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U. S. COAST AND GEODETIC SURVEY.

HISTORICAL COMPILATION.

A systematic survey of the coast was first inaugurated by the act of Congress February 10, 1807, which read as follows :

AN ACT to provide for surveying the coast 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 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 headlands, 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.

The work was assigned to the direction of the Treasury Department where it continued until 1817, when the act of April 14, 1818, repealed so much of the foregoing statute as authorized the employment of others than persons belonging to the Army and Navy. The work, which, owing to interruptions consequent upon European complications, our war with England, &c., had only just fairly begun, by the commencement of field operations in 1815, was discontinued as a separate organization, and was fitfully and disconnectedly prosecuted under the Navy Department until 1832.

In 1828, in reply to the Committee on Naval Affairs of the House of Representatives, the Hon. Samuel L. Southard, Secretary of the Navy, in whom the control of the Coast Survey was then lodged, declared that the maps and charts produced under the operation of the act of 1818 :

“Do not furnish a satisfactory survey of the coast for the following reasons : 1. They exhibit detached parts unconnected with each other. 2. Are generally confined to the shores, and do not extend sufficiently far into the ocean. 3. Were many of them made by incompetent men, with incompetent means. 4. They were governed by no fixed and certain principles or guides in ascertaining the latitude and longitude of the principal points and positions. 5. They do not embrace the whole coast. For these and other reasons they are unsafe, and in many instances *useless and pernicious.*”

Secretary Southard further recommended a revival of the Act of 1807, and a return to the comprehensive and adequate scientific methods and plan approved at the outset by President Jefferson and Secretary Gallatin. In his annual report for 1828, Secretary Southard again declared that the surveys executed under the Navy Department —

“ Do not afford materials for an accurate chart of the harbors and the approaches to them, and assist but little toward a perfect knowledge of our coast, which can only be acquired by that scientific survey of the whole, the importance of which I have ventured to urge and would again respectfully suggest.” And he added that “ these surveys with others, which from time to time have been made under the direction of the department have, to a certain extent, been useful, but they have also been very expensive in proportion to their usefulness.”

After a full consideration of the unsatisfactory results of the Naval supervision, as repeatedly suggested by the Secretary of the Navy and others, Congress revived the law of 1807, with somewhat extended scope, by the Act of July 10, 1832, as follows :

AN ACT to carry into effect the act to provide for a survey of the coast of the United States.

SECTION 1. *Be it enacted, &c.*, That for carrying into effect the act entitled “ An act to provide for surveying the coasts of the United States,” approved on the 10th day of February, 1807, there shall be, and hereby is, appropriated a sum not exceeding twenty thousand dollars, to be paid out of any money in the Treasury not otherwise appropriated ; and the said act is hereby revived, and shall be deemed to provide for the survey of the coasts of Florida, in the same manner as if the same had been named therein.

SEC. 2. That the President of the United States be, and he is hereby, authorized, in and about the execution of the said act, to use all maps, charts, books, instruments and apparatus which now, or hereafter may, belong to the United States, and employ all persons in the land or naval service of the United States, and such astronomers and other persons as he shall deem proper.

The work was again placed under the Treasury Department, and Hassler, its original Superintendent and the friend of Jefferson and Gallatin, was again placed in charge.

Operations under the Treasury Department had hardly been fairly resumed before President Jackson, in pursuance of the recommendation of Mr. Taney, Secretary of the Treasury, directed the Survey to be again transferred to the control of the Navy Department. The transfer was ordered March 11th, 1834, Mr. Woodbury being Secretary of the Navy. Again the work proceeded so unsatisfactorily that within two years—in March, 1836—it was re-transferred by President Jackson to the Treasury Department, of which Mr. Woodbury had in

the meantime become the Secretary. The re-transfer of the Survey to the Treasury Department by President Jackson, who had but recently directed its transfer to the Navy Department, and its re-transfer to Secretary of the Treasury Woodbury so soon after its transfer to Secretary of the Navy Woodbury, was specially significant as being the result of an actual, experimental test, by the same eminent officials of the comparative merit of the two systems of operating the Survey.

By the act of March 10, 1843, prompted by suggestions of the expediency of a re-transfer of the Survey to the Navy Department, Congress provided for an intelligent and efficient inquiry for the development of a permanent plan of organization of the Survey, as follows :

AN ACT making appropriations for year ending June 30, 1844.

For survey of the coast of the United States, including compensation of Superintendent and assistants, one hundred thousand dollars: *Provided*, That this and all other appropriations hereafter to be made for this work, shall, until otherwise provided by law, be expended in accordance with a plan of reorganizing the mode of executing the survey, to be submitted to the President of the United States by a board of officers, which shall be organized by him, to consist of the present Superintendent, his two principal assistants, and the two naval officers now in charge of the hydrographical parties, and four from among the principal officers of the corps of topographical engineers ; none of whom shall receive any additional compensation whatever for this service, and who shall sit as soon as organized. And the President of the United States shall adopt and carry into effect the plan of said board, as agreed upon by a majority of its members. And the plan of said board shall cause to be employed as many officers of the army and navy of the United States as will be compatible with the successful prosecution of the work ; the officers of the navy to be employed on the hydrographical parts, and the officers of the army on the topographical parts of the work ; and no officer of the army or navy shall hereafter receive any extra pay out of this or any future appropriations for surveys.

The board selected by the President consisted of *three* civilians, *two* naval officers experienced in hydrography, and *four* topographical engineers of the army. Those officers, practically experienced in the work of the Survey, united in a plan not only fulfilling the requirements of the law as to the composition of the organization, but providing with sufficient detail for—

“The mode of executing the Survey” * * * “in accordance with the most approved means which modern science affords,” “using always the most approved instruments and principles” * * * “the topography to be carried as far inland as may be necessary for a proper delineation of the shore and for purposes either of commerce or of defense,” and with soundings “as far inland as the ports and harbors for commerce.”

Although the board consisted of *six commissioned officers* of the Army and Navy and only *three civilians*, there was no dissent from the elaborate plan of a work of the highest scientific and accurate—and therefore practical and trustworthy—character, as outlined in “The Plan for the reorganization of the Coast Survey,” adopted by them on the 30th of March, 1843; nor did the military and naval members of the board hesitate to unite in a resolution, submitted to the President, expressive of an opinion derived from their experience in and acquaintance with the work, to the following effect :

Resolved, That inasmuch as the object and purpose of the survey of the coast refer principally to the commercial interests of the country, and as all the laws of Congress in relation to the same contemplate the employment of civilians and officers of the Army and Navy upon said work, it is the opinion of this board, and they do hereby respectfully recommend, that it should be under the control, and considered a part of, the Treasury Department.

In compliance with that recommendation the President, in his formal approval, April 29th, 1843, of the plan submitted by the board, declared that “the charge of the survey of the coast is continued in the Treasury Department, and is to be under its control.”

An attempt, in 1848, to secure the transfer of the Survey to the Navy Department, was defeated in the House of Representatives by a vote of 90 to 36. In 1849 a similar effort in the Senate led to a debate, in which the scope and plan of the Survey and its methods were so ably presented by Senators Pearce, of Maryland, and Davis, of Miss., that the project received but two votes. (See Cong. Globe and Appendix, Vol. 20, 2d Session 30th Congress, pp. 553 Globe and 196 Appendix.)

The attempt in 1849 to re-transfer the Coast Survey to the Navy, evoked not only from scientific bodies like the American Academy of Arts and Sciences, the American Philosophical Society of Philadelphia, the Franklin Institute of Pennsylvania, and from Colleges and Universities, but also from the officers of nearly every Marine Insurance Company, Chamber of Commerce and Board of Trade, the most earnest protests against a remission of the Survey to the control of the Army or Navy or the abandonment of the existing wise, effective and practical plan of organization, whose results in the production of charts, accurate in latitude and longitude and replete with every form of safeguard to navigators, had so rapidly reduced the risks of navigation, disarmed of its terrors the mysterious sea and given safety to commerce along many a fatal reach and reef where pilots had been useless. (Appendix to speech of Senator Davis, Miss., Feb'y 19, 1849.)

On Dec. 31, 1850, a resolution of the Senate called upon the Secretary of the Navy to report what advantages would be derived by a transfer of the Coast Survey to the Navy Department, and upon the Secretary of the Treasury to state why, in his opinion, such transfer should not be made. Their replies are printed as Senate Ex. Doc. Nos. 35 and 36, 31st Congress, 2d Session. (15 Feb., 1851.)

The reply of the Hon. Thomas Corwin, Secretary of the Treasury (Ex. Doc., Senate No. 36, 31st Congress, 2d Session), is a very full, fair and convincing statement of reasons—historical, experimental and statistical—for adhering to the original Jefferson-Gallatin plan of 1807, elaborated by the plan of 1843, providing for civilian instead of either military or naval control: and his views were sustained by the abandonment, in Congress, of the scheme of transfer.

The then recent withdrawal of all but three of the fourteen army officers, and the threatened withdrawal of all the naval officers, from employment on the Survey, as the result of our brief conflict with Mexico, appears to have admonished Congress of the importance of maintaining the civilian organization ready and equipped for the continuance of its indispensably important work whenever the call to arms should summon its army or navy contingent to the field and monopolize all the attention and energies of the War and Navy Departments. The same admonition was soon afterward still more impressively conveyed by the abrupt withdrawal from the Survey of every representative of both the army and navy at or soon after the commencement of hostilities in the late civil war. But for its civilian organization under a civil department, whose functions are liable to be neither interrupted nor monopolized by the operations incident to war, the Coast Survey would have been incontinently dismantled and its functions paralyzed at the outbreak of the rebellion. But with its permanent civilian corps, familiar with every feature of work in field or in office, the Survey was enabled not only to measurably continue some of the more important of its ordinary work, but to continuously render to the military operations of the Union, service of inestimable value. Besides numberless reconnaissances and rapid topographical surveys for immediate military purposes about Washington, in the vicinity of Baltimore and Philadelphia, in the Virginia peninsula, at Vicksburg, Chattanooga, with Sherman's march to the sea, and in connection with nearly every important operation of the army or navy, and a multitude of hydrographic sheets and war maps rapidly supplied to blockading squadrons and commanders of expeditions, which service elicited at various times the highest commendation from Generals Sherman, McClellan, Banks, Butler, Totten, Barnard, Wright, W. F. Smith, &c., and Admirals Porter,

Dupont, Davis and others—on two occasions the Survey was able, through its continuing power of organizing effective surveying parties, to do work amply worth to the Government more than all the cost of the Survey since its organization.

With a bar so far to seaward as to deprive an approaching fleet of the benefit of any land-marks for reliable bearings, and with every buoy, spar, beacon or other aid to navigation removed by the Confederates, Port Royal lay in fancied security against successful attack from the expedition under Dupont and Sherman in November 1861. But within twenty-four hours after the arrival of the fleet off the bar the channel was buoyed under direction of a Coast Survey civilian, Forts Beauregard and Walker were speedily taken, and possession of the best seaport of the South was secured to the Union as a base of supplies and operations until the close of the war.

In April, 1862, a Coast Survey party, under fire of shot and shell and sharpshooters and in advance of Farragut's fleet, determined the positions of each of Porter's mortar-boats and by triangulation their exact distances from Forts Jackson and St. Philip—renewing the triangulation with each change of a boat's position—so that the shot and shells from the Union fleet, invisible from the Confederate batteries, were dropped with unerring accuracy and irresistible effect within the doomed forts, compelling their speedy surrender. The Coast Survey's share in that operation which opened the lower Mississippi and gave to the Union New Orleans and a substantial foothold in the Southwest is glowingly described in the following :

EXTRACTS FROM COMMODORE D. D. PORTER'S LETTER TO PROFESSOR A. D. BACHE, DATED "HARRIET LANE, FORTS JACKSON AND ST. PHILIP, APRIL 29, 1862."

DEAR SIR: Amid the exciting scenes here, and the many duties that are imposed on me, I must steal a few moments to tell you something of the share the Coast Survey has had in our doings, and to thank you for the valuable assistance rendered me by the party you sent out here. * * * The results of our mortar practice here have exceeded anything I ever dreamed of; and for my success I am mainly indebted to the accuracy of positions marked down, under Mr. Gerdes's direction, by Mr. Harris and Mr. Oltmanns. They made a minute and complete survey from the "jump" to the forts, most of the time exposed to fire from shot and shell, and from sharpshooters from the bushes. * * * The position that every vessel was to occupy was marked by a white flag, and we knew to a yard the exact distance of the hole in the mortar from the forts, and you will hear in the end how straight the shells went to their mark. Mr. Oltmanns and Mr. Harris remained constantly on board to put the vessels in position again when they had to haul off for repairs, or on account of the severity of the enemy's fire. * * * I cannot speak too highly of these gentlemen. I assure you that I shall never undertake a bombardment unless I have them at my side. Mr. Gerdes has been inde-

fatigable in superintending the work, laboring late at night in making charts and providing the officers in command of ships with them, marking the positions of obstructions in the channel, and making all familiar with the main way. No accident happened to any ship going through, notwithstanding the gentlemen in the forts thought the obstructions impassible. * * * You must excuse my hurried letter, but I could not omit writing to thank your good fellows for what they have done for me, and to thank you for sending them.

* * * * *

Yours very truly,

DAVID D. PORTER.

Professor A. D. BACHE,
Superintendent U. S. Coast Survey.

On May 16, Porter again wrote to the Superintendent :

“ I forward to you by the Baltic a plan of Fort Jackson (or the remains of it) faithfully drawn under the direction of Mr. Gerdes, by Mess. Harris and Oltmanns, assistants of the Coast Survey. It is a striking specimen of the effects of mortar-practice, showing what can be done when distances are accurately determined, as they were in this case, by the gentlemen belonging to the Coast Survey.”

The plan referred to, precisely depicting the mark of every shot and shell, and also the original field-sheet of Gerdes's triangulation and marking of positions for the Union mortar-boats remain among the archives of the Survey.

A mere *resumé* of the great service which, by reason of its independent organization, the Survey was able to render in that crisis of the nation's history, would require more than a score of these pages. It is enough to say, as the records show, that those services elicited warm expressions of the highest appreciation from the Union commanders under whose eyes the varied and skillful work was performed on land and sea and rivers.

In 1858, in response to a resolution of the American Association for the advancement of Science, a committee of twenty of the most distinguished scholars and scientists of America, to whom the matter had been referred, joined in a report on the History and Progress of the American Coast Survey, which is still extant in an octavo pamphlet of 125 pages, presenting an exhaustive and intelligent review of its objects, history, methods and results, its relations to various other departments and bureaux, commending the nature of its work on scientific and practical grounds, asserting its equality with the best work ever done, and its superiority, in rapidity and economy, to any similar work abroad, urging adherence to the existing general plan of organization, and quoting, in support of its own high estimate of the Survey, not only the unanimous opinion of the scientific, educational, and commercial individuals and organizations of America, but the almost enthusiastic encomiums of

such judges as Humboldt, Arago, Schumacher, and Murchison, extorted from those austere intelligences at a time when European compliments for American science or literature were rare indeed.

In 1871 (Act of March 3d), the field operations of the Coast Survey were extended so as to include the execution of a primary triangulation across the continent to form a geodetic connection between the Atlantic and Pacific coasts, and the organization has since been known as the U. S. Coast and Geodetic Survey.

In pursuance of the original plan of 1807 and of the completer plan of 1843, and to avoid disgraceful inferiority and imperfection in its results, the operations of the Survey were always—except when withdrawn from civilian control—conducted in conformity with the requirements of geodesy—it was in fact a Geodetic Survey. The transcontinental operations were not only strictly related to the survey of the coasts, (as essential to the harmony of the measurements along the Eastern and Western shores, and as affording a most valuable contribution to that knowledge of the form of the earth and its local variations which is essential to the accuracy of the surveys of the coast), but incidentally they supply to the traversed states accurately located points—otherwise practically unattainable by them—upon which to base their own topographical or geological surveys, for the construction of accurate County or State maps. It will also provide part of that framework without which no accurate map of the United States is possible. Upon that arc has already been achieved some of the best work ever done in accuracy of base-measurement, accuracy and range of observations and area of geometrical figures, and at much less than the cost of similar, but less notable, work abroad. That the enterprise is either premature or extravagant will hardly be urged in face of the fact that Europe presents not a single transcontinental arc of triangulation, but a complete net-work covering every country except Turkey and a portion of Russia, and that even in remote and mainly uncivilized India, a superb work of triangulation ten times as extensive as our transcontinental arc has already been completed.

In 1878, a clause of the Sundry Civil Bill (June 30,) read as follows :

“ And the National Academy of Sciences is hereby required, at their next meeting, to take into consideration the methods and expenses of conducting all surveys of a scientific character under the War or Interior Department, and the surveys of the Land Office, and to report to Congress, as soon thereafter as may be practicable, a plan for surveying and mapping the Territories of the United States on such

general system as will, in their judgment, secure the best results at the least possible cost ; and also to recommend to Congress a suitable plan for the publication and distribution of reports, maps, documents, and other results of the said surveys."

The report (H. R. Mis. Doc. No. 5, 45th Congress, 3d Session, Dec. 3, 1878) recommends the consolidation of all surveys of *mensuration* under one head ; has carefully considered the various questions, and believes that the Coast and Geodetic Survey is practically best prepared to execute the entire mensuration system required ; and suggests such consolidation under the Coast and Geodetic Survey, its name to be changed to the Coast and Interior Survey.

At the same time it recommended the establishment of an independent organization, to be known as the U. S. Geological Survey, to be charged with the duty of examining into the geological structure, natural resources and production of the public domain, but that no surveys of mensuration be made by it other than local topographical surveys for development of special mineral deposits.

The recommendations of the Academy were so far adopted as to leave the Coast and Geodetic Survey in charge of the survey of the coast, and of the State surveys and interior geodetic work, to discontinue the various "geological and geographical" surveys, and to organize the U. S. Geological Survey, charging it with the duties specified by the Academy. Its functions were to be confined to geology, and not to embrace geodesy. (Sundry Civil Bill, March 3, 1879.)

Among the members of the Academy, as well as in the opinions submitted for its consideration, there seemed to be a general recognition of the propriety of remitting the surveys of mensuration to the care and accurate methods of the Coast and Geodetic Survey ; and the director of the present Geological Survey, referring to the Coast Survey transcontinental triangulation and to its corps of trained experts, urged that its system of triangulation, then in progress, "should be made the basis of all future geographical work in the United States."

In his annual message to Congress, presented in December, 1882, the Secretary of the Navy recommended the transfer to his department of the Coast and Geodetic Survey, the Revenue Marine, the Life Saving Service, the Light House Board, and other Bureaus of the Treasury Department. The heads of the various bureaus named were invited by the Secretary of the Treasury to make such statements in regard, to the proposal as should seem advisable. Their replies published as Treasury Doc. No. 395 (January, 1883,) and the arguments presented in opposition to the transfer of any of the bureaus, were such that no action was taken.

The Sundry Civil Act of July 7, 1884 contained a clause providing for the appointment of a joint Commission of three Senators and three Members of the House to "consider the present organization of the "Signal Service, Geological Survey, Coast and Geodetic Survey and the Hydrographic Office of the Navy Department, with the view to secure greater efficiency and economy of administration of the public service in said Bureaus," &c.

The inquiry by the Joint Commission occupied nearly two years, including frequent sessions during several months. A large number of witnesses were examined and the organization and methods of each of the bureaus thoroughly investigated. The reports were accompanied by nearly eleven hundred pages of testimony. That portion relating to the Coast and Geodetic Survey, at least, was thorough and exhaustive, including written or oral statements from the National Academy of Sciences, eminent scientific experts, distinguished and experienced Naval Officers and hydrographers uniformly commendatory of its plan of organization and general methods and results.

The majority of the Joint Commission, in whose views both Houses concurred, declared that they—

"Do not feel justified in proposing a change in the organization and method of the Survey unless the most urgent reasons therefor can be given, especially in view of the fact that those best qualified to judge who have testified before the Commission, including some eminent officers of the Navy uniformly agree that, at least until the Survey of the Coast shall be completed, the work should be continued under the present organization."

They concluded, after thorough discussion, that—

"There is nothing in the testimony to indicate that the work now performed by the Survey can be more efficiently performed if transfer is made, nor is it shown that the Navy can more economically execute the work, so there is no reason either on the score of efficiency or economy for making the change." (Senate Report No. 1285, 49th Congress 1st Session.)

Such a conclusion must inevitably follow from a consideration of the facts :

1. On both occasions 1818,-1832 and 1834,-1836, when the Survey was under Naval control its performance was unsatisfactory. This involves no reflection on the Navy, but simply implies better co-ordination of various scientific and technical operations when under civilian control.

2. The Survey has been under civilian control for an unbroken period of 52 years with results which, whether in ex-

cellence of quality or economy of cost, challenge comparison with similar work anywhere.

3. Not one of the Naval Officers who has under the Superintendent had official supervision of the hydrography of the Survey, since the functions of a Hydrographic Inspector were suggested in 1861, has favored the transfer of the Survey to the Navy. With possibly one exception every one of them has been opposed to such transfer—an attitude to which responsible connection and intimacy with the Survey will almost inevitably lead any one.

4. If temporary maladministration is to justify a transfer or dismantling of the institution in which it occurs, then quite recent history demonstrates that none of the executive departments—certainly not the Navy Department—should escape that drastic remedy. There are few Government bureaus of equal magnitude in which has not been disclosed negligence or malfeasance more gross or longer continued than any known to Coast Survey management, and that, too, without suggesting dismemberment or transfer of organization as a remedy for the delinquencies or derelictions of individuals.

5. While no statement, however detailed or extended, can even remotely supply the place of actual experimental acquaintance with the blending and inter-relation of the varied work, the following terse synopsis, which was submitted to the joint commission, may give some slight idea of how little of the indispensable work falls within the scope of nautical functions, and how incapable even that little is of being separated from its various auxilliary operations :

The field work of the Geodetic Survey is in eight different lines, all but one (the fifth) of which are necessary to the production of a perfect map. These divisions are:

First. *Triangulation*, including base measurements, by means of which distances between prominent points are made known.

Second. *Astronomical observations*, by means of which directions of all measured lines are made known, and also the locations of points on the earth are made known by astronomically measuring their distance from the equator (latitude), and their distance from a prime meridian (longitude).

Third. *Leveling*, by means of which the heights of objects above mean level of the sea are made known.

Fourth. *Tidal observations*, for determining the mean level of the sea, from which heights are reckoned ; also for predicting the rise and fall of tides for the use of navigators and others, and also for the reduction of soundings taken at any time to what they would have been if made at low water.

Fifth. *Gravity observations*, for determining the density of the earth.

Sixth. *Topography*, or the picturing by conventional signs of all the surface features of the land, its elevations and depressions, its streams, roads, canals, its forests, plains, and mountains, its towns, fields, &c.

Seventh. *Hydrography*, by means of which the configuration of the bottom of the sea, lakes, and rivers becomes known; also physical hydrography which makes known the character of rivers, tidal, and ocean currents, their effects in producing progressive or periodic changes in the configuration of the bottom.

Eighth. *Magnetic observations*, from which we learn the direction in which the compass needle points, the changes in this direction, the intensity of the magnetic force which directs the needle and the variations of this force. and thus get material to foretell the changes of direction to which the compass needle is subject, and variations of the force directing it.

The order in which these operations are carried on is not an arbitrary but a logical one, and in this logical order the hydrography comes last.

2. The first need of the hydrographer in making his survey is a projection or skeleton outline map, showing the parallels of latitude and meridians of longitude, together with the shore line and all the land features visible from the water, prominent objects, church spires, houses, artificial signals, capes, headlands, and outlying rocks and islands visible from the shore. If, "off-shore" or deep-sea hydrography is to be executed, the variation of the compass and the latitude and longitude of all prominent objects must be first made known and shown on the projection, to furnish points of departure and to correct the tracks after returning.

3. Before the hydrography is begun, therefore, we, in general, require the astronomical work, the magnetic work, the topography; and furthermore, tidal observations must accompany the hydrography. Of all the data required by the hydrographer the scale of the proposed work and the projection come first in importance. On this projection must be shown in proper relative position all conspicuous points and marks useful for determining the position of the sounding boat. In short, all topographical features and complete shore-line are necessary, and before these can be had the triangulation upon which this topography rests must be executed.

Thus the hydrography requires for its execution, first, if in-shore, the triangulation and topography together with tidal observations; second, if off-shore, it requires the same data, together with the astronomical and magnetic observations.

4. After the execution of the hydrographic field work the rough original sheets are to be carefully verified by re-plotting the soundings, drawing the contours, making the finished drawing, engraving, and printing. This work is done by trained experts, who, by natural ability, education, and long experience, attained the best possible results.

5. The hydrographic surveys are made in part by naval and in part by civil parties. Civil parties are usually engaged upon hydrography in regions where it is expedient for economy's sake to execute the secondary triangulation, topography, and hydrography simultaneously. This is usually in interior waters, sloughs, lagoons, bayous, &c., where parties are organized to work advantageously on land or water, as need arises.

6. It is, therefore, obvious that to separate the hydrography from

the topography and triangulation would be idle, since it would require two distinct organizations to do the shore-work. Besides, since very considerable portions of our sea and river shores are alluvial, much of the future work will be the repetition of surveys in districts where the sea by undermining the land has acquired material for shoal building, or where the caving of river banks has caused channels to be obstructed. In such instances the topographical and hydrographical parties must be intimately associated, because their operations must furnish reciprocal results.

7. To put all those indispensable operations into the hands of naval officers is to entrust them, without preparation or previous technical education for it, with scientific works of the utmost accuracy and refinement, the proper accomplishment of which has required, from the corps of civilian experts now employed, many years of diligent study and hard work. The character of all but the hydrographic work is foreign to the requirements of the naval profession. Due proficiency in such extrinsic accomplishments cannot be acquired during such brief detail to such special service as is permitted by naval routine. That such proficiency does "not come by nature," nor as a part of the naval education and experience, is confessed by the repetition of the effort to secure legislation which shall relieve the Hydrographer of the Navy from active naval duty and give him permanent shore duty.

On the other hand, detachment from naval duties long enough to acquire such proficiency, must be seriously detrimental if not destructive to proficiency in naval affairs, to which, indeed, it is as foreign as would be proficiency in the work of the geologist, the biologist or the Fish Commissioner.

8. If the naval officers are not to perform those extrinsic operations, they must continue to be performed, as they are now, by trained civilian experts and specialists, which, of course, precludes the employment of any larger number of naval officers on Coast Survey work than are now employed.

9. As a matter of fact, for two years past, all the officers who could be spared by the Navy Department for Coast Survey work have been employed by the Coast and Geodetic Survey. Sometimes, indeed, the supply has been temporarily short.

10. The naval vessels are not adapted to Coast Survey purposes, except in a few localities, and in those localities their employment would involve greatly increased expense because of the superfluous size, &c., of the naval vessels.

11. It would be impracticable to substitute naval officers for the civilian office force which is, and in any event must be, employed in computing, drawing, engraving, electrotyping,

photographing, printing, compiling, and publishing the records and results and performing the clerical work.

12. There being no duplication of work done by the Coast and Geodetic Survey its transfer would in nowise simplify the work of the Government

13. If only the hydrography were transferred to the navy, all the auxilliary operations indispensable to, and frequently performed side by side with hydrography, must needs be performed by a separate bureau. Thus two bureaus would be required to accomplish what is now done by one and that too without the possibility of efficient and economical co-operation and co-ordination.

14. Naval officers on duty in the Coast Survey are at all times subject to the control and call of the Navy Department, and they enjoy every advantage of practice in navigation, study of the coasts and approaches, &c., &c., which they would have if the survey were a part of the Navy Department.

15. Twice already, since the work was begun, it would have been interrupted by war, but for its independent organization which enabled it, on two occasions at least, to render most vital service to the Union arms.

16. The surveys made on foreign coasts by the Navy are of the description usually known as reconnoissances not approximating to the standard of those made by the Coast and Geodetic Survey along all of our own coasts, except in Alaska and along the more desolate portions of Oregon and Washington, for temporary purposes;—a standard which has commanded the highest admiration from the most eminent authorities at home and abroad, and which must be maintained, unless we desire to sacrifice many elements of utility (to works of civil, municipal, constructive and military engineering), and to invite invidious and humiliating comparisons with the similar work being done by even the weaker of the nations of Europe.

CONCLUSION.

Since, therefore, the experiment of naval control repeatedly tried, has repeatedly produced unsatisfactory results, and the covetous demand of the navy for such control has, at every examination of the subject during a period of more than fifty years been refused; since no institution of learning or of science has ever recommended such control, but all—from the unofficial associations and universities to the legally accredited

organ of the Government, the National Academy of Sciences—have repeatedly urged its inexpediency ; since no commercial or marine insurance organization, after intelligent consideration, has ever recommended such control, but, on the contrary, all have invariably, after such consideration, opposed it ; since such distinguished naval authorities as Captain Smyth, R. N., formerly President of the Geographical Society, London, and Admiral Beaufort, R. N., long ago conceded that under the existing organization of the Coast Survey, though the “Americans were the last in the field, they have, *per saltum*, leaped into the very front of the rank,” and that “the progress and character of the hydrography of Great Britain have severely suffered from want of co-operation with the Ordnance or land survey,” which co-operation has been ensured by their co-ordination in the U. S. Coast Survey ; since the expressed opinion of the most eminent scientists of the world, like Humboldt and Arago, accords with the assertion of Sir Roderick Murchison in effect that the existing organization of the Coast Survey “could not fail to make this one of the most perfect exemplifications of applied science of modern times,” of the work of which he subsequently declared “all unprejudiced persons must agree that the Trigonometrical survey of the United States stands without a superior” ; since the present form of organization of the Coast Survey, co-ordinating its work under civilian control and as a part of the Treasury Department was unanimously reported by a board, experienced in Coast Survey work, six of whose nine members were officers of the Army and Navy and it was reported *after* two experiences with Naval control ; since no one of the Naval officers charged with the immediate official supervision of the hydrography of the Coast Survey has ever favored the transfer of the Survey to the Navy, but with one exception every one has earnestly opposed it ; since the Survey now utilizes every Naval officer who can be spared by the Navy Department for Coast Survey work—the demand occasionally even exceeding the available supply of such officers—so that in the event of transfer no employment would be afforded for additional naval officers nor additional naval vessels, without diverting officers from professional duties and employment and devoting vessels to a work which their size, cost, &c., must render extravagantly expensive ; since it would be impracticable to utilize naval officers in the multifarious technical office-work of the Survey, even if it were the duty of the Government to supplement its generosity, in educating a redundancy of such officers, by crowding them into positions and vocations foreign to their profession and which should be the just reward and encouragement of the private citizen who

has educated himself; since a transfer would extend to naval officers no facilities, which they do not already enjoy, of practice in navigation, study of coasts, harbors, approaches, &c., and that too without the slightest interference with the discipline or authority of the Navy Department; since the reason assigned by the board for placing the Survey under the control of the Treasury Department in 1843—that “the object and purpose of the survey of the coast refer principally to the commercial interests of the country”—is confirmed by the fact that of the 34,016 of the charts issued by it last year only about 4,000—less than one-eighth—went to the Navy Department, and since the wisdom of maintaining a civil organization of the survey under a civil bureau where it may be exempt from the interruption of any of its functions and operations by the emergencies of war, has been twice signally vindicated, every consideration of experience, expediency, economy and prudence seems to unite in deprecation of a dismemberment of the Coast and Geodetic Survey or the transfer of any portion of it to the Navy Department.

