that admits, even at low water, every size of merchant vessels. This channel has already been buoyed out for service in future; and the passing of the OHIO, 74 gun ship through it, is a fact of public notoriety."

Although Gedney testified in 1842 at Congressional hearings on the Coast Survey that he could have found and buoyed out Gedney's Channel by the old survey methods, this was doubtful as mariners had been entering New York harbor for over two hundred years on a regular basis and had not yet discovered any channel but by Sandy Hook. Hassler, continuing his 1837 report, promoted both the Survey and his methods when he expounded on the reason for this:

> "That such a valuable discovery, which appeared to lie so near, was not made earlier, is to be attributed simply to the manner in which nautical surveys have generally been made. Without sufficient accurate fixed points on the shore, which the other works of the coast survey furnished, such a discovery was impossible; the most experienced and attentive seaman might have sailed about this channel ever so often, without being able to ascertain the fact; because the place of his vessel, at any time, presents him only an insulated point, disconnected with other parts, and even to a number of such points he is unable to assign a direction sufficiently accurate to aver any such facts; such discoveries can only be the result of a systematic work, grounded upon full mathematical principles, as applied in our works."

Equally important discoveries were made in Delaware Bay between 1840 and 1843 by adhering to Hassler's methods. Hassler only alluded to some of these discoveries in his report for 1841 when he stated, "The coast survey has far more than paid its expenses up to this time, by the advantages which it has procured to two of the principal ports of the country, New York and Philadelphia, the accurate knowledge of which has made known advantages in their navigation superior to those hitherto known." Lieutenant Commanding George S. Blake, who conducted the surveys in Delaware Bay, expanded on these discoveries in his letter of January 11, 1844, to the Superintendent of the Coast Survey:

> "DEAR SIR: In reply to your letter of the 6th instant, relative to recent discoveries made in the Delaware Bay by the parties of the coast survey engaged there, I beg to say, that our charts show a perfectly safe and direct channel, practicable for merchant vessels of the largest size, at low water, and, when the tide is two-thirds up, for frigates, to the westward of a narrow dangerous ridge, about fourteen miles long, running through the middle of the bay, called upon the old charts Joe Flogger, or Folger, and where no channel has heretofore been supposed to exist.
>
> "The advantages of this discovery to the commerce of Philadelphia, as well as to the naval establishment there, when this channel is properly buoyed, must be very great....
>
> "Other discoveries have been made in the Delaware of much importance. Among them, three channels over the 'ridges of Cape May,' which, when properly buoyed, will be of very great utility to the great and increasing coal trade of Philadelphia ...."

In an amazing comment on the accuracy of the existing charts of Delaware Bay, Blake continues:

> "I should add, that there is no chart extant of the Delaware, deserving the name. The situation assigned by the most authentic chart to one of the principal light-houses is nearly seven miles in error. Many dangerous shoals having but few feet water upon them, and upon which numerous wrecks have occurred, are laid down from three to five miles from the truth, and the bay is in one part represented as fifteen miles in width, when it is actually but seven."

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