

STANDARD WEIGHTS AND MEASURES.

LETTER

FROM

THE SECRETARY OF THE TREASURY,

TRANSMITTING

A report of F. R. Hassler, Superintendent of the works of Standard Weights and Measures.

JULY 21, 1840.

Read, and laid upon the table.

TREASURY DEPARTMENT, July 14, 1840.

SIR: I have the honor to transmit, herewith, a report made to this department by Mr. F. R. Hassler, superintendent of the work on standard weights and measures, showing the progress made therein, and representing that the standard yard measures, prepared for the respective States, under the joint resolution of Congress of the 14th of June, 1836, are completed and ready for delivery.

All which is respectfully submitted:

LEVI WOODBURY,
Secretary of the Treasury.

HON. R. M. T. HUNTER,
Speaker of the House of Representatives.

WASHINGTON CITY, July 10, 1840.

SIR: 1. By the present I have the pleasure to inform you that a number of standard yards (forty) have received their final adjustment and comparison in this establishment, which will be sufficient to enable to offer to each State the one decreed by the joint resolution of Congress of 14th June, 1836, and at the same time to furnish the principal custom-houses with this most desirable part of the standards.

2. A further number of these yards are in such progress as only to need the final verification, which will enable some time next winter to deliver the whole of what is needed, to complete entirely this part of the system of uniform standards.

3. I take the liberty to suggest that this information might be communicated to Congress, in order thereby to invite its members, and particularly the Senators, to call the attention of the Governors of the States to this sub-

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National Oceanic and Atmospheric Administration
Annual Report of the Superintendent of the Coast and
Geodetic Survey

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ject, that these yards may be called for, under their orders, for their respective States. Those for the custom-houses being, of course, directed to their destination by the Treasury Department direct.

4. This might be at the same time an invitation to those States, who have not yet taken the sets of standard weights, which are here ready for them, (as Pennsylvania, South Carolina, Arkansas, &c.) to induce the Governors to give directions for both *yards* and *weights* to be safely conveyed to their destination.

5. The form selected for these standards, as most proper to secure their safe preservation, has already been mentioned in my report of 1832, upon weight and measure comparisons. In a future general report upon the operations, principles, and works that will have been employed in the whole of the constructions of the uniform standards of weights and measures, a more detailed account will be presented; here is rather to be presented only that part of it which is necessary to guide the persons who may have the guard and use of these standards at their places of deposit.

6. Each standard consists of two parts, being brass bars, of which the one presents the *yard*, and the other the *matrix*, in which the yard fits exactly; they, therefore, preserve one another mutually, and present themselves like one bar. Both bars are of equal thickness, of about $\frac{1}{2}$ inch, the same as the scale of 82 inches of Troughton, which forms the well appropriated original of all the length measures. The one bar presenting the yard length is 1,95 inch broad in its middle part, for exactly the length of the yard. At each end of the yard *exactly*, this breadth is perpendicularly diminished for 0,9 of an inch, so that the outer parts of each end, which extends still 2,5 inches farther, is only 1,05 inch in breadth. The other bar presents in the middle part, for the length of the yard, a breadth of 1,1 inch; at the end of that part its breadth is perpendicularly increased for 0,8 inch, so as to present the form of a lying L, extending 2,4 inches farther outwards, presenting a breadth of 1,9 inch in that extended part.

7. The broader part of the *first* of these bars being adjusted exactly to the length of one yard, within the parts where this breadth is perpendicularly cut off, to the diminished breadth of 1,05 inch, forms most particularly the standard; this part fits so exactly in the narrower middle part of the second bar, which forms a matrix for it, that great care is required, when they are brought together, to move the bars exactly paralalled to each other, that the accurate fitting may not be disturbed by a slant pressing of the part forming the joints, which would make it shake in the fitting.

8. The distance between these two end-joints, presented by its lines of contact, is the actual length of the yard, as standard. The two parts protecting each other by their close fitting, while the outer parts of the same bars have a vacant space between them, in the direction of the length, of about one-tenth of an inch in breadth; which is managed expressly to admit a wedge-formed piece of soft wood, by which the yards are gradually separated, when needed.

9. It is evident, from the above description, that this joint, formed by the perpendicular cuts of these two bars, forms the most important, as well as the most delicate, part of the standard; and must, therefore, not be opened and shut, without there being an important comparison of other measures with the standard to be made by (what is called) contact.

10. When both parts are united, this joint can be brought under two microscôpes, and thus may serve for comparing other yards with it, by the

same method which has been employed to compare these very standards with the scale of 82 inches of Troughton, the mean yard of which has been adopted as the most accurate standard of the English measure in this country, and is considered equally so in England. To procure the proper distinct vision for such a use, which is not obtained by a polished surface, the polish of the yard is interrupted at these joints by a narrow strip, from which the polish is taken away for about $\frac{1}{4}$ -tenth of an inch, parallel to the joining of the yard and matrix.

11. To facilitate the tracing from this standard yards for common use, there has been added, upon the matrix part, a yard divided into tenths and hundredths; a right angle and scribe are in the box, so arranged as to facilitate the tracing of the same divisions upon a piece of metal, or wood, laid parallel to it in the place destined for it in the box.

12. Every application of mathematical principles to subjects of practical natural philosophy, furnishes a proof, that the physical means, whatever, and however perfect, they may be, will always leave a certain distance between absolute mathematical accuracy and the result of our best exertions and assiduity. To reduce this distance to its minimum, is the aim of all arrangements, and the hardest task of the operator in such a work. Certain limits are, therefore, always accepted, within which the exactitude must be brought; and the variations within these are to be observed, registered, and, in any case of application, accounted for. The limit within which such a latitude in the accuracy may be allowed, is every time given by the nature of the problem, and the aim and application of the physical result of the operation.

13. In the individual case of the adjustment of length measures, this limit must be brought within a microscopic quantity, so that, in all applications, to even generally considered accurate works, no difference may be observable with the means in application in common life; therefore, also, the yards herewith presented are to be considered in this light. They are all brought within the limit of less than $\frac{1}{100000}$ of an inch; that is, within about $\frac{1}{750000}$ part of the whole, or suppose to 1 yard in about 750,000. While calculating upon the mean of the results of the ultimate comparisons, the accuracy would be within about one yard for one million of yards. Of the variations within this limit, a regular register has been made. To each of the yards will, therefore, be given a certificate or statement of its individual difference from the absolute accuracy. By this means, they will all be exactly comparable at any time hereafter, if they are properly and safely preserved, and compared by means of microscopes, or similar perfected means. For that purpose, also, they are numbered, so as to distinguish each individual from the others. In the ultimate account of all the works for the system of standards, the full register of the yards will contain, with each number, the individual standing of each yard in respect to this minute accuracy.

14. For the proper manner of using these standard yards, it will be proper to make again an adequate instruction, to be added to each box, the same as has been done for the weights; which will be joined here.

15. To add a few words upon the other part of the works for the construction of standards, I may state here, that the capacity measures, for liquids, have passed a first adjustment and verification, by the weighing with distilled water, at temperatures near the maximum density of the water; always reducing to that point of temperature, as required by the proper

principles. They are, therefore, in readiness to receive their final adjustment next winter, when the temperature will again be favorable for the work of final adjustment.

16. The mechanical work of the half-bushels is very far advanced; a large number of them being constructed, and the boxes for them even made. The weight of the half-bushel, in metal and in water, exceeds the capacity of the balances constructed for the standard weights. To obtain the greatest accuracy in weighing, the balance, and the weights for which it shall serve, must be in such proportion to each other that all the necessary strength and stiffness is obtained, with no more weight of the balance (which always acts as a dead weight) than what is required to obtain these qualities; for it is evident that, by otherwise equal accuracy of workmanship, the sensibility of the balance is determined by the absolute weight of the balance and the weights together. This dictates, for this case, a balance of considerable strength, because it must be able to bear the double weight of the bushel with its appurtenances. Such an appropriate balance is now constructing here, of a solid brass beam, and with such arrangements as will serve conveniently in its special use.

17. After this balance will be finished, it will be proper to begin the works for the balances to be made for the States, in conformity to the joint resolution of Congress of July, 1838.

I have the honor to be, with perfect respect and esteem, sir, your obedient servant,

F. R. HASSLER.

Hon. LEVI WOODBURY,

Secretary of the Treasury of the United States.

Instruction upon the safekeeping of the standards of yards, and their use in comparisons, &c.

1. The standard shall never be touched with the naked hand, warm, or in any way damp, from perspiration or otherwise; it is proper not to suffer any dust to collect upon it, which could occasion hard rubbing; any dust is to be removed, in any case, by wings or feathers of a *wild bird*, because they will not occasion any scratches, like the wings of fowls, ducks, &c., would do.

2. It must not be removed from its place in the box, except for the most important comparisons of metallic measures.

3. To take it out of the box, if necessary, the following is the best process: While the box is shut and hooked, turn it upside down upon some table; by that means the standard will come to lie upon the velvet lining of the cover; in this position the box is opened, and the two parts of the standard may be separated by gently taking hold of the two ends, and, by equal and gradual motion, applying the thumb to the yard part, and the middle finger to the matrix part, pressing them apart from one another; or, also, by inserting into the space left between the two bars at those places, two light pieces of soft wood at each side, uniformly, until entirely disengaged. Then the parts may be removed for use, each separately, with proper care and management; both parts cannot be moved together, because their pressure

and friction within one another can and shall not be such as to hold them together sufficiently for that purpose.

4. In putting the two parts together, the same movements of the two parts parallel to one another, are to be made gradually and gently, in inverted order and effect; after an entry of the yard into the matrix is first obtained, by a contact of less than five hundredths of an inch at each end, until the two parts close fully together.

5. For any common comparison of scales of wood, or other materials, or the division of any such scale, the part thus fixing the actual standard is not to be used; therefore there is added upon the matrix a scale divided into hundredth parts of the yard; this division being habitually, and most conveniently, used in the custom-houses.

6. To use this division, to trace a measure from it upon a rule, yard, stick, or other similar, there is added in the box a right-angle, with a handle over it, which is placed by its under-projecting part in contact with the outer edge of the matrix, while the upper part, projecting in both directions perpendicularly over it, is applied to any of the divisions by the edge of the farther part, while its nearer part, in continuance of the same line, serves to trace the corresponding division upon the bar to be divided; for that operation, the bar to be divided is placed in the near part of the box excavated for that purpose. In this place, or deepening, the scale to be divided is held fast by pressing it to the inner side of it, by means of the small wedges and the brass pins projecting from the nearest edge, and pressing the bar inward from the side nearest of the box; this inner partition of the box is parallel to the standard, when this touches the near side of its location, forming the partition between the two. In this position the division is to be made.

7. The arrangement just described will be found sufficiently accurate for common measures; but no beam-compasses of any kind are admissible, in no way whatever. For fully accurate copies of the standard, from between the butting-pieces, various methods may be used, completely different, and grounded upon various principles; as, principally, by means of microscopes and tracer, or by the feeling lever. The description of these, in detail, would be too long here; they belong more particularly to the actual scientific use of standards, and may therefore best be supplied by the man of science having charge of the work. My report of 1832, upon the comparison of standard weights and measures, may be a guide in the case; and various other works, well known to professional men, will assist in planning arrangements, according to the means and circumstances of a given case.

8. When brass scales are to be compared with the standard, or to be made from it, the equality of the metal with that of the standard requires only the precaution to have both standard and scale of the same temperature; which is generally obtainable by laying them together the evening before the work, and by the proper care not to give them unequal warmth, by touching, by draughts of air, or such like. But, when different metals are used, it becomes necessary to keep account of the difference of expansion of the metals employed.

9. To facilitate the reductions of yards, of different or the same metal, for different temperatures, it may be convenient to find here the expansion for the following metals, viz:

A yard expands, for one degree of Farenheit's in temperature, in decimals of an inch—

In platinum	-	-	-	-	-	= 0,0001848384
In brass	-	-	-	-	-	= 0,0003732508
In iron	-	-	-	-	-	= 0,00025068726

Which may serve for the reduction to a given temperature, of yards, for these three metals, which are those most habitually used.

WASHINGTON CITY, *July* 10, 1840.

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REPORT

FROM

THE SECRETARY OF THE TREASURY,

TRANSMITTING

A report of Professor F. R. Hassler, superintendent of the coast survey, and the fabrication of standard weights and measures, &c.

DECEMBER 15, 1840.

Read, and laid upon the table.

DECEMBER 21, 1840.

Ordered to be printed, and that 300 additional copies be furnished for the use of the Senate.

TREASURY DEPARTMENT, *December 14, 1840.*

SIR: I have the honor herewith to transmit a report made to this department by Professor F. R. Hassler, superintendent of the coast survey, and of the work for the fabrication of standard weights and measures, showing the progress made during the present year in those works respectively.

I have the honor to be, very respectfully, your obedient servant,

LEVI WOODBURY,

Secretary of the Treasury.

Hon. R. M. JOHNSON,
President of the Senate.

Ninth 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 1840.

1. The task of the coast survey for the present year, as well as that for the construction of standards of weights and measures, has been in part stated, and intimated in my last yearly report; it has been pursued with all attention and diligence, it was somewhat more complicated than in the preceding years, as may well be expected to be inherent in such kind of works, in proportion as they progress.

2. Notwithstanding the calculations consequent to the primary and secondary triangulations, are always carried on immediately after the field work, and in proportion as the data are obtained, a full repetition of the series of calculations was required, and occupied several calculators all last winter, principally on account of the special task of executing the

map of the harbor and neighborhood of New York, and by the bringing together upon the, so called, register maps, the full connexions of the works, for future use ; of these it was required to begin a second sheet for the part of the country south of Raritan bay, to the mouth of the Delaware, which will receive considerable filling up, by the works of last summer.

3. The projection, and reduction of the map of New York, was begun upon the scale of 1 to 30,000, in duplicate, by two assistants separately, both equally reducing from the original topographical maps, resulting from the plane-table works ; these two original reductions will verify each other, and prevent accidental errors, each of them will have its particular useful destination, which will appear in future.

4. The detail topography of the surveys in the field being grounded upon the triangulation, it is proper that the reduction of the results of it be again grounded upon the same, whenever any part of the work shall be brought into execution, for the construction of a map. To obtain this aim I adopted the following new method : all the triangle points being placed in the projection, made for the map, by their latitude and longitude resulting from the accurate calculations, just mentioned, by their rectangular ordinates, referring to the nearest sides of the respective quadrilateres of the projection, the lines of triangles therefrom resulting upon the map, are used as abscisses, to which every detail point is referred by its rectangular ordinate, referred to the triangle sides.

5. This operation is very satisfactorily executed by rules and rectangular triangles, divided one set upon the scale of the original, the other set upon that of the map to be executed. By this means the union of the great number of detail maps, which in a large work concur in a reduced map, is obtained with the greatest accuracy, and the most ease, therefore also celerity.

I make this detailed statement, because the indication of this method may be of service to gentlemen, who may have similar works to execute.

6. The copper-plates for this map, which had been ordered in Vienna (Austria) have arrived in due time, by the kind assistance of the United States consul Schwarz at that place.

7. All the works here stated have of course required considerable of my personal attention and attendance, they are now in full active, and regular, progress ; adding to this the propriety of finally executing and comparing the number of standards of yards, upon which I have had the satisfaction to report to the Treasury Department the 10th of July last, there was sufficient good ground for me, to delay my going out in the field, to measure angles for the main triangulation, until later in the season ; some of my assistants being engaged, during that time, in reconnoitring preliminarily for appropriate station points for these triangles, at the same time that they pursued the secondary triangulation, a work which would have cost to me a considerable loss of time, in travelling about the country, which I considered far better employed in the manner I did.

8. This latter part of the season in which I am now engaged at the main triangulation, has hitherto been very favorable, and promises to continue so still onwards ; this is so much more desirable as the nature of the country presents considerable difficulties by its configuration. If the weather of the coming season will allow it, I shall keep the field for the measurement of angles for the main triangles as long as ever possible,

after which I intend still, under the favor of the woods being free of leaves, to reconnoitre myself for the discovery of more southern points for the main triangulation.

9. The elevations on either side of the valley of the Delaware, through which the main triangulation must necessarily pass, as has been already stated in my first plan of operation, are so little prominent, the one over the other: that it is difficult to find such as are elevated enough over the others, to afford a view to a sufficient distance, clear from intervening interruption. This occasions of course frequent cuttings of wood upon many hills, which are not always easily acceded to by the owners.

10. The denser atmosphere of the lower countries, and particularly the circumstance consequent thereto; that the rays of light between distant objects pass nearer to the surface of the earth, form a considerable impediment to the good vision required for the work; even the heliotropes, which render so essential services in the triangulation in general, by their light penetrating through a denser atmosphere than any signal, become by it inconveniently large, and diffused. The heliotropes had to be not only considerably multiplied, on account of the number of stations requiring them, but also I gave them a new form, easier transportable, and of little work in the construction, and the mirrors of the older ones were reduced, by diaphragms, to less than one-third of their size, to circles of about one inch diameter, this size proved far better appropriated to the shorter distance of the triangle points, and diminished very much the so inconvenient irradiation, which the larger square mirrors present in a denser atmosphere.

11. Two secondary triangulation parties were engaged this year, as habitual, the one following mainly the country west of the Delaware, and southerly to the head of the Chesapeake bay, over which triangles are laid out farther south than last year, the irregular conformation of the elevated parts of that country, and their generally more extended flat tops, lead naturally to equally irregular combinations of the triangles. These works therefore include all the State of Delaware, and parts of Pennsylvania, New Jersey and Maryland.

12. The monuments of the Mason and Dixon line, which are met in the course of this work, were found up, and triangles projected, by which they will be united to the general triangulation, which may afterwards be pursued further southerly and westerly, as well for the purely scientific purpose stated in my former report, as otherwise. It appears that some of the principal monuments at the north end of the line have been moved, and in general that not much attention has been paid to them since a long time; there is however still information enough obtainable for the approximate verification of the scientific result, which I mentioned as the only use proper for the coast survey work, to make of these monuments, for they do not enter into consideration in that work in their quality of limits.

13. The other secondary triangulation party was engaged in the southern part of New Jersey, laying out a triangulation, from some lines of the other party near the Delaware, towards the Atlantic to the east, and towards the southern extremity to Cape May.

By these triangles the detail works of the Jersey shore, of which the topography had been surveyed last year, will be joined to the main triangulation, which, as above stated, must pass the shortest way through the

valley of the Delaware; and the further continuation of the survey of the Jersey shore, as well for the topography, as for the hydrography, will be grounded upon them in the next operations of that kind, as well on the side of the Atlantic, as on the side of the Delaware.

The absence of all prominent elevations, and the wooded state of all except the lower valleys, renders these operations very tedious and time-consuming.

14. As stated in my last report, there were yet some parts of the topography in Connecticut and Rhode Island: that had not been reached by the works of the previous years, on account of the close attention which was always given to the wants of the naval parties in the Long Island sound, whom it was necessary to supply constantly with the elements required for their works; the topography of these parts have been filled up this year, and also what remained of the parts of New Jersey to the southwest of Raritan bay, and a part on the Hudson river, yet needed to fill up the map of New York.

15. After the completion of these works, the topographical parties were turned, at different times, upon the parts of New Jersey between the formerly established shore-lines of the bay of New York, or rather Raritan, on the north, and the last year's work on Barnegat bay, and that neighborhood, to the east, as far south as the strength of the parties allowed to extend their tasks.

16. In this part of the work will necessarily also be included a part of Pennsylvania, in which it has been necessary by the configuration of the country to step over with the main triangulation, so much the more: as an important seaport Philadelphia and its approaches and communications, with the northern parts of the country, form a very essential part of the survey of the coast in that neighborhood.

17. Two naval parties were employed again this year, as formerly, but each of them had two vessels, instead of one as before, the two additional vessels were transferred to the coast survey from the revenue service, one to each party, they are both very well spoken of by the officers having command of the parties, as well appropriated to that service &c; the expenses occasioned by their purchase, their repairs and fitting up appropriately for the service in that work, occasioned of course additional expenses, which had not been taken into consideration in forming the last year's estimate for the coast survey appropriation, thence contributed considerably to the diminution of the balance of funds now in hand for the coast survey work.

18. Both the naval parties had, like the topographical parties, still to fill up small portions of their work, at the eastern extremity of their former works, on both sides of Long Island sound. The one in Fisher's sound, and the other about Block Island, and the eastern extremity of Long Island. These tasks were only of short duration, and of course executed the first.

19. The variations which all seacoasts, and particularly those of our country, are subject to in the depth of their channels, made it proper to inquire if any change had occurred in the depth of the northern channel of the bay of New York, discovered by this coast survey; this channel was therefore sounded again, in the whole of its separate course; the result was fully satisfactory, indicating rather a small deepening of the channel, than any diminution of depth, so that full reliance may be placed upon its permanency.

20. At the first beginning of the works of the coast survey, I had intended to carry on constant observations of the declination of the magnetic needle, and its variation, at the stations of the main triangulation, by which some data might be obtained, at different parts of the coast, upon this important element of this guide of the navigator, but the general press of the work not allowing to devote time for this purpose, the plan was abandoned after the first year; so much the rather as the main stations lay most generally more inland, than an adequate conclusion, upon the bearing of the needle on the approaches to the shore, could not fairly be drawn from them.

21. But I considered it proper, and advantageous: that at the entrance of the principal ports, such observations should be made once, for a certain time, as will give a proper fixed epoch, with corresponding determinations for this element; such as may be used and referred to in future; and which it will therefore be possible to bring to permanent usefulness, by the guidance of the results of the regular series of observations of the magnetic needle, by which its theory is now so extensively investigated. Such observations may so much the rather be expected to become useful, as a regular magnetic observatory is now established at the Girard College in Philadelphia, as it would be desirable to establish also at other places in this country, in systematic order.

22. With this view there has been made, during the greatest part of last summer, a regular series of observations of the declination of the magnetic needle, at a place near the entrance of the harbor of New York, with a needle of one foot length arranged for inversion, and constructed for this purpose already in 1813.

The observations were made by observing the magnetic bearing of one of the lines of the triangles of the survey; this will furnish the magnetic azimuth of that line, while the terrestrial azimuth of it is given by the survey, the difference between them is the declination of the magnetic needle.

23. From out of the harbor of New York an excursion for soundings has been made till thirty miles from the shore, in search of accidental notable differences of soundings, which might occur; nothing deserving of special notice has as yet been found, but such investigations are of course to be continued in future.

24. The same naval party executed also, at the same time, with the smaller vessel belonging to it, the soundings of the bays along the outer shore of New Jersey, of Shrewsbury, Barnegat, Tuckerton, and Little Egg harbor about as far as the topography had been extended in that part last year, and elements had been given for the naval operations, to attach the soundings to the topography; the outer shore of that part of the seacoast was of course investigated and sounded at the same time.

25. The other naval party, after having finished its work in Fisher's sound, was occupied in the river and bay of the Delaware; regular series of observations of the tide were made at different stations from Philadelphia to Cape Henlopen, the whole distance was besides reconnoitred with the view preparatory to the full survey, and accurate determinations of soundings, this will then be grounded upon the points of the two secondary triangulations which embrace more particularly that river and bay, and those of the topographical survey, to be made of the two shores, simultaneously with these works, like this has been practised for the Long Island sound, and the other inland waters, hitherto surveyed.

26. This survey will require peculiar attention on account of the variability of the courses of the tides, which are different in ebb and in flood, besides their being much varied by the winds, and other circumstances, by which the channels are most likely constantly varied, either temporarily or permanently, so that no chart at present existing is trusted to present any accuracy, though however that may have been the case at the time of their construction.

27. When I was in Philadelphia in 1806, Mr. J. J. de Ferrer, a scientific gentleman as well known in this country as in Europe and South America, and I, were consulted upon the means of removing a bar then forming near Fort Mifflin, which was thought to endanger the navigation of the port by permanency; we were both equally of opinion that it would remove itself, by the nature and course of the working of the river, by being removed step by step down the river, until it should find a proper place to lodge its ground, and that so much the rather as a dam, then making at the Jersey shore of the river, with other views, appeared to me to have a tendency to promote this removal of the bar, from its then most unfavorable place; according to all informations this has been the case ever since, and the remains of this former deposit have almost disappeared in distributing themselves in the different opportune places which they met underways.

28. In the view of these circumstances it is evident, that there will be no just comparison possible to be established between the results of the present survey, and the older ones, made at different epochs, the certitude which the results, to be obtained by the present survey shall give, will therefore be the most important result; establishing a determined state of the river, at a determined epoch of time; perhaps the comparison of it with the older works may lead to, or at least furnish some data for, what might be called the history of the changes of the river, from which conclusions might be drawn advantageous for the future.

29. The special principles upon which the instruments used in the coast survey have been constructed, have continued always to be very advantageous and appropriate; the shop established in the office, necessary to maintain them constantly in good serviceable order, has furnished besides a number of instruments, and implements, of much superior accuracy, and adaptedness than would have been obtainable in any other way, besides that being always at hand, and every minute ready for such calls as cannot fail to occur constantly in such a work; the gain in time is an additional advantage of great economy, it is therefore of essential benefit, and continually in full activity.

Much of the parts forming in some measure materials for the works, have been procured, others ordered since more or less time, and not yet received, I have so much more hopes to receive them before the next yearly report, as I have had occasion to cause them to be pressed at their place of construction itself.

30. Several years ago propositions were made on the part of the State of Maryland, upon whose territory the coast survey has now entered, to partake in the survey of the coast, by certain arrangements with the Treasury Department, the principal character of which would be: that the triangulation of the coast survey should be made to extend, at the expense of the Government, farther inland, so as to serve as guide for the survey of the State, while the State would, in compensation of this, bear the expense of the whole of the topographical surveys, within its

limits, to communicate them to the coast survey; the whole remaining under the same direction, and being carried on upon the same principles as the coast survey has been hitherto.

31. A similar proposition was made in 1817 by the State of New Jersey, when the coast survey was begun in that State, but the interruption of the coast survey at that time interrupted the negotiation. The double advantage that might result from such arrangements, with States partly covered by the coast survey, appears to me very evident, both in respect to the more economical manner in which by this mutual assistance the works would be made, as by the evidently greater perfection of both works, resulting from the greater extension of a regular system; it would equally tend to accelerate generally the final execution of both so desirable works.

32. If any proposition having a tendency to that effect, should be made by the State of Maryland, I wish to recommend it to the favorable consideration of the department; nearer particulars can be matured at the time, when the subject would be agitated, and the advantages to be obtained will then be nearer developed.

33. In relation to the amount of appropriation, which it is desirable to propose to Congress to grant for the coast survey expenses for the next year, I take the liberty to propose again the same amount of \$100,000, which Congress has been so kind as to grant the two last years, it will appear by this report as well as by the general tenor of the work, and the state in which it is now, that its progress is just steadily going, adequate to that amount of expenditure, the appropriation being generally nearest expended fully by the time a new appropriation is made, and if any reduction would be required in the general establishment now existing for the work, it would prove a much greater disadvantage, and in fact actual loss, than the amount retained by a lesser appropriation would warrant, or make advisable to expose the work to particularly at the present momentaneous state of it. I have also no doubt but Congress will willingly grant it, upon the confidence which I believe exists in Congress that the grants made for this work have always been applied with all possible economy, to the best advantage of the country, and that the work executed by their means are of great value for the general interest of the country, and adequate to the grant made for it.

Upon the construction of standards of weights and measures.

1. Since my last yearly report upon this part of my works, which is always, like now, added to that upon the coast survey works, I have had the honor to address to the Treasury Department a letter announcing the readiness for delivery of forty-one yards fully adjusted; having there also said a few words upon the other parts of the works relating to the construction of standards of weights and measures, I shall here take the liberty to refer to that letter for the most part of the account which might be given of these works since last year's report, and relate only what referred to the continuation since then.

2. The direction of the Treasury Department received in consequence of the above letter, having been: to send to certain named custom-houses eighteen of the yards thus finished, they were placed in proper packing-boxes, with paper wrapped around their inside mahogany fitting-boxes, and delivered to the collector of the customs at Alexandria, to forward according to their respective directions. The other twenty-three were

equally packed, and prepared for delivery, the names of the States for whom they are intended are inscribed upon them; they are therefore ready to be forwarded, when called for, upon the invitation which the Treasury Department has directed to these States.

3. The quantity of standards of weights, and the yards for the States, just stated, fully ready and on hand in the office, all reported upon, made it desirable to make room for the other works now on hand, which required the full room again by their increase; with that view I took the liberty to propose, to deliver all this work, fully ready, and reported upon, into some of the vaults of the Treasury Department, for safe keeping; upon the answer of the Treasury Department acceding to this proposition, I delivered seventy-nine boxes of full sets of standard weights, packed ready for forwarding, which were deposited into a vault selected in the Treasury Department. Among these are yet several sets *belonging to States who have not yet called for them*, upon repeated invitations. At the same time there were deposited in this vault the twenty-three boxes of standard yards destined for States, the names of which they are inscribed with. The number of boxes deposited being thereby eighty-two, and the whole number of boxes delivered on that occasion, including the yards for the custom-houses, were one hundred and twenty. This gave room in the office to establish more order, and the free motion necessary to carry on the works still to be done.

4. The works which I stated in my letter of July as in hand, and yet to be executed, have gone on since, in the full proportion to the time elapsed, and will continue at the same rate henceforward.

5. In the winter it will be proper to take up again the revision of the liquid-capacity, measures by weighing, up to their final adjustment, (but the boxes, which shall contain them when finished, are not yet made.) After these operations, which will still occupy some time, it will be possible to begin the adjustment of the half bushels, of which the mechanical work is finished, and which are placed in the boxes already made for them. These two operations of adjustment will be the most tedious of the whole work, the great attention to be paid to the reduction for physical influences in the weighing, with the daily renewed distilled water, requires much attention, and the long-to-be-continued equal strain of attention in the sameness of weighing, are very fatiguing labor, to which no interest of variation or means of verifying the works, by varying the methods of operating, can be applied, like I did in the smaller weighings, by introducing a combinatory method, which excites some interest, at the same time that the independent mutual verification, which it affords, relieves the mind of the operator from the anxiety accompanying such operations, upon their success in accuracy; the masses to be weighed are too large to admit combination, which besides would become too complicated an operation. It can therefore also not be expected that they can progress with great celerity, or be pressed onwards in a hurried manner.

6. The plate-glass covers for all the capacity-measures, ordered at the plate-glass factory of St. Gaubin, have arrived in due time, and are fully satisfactory; by this the whole of this part of the establishment of standards, will present the most complete, and extensive systematic collection, that the present state of means, and knowledge admits, and as accurate as the wants of any transactions of the society requires.

F. R. HASSLER.

STATION MOUNT HOLLY, N. J., Nov. 17, 1840.