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LETTER

FROM

THE SECRETARY OF THE TREASURY,

COMMUNICATING

The annual report of the superintendent of the coast survey, and of the fabrication of standard weights and measures.

December 27, 1839.

Read, and ordered that 500 additional copies be printed.

Treasury Department,
December 26, 1839.

Sir: I have the honor to submit, herewith, for the information of the Senate, copy of a joint report, made to the department by F. R. Hassler, Esq., superintendent of the coast survey, and of the work for preparing standard weights and measures, showing the progress and present condition of those works respectively.

All of which is respectfully submitted.

LEVI WOODBURY,
Secretary of the Treasury.

Hon. Wm. R. King,
President pro tem. of the United States Senate.

Eighth report of F. R. Hassler, as superintendent of the survey of the coast of the United States, and of the construction of standards of weights and measures; rendering account of the works of 1839.

Upon the survey of the coast.

1. The proper organization and course of operation in a geodical work of such extent as the survey of the coast of the United States, is dictated by the nature of the country, and the relative position of its parts; presenting a long stretch of very unequal coast, with only such a breadth as the exigences of the work required; this dictated to begin at such an approximately central part of the country as would present the most facility and best prospects for large triangles, to serve as foundation of the work, and produce the greatest quantity of data for that purpose in the shortest time; presenting, also, within its limits, a locality for a base line of proportional length, and the necessary facility for its accurate measurement,

Blair & Rives, printers.

National Oceanic and Atmospheric Administration

Annual Report of the Superintendent of the Coast and Geodetic Survey

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from which the work might afterward spread in both directions of the country simultaneously, and alternately, as circumstances would dictate or allow.

2. Thence the work was begun in the neighborhood of New York sound, Long Island, and its large sound, &c., which evidently present the requisites and qualifications above stated. The works of the preceding years had filled up with the main and secondary triangulation, and the topographical, as well as hydrographical detail, most part of the district from the Jersey shore of the Rariton and New York bay, till towards the east end of Long Island, the sound, and opposite islands, the shore of the main land of New York, Connecticut, till Black Point, &c.

3. The field works of this last season were in some measure a beginning of the stepping over from the eastern side of these works to the southwestern, to open on that side, also, the field for the topographical and hydrographical detail works through the southern parts of New Jersey, part of Pennsylvania, to the seashore of Jersey, along Barnegat bay, and the Delaware.

4. All the survey of Long Island, as well the topographical, as the hydrographical part of its outer seashore on the south, and that of the sound to the north, had been completed the preceding years, till to Gardner's bay, of which a part of the sounding remained yet for this year.

5. The works of this year on the northern shore of the sound, include, as well the topographical, as the hydrographical surveys of Block island, the numerous islands of Fisher's sound, and others, the shore of Connecticut, and Rhode Island, with their deep inland waters, from Black Point, where the hydrographical works had ended last year, through the whole of Fisher's sound, so that the work reaches now on that side the shores and waters of the eastern States.

6. The surveys on land were carried inland as far as the nature of the coast on one side, and the time on the other, dictated or allowed; always furnishing, to the hydrographical party, which is carried on paralled with the works, on the shore, the fundamental points to ground their determinations of the points of sounding upon them: these works occupied one of the sounding parties, and a number of topographical parties.

7. The other sounding party finished the works in Gardner's bay, thence round Block island, along the shores of the row of islands, turning up to the main, and a part of the main shore, in continuance of where the other party left off, from the side of Fisher's sound; a part of the same topographical parties furnishing the determining land points as always usual.

8. A second part of the work to be executed this year, in that eastern part of the survey, was the topography of the parts, between the country near the shore, surveyed with reference to the sounding more especially, and the limit of the main triangulation, farther in the interior; the former having always been accelerated in its progress, so as to assist constantly the hydrographers in their progress on the water, it could not be carried sufficiently deep, land inward, for all the wants of the survey in general, this part of the topographical works was therefore to be completed, and it required yet some secondary triangles to complete it, besides the plain table works. It appears, however, that the season will not serve long enough to prevent operation if it fall yet in next year's work. But this will not prevent the house works of mapping, which are intended to be done the coming winter for that part of the country.

9. A work similar to the above, but of much smaller extent, was executed on the west side of the New York and Rariton bay through the country from the North river near the sloat on the west side of the Hudson river, corresponding opposite to Tarrytown, on the east side of it, which is the boundary point from which the work, which has just been mentioned, starts towards the east.

The western limit of this work following the Newark mountains, and the triangle points established upon them, until to their intersection with the Rariton river behind New Brunswick, and to the parts surveyed as shore line in that part of the country.

10. Thus the survey of the whole country from the New Jersey shore of the Rariton bay, Sandy Hook, and Shrewsbury, till to the waters of the eastern States is completed in topography and hydrography, grounded upon, and included in, a great number of secondary triangles, which themselves are based upon the main triangulation.

Only over a small portion, at the east end, the primary triangulation does not yet reach, but the secondary triangulation is accurate enough, and near enough to the main triangles upon which they are grounded, to secure against all doubts upon sufficient accuracy for the detail operations of topography and hydrography. When the main triangulation will be again carried to that side of the work, it will soon cover it over. The whole of the works presents to the south in some measure a straight line, from which the work will proceed southerly through New Jersey and Pennsylvania.

11. Views for the guidance of the navigator approaching the shore, as mentioned in the last report, have been made last summer by one of the assistants, on the whole extent of the outside coast of Long Island, and at such places of the eastern part of the sound, as were found properly the hydrographic parties, who had of course to lead the selection of these points; these are of two kind, the one guiding, the others warning. The first are aspects of the shore from the most important points of a channel or entrance of a port, &c., by which the seaman is guided in his proper course in approaching. The second kinds are views taken from rocks, shoals, or other dangerous places in the approaches of the shore, which the view given shall warn him to avoid.

12. In extension of these principles, the views of every light-house were taken double, first from the habitual ship channel at a distance at which vessels would habitually pass it, and second from the proximity, where the light-house becomes entirely visible, and so near as to warn from nearer approaching unless special views of landing, &c.

The south shore of Long Island is well known for its dangers by the multiplicity of shipwrecks on it; therefore, special direction was given to draw views from the habitual ship channel outside, at every short interval, or in some kind of a moving panorama, by which the approaching seamen may reconnoitre the part to which he is near, and guide himself in his course by the views which he is thus shown that he shall meet in succession in his intended course.

13. From Sandy Hook southerly, the Jersey seashore, with Barnegat bay, and a certain breadth along the inner shore of the same, has also been surveyed, till down to the neighborhood of Egg Harbor river. This part of the shore is difficult of access, from the interior by triangulation, on account of the heavy wooded, but low hills which separate it from the other land of Jersey, so that it will become unavoidable to cut through the forests in

various places, to get lines for triangles, joining this work to the interior parts in several places, in order to bind up with accuracy the long series of small operations, necessitated by the peculiar difficulties, presented by the nature of the locality. The hydrographical part of the same locality was also intended to be begun, but as it could not be attended to this year, it will form the first work for sounding vessels next spring.

14. The extension of the secondary triangulation over New Jersey, between the Rariton bay, the Delaware and the seashore, for which the accurate first elements are given by the main triangulation, carried entirely to the same extent; and from the southern line, stated above, for all other works, was carried in advance of the main triangulation the most favorable points. This same operation has been continued this year more southerly, so as to lay out triangles for future extension westerly, to join the head of the Chesapeake, including in its course the northern monuments of the so called Mason and Dixon's line.

15. It is well known that the meridional part of this Mason and Dixon's line has been applied to conclude upon the length of a degree of the meridian in that country and latitude, and that the result has been used, in former times, by European mathematicians, in their comparisons with the other measurements of degrees in different parts of the world, but gave so unsatisfactory results as to be always rejected. It will, therefore, be of interest in the course of the present survey, if ever possible to verify the meridional distance, by means of the triangulation for the coast survey, and the latitudes of the two end points, either by the same, or by new astronomical observations.

16. The scientific account of the operation being recorded in the transactions of the London Philosophical Society, that part can be easily verified. But the monuments placed on the ground may, or may not, be found again in the old places, with the necessary accuracy to warrant proper confidence. In the archives of the State of Maryland such documents exist as may give a clew to designate the localities of them. Therefore there have been already some researches made upon the subject, and the verbal accounts of the persons living in the neighborhood may fully lead and decide upon the application of the diplomatic documents, that will be found to the locality when compared upon the spot. Whatever may be the result, this investigation is of scientific interest, and can, therefore, not be passed over uninquired or unverified in a work like the coast survey, passing over the same ground.

17. From some proper points below Philadelphia, there will be a branch of the triangulation carried on easterly towards the sea, to join the topographical works made along the seashore, Barnegat bay, &c, as stated above, and also southerly to Cape May and Cape Henlopen, at which point it will be proper to join again both these two series of triangles.

18. The place of Cape Henlopen light-house must form a point of the main triangulation, though lying somewhat out of its shortest course, to bind up and compare with all accuracy, the results of the latitude and longitude determinations, made there on the occasion of the passage of Venus over the sun in 1769; which is another scientific work, executed in that neighborhood in the last century, and a more interesting one than the preceding, it being generally considered as more accurately executed.

19. This summer the main triangulation has been carried on through Jersey, from the triangle points lying in the district of the works first

enumerated, southerly to the neighborhood of Philadelphia; how far it may be possible to continue it south of it, must, of course, depend upon the weather, which at this time of the year is very uncertain. Over all this district the secondary triangulation must necessarily next year be carried more into details, and the topographical parties will also begin operations in it.

20. The main triangulation having been begun earlier this year than the former, more stations of it have been executed, and it will be brought as soon as possible, in following years, to the head of the Chesapeake bay; the part of the country thereby obtained will then present again a systematic mass of work, connected so as to form the elements of another series of maps and data for publication, similar to the works now executed and above enumerated.

21. The results of the whole work in triangulation, topography, and hydrography, as far as obtained, the end of last year, were last spring collected together in one map, upon the scale of $\frac{1}{100000}$, as already noticed in my last report as begun; every separate sheet of work is there numbered, as it is in the register of the works, and its limits marked, so that any execution of maps, within the limits of the work, can be guided by this preliminary in some measure tangible register of the works; the same system is, of course, to be pursued in future.

22. It will be a special question to decide in each case of executing any map from the coast survey works, upon what scale it shall be executed, according to the different aims and purposes; this register map will in all cases give the means to form appropriate plans upon that subject, calculate the size and position of the whole map of the sheets, or any part of them.

23. During the coming winter the assistants will again be occupied as in the preceding ones, only the calculations being of a somewhat different nature, principally relating to the systematic junction into one body, of the results of the trigonometric operations that have been executed; all the calculations are always to be made three-fold; being now numerous, much of the time of the assistants will be used in it, and as well this as the reduction of some of the works to ultimate maps for final execution, will occasion to keep some of the assistants engaged in these work, instead of in the field work.

This arrangement is well appropriated to the work in its present stage, and, at the same time, agrees with the state of the balance remaining from the last appropriation, as it will postpone some of the expenses of the field equipments.

24. This will make ready for any final execution for drawing, &c., the whole extent of the coast and country adjacent, from the New Jersey shore to the end of Rhode Island shore, in the topographical and in the hydrographical parts.

This part of the coast, forming, in some measure, a whole work by itself, containing about three thousand square miles, will therefore be taken in hand immediately, for final execution upon two different scales, for the different purposes, to which they must naturally serve in future.

25. The map of the bay and port of New York, which has been especially mentioned last winter, as desired to be published, forms an essential part of this work, and will, of course, be attended to the first; with this view, for which, arrangements are in progress.

26. A provision of the best quality of large drawing paper, appropriated to our work from the manufactory of Annonnay has just been announced as having arrived in New York for our use.

27. With the view to prepare for engraving maps, copperplates have been ordered in Vienna from Hungarian copper, on account of its best quality: these have just been announced as being under preparation, and that they may be expected in a few months: they will, therefore, certainly arrive before actual use will press for them.

28. In respect to the appropriation for the coast survey, to be proposed to Congress at the next session, I have only to state that it will be most economical for the best progress of the work, that Congress would please to appropriate $100,000, as I had taken the liberty to propose last year, because it will be necessary to begin incurring special and new expenses, for the arrangements and provisions required for executing final drawings, and begin to engrave. If the final appearance of the maps, when published, shall do justice to the trouble and expense incurred in the survey, the whole must come out of one systematic establishment, from which nothing should go out without the stamp of the establishment.

29. It is not proper, nor in fact possible, to separate these works from the drawings consequent upon the coast survey generally, because the works naturally interlock in one another, so that no distinct account can be kept, nor the works be detached from the assistants, who have worked at them in their origin; there should, therefore, be applied for the final drawing the necessary preliminary expenses of different kind of engravings, &c, such moneys of the appropriation total as may be needed, and the whole will enter into one mass of expenditure, like it is one system and map of work.

30. Except these establishments, and the expenses which must naturally be incurred in consequence thereof, there will be no change in the assistants employed; and the general arrangements and organization of the work, so that it is expected the diminution of some of the field expenses, as mentioned above, will about cover the additions which the last two sections show as necessarily to be added in the present state of the work: this presents a stepping over towards its full fruition at an epoch of its age, shorter than I believe can be shown in other similar work.

Upon the construction of the standards of weights and measures.

1. Since my last report upon these works, the full sets of weights for all the custom houses have been delivered and distributed according to their destination.

2. Weights had been prepared to become, when standarded, the heavy ounce weights for the mints, to be grounded upon the sets of ounce weights, till to the one hundred ounce weight, which were delivered to the mint in Philadelphia, early in 1838, as has been reported upon in proper time.

The mint having, in the meantime, constructed more accurate balances, desired for the sake of acceleration, to receive these weights in that unfinished state, and adjust them in their own establishment. This being granted by the Treasury Department, the whole of the sets, with their packing boxes, &c., complete, were delivered to the director of the mint at Philadelphia, and also the beam of an unfinished brass balance, of large size, which had been begun, and which they were in need of, to assist in the adjustment of the weights delivered.

3. The principal attention in the way of adjustment of standards this year, was put upon the numerous yards ready for it, a task which it is impossible to make hasty, and which requires in all cases continued and very

fatiguing application; many thousands of microscopic observations are required for it. The specialities of these minuted parts of the work belong rather to an ultimate full account of all the means and methods employed in the execution of the whole task of the establishment of the standards which it will then be proper to publish, and distribute on Government account, like a similar account of the works of Mr. Bessel, of Königsberg, for the establishment of a standard length measure, has been published lately by the Government of Prussia.

4. The feeling lever apparatus, which Professor Bessel has directed to be made for this establishment, at Berlin, he has lately announced to me as being nearly ready, so that it may perhaps yet arrive before the final delivery of the yards. This would afford the opportunity of establishing some comparisons by two methods, by the microscopes, and by the lever, which would be the more desirable, as the latter is intended to remain in the establishment for future use in comparisons.

5. A number of yards sufficient to furnish all the States are ready; but it is not proper to deliver them as yet, as it will tend to more accurate coincidence, to combine more numerous comparisons, under a variety of temperatures, and with different means. Besides the original standard scale of eighty-two inches, described in the report, upon the comparison of the weights and measures of the custom-houses, various other sets of microscopic arrangements were constructed, and constantly employed, whereby always a number of comparisons are carried on at the same time.

6. The form of the yards is that which has been formerly already mentioned, as best adapted for the preservation of their accuracy; the yards being cut to a length, in about the half-breadth of a strong brass bar, and fitting between the butting pieces at both ends of a similar bar of equal thickness, which it fills exactly, so that when joined they form one piece, and nothing can ever touch the ends, which determine the exact length; this arrangement presents evidently two different means of ascertaining the length of the yard to the nicest; but it should be used only when it is desired to give the length of other yards that are intended *to form again standards.* For the transfer of the yard for common purposes, there is a special decimally divided length of a yard traced upon the outer piece of the yard, or matrix, between two parallel lines. A tracing arrangement is given with it, by which means, the yard being left undisturbed in its proper place, in the box fitted for it, a bar of metal, or wood, for which a location is made parallel to the yard, can be laid off and subdivided, without in any way injuring the original; the use of this will be described in a statement to be added, as instructions at the delivery of the yards. My assistant worked at a considerable number of these divisions, until interrupted by sickness.

7. Of the liquid capacity measures the full number is finished, until to their adjustment, which requires their being weighed filled with distilled water, at the temperature of the maximum density of water, which is a most tedious and minute, therefore not very quick operation.

For the use in it a special balance has been constructed. Their actual adjustment will begin immediately after that of the yards, when the arrangements which it requires will be completed. Handles of a peculiar construction, to take off and put on, are constructed for their easier manipulation in use, without charging in the weighing.

8. As it is necessary to close the tops of the vases exactly at the proper height, to contain a determined weight of distilled water, at a given temperature, in a given cubic space of a brass vessel, it is necessary that this vessel be *exactly* covered, no air bubbles admitted in it, and no overflowing; to effect that, glass plates are required, exactly plane, of proper thickness, ground, unpolished on the side which touches the liquid, and of the size of each vessel's top; only large plate glass factories can procure these good; to construct them expressly would have necessitated a great establishment, different in its kind from all that is now in the establishment, therefore these plates have been ordered at the manufactory of plate glass of St. Gaubin, where they can be made with ease; which has established arrangements for such works, and can execute them at short notice, and with proper accuracy; they will, besides, cost a great deal less than in any other way.

9. The half bushels require a manner of casting different from that of the other parts of the work, which takes also more time and special cares; it has been in full operation, as much as possible; but this casting cannot be made in our establishment at all seasons of the year with equal success, and will, therefore, suffer temporary interruptions; during which other castings are executed. Some of these half bushels have also been turned; but it is evident that in the proper order of the work, there could not yet be any attempt towards their adjustment. The glass plates, that shall serve to cover them, have been ordered, together with those for the capacity measures for liquids for all of them: the proper size has been given to the factory for guide.

10. Thus it appears that the different tasks of the establishment for standard weights and measures have advanced properly, each in that proportion which the kind and the quality of the work they require, indicate naturally as the time required for their execution. The weights being already fully executed and delivered, except the ounce weights for the States, have made known in the country what is to be expected from the establishment, and have, I believe, given general satisfaction, which I doubt not every part of the works will give, whenever it appears before the public.

STATION OF WILLOW GROVE,
Pennsylvania, November 16, 1839.

F. R. HASSLER.